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ӨСІМДІКТЕР БИОЛОГИЯСЫ ЖӘНЕ БИОТЕХНОЛОГИЯСЫ ИНСТИТУТЫ

Министерство образования и науки Республики Казахстан  
Комитет науки

ИНСТИТУТ БИОЛОГИИ И БИОТЕХНОЛОГИИ РАСТЕНИЙ

## PLANT BIOLOGY AND BIOTECHNOLOGY INTERNATIONAL CONFERENCE

Best Western Plus Atakent Park Hotel  
May 28-30, 2014, Almaty, Kazakhstan

**МАТЕРИАЛДАР**

**МАТЕРИАЛЫ**

**PROCEEDINGS**

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ӨСІМДІКТЕР БИОЛОГИЯСЫ ЖӘНЕ  
БИОТЕХНОЛОГИЯСЫ БОЙЫНША ХАЛЫҚАРАЛЫҚ  
ҒЫЛЫМИ КОНФЕРЕНЦИЯ

Best Western Plus Atakent Park Hotel

Қазақстан, Алматы қ. 2014 жылдың 28-30 мамыр аралығы

МЕЖДУНАРОДНАЯ НАУЧНАЯ КОНФЕРНЦИЯ  
ПО БИОЛОГИИ И БИОТЕХНОЛОГИИ  
РАСТЕНИЙ

Best Western Plus Atakent Park Hotel

28-30 мая 2014 г., Алматы, Казахстан

**УДК 57 (063)**

**ББК 28.54**

**М34**

**Материалы «Международной конференции по биологии и биотехнологии растений». – Алматы: ИББР, 2014 – 510 с.**

**ISBN 978-601-7343-00-2**

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В сборнике представлены материалы «Международной конференции по биологии и биотехнологии растений», проведенной в г. Алматы 28-30 мая 2014 г. В публикациях изложены результаты оригинальных исследований в области изучения, сохранения и использования генетических ресурсов, генетики и селекции, физиологии и биохимии, клеточной и генетической инженерии растений.

Сборник рассчитан на биологов, селекционеров, экологов, специалистов, занимающихся генетическими ресурсами растений, фермеров, и студентов биологического и сельско-хозяйственного профиля.

Тезисы докладов представлены в авторской редакции.

**Рекомендовано к изданию Ученым советом РГП «Института биологии и биотехнологии растений» Комитета науки Министерства образования и науки Республики Казахстан (Протокол № 1 от 04.03.2014 г.).**

**УДК 57 (063)  
ББК 28.54**

**ISBN 978-601-7343-00-2**

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## **GREETINGS FOR PARTICIPANTS OF INTERNATIONAL SCIENTIFIC CONFERENCE ON PLANT BIOLOGY AND BIOTECHNOLOGY**

**Dear participants of the International scientific conference, dear guests!**

I am cordially welcome you at the International scientific conference in Almaty 2014. On behalf of our organization I am thankful you for attending this event.

Twenty first century is considered as a time of life science, when biology and biotechnology are beginning to play very important role in improving of crop productivity, in development of new products, in medicine, in protection of environment, in improving the life in general. The world is changing to new type of economy based on use of renewal resources classified as a “green or bioeconomy”.

Due to these challenges the International conference in Almaty is very important scientific event on national and international scales. For instance, the output of this event can be helpful for realization of plans by President of Kazakhstan, Mr. N. Nazarbayev, which is outlined in his annual message on Januray 17, 2014 entitled as “Kazakhstan-2050”. Biological community can surely contribute significantly to meet those global challenges listed in that message.

The participants of this conference come from 17 countries, including from many regions of Kazakhstan. The scientific results will be discussed in 4 different sessions in the fields of plant biology and biotechnology. The results of those biological studies can be summarized in one very important aspect, which is transition of results from fundamental science to applied science. This aspect is the basement for realization of new policies related to development of innovative science. We hope that the conference will help boost development in agro industrial sectors, medicine, and food industry. Also, it is assumed that local scientific community will share their results, which were obtained within local projects funded by the Government of Kazakhstan.

I am confident that the conference will improve collaboration between local and world scientific communities, and every participant will find it as interesting and beneficial event.

My special acknowledgment to sponsors of our conference who helped us better organize this meeting that will last three days!

I wish to every participant of the conference excellent scientific results, fruitful professional discussions and new contacts that will help in your research activities!

K. Zhambakin

General Director,  
Institute of Plant Biology and Biotechnology

**ӨСІМДІКТЕРДІҢ БИОЛОГИЯСЫ ЖӘНЕ БИОТЕХНОЛОГИЯСЫ БОЙЫНША  
ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ КОНФЕРЕНЦИЯ ҚАТЫСУШЫЛАРЫНА  
ӨСІМДІКТЕРДІҢ БИОЛОГИЯСЫ ЖӘНЕ БИОТЕХНОЛОГИЯСЫ ИНСТИТУТЫ  
БАС ДИРЕКТОРЫНЫң ҚҰТТЫҚТАУ СӨЗІ**

**Құрметті халықаралық ғылыми конференция қатысушылары,  
құрметті қонақтар!**

Өсімдіктердің биологиясы және биотехнологиясы бойынша Халықаралық ғылыми конференция қатысушылары мен қонақтарын шын жүректен құттықтаймын. Біздің шақыруымызды қабыл алғып, бүгінгі күні бізben бірге осы конференцияға қатысып отырғандарыныз үшін Өсімдіктердің биологиясы және биотехнологиясы институты атынан Сіздерге үлкен ризашылығымды білдіруге рұқсат етініздер.

Шындығына келгенде, XXI ғасыр өмір туралы ғылымның заманы болып саналады, осы ғасырда биология мен биотехнология ауылшаруашылығы өнімділігін арттыруды, жаңа материалдар жасап шығаруда, медицинада, қоршаған ортаны қорғауда, жалпы өмірдің сапасын көтеруде күннен-күнге үлкен рөл атқарып келеді. Әлем жаңаған шикізатты пайдалану, биоэкономиканы құру («жасыл» экономика) сияқты жаңа экономикалық сатыға қарқынды қадам басып келеді.

Осыған байланысты бүгінгі конференция ұлттық және халықаралық деңгейдегі өзекті ғылыми оқиға болып табылады, ол Қазақстан Республикасының Президенті Н.Ә. Назарбаевтың 2014 жылғы 17 қаңтардағы «Қазақстан жолы – 2050: бір мақсат, бір мұдде, бір болашақ» атты Қазақстан халқына Жолдауындағы ғалымдар мен ғылымның алдына қойылған маңызды міндеттерді орындауға ықпал етеді. Ғалым-биологтар Жолдауда көрсетілген XXI ғасырдың ғаламдық қызындықтарын жеңіп шығуға өздерінің шешуші үлестерін қосуы тиіс және қоса алады да.

Конференцияға Қазақстанның түрлі аумақтарынан, шетелдерден, оның ішінде ТМД елдерінен келген ғалымдар мен мамандар қатысада. Биология мен биотехнологияның түрлі салаларында алынған ғылыми зерттеулер нәтижелері 4 секцияда ұсынылған. Биологиялық зерттеулердің түрлі бағыттарын бір жерге топтастыру қазіргі заман ғылымының неғұрлым маңызды функцияларының бірін атқарады - ол инновациялық зерттеулерді дамытудың жаңа саясатын енгізуіндегі негізі болып табылатын, қолданбалы зерттеудердегі ғылыми жаңағыларды жүзеге асыру жолдарын әзірлеу. Бұл конференцияның өткізілуі агроөнеркәсіп кешенінде, медицинада және тамақ өнеркәсібінде ғылыми сыйымдылығы кең технологияларды дамытуға ықпал етеді, сондай-ақ отындық зерттеушілер мен әзірлемешілерге грантты және мақсатты бағдарламалар аясында орындалған жетістіктерін көрсетуге мүмкіндік тұгызады.

Конференция қазақстанның және шетелдік ғалымдар, ғылыми ұйымдар арасында ғылыми байланыстар мен шығармашылық өзара қатаинастарды нығайта түседі және әрбір конференция қатысушысы өзі үшін қызықты және пайдалы бір жаңағылар ашады деп сенемін

Конференцияның іскерлік бағдарламасын ұйымдастыруға көрсеткен қолдауы үшін біздің демеушілерге ерекше алғысымды білдіремін.

Барлық қатысушылар мен қонақтарға конференция шеңберінде жемісті жұмыс, шығармашылық табыс және кәсіби қарым-қатаинас тілеймін!

К. Жамбакин

# **Session 1.**

## **Genetic Resources:**

## **Study, Preservation and Use**



**WORLD GENETIC RESOURCES OF CULTIVATED PLANTS  
IN XXI CENTURY**

**N.I. Dzyubenko**

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Nikolai Vavilov was the first scientist to recognize the utmost importance for the humanity and potential value of world-wide collecting of crop seed, including crop wild relatives, and their conservation in viable conditions. Later his views were shaped into an international scientific concept, while his activities in building up seed collections served as a model. It was Vavilov who showed to the world's scientific community that the vast diversity of genes in populations of wild and weedy species, landraces and improved cultivars is a treasury of promising breeding sources.

By 1901, the collection of cultivated plants in Russia consisted of 301 accessions; in 2012, it has grown to more than 324,000. In the past 90 years, the Vavilov Institute organized and implemented 1558 collecting missions over the ex-USSR territories and 282 to foreign countries.

At present, there are 1750 plant genebanks over the world. Their holdings amount to 7.3 million plant accessions (FAO, 2010), with more than 1.84 million (24.7%) in the five leading national genebanks (USA, China, India, Russia and Japan).

The modern algorithm of crop collecting management comprises the following key components: analysis and assessment of the global plant genetic diversity in nature and in genebanks; systematic inventorying (revision) and assessment of the collected genetic diversity in a national genebank; identification of "gaps" in the genebank's holdings; systematic analysis of national breeding programmes, identification and prognostication of their demands for genetic sources; evaluation of genetic erosion and genetic vulnerability of the accessions for economically important crops and their wild relatives.

The ongoing globalization and international integration processes, rapid development of science and technology, introduction of novel technologies, acceleration of genetic erosion, climate change, and escalation of inter-country competition on the world market call for the need to solve common global problems by cooperative and most effective efforts. The main strategic task for the future is to work out governmental and non-governmental measures aimed at abating negative tendencies and securing the most optimal conditions for safe *ex situ* and *in situ* conservation of plant genetic resources, promotion of fundamental and applied research in the sphere of agricultural biodiversity, avoidance of duplication in such activities, increasing the capacity in collecting valuable genetic diversity, and enrichment of national germplasm holdings through targeted collecting missions all over the world.

## **MANAGEMENT OF GENETIC RESOURCES IN THE USA**

**Barbara M. Reed**

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The US National Germplasm System is one of the world's largest, encompassing large collections of plant, animal, microbial and invertebrate genetic resources important to the US and the world. The US system charged with collecting, maintaining, characterizing and distributing this diverse germplasm. The National Plant Germplasm collections include grains, vegetables, fruits and nuts, oil and fiber, root and tuber and forage crops. Over 40 active sites store, regenerate and distribute plant germplasm to qualified users throughout the world. The germplasm may be stored as seeds, growing plants, and tissue cultures or cryogenically as pollen, shoot tips or seeds. Base collections are conserved at the National Center for Germplasm Resources Preservation (NCGRP) in Ft. Collins, Colorado. The National Animal Germplasm Program is centered at NCGRP and stores gametes of major, minor and rare livestock breeds. Collaboration with university and industry partners allows in situ conservation as well. The National Microbial Germplasm System is designed to ensure that the genetic diversity of agriculturally important microorganisms is maintained to enhance and increase agricultural efficiency and profitability. These collections are housed at several sites throughout the USA. The National Invertebrate Genetic Resources Program includes insects that impact American agriculture including pests, parasites, predators, products, and pollinators. These collections are held at multiple sites throughout the USA. All of these collections are accessible through the Germplasm Resources Information Network (GRIN), an online database with information on all the accessions in the system as well as evaluation information. In addition, GRIN Global is a multilingual database that is now freely available to the international community for managing germplasm collections.

**ARRANGEMENT OF SEEDBANK OF KAZAKHSTAN  
WILD CONGENERS OF CULTIVATED PLANTS**

**G.T. Sitpayeva, T.Sh. Murzatayeva, K.Kh. Makhmudova**

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According to the international estimates of experts there formed an alerting situation in the world. Within the XX century about 75% of the world genetic variety of crops was lost; approximately third part of higher floral plants existing on the Earth will have already disappeared by the middle of the XXI century. Today about one hundred thousand global plant cultivars are under the threat of disappearance for the following reasons: global warming of climate, overexploitation of ecosystems and irrational economic activity. All this promotes the accelerated disappearance and reduction of genetic resources and it is an irreplaceable loss of material which is valuable to humanity that also defines imperative and urgent need of creation of collections and gene banks of plant resources. Preservation of gene pool of wild congeners of cultivated plants in particular is the extremely important purpose for solution of those environmental problems which have faced before humanity at present or will have arisen in future. At present the most priority way of preservation of genetic variety of plants is their preservation as a part of natural communities *in situ*. And the *ex situ* method, preservation of biological diversity components out of their natural habitats, is also used in other words seed banks of plants are arranged.

Creation of seed bank of plants causes great importance for preservation of variety of species and their transfer to future generations. At present in China the largest gene bank of plants has been formed. There genes of 300 000 plant species are being kept. In the USA the second by size gene bank keeping 280 000 species of plants is located. Under the authority of Norway government (Global trust fund of variety of crops) and Center of genetic resources of the Northern countries there is a Svalbard Global Seed Vault Storage. By March 5, 2013 the number of samples having arrived to this Storage from 27 gene banks of the different states of the world exceeded 770 000 samples. It should be noted that the share of seeds of wild congeners of cultivated plants in gene banks is quite small. In this connection we have studied the international experience on creation and preservation of gene pool of field cultures and their wild congeners. It is necessary to note that in most cases the emphasis is usually made on preservation of cultivated plants.

For the first time at the Institute of Botany and Phytointroduction work on creation of seed bank of wild congeners of cultivated plants within the State scientific and technical program "Botanical variety of Kazakhstan wild congeners of cultivated plants as a source of enrichment and preservation of gene pool of agrobiodiversity for realization of Food programme" for 2013-2015 has been begun. The specialized premises for deployment of active and basic collections have been prepared and equipped: the drying chamber, the refrigerating room, and the room for preliminary freezing. The necessary equipment for vacuum packing of seeds and for definition of their morphology and quality has been bought.

In 2013 by the staff of the Institute and its collaborators 538 samples of wild-growing plants of 200 species of 33 families from 17 floristic regions of Kazakhstan were collected and put for preservation. Also work on adjustment of contacts with seed banks of the different states of the world for duplication of already created collections of wild congeners of cultivated plants is being carried out.

**CONSERVATION OF A RARE ENDEMIC SPECIES *ASTRAGALUS SERICEOCANUS* (FABACEAE) BY USING *IN VITRO* METHODS**

**E.V. Ambros, T.I. Novikova**

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Conservation of rare and endangered species is important techniques to protect genetic plant diversity. *Astragalus sericeocanus* Gontsch. (Fabaceae Lindl.) is an endemic threatened species of Siberian Flora, rarity status 3(R). According to evaluation of the total flavonoid content (above 2%) the species belongs to a promising source of biologically active substances. Anthropogenic load and habitat ecology interfere with natural reproduction of the species. Analysis of electrophoretic spectra of seed storage proteins showed low magnitude of genetic variation in the population of *A. sericeocanus*. This is the evidence of the degradation processes occurring in a given population. According to G.P Semenova's (2007) adaptation criterion data this species belongs to a group of mid-promising plants. *In vitro* methods in combination with traditional approaches of *in situ* and *ex situ* conservation of plants allow to solve the reintroduction and introduction problems.

The aims of this study were to optimize the germination conditions for seeds of *A. sericeocanus*, to multiply and conserve the species in *in vitro* collection. Mature seeds of *A. sericeocanus* from three populations located in the vicinities of LakeBaikal (of collections 2010 - 2012) were used. The laboratory of rare and endangered plants of CSBG were provided our research with seeds. Seeds were sterilized by 70% solution of ethyl alcohol (for 2 min), then 20% «Domestos» solution (for 15 min). The explants quantity without contamination were 96.7% after sterilization. Scarification by 50% sulfuric acid (till 60 min) was applied for exogenous dormancy-breaking. Seeds were placed on modified hormone-free MS media with the half content of mineral components, 2% sucrose and 0.7% agar at a temperature of 24°C. Intact seeds were used as a control. It is shown that treatment with sulfuric acid increased seed germination in comparison with control. Germinability after scarification was 37%, in control – 13%. The explants (plantlets, cotyledons, hypocotyls, axillary meristems of shoots) were placed on the Gamborg and MS media supplemented with zeatin (0.1-2.0 mg/l), 6-benzylaminopurine (0.5-0.75 mg/l), thidiazuron (0.05 and 0.1 mg/l). The Gamborg medium with 0.25 and 0.75 mg/l zeatin was the optimum for development of axillary meristems from the plantlets and the MS medium with thidiazuron - for induction of adventitious shoots from the axillary buds.

Thus, the effective methods of *A. sericeocanus* micropropagation by activation of axillary meristems and induction of an adventitious shooting were developed.

This research was supported by Project no. 30.3 of the Russian Academy of Sciences Program «Living Nature: Status and Development».

**PARENT MATERIAL FOR RICE BREEDING**

**S.M. Baibossynova, A.N. Podolskich**

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Hybridization of varieties of different subspecies of indica/japonica now the main method of creation of grades in world selection of rice. Main goal of intersubspecific hybridization – creation of varieties with higher potential of productivity and quality of grain. Achievement it is supposed a recombination of the best signs and properties of the main cultivated subspecies of rice.

Use of intersubspecific hybridization in the Kazakhstan selection programs for rice encounters the considerable difficulties connected with ecological specifics and agricultural features of cultivation of rice. Therefore the task of creation own the wide compatibility variety of the line of rice of indica of subspecies of the moderate zone, earlier not existing in this climatic zone was set. They will be used and as forms intermediaries, and for direct crossings with the best grades of a japonica.

The first 70 elite of indica forms of a temperate belt are selected and their selection and genetic signs in collection nursery are studied. Studying of an parent material is first and very important link of selection work which in many respects defines success of work on creation of new varieties of any crops. The main requirement imposed to new varieties of rice – high-quality and high-productivity.

Field and laboratory experiments were carried out in Kazakh rice research institute according to Methodical instructions VIR. The standard was the zoned variety Marzhan. The Indica Own Populations (IOP) were studied on signs: height of plants, length of panicle, number of grain on a panicle, and also in physical parameters and a consistence endosperm: the grain shape (length, width, thickness and the ratio of length to width of caryopsis), hull contents, a translucent, a cracking of endosperm and weight is 1000 seeds.

All samples differed dwarf plant (62-73 cm), rather high number of spikelet (130-158 pieces), high and with an average weight of 1000 seeds (29.0-32.5g.). The grain shape and consistence endosperm are the most important indicators of quality. So, the studied set of samples was characterized by a long-grain (the ratio ratio of length to width of caryopsis 2.4-3.04). It is known that in the world market trade in long-grain rice of subspecies of Indica, with long grain prevails. Further research and their use is actual for creation the long-grain of rice which is a basis of division of commodity rice on commercial types.

The consistence endosperm defines not only a commodity of rice, but also culinary and flavoring properties. Range of a translucent and cracking of endosperm didn't differ from the standard Marzhan, but it should be noted that at such long-grain rice presence of low quantity of a cracking of endosperm specifies about high stability and stability of these forms. All studied samples are of special interest.

Therefore, Indica own populations are not only an important factor of expansion of genetic basis and overcoming of genetic unification of the RK future high-quality resources, but also effective sources of improvement of quality of grain and cereal.

**GENETIC RESOURCES AND SUNFLOWER BREEDING RESULTS  
IN THE EASTERN REGION OF KAZAKHSTAN**

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History of sunflower (*Helianthus annuus* L.) gene pool collection creation in the "Experimental farm of oil-bearing crops", Ltd. begins since 1965 – the year of the Kazak experimental station of oil-bearing crops establishment, tasks of which included the study of different sunflower kinds samples for population breeding. Since 1973 there have been started scientific and research works on heterotic breeding with usage of genetic systems CMS – Rf. Self - pollinated lines gene pool, created by inbreeding method, counts 1720 samples, 180 CMS from them are analogs created on *H. petiolaris*; 12 lines – on *H. rigidus* cytoplasm. There have been created 516 paternal lines, containing Rf genes – pollen fertility restoring agents for CMS – PET. Work for creation pollen fertility restoration agents for CMS – RIG is carrying on. One-year wild growing sunflower forms, amount of which in collection is not considerable, are used for initial material creation. 157 samples of the domestic and foreign breeding involved in sunflower collection by breeding works and interchange of collection samples between scientific establishments. Keeping, forming of sunflower gene pool, investigation of biologic properties of collection samples is a very significant task for today. Sunflower gene pool passport system has been conducted according to international descriptors. The form with 15 margins with information about a sample, which includes the date of registration, place and status of storage, country of origin and donor, biological status, type of development, availability of herbarium material and others has been assumed as basis. For more effective usage of sunflower gene pool in breeding programs feature collections has been created: according to early ripeness, macrocarpousness, oil content, husk percentage, according to plants height, diameter head, mildew, broom rape resistance and also according to marker features.

There are created 10 early ripe high effective sunflower hybrids and 3 kinds on base of genetically diverse collection of sunflower self-pollinated lines. This hybrids and kinds are recorded in the Public register of breeding achievements of the Republic of Kazakhstan. 4 perspective hybrids are being under the State kinds trials of agricultural crops of the Republic of Kazakhstan.

**CHARACTERIZATION AND EVALUATION DIVERSITY OF  
AGRONOMIC CHARACTERISTICS IN 27 *LINUM* GERMPLASMS  
OF NATIONAL GENBANK IRAN**

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There are different reasons for characterization and evaluation of landrace populations and their relatives, and also to study the genetic diversity and their conservation. The present study which is based on the gene banks mandate and objectives was conducted for a period of 1 years in Saetlo Agricultural Station of West Azerbaijan, Iran, based on the descriptors of IPGRI. An experiment was conducted in RCBD to study characterization and evaluation of agronomic treat of 27 *Linum* germplasm of National Genbank, Iran. The results obtained in this study indicate that grain yield, biological yield, harvest index, plant high, brench high, capsol number, 1000 grain weight and grain oil varies widely within agronomic linum genotypes. It appears that a special breeding programmer of linum cultivars for high grain and oil yield could be successful and divers agronomic treats and oil content between landraess.

**DISTRIBUTION OF WILD RELATIVES OF CULTURAL PLANTS  
IN FLORA OF MANGISTAU REGION**

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Creation of the new highly productive plant varieties, used for production of high-quality foodstuff and forages, adapted for adverse environmental conditions, diseases and wreckers, demands widely a choice of the initial material, which important component are the wild relatives of cultural plants (WRCP). In recent years there was the imperative need of preparation of the DSKR's list for Kazakhstan, because without the special researches directed to careful inventory of economic and valuable plant species of the republic, it is impossible to plan actions for their protection and practical use.

The purpose of the present researching was detection of the full list of DSKR in Mangistau's flora.

As material for drawing up the DSKR's list of Mangistau region served the republican and regional floras, literary data, and the recommendatory list, developed by staff of Institute of Botany and Phytointroduction.

As a result of the literary review and field researches in flora of Mangistau region 118 species of DSKR relating to 65 genes and 21 families were allocated. The greatest specific varies of DSKR is revealed in the territory of the floristic area Mangyshlak – the 103 species, twice smaller number of types grows at Northern Ustyurt – 51, the smallest number is noted at the Southern Ustyurt and Buzachy – 30 and 32 look respectively. This distribution of species is caused by soil climatic conditions. So, at the conditions of Mangyshlak peninsula more favorable, therefore the maximum specific structure is observed.

Species of DSKR from different families are distributed unevenly, the most widespread are representatives this: *Chenopodiaceae*, *Fabaceae*, *Nitrariaceae* and *Poaceae*. Other families grow mainly in the territory of the floristic area Mangyshlak.

We carried out the analysis of economic and valuable groups of plants. So, it was defined that among DSKR the greatest number belongs to fodder plants – 91 species, the second position is taken by food plants – 34 species, on the third place herbs – 23 species. Melliferous plants are presented by 20 species, technical – 14 species, vitamin – 14 species, decorative – 15 species.

Thus, in the territory of Mangistauregion grows 118 species of DSKR from 65 genes and 21 families. The greatest specific variety is dated for the floristic area 136. Mangyshlak.

The most widespread are representatives the plants from *Chenopodiaceae*, *Fabaceae*, *Nitrariaceae* and *Poaceae* families. By economic and valuable groups among plants of DSKR possessing fodder, food and medicinal properties prevail.

Results of researches show wide biological diversity of DSKR of flora of Mangystau and prospect of their wide use and introduction into culture.

Researches are executed within the subject "The Botanical Variety of Wild Relatives of Cultural Plants of the Western Kazakhstan as a Source of Enrichment and Preservation of a Gene Pool of Agrobiodiversity for Realization of a Food Program".

**GENETIC DIVERSITY OF IRANIAN MELON GERMPLASM**

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Genetic diversity of 110 Iranian melon landraces from the National Plant Gene bank of Iran were characterized based on 40 agro-morphological traits. Diversity was analyzed using correlation, cluster, factor analysis. Factor analysis have shown that 7 factors were identified which together explained 0.5 % of the variation. To select the relevant characters, those correlation values  $\approx 0.5$  were considered as relevant for that factor. The variation to select the factor. The first factor explained 18.4 % of the variation and is associated with fruit characters such as fruit shape, fruit length, fruit width, flesh thickness, fruit cavity diameter, amount of placental tissue, fruit skin hardness, fruit skin thickness, color of cavity, internal aroma, soluble solids, flesh moisture, fruit skin texture. The second factor which accounts for 7.2% of the variation and is associated with seed character such as seed color, seed length, seed width. The third factor explained 6.9 % of the variation and is associated with fruit characters such as fruit skin main color, fruit skin secondary color. The fourth factor explained 5 % of the variation and is associated with leaf characters such as leaf pubescence density. The fifth factor explained 4.8 % of the variation and is associated with flower such as type of flower. The melon germplasm was grouped into six clusters. Correlation among some pair characters were significant.

**MULTIPLICATION OF RARE *FRITILLARIA* SPECIES  
BY BIOTECHNOLOGICAL METHODS**

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One of the most important problems of modern biological science is the prevention of decrease of species on the planet, inducing to both natural causes and increased anthropogenic load. Species of the genus *Fritillaria* are characterized by low speed as vegetative and seed-breeding, with many members of this genus are widely used in traditional Chinese medicine, for which often leads to uncontrolled blanks. A lot of members of this genus are rare species listed in the Red Books of different levels. On this basis, the problem of intensification of reproduction of these plants, in order to preserve biodiversity. The solution is to use the biotechnology – clonal micropropagation.

*Fritillaria sonnikovae*, *F. meleagroides* and *F. dagana* are rare perennial species belonging to the *Liliaceae* family, having enormous potential as ornamental plants used in landscaping and for cutting.

The aim of this work is to optimization technology of clonal micropropagation of the genus *Fritillaria* (*F. sonnikovae* Schaulo et A. Erst, *F. dagana* Turcz. ex Trautv. *F. meleagroides* Patrin ex Schult. et Schult.).

The bulbs *Fritillaria sonnikovae*, *F. meleagroides* и *F. dagana* were starting material for the initiation of *in vitro* culture, which were sterilized 70% ethanol (30 sec.), then 0,1% HgCl<sub>2</sub> with 1% Tween 80 (30 min.). Further, the sterile plant material washed three times with sterile distilled water. The main nutrient media were medium by the prescription Dunstan and Short (BDS), and also medium of prescription Gamborg (B<sub>5</sub>) supplemented with growth regulators: 6-benzylaminopurine (BAP), thidiazuron (TDZ), α-naphthaleneacetic acid (NAA), indol-3-acetic acid (IAA) in different concentrations. The morpho-histological development of the plant development has been analyzed with Carl Zeiss Stereo Discovery V 12 stereomicroscope, Axioskop-40 light microscope (Carl Zeiss, Germany).

The work was evaluated the influence of the mineral composition of nutrient media BDS and B<sub>5</sub>, which are used for micropropagation of bulbous. We have used combinations of 12 growth regulators, introducing to growth media at a concentration of 2.0-10.0 μM. Control is a medium BDS devoid of growth regulators. It has been found that the most preferred for *Fritillaria sonnikovae* and *F. meleagroides* use media containing auxins and cytokinins together, allowing receiving 3-4 bulblets per explant. In evaluating the effect of the type of cytokines on the regenerative capacity revealed that TDZ at 10.0 μM concentration induced more intense shoot formation in *Fritillaria sonnikovae* and *F. dagana*, compared with the same concentration of BAP. The high rate of reproduction on no plant grown regulator BDS medium for *F. sonnikovae* indicates that microplants contain a sufficient amount of endogenous growth regulators to induce shoot formation. Histological analysis of the development showed that the plant *Fritillaria dagana* and *F. sonnikovae* in culture *in vitro* characteristic of adventives shoot formation.

The work was supported by the grant of OPTEC.

***EX SITU PRESERVATION OF KAZAKHSTAN'S RARE  
AND THREATENED SPECIES LONICERA ILIENSIS***

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Kazakhstan contains a wide range of genetic diversity of *Lonicera*, with 21 species found throughout the country. *L. iliensis* Pojark. is a rare, threatened, almost endemic species listed in the Red Book of Kazakhstan. Three natural populations of *L. iliensis* in the Almaty region were investigated recently and the growth and age structure in the Ili River population are much worse than the populations near the Chilik River and the Charyn River (Mukhittdinov et al., 2013).

The present work developed protocols for *L. iliensis* germplasm *ex situ* preservation including seed storage, *in vitro* culture and cryopreservation. Seeds were collected in May-June of 2012 and were air dried for one month to 11.3% moisture content. The laboratory germination of seeds from three populations didn't significantly differ at P<0.05 with germination of 76.3 (Ili), 71.5 (Chilik) and 81.7% (Charyn). Dried seed were cryopreserved in liquid nitrogen and no significant changes in germination were apparent following LN exposure for 1 h and 3 months. *L. iliensis* seed collections were stored at +4°C, -20°C and -196°C for further study. *In vitro* plantlets of *L. iliensis* from seeds of the three populations were initiated into culture and micropropagated on MS medium with 1 mg/l 6-benzylaminopurine (BAP). Cryopreservation protocol of shoot tips was optimized: the cold acclimation duration of plants (1-3 weeks at +4°C, 8 h light (10 µmol /m<sup>2</sup>/s) / 16 h darkness), medium composition for shoot tips preculture (0.3 M sucrose or 5 % DMSO), PVS2 treatment duration (20, 40, 80 min) were compared. The highest percentage of shoot tips recovery following liquid nitrogen exposure was obtained at 3 weeks cold acclimation, 2 days of shoot tips preculture on MS medium with 0.3 M sucrose, 80 min PVS2 treatment and was reached 76.2 %.

Thus, *ex situ* preservation of *Lonicera iliensis* – rare species of South-East Kazakhstan, has been developed by three ways – as *in vitro* collection of aseptic plants, as well as cryogenic collections of seeds and shoot tips.

**Keynote**

**USING OF BIOTECHNOLOGICAL METHODS FOR PRESERVATION  
OF THE GENE POOL PLANTS**

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Equally with traditional methods of plant preservation ex situ application of isolated tissue and organ cultures has become more and more actual.

The purpose of our research is to improve the clonal micropropagation technology, to investigate the morphogenetic processes in the course of propagation and to create the bank and of cultures in vitro of valuable and rare plant species.

The development of sustainable reproduction plants methods to constitute the basis for the work on preserving the plant gene bank.

The highly efficient technologies of clonal micropropagation of various taxonomic group of plants have been elaborated and improved on the basis of mass screening for more than 1200 plant genotypes attributed to 144 genera and 57 families ,including, 64 species listed the Russian Federation Red list. On the basis of these researches the largest in Russia genepoll collection in vitro of valuable species and cultivars plants was created.

Rare, valuable hybrids of medicinal, decorative culture and wild form of plant species have been represented most complex.

Application of biotechnological methods for preservation of rare plant species the special attention is given. *Orchidaceae, Iridaceae, Liliaceae, Paeoniaceae, Rosaceae, Amaryllidaceae, Araliaceae* families are the most representative in bank of rare plant species.

The ability for organogenesis plant differed essentially between families, species and cultivars of plants. Were developed competent explants for sustainable reproduction of plants (apical meristem with leaf primordial).

The optimum storage conditions in the genetics bank of aseptic cultures have been found for 3-7°C. The major factors influencing on duration of explants of plants in condition in vitro were established. Special roles in plants conservation in vitro play retardants, osmotic and physical factors of cultivation, temperature and light intensity.

At creation of gene bank *in vitro* primary importance is given to representative and preservation of genetic stability.

For model species RAPD-analysis has been carried out to control the genetic stability of the items kept in bank in vitro. Evaluation of relative genetic distance between microclones and known taxa is proposed as method to verify in vitro germlpasm collections.

Hence the storage in vitro of valuable plant forms is a highly efficient way for maintenance of plant collections and conservation of plant biodiversity.

**Keynote**

**THE IMPORTANCE OF PASTURES IN THE PROTECTION  
OF BIODIVERSITY**

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Turkey is a bridge between Europe and Asia. Biodiversity of Turkey is also important besides its cultural richness. The European continent while 13.000 angiospermes and gymnosperms species, only in Anatolia close to this number (about 11.000) are known. Approximately, one third of them is endemic species. Endemic species are defined as "which grows only in limited area and often rare species". In terms of endemic plants, Turkey is one of the world's richest countries. The Mediterranean, Central Anatolia and Eastern Anatolia Regions of Turkey are rich of endemic plants. Also, these regions of Turkey are the largest pasture areas (14.6 milion hectar).

Pastures are important gene center besides of being an important source of feed. Pastures are considered in important life areas of plants and animals. Pastures are areas that the most cost-effective, easy way and protected in natural state of biodiversity. If the pastures are used in accordance with pasture management technique, level of productivity and life chances of genetic resources increases. Otherwise, both of pasture productivity and biological diversity is declining.

**ROOTING ACTIVITY OF *BERGENIA CRASSIFOLIA*  
AND *SANGUISORBA OFFICINALIS***

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Development of ecologically safe growth regulators based on natural raw materials becomes relevant. The important features of the regulators of growth are effective at low concentrations, low-toxic, low rates of application.

The rich and diverse wild flora of Kazakhstan is available and cheap source for the production of various bio preparations, but «the flora of Kazakhstan according to the research degree can be considered as insufficiently studied in phytochemical and biological activity aspects» (1).

The study of tannins which are widely used in traditional medicine, pharmaceuticals, in the leather industry and in other fields is a particular interest (2).

The aim of the research is to study the growth-regulatory activity of total extracts and fractions of tannins isolated from *Bergenia crassifolia* (L.) Fritsch. and *Sanguisorba officinalis* L. grown in Kazakhstan.

Initial samples of plants were collected in East Kazakhstan region and dried in the shadow for extraction. Total extracts were obtained from collected plant materials using dichloromethane, ethanol and distilled water as solutions followed by evaporation.

Predominant contents of hydrolyzable and condensed tannins (20.87%), flavonoids, phenolic acids, amino acids and carbohydrate compounds in *B. crassifolia* were defined. In samples of *S. officinalis* the highest content of hydrolysable tannins (21.08 %), phenol acid, amine compounds, flavonoids and steroids were defined.

Individual fractions of condensed and hydrolysable tannins, gallic and ellagic acids, gallotannins, ellagotannins using column chromatography were obtained. In individual fractions gallic acid, pyrogallol, catechol, gall- and ellagotannins were identified.

In test systems in vivo and in vitro it was shown that total extracts and individual tannin fractions of *B. crassifolia* and *S. officinalis* have a synergistic effect on the root development when combined with indolebutyric acid or different growth regulators based on it.

**Literature**

1. Introduction to phytochemical studies and identification of biological activity of substances of plants. Edited Mamonov LK Muzychkina RA - Almaty School of the XXI century, in 2008. - 216.

2. Cseke L.Y., Kirakosyan A., Kanfman P.B. Natural Products from Plants// Boca Raton. London. New York, 2006. – 611 p.

**Keynote**

**PLANT GENETIC RESOURCES OF TAJIKISTAN**

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Given the population projections for the growing human population, we need to increase food potential annual average of 2%. Since time immemorial, to ensure the development of agricultural plant genetic resources are an important source for meeting the food. Therefore, the primary task is to protect the world's genetic resources while preserving them for management.

In the current context of climate change, when the reserve of arable land near the end of the limit on the yield of important crops almost achieved as a result of intensive breeding, held in the last 100 years, the remaining reserves are very small and do not in any way ensure population growth. Hence, we need new approaches to solving the food problem that can only come from the analysis of the fundamental achievements of modern science. Naturally, in order to double the volume in the future of food production, it is necessary to create a fundamentally new form - with the reconstructed genomes and more productive, quality and resistance to abiotic and biotic stress. For this purpose, wild relatives and cultural extensively used to search for and transfer to new modern commercial varieties stress resistance gene. The work begun by Vavilov and his colleagues has shown exceptionally high efficiency of selective breeding to create high-yielding crop varieties.

In this context an investigation of wild relatives of cultivated plants in Tajikistan by the example of wild fruit and cereals, a description of places where they grow, taking into account ecological and geographical and climatic condition is very important. Under the framework of ISTC project #T-1105 "Genome analyses of cereals in Tajikistan" the biochemical and molecular genetic study of wild relatives of *Aegilops* have been conducted.

Undoubtedly, the widespread use of DNA markers in assessing polymorphism genomes of various species of the genus *Triticum* will make it possible to build their genetic classification, which will reveal the history of the origin, distribution and adaptation of wheat. Therefore, this line of research should be developed further in assessing the genetic diversity of different types of culture. In general, the estimation of genetic diversity and breeding varieties of wheat and its wild relatives using genealogical analysis may be useful to clarify the strategies and programs of selection of priority areas in the study of the collection, as well as sampling the formation of various samples for analysis.

**ADVANCES OF GREEN ROOFS FOR ENVIRONMENT IN URBAN AREAS**

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In 21th century, the unplanned urbanization, global warming, lack of green space, and the human effects on the ecological balance in the nature influence the human life particularly in our cities. Additionally, the mentioned changes cause to decrease on other open-green spaces as well as the reduction of the natural places in the cities. That's the reason for ecological anxiety as well as the demand for recreational and roof areas in urban places.

Establishing of the plant material on roof tops provides numerous ecological and economic benefits which might be summarized as following: improving of the microclimate and air quality, offering to a natural habitat, providing for additional space, increasing of water retention and noise protection, storm-water management, energy conservation, mitigation of the urban heat island effect, and increased longevity of roofing membranes, as well as providing a more aesthetically pleasing environment for life.

This paper is a review of current knowledge regarding to the benefits of green roofs in urban areas that are so far from the nature and lack of green space.

*Keywords:* Urban Areas, Green-roof, Benefits of Green-roofs

**Special**

**PLANT BIOTECHNOLOGY IN KAZAKHSTAN**

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The research on plant biotechnology in Kazakhstan was started in 1970. Biotechnological protocols of micropropagation in tissue culture and isolated organs of rare and endangered species, as well as medicinal, fodder, technical and ornamental plants were developed. Concentrations of growth regulators in the composition of nutrient medium were optimized with regard to the content of endogenous phytohormones in tissues of intact plants. Proposed methodological approach contributed to improve the efficiency of biotechnological methods for plant clonal propagation.

Extensive research on tissues, cells and protoplasts culture of cereal crops was conducted. Regularities of proliferation, differentiation, morphogenesis and regeneration in germ and somatic cell culture were clarified. There were developed regulations of regeneration of homozygous dihaploid plants in anther culture and isolated microspore and obtaining heterozygous diploid somaclonal variants in the culture of somatic tissues based on established theoretical concepts. Plant regeneration protocols were developed in culture of isolated protoplasts. The ways of regulation of cytodifferentiation and morphogenesis were indentified in long-term cultured embryogenic tissues. Technology of plant regeneration from repeatedly subcultured callus tissues of wheat and barley was created.

There were studied cytophysiological patterns of ultralow temperatures influence on plant cells and biotechnological regulations were developed for cryopreservation of fruit and berry crops germplasm. Methods of embryo culture have been developed to improve the viability of wheat hybrid embryos with its wild relatives.

The influence of space flight factors on the growth and morphogenesis in barley callus tissues, as well as on the development of the generative organs of wheat was studied. It has been established that there is a significant decrease in the rate of callus growth and cell secretory activity. It is also shown that the formation of gametes and embryo development can be involved in zero-gravity experiment in the culture of isolated wheat ears.

Priority area in the development of biotechnology in Kazakhstan is genetic engineering. Methods on stable genetic transformation and regeneration of transgenic plants were established. There were obtained transgenic potato plants with genetically fixed Y-resistant virus. Viral genome fragment was introduced to the potato genome in the antisense orientation. Maize genetic transformation was implemented by transferring genes to protoplasts that code for the synthesis of antifreeze proteins involved in resistance to low temperatures. It was optimized the technology for producing transgenic rape plants.

Intellectual potential of biotechnology in Kazakhstan is quite high. However, the weak link remains low innovation activity. The main reasons for this are, firstly, the deficiency of experience of research teams in commercial activity, the lack of qualified managers in bio-business, and secondly, the high research intensity, duration and expense of the creation of biotechnological products that require significant government support. Enactment on genetic engineering and its harmonization with international law will promote more effective further development of biotechnology in Kazakhstan.

**INVESTIGATION OF MONOSOMIC STOCKS FOR CREATION OF  
SUBSTITUTION FORMS IN COTTON *GOSSYPIUM HIRSUTUM* L.**

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In Uzbekistan, long-term investigations are carried out towards development of cotton monosomic stocks that use different types of irradiation as a source of monosomes. Between 1987 and 2010, we developed a total of 94 *G. hirsutum* primary monosomics from the common genetic background of the highly inbred line L-458 after irradiation of seeds by thermal neutrons or pollen gamma-irradiation. Most of them (75 of 94) arose from the two irradiation types directly in M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> generations. The remaining 19 monosomic plants resulted from chromosome aberrant progenies (desynapsis and interchanges).

An addition to traditional radiation-induced cotton monosomics, we used the desynaptic effect which have been found to be a useful source of aneuploidy in other crops. As a result, 17 primary monosomics were isolated from the progenies of 7 desynaptic plants and one unexamined plant from the desynaptic plant progeny.

Meiotic metaphase I analysis of 94 cotton primary monosomics was revealed modal chromosome pairing with 25 bivalents and univalent in 38 plants. Fifty monosomic plants were characterized with the presence of additional univalents. In seven primary monosomics, besides univalent and bivalents, rare trivalents formed at metaphase I meiosis. Analysis of the sizes of monosomes revealed medium univalent size in 44 monosomics; whereas there were 22 monosomics with large univalents. The number of monosomics having small univalents was slightly higher (27); moreover, among these, 6 monosomics with very small univalents were detected. Therefore, according to a preliminary assignment of monosomes on the basis of their sizes to the subgenomes, 22 large monosomes can be assigned to the A<sub>t</sub>-genome and 27 monosomes of small sizes to the D<sub>t</sub>-genome. Since it is known that only three chromosome pairs of *G. hirsutum* have long arms that are two or three times the length of the short arms, monosomes of medium sizes demand special analyses using translocations with subgenome assigned interchanges.

We have already begun to use interspecific monosomic F<sub>1</sub> hybrids from the crosses of the monosomic stocks from our collection and *G. barbadense* L. doubled haploid line known as 3-79 (USA) as a donor parent for chromosome assignment of chromosome-specific SSR markers. At present, F<sub>1</sub> hybrid monosomics were isolated and studied in 27 hybrid families. In 5 hybrid families, 3 hybrid chromosome deficient plants were detected in each monosomic progeny, in 8 families 2 hybrid monosomics were isolated, and in remaining 14 families, 1 monosomic per progeny was identified. These results pointed out both the ability of monosomic detection in various hybrid backgrounds and differences in monosome transmission rates. In addition, the presence of additional univalents was observed in 9 hybrid monosomics with a small frequency average per cell.

## **CONSERVATION OF AGRICULTURAL PLANTS GENETIC RESOURCES FOR A BREEDING**

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Annually in the world created thousands varieties, however, growing demand for new varieties that have a set of valuable features that can produce crops in a variety of environmental conditions and take advantage of energy-saving and environmental technologies . Leading place is given to the rational use of the gene pool. According to data reported on 01.01.2014 by the project "The formation of the gene pool of crops for a sustainable and competitive development of the agro-industrial complex of the Kazakhstan Republic" by SRI of MOA RK support and store more than 50.0 thousand ( 59422 ) samples. Over 50% of the collections are a grain and grain forage crops, ≈ 20,0% - fodder , ≈ 1,0% - oilseeds and legumes, ≈ 1,0% - technical, ≈ 25,0% - vegetables and potatoes, ≈ 5,0 % - fruit and berry .The assembled gene pool have unique structure- commercial varieties of national and world breeding, wild and wild relatives, landraces, the best breeding lines, genetic collection, mutants. The major gaps found in stored collections - incomplete coverage of the intended taxon, incomplete geographical coverage, loss of well-known local and old varieties, loss of historical varieties.

Large collections stored with varying degrees of risk. Short-term storage marked decrease (an average from 20 to 30%) viability; in some cases registered loss of germplasm (reports KazRIA, 2009 - 2011). Regeneration is priority of the PGRFA programs in Kazakhstan. Since 2010 KazRIA storing ≈ 1/3 of the national gene pool, introduced standards of medium storage (-5, - 10°C ) with regular monitoring viability and regeneration of seed collections at critical germination ( $\geq 50\%$ ). In 2013 was monitored viability and regeneration of 2230 samples of seed collections. Kazak Researh Institute of Fruit and Grape organized storage in vitro (+4°C) 422 varieties and wild germplasm forms of fruit, berries and grapes. Storage gene pool of fodder, fruit and vegetables crops conducted in partially by foundation of field genebanks.

The research of the majority samples carried out insufficiently. Necessary pre breeding research that can significantly raise the ceiling of breeding achievements, extend adaptation of crops to changing environmental conditions. According to published data are insufficient sources of polygenic traits of drought resistance, cold resistance, salt tolerance, with different periods of the growing season, certain quality parameters. A lot of valuable genetic material, obtained by breeding programs are not saved and identified - need careful study of lines produced in practical breeding.

**CLONAL MICROPROPAGATION OF *RHODODENDRON DAURICUM* AND *RHODODENDRON SCHLIPPENBACHII***

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Growing on territory of the Russian Federation the species of genus *Rhododendron* are not only a valuable genetic resource for breeding of forms and cultivars promising for landscaping, but also a source of biologically active substances. *Rhododendron dauricum* L. and *Rhododendron schlippenbachii* Maxim. are the frost-resistant species successfully adapting to the south of Western Siberia. However, the mass propagation of these species in the culture, using traditional methods is difficult. Furthermore, *R. schlippenbachii* is a rare endangered species listed in the Red Data Book of the Russian Federation that needs to be protected. The aim of the research is to reveal seedling morphogenic responses of *R. dauricum* and *R. schlippenbachii* on various growth regulators in *in vitro* culture and to develop effective clonal micropropagation technologies of these species.

To obtain a sterile culture aseptic seeds were germinated under the light at the surface of agar aqueous solution (0.6%). Explants (plantlets with cutting roots) were inoculated on Anderson's medium (AM), supplemented with different concentrations and combinations of plant growth regulators (1.0-10.0  $\mu$ M zeatin; 5.0  $\mu$ M zeatin with 5.0  $\mu$ M inodolil-3-acetic acid; 1.0  $\mu$ M thidiazuron). The frequency of morphogenic response, the multiplication level and the shoot length were determined after 8 weeks of cultivation. The number of shoots per explant obtained under the influence of thidiazuron (TDZ) was recorded after 8 weeks of elongation on the hormone-free medium (AM0).

To stimulate the root formation 4-hour pretreatment by solution of 148.0  $\mu$ M indole-3-butyrlic acid (IBA) or 6-week cultivation on AM, supplemented with IBA (10.0  $\mu$ M; 25.0  $\mu$ M) were used. For rooting regenerates were placed either *in vitro* on AM0 or *ex vitro* in a mixture of peat and sand (1:1). Adaptation of rooted plants was carried out in the mixture of peat and sand for 6 weeks. Adapted plants were planted in the pots with soil and transferred to the greenhouse.

The seeds of *R. dauricum* and *R. schlippenbachii* were found to be a promising system for *in vitro* obtaining sterile explants, since they have a high rate of germination (74 and 96%, respectively) and a shallow physiological type of endogenous dormancy (type B<sub>1</sub>). The low concentrations of TDZ and Zea stimulate the activation of axillary meristems as well as the formation of adventitious buds formed on the seedlings hypocotyl. The concentrations of 1.0 – 2.5  $\mu$ M Zea in micropropagation medium are optimal for these species. TDZ significantly increases the rate of explants propagation. However, it requires further shoots elongation.

Pretreatment with IBA (148.0  $\mu$ M), followed by *ex vitro* rooting and adaptation in the mixture of peat and sand, significantly increases the yield of a high-quality planting material of *R. dauricum* up to 89%, *R. schlippenbachii* – up to 60%.

**PECULIARITIES OF INITIATION AND PROLIFERATION  
OF *PICEA PUNGENS* SOMATIC EMBRYOS**

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Blue spruce (*Picea pungens*) is considered one of the most ornamental conifer species as well as this species tolerated to urban conditions and dust- and smoke-resistant. The processes of *Picea pungens* somatic embryogenesis initiation and proliferation under controlled conditions *in vitro* were studied. The isolated zygotic embryos selected at the stage of early and late embryogenesis and at the stage of mature embryo were used as explants. The material was collected from the open pollinated trees growing in artificial planting of Novosibirsk. The basal media  $\frac{1}{2}$  DCR and  $\frac{1}{2}$  LV supplemented with ascorbic acid (0-300 me/l) and glutathione (0-300 me/l) were employed for initiation of somatic embryogenesis. The 2,4-dichlorophenoxyacetic acid (2,4-D) and 6-benzylaminopurine(6-BA) were used as plant growth regulators. The transition from initiation to proliferation was regulated by lowering the level of sucrose and 6-BA. The cultures were incubated at  $24\pm2^{\circ}\text{C}$  at darkness. Cytological characteristics of cells were controlled by using the squashed preparations.

At establishment in culture at early stage of the zygotic embryogenesis the morphological reactions weren't observed. At inoculation on nutrient mediums at late stage of the zygotic embryos (stage of cotyledons initiation) morphogenic response was observed only of explants on  $\frac{1}{2}$  LV medium. It was dependent upon donor plant genotype and consisted 30-40 %. The addition of ascorbic acid in the medium increased up to 50 % ability of explants for callus formation. However, according to cytological analysis the embryogenic structures were not observed in this callus.

The inoculation the embryos with mature cotyledons in culture stimulated the increase of morphogenic response and varied from 60 to 100 %. The frequency of embryogenic callus formation achieved 8,4 % on  $\frac{1}{2}$  DCR medium and 28 % on  $\frac{1}{2}$  LV medium. Cyto-embryological analysis of the initial callus indicated the presence of somatic embryos in all investigated genotypes. They were at early and/or globular-stages, but only one genotype was able for proliferation. Morphological, ontogenetic and quantitative characteristics of proliferating somatic embryos were different depending on the medium composition used for initiation and proliferation embryogenic suspensor mass (ESM). The addition of glutathione to medium increased the frequency of ESM formation on initiation stage, but inhibited the somatic embryos development and even led to their degradation in proliferation stage. The addition of the ascorbic acid increased the ESM formation at SE initiation and accelerated the globular embryos ontogenetical development at the proliferation stage. The inoculation the mature zygotic embryos in culture stimulated the growth of morphogenic response from 70 to 100 %. The frequency of embryogenic callus formation was varied from 2 to 8 %. The cytological analysis of initial callus indicated the presence of two types of cells that were able to proliferate: 1) elongated embryogenic tubes 2) round embryogenic initials. The development of somatic embryos was observed up to the late globular-stage.

Thus, it was found that the somatic embryogenesis induction is affected by the stage of explants development, nutrient medium composition and plant genotype.

**COMPONENTS OF ESSENTIAL OIL PLANT OF GENUS *ARTEMISIA* L.  
BURYATIAN AND MONGOLIAN FLORA**

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The territory of Buryatia represents difficult phyto-geographical node at the intersection of ecosystems of North and Central Asia, and it is a classic variant of the buffer territory. The main centers of origin of *Artemisia* of Eurasia are: Chinese-Japanese, Angarsk center, central-Asian, Bering center, Average Asian and Mediterranean (Krasheninnikov, 1958). Very important center is the Angarsk, including area of our researches – Buryatia and Northern Mongolia.

There are 46 species of *Artemisia* represented in Buryatia (Namzalov, 2001). The *Artemisia* are applying in national and official medicine. *Artemisia* contains a large variety of biologically active substances, including essential oils. Essential oils are using for cosmetic, food and pharmaceutics.

Chemical composition of essential oils was determined by GC-MS. The component identification was based on the comparison of retention indices (RI) of GC peaks on HP-5ms column and confirmed by comparison with fragmentation pattern of plant volatiles library (Tkachev, 2008).

All samples were divided into three groups. The first group includes species which are rich in chamazulene. The second group of essential oils with acetylene hydrocarbons (benzyldiacetylene, capillene and capillin) as main components. The third group is rich in terpenoids (1,8-cineole, camphor, germacrene D, caryphillene, spathulenol, etc.).

Some wormwood species have the high content of chamazulene in the essential oil. Essential oil are investigated of *Artemisia sieversiana* Willd., *A. jacutica* Drob., *A. macrocephala* Jacq. ex Bess. *Artemisia siversiana* is widespread in Mongolia and Russia, particularly in Buryatia. *Artemisia jacutica* is the endemic of Eastern Siberia, having a limited range of distribution. In Buryatia the only is growing is known, and on the territory of Mongolia this species is not found. The oil yield from *Artemisia sieversiana*, *Artemisia jacutica*, and *Artemisia macrocephala* was 0.19%, 0.01%, and 0.50 %, respectively.

*Artemisia glauca* Pall. ex Willd. is the typical representative of the second group of *Artemisia* with prevalence in oil of acetylene hydrocarbons. The yield of essential oil are 0.44-0.90%.

Third group consist of *A. gmelinii*, *A. anethifolia*, *A. mongolica*, *A. dolosa*, *A. tanacetifolia*, *A. scoparia*, *A. subviscosa*, *A. dracunculus*. Main components of *A. frigida* from different populations are 1,8-cineole (6.6-23.4%), camphor (3.6-35.9%), borneol (6.1-17.0%) terpineol-4 (4.2-14.1%) bornylacetate (1.1-6.0%) germacrene D (0.8-5.0%).

Our data very closely related with data for composition of essential oils for China and Mongolia.

**ISSR DIVERSITY AND KARYOTYPE VARIATION IN THE ENDEMIC  
PLANT OF TUVA REPUBLIC *HEDYSARUM CHAIYRAKANICUM*  
(FABACEAE)**

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*Hedysarum chayrakanicum* Kurbatsky is a strongly endemic to Tuva Republic. It is known for two localities only: the Chaiyrakan Mountain where the species prototype was collected from in 1990 and the Novyi Shagonar village. An extremely restricted endemic geographic area of *H. chayrakanicum* tends to decrease due to overgrazing and engagement the lands into limestone output. The species was included in the Red Data Book of the Tuva Republic with the status 2 (U) – vulnerable species. However *H. chayrakanicum* is one of the insufficiently studied rare species of steppe vegetation in Central Tuva. Therefore elaborating the appropriate conservation and management program for the species remains difficult. The objective of the study was to characterize the genetic diversity through ISSR analysis and to precise the chromosome number in *H. chayrakanicum*.

In all, 134 loci have been amplified from 37 individuals of *H. chayrakanicum* using 5 ISSR-primer combinations. Genetic variability  $H_{sp}$  estimated for *H. chayrakanicum* was of 8.06 which is relatively high for rare endemic species. Variability of *H. chayrakanicum* exceeds the same value detected for endemic Altai-Sajan *H. theinum* ( $H_{sp} = 7.71$ ) but it is below than the meaning of Mediterranean *H. coronarium* diversity ( $H_{sp} = 8.99$ ). Genetic variability on the population level in *H. chayrakanicum* was not significant ( $D = 0.343$ ). Low genetic differentiation together with relatively high amount of genetic variability in *H. chayrakanicum* is thought to be caused by the presumably allogamous mating system which contributes to outcrossing and gene flow.

The disjunctive geographic range of *H. chayrakanicum* allows to propose that the past area of the species was more extensive including the present area and undergone the changes, resulting in the modern local geographic range.

The cytotype  $2n = 14$  was registered for *H. chayrakanicum*. Therefore the cytotype  $2n = 16$  revealed in our study is new for the species. Chromosome number variability and polyploidy are known to be a widespread phenomenon in *Hedysarum* genus. Thus for *H. coronarium*  $2n = 16, 18$ , for *H. setigerum*  $2n = 14, 28, 32, 48$ , for *H. gmelinii*  $2n = 14, 16, 28, 32, 56$ , etc.

In summary, our results indicated that in spite of local endemic geographic range genetic diversity of *H. chayrakanicum* was high at the species level and variability chromosome number was known for the species:  $2n = 14, 16$ . Based on these findings, high evolutional potential and adaptiveness of *H. chayrakanicum* are proposed. Nevertheless extremely local geographic area and low seed productiveness of the species indicate the necessity of protection its natural habitats and implementation of *ex situ* conservation such as construction of germplasm collection. The conservation arrangements will be more helpful and sufficient if the species is included in federal protection programs.

This work was supported by the Russian Fund of Fundamental Investigations (No. 14-04-31249).

**BEAN COLLECTION OF KAZAKH UNIVERSITY: ENRICHMENT  
AND INVESTIGATION ON MORPHOGENETIC TRAITS**

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Under mountain and steppe (plain) conditions of the Almaty Region, morphogenetic traits of 37 cultivars of common bean from different soil and climatic zones (Kazakhstan, American, Chinese, Polish, Russian, Turkish, and Czech collections) have been evaluated.

This study was carried out under crop rotation in mountain and steppe (plain) zones of the Almaty Region in 2011-2012. Thirty-seven cultivars of common bean and its relatives were planted: i, generation and study on domestic cultivars of common bean; ii, setting up the collection so as to be processed by the students under the supervision of researchers; iii, development of field and seed research capability at new “Zhanga Talap” Agrobiocenter of al-Farabi Kazakh National University.

Basic morphogenetic features have been studied across the collection of common bean, *Phaseolus vulgaris* L. (Kazakhstani, American, Chinese, Czech, Polish, Russian, and Turkish), from different soil and climatic areas. The collection was grown under mountain and steppe zone conditions of the Almaty Region. A number of useful genetic stocks have been identified for agronomically desirable traits. Part of stock varieties after preliminary propagation and introduction has been registered as the State Certificate on the subject of author rights No. 612 of 14 May, 2012 entitled: “Distribution and exchange of bean specimens”.

Out of the Czech bean collection introduced in the mountain zone, the cultivar to reach maturity earliest was cv. “Luna” (80 days of maturation), whereas other cultivars reached their technical maturity 10-12 days later than “Luna”. As for germination percentages, tested by computational cluster analysis, the local line “Nazym” being closer by maturity date to cv. “Zuzka” and other local bean line “Talgat”, appears to be more promising to be grown commercially in southeast regions of Kazakhstan on the basis of this and its other desirable traits.

Using local “Aktatti” line, the effect of new domestic bioorganomineral fertilizer on morphogenetic traits were investigated, and the fertilizer was shown to increase the yield by as much as 25%.

In addition to Czech and local cultivars and lines, six French cultivars of bush and liana common beans (“Argus”, “Coco nain blanc precoce”, “Triomphe de Farcy”, “Merveille de Venise”, “Mistica”, and “Phenomene” manufactured by Truffaut and Vilmorin companies), are currently being investigated. Five of these cultivars (except cv. “Coco nain blanc precoce”) show high or average productivity (the data are in progress). Investigations on domestic collection of cultivars and lines are also in progress with respect to biochemical, cytogenetic and other properties for use in further breeding work.

**CONSERVATION AND USE OF GENETIC RESOURCES  
OF VEGETABLE CROPS IN KAZAKHSTAN**

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Plant genetic resources provide the biological basis of the food security of any country. Genetic variations are the strategic resources of breeding programs to create new varieties and hybrids of plants, including vegetable and melon crops.

In the Kazakh Research Institute of Potato and Vegetable Growing the investigations on the collection, conservation and study of the gene pool of vegetable crops have been conducted since 1995. By the end of 2013 over 10.7 thousand accessions of 156 crop plants of 182 botanical species belonging to 22 botanical families have been collected. The accessions collected in the gene pool of the Institute have come from 97 countries of the world. By origin for Kazakhstan and Russia account for 72.8 % of the accessions collected , for the CIS countries and Georgia – 4.6% to European countries – 10.7 %, for the countries of foreign Asia – 4.6%, for the Americas and Australia – 4.9 % , for Africa – 2.4 % of the accessions.

The most number of accessions collected have come to cucurbits - 3472 accessions on 13 crop plants of 12 botanical species. A significant proportion of them have made accessions of melon (2186) and watermelon (562).

Solanaceous plants also have made a large group of the Institute's gene pool – 3231 accessions of 7 crop plants, most samples of them have been in tomato (2266) and pepper (728).

Root vegetables gene pool includes 826 samples representing 3 botanical families, uniting 12 botanical species, among them the largest collected have been carrots - 255 accessions. Onion crop plants in the gene pool have been represented by 797 samples of 36 botanical species; the most have been accounted for garlic (285) and onions (205) accessions.

Green vegetables have been represented by 10 botanical families of 29 species; most of the samples collected in the gene pool have been of fennel (410). On leguminous vegetables have been collected 628 accessions representing 9 plant species, among them the most collected have been common bean samples (370).

The gene pool of spicy vegetable group have been represented by 494 accessions belonging to 42 botanical species, where the largest number of samples have been calendula (62) and Tagetes(60).

In the group of crucifer vegetables have been concentrated 421 accessions, here the leader has been white head cabbage (197 samples).

The other vegetables listed have included 90 samples, of which 35 accessions have been of sweet corn samples.

In the structure of the gene pool by the status the largest number of accessions have made the breeding material, which has been accounted for 41.2 % of the gene pool. Most selection samples have been concentrated in groups of cucurbits (watermelon, melon), solanaceous crops (tomato, pepper) and onions (bulb onion, garlic). The share of selected varieties has accounted for 36.8 % of the gene pool, and most of them have been in groups of solanaceous crops and root vegetables. The share of the crop plant populations and the local varieties have accounted for 15 % of the gene pool, most of them have been among the solanaceous crops, green and spicy crop plants. Hybrids F1 with 6.3 % share in the gene pool have been mainly found in the solanaceous, cucurbit and crucifer crop plants. The share of wild plants being used as vegetables, has accounted for only 0.7 %, representing mostly solanaceous crops, green vegetables and onions.

**“SLOW GROWTH” APPROACH AS A TOOL FOR *IN VITRO* PRESERVATION OF LARGE-SCALE PLANT COLLECTIONS**

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Role of biotechnology methods for plant biodiversity preservation is widely discussed. Both seed banks and *in vitro* plant collections are considered as an organic part of the nature protection system. An important prerequisite of successful application of *in vitro* approach is availability of reliable propagation methods. Aseptic plant collections are mainly maintained *via* regular subcultivations to the fresh culture media. So-called “slow-growth” approach is a way to minimize the risk of contamination of aseptic cultures in the course of frequent subcultivations and to reduce the general costs of the work. Elongation of subcultivation intervals can be achieved either with changing culture conditions (temperature or light) or application of growth-reducing chemical substances in the nutrient media composition.

The aim of the work was to study an effect of mannitol and abscisic acid on growth characteristics of aseptic plants kept in large-scale *in vitro* collection maintained in ICBGI. Plants of 25 species representing 13 families were used as an initial material in order to find out the optimal slow-growth conditions for each species and to estimate whether their culture response is connected somehow with their taxonomic position. Shoot tips 10-12 mm long were placed on MS media supplied with ABA (0.1; 0.5; 1 or 5 mg/l) or mannitol (10, 15 or 20 g/l) and cultured at the standard conditions of 24°C and 16-h photoperiod. Rooting ability, plant height and general viability were estimated every month in comparison with the control plants grown on hormone-free MS medium. Maximum growth periods without subcultivations were defined for each studied species. Statistical significance of the differences was calculated. It was shown that the impact both of ABA and mannitol resulted in growth retardation depending on the concentration of the chemical agent. Mannitol was more effective growth retardant than ABA for a great number of studied species. Thus, application of 15 g/l mannitol allowed prolongation of subcultivation interval up to 12 months for *Lotus uliginosus*, *Spiraea menziesii* and *Sedum cepaea* plants while in control every 2 months they should be transferred to the fresh media. Application of 5 mg/l ABA led to maximum subcultivation intervals of 3, 4 and 4 months, respectively. The similar results were obtained for majority of the studied species. Maximum growth periods for different plants were 6 – 12 months that at least twofold exceeds the same parameters in the case of ABA application. Surprisingly ABA even at a rather high quantity (5 mg/l) seemed to have no effect on growth rates and general viability of *Dianthus gratianopolitanus*, *Solanum transcaucasicum*, *Ixoca quadrifida*, *Centaurium erythraea* plants and according to our results it cannot be recommended as *in vitro* growth retardant for these species. In some cases the prolonged cultivation of plants in the presence of ABA and mannitol resulted not only in reduction of growth rates but in plant viability deterioration. The main effect of prolonged application of mannitol was an increased shoot vitrification (ex., *Ageratum houstonianum*, *Gnaphalium uliginosum*, *Veronica fruticans*, *Deutzia villosa*) while cultivation on the media supplied with ABA of some other plants (ex., *Lotus uliginosus*, *Spiraea humilis*, *Scutellaria altissima*) led to their quick yellowing and marcescence. The rate of living plants in the course of cultivation at slow growth conditions is an important factor of the method efficiency. In our experiments only *Monopsis lutea* plants retained 100% viability after 10 months cultivation in the presence of mannitol. For majority of plants the index of viability (% of survived plants) in the presence of 15 g/l mannitol ranged from 20% (ex., for *Gnaphalium uliginosum*, *Scutellaria altissima*) to 80% (for *Centaurium erythraea*, *Hypericum obtusiusculum*, *Ixoca quadrifida* and some others). Individual protocols for “slow growth” should be worked out for each plant species before they can be successfully applied in large-scale *in vitro* plant collections.

**MICROCLONAL PROPAGATION OF THE RARE ENDANGERED SPECIES  
OF THE RUBBER PLANT TAU-SAGYZ (*SCORZONERA TAU-SAGHYZ* LIPSCH.  
ET BOSSE) FOR THE RESTORATION OF PLANT POPULATION IN THE  
KARATAU NATIONAL NATURAL PARK**

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In present time, the growing demand in the world to natural rubber, forced researchers to search alternative, in addition *Hevea (Hevea brasiliensis)*, sources of natural rubber. Since 1929-1930 years in our Republic, when studied mountain systems of the Southern Kazakhstan it was found that the Karatau mountain is the homeland of new excellent and unsurpassed still a rubber plant - Tau-sagyz. However, stocks of rubber plants were strongly decrease in premilitary and especially in military years (1941-1945 years). In those time more than 12 million roots, by dry weight about 908 ton were dug out. Applicable to rubber it means 250-300 ton - contribution of Kazakhstan to country defense. Since 1978 year *Scorzonera tau-saghyz* was included in the Red List USSR and in the Red List Kazakh Soviet Social Republic

Rubber plant Tau-sagyz (*Scorzonera tau-saghyz* Lipsch. et Bosse) is plant from family Asteraceae, a rare, endemic species with a reduced amount on the disjunctive Tyan-shan-Pamir-Altay area, an including row of the narrow local races of a different rank. Perennial plant 25 — 40 sm high, with the powerful branching caudexes and deep rod root. Each branch of caudex comes to an end with the socket of leaves which forms as cereals, sometimes with one-year-old flower escapes. Baskets are single, flowers - yellow. At a break of a root and stem in the lacteal cells are visible elastic, lasting threads of rubber. The content of rubber in roots is about 20 - 40% of the dry weight of roots it depend on an age and a cultivar.

From behind of limitation of rubber plants, practical absence of nurseries on their production in Kazakhstan, the technology of the mass and quickly propagation, in particular, the technology of clonal propagation of valuable rubber culture *Scorzonera tau-saghyz* is one of the actual task for Kazakhstan. The experiments according introduction of tau-sagyz plants *in vitro* were carry out during active plants vegetation (May-June). As explant for cultivation *in vitro* have been used the leaf segments taken with from active vegetable plants (1-2 old escapes), root segments of the same plants and seeds.

The physiological statement of explants and compound of a medium influence on an efficiency *in vitro* cultivation. The roots tissue of one-year-old plants have more ability to a morphogenesis, than roots of two-year-old plants of Tau-sagyz. Kseromorphed leaves one - and two-year-old plants of Tau-sagyz are high-differentiated (highly specialized), therefore they have low level of ability to dedifferentiation processes *in vitro*. Optimumal medium for induction of a morphogenesis in culture of leaf and root explant was MS medium (Murasige-Skug medium) containing 1 mg/l BAP, 0,1 mg/l NAA, 0,1 mg/l 2,4-D. Addition of gibberell acid positively influence on plant regeneration from callus biomass Tau-sagyz. The received plant-regenerants in the subsequent cloned for increase reproduction coefficient of Tau-sagyz.

Thus, the presented results confirm a possibility of receiving Tau-sagyz microclones and there are a base for development unique technology of microclonal propagation and creation a collection of Tau-sagyz samples, representing scientific and commercial interest.

**DETERMINATION WITH PATH ANALYSIS OF SOME  
MORPHOLOGICAL CHARACTERISTICS OF TWO GENOTYPES  
OF REDTOP (*AGROSTIS GIGANTEA* ROTH.)**

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In this study, selected for breeding two different genotypes ( $G_1$  and  $G_2$ ) of redtop (*Agrostis gigantea* Roth.), were aimed to determine some morphological characteristics of correlations between. The selected genotypes were amplified by clones leaving, after; genotypes were planted by completely randomized design with intervals 0.5m x 0.5m and to be 5 plants each of the plots as 6 repetitions in land application of agricultural faculty S.Ü. Experiment was carried out as two separate studies. The correlations between morphological characteristics (leaf width X leaf length, plant height, bunch length, the length of the last node, plant diameter, seed yield per plant) of genotypes were assessed by path analysis. According to the results of the analysis,  $G_1$  genotype has been significant at level  $p<0.01$  correlations between characteristics of plant height with bunch length, while  $G_2$  genotype has been significant bunch length with seed yield per plant. In  $G_1$  genotype, level of  $p<0.05$  correlations between plant diameter with the length of the last node and level of  $p<0.01$  correlations between bunch length with plant diameter has been. In the genotype, level of  $p<0.05$  correlations between bunch length with the length of the last node has been significant. In  $G_2$  genotype, level of  $p<0.05$  correlations between leaf width X leaf length with the length of the last node and level of  $p<0.05$  correlations between bunch length with plant height and level of  $p<0.01$  correlations between seed yield per plant with bunch length has been significant.

## **ORGANIC AGRICULTURE AND BIODIVERSITY**

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Organic farming works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it.

Organic farming depends on encouraging a diverse ecosystem to maintain soil fertility and to keep pests under control naturally. It does this by encouraging nature's own predators by maintaining hedgerows and creating open, 'wild' spaces at the side of fields, and changing the crops planted each season, to keep soil fertile and avoid the need for chemicals.

The level of biodiversity that can be yielded from organic farming provides a natural capital to humans. Species found in most organic farms provides a means of agricultural sustainability by reducing amount of human input (e.g. fertilizers, pesticides). Farmers that produce with organic methods reduce risk of poor yields by promoting biodiversity. Common game birds such as the ring-necked pheasant and the northern bobwhite often reside in agriculture landscapes, and are a natural capital yielded from high demands of recreational hunting. Because bird species richness and population are typically higher on organic farm systems, promoting biodiversity can be seen as logical and economical.

When the term biodiversity is used in organic farming, it doesn't just mean more plants and animals, but also that more of the plants and animals native to a particular area grow in a natural way. Particular emphasis is also given to the preservation of native and endangered species of animals and plants.

Many practices that increase productivity in organic agriculture have the natural knock-off effect of increasing plant and animal life and maintaining natural biodiversity. For example:

- Using livestock manures increases the concentration of micro-organisms, earthworms, spiders and beetles in the soil
- Using multi-annual crop rotations and appropriate plant varieties that can compete with weeds and resist pests and diseases, strengthening the wanted plants and disfavouring the unwanted ones
- Multi-annual crop rotations result in the growing of a wider variety of primary crops, legumes and fodder crops
- Prioritising indigenous breeds of plants and animals maintains the natural diversity of different areas
- Introducing natural enemies of weeds and pests, rather than using chemical synthetic pesticides, helps to increase animal life

In this study, by considering the importance of organic agriculture on biodiversity has been described with explanations and examples.

**SOURCES OF AGRONOMIC CHARACTERS FOR SPRING  
TRITICALE BREEDING IN BELARUS**

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Spring triticale became widespread in South-East Asia, South America, Canada, Spain, Portugal, Poland, Ukraine and in other regions. In RUE "Research and Practical Centre of NAS of Belarus for Arable Farming", using intraspecific hybridization method, we developed five varieties of spring triticale, three of which are included in the State Variety Register in Belarus (Lana, Uzor, and Sadko) and 2 varieties are included into the State Register in Russia (Ulyana and Lotas). Under the conditions of Nonblack Soil Zone, spring triticale exceeds winter triticale in protein content in grain by 1.5-2% and is unreplaceable in the areas with unfavourable conditions of overwintering.

The aim of the study of the hexaploid spring triticale collection was to isolate sources of agronomic characters for breeding. 150 accessions of spring triticale from Mexico, Poland, Ukraine, Russia, USA, Canada, Argentina, Australia, Chile, Ethiopia, Spain, Brazil and other countries have been the object of the researches for 2007-2013.

As a result of the field and laboratory studies, the following sources have been identified and are used in the breeding process as agronomic characters:

- short stalkness (80-82 cm): Nagano, Matejko (Poland), T - 476, Fahad 8-2, T- 39 (Mexico);
- early ripeness (90-94 days): Uzor (Belarus), Grebeshok, Normann (Russia), Legin Kharkovsky, Aist Kharkovsky (Ukraine), Armadillo (Mexico), and others;
- high yield (60-80 c/ha): Mieszko (Poland), Uzor, Ruslo, Sadko (Belarus), Amigo (Russia), WS - 104 (Germany), and others .
- high number of kernels per ear (70-86): Ultima (Canada), Sel - 002 (USA), Maja, Andrus (Poland), Chucal - 5, Faca 2/1 (Mexico), Lotas (Belarus), and others;
- high thousand-kernel weight per ear (50-55 g): Fahad 8-2 (Mexico), Ruslo (Belarus), L - 2, L-1, LT - F6 540 - 4, Ukro (Russia), Karovay Kharkovsky, Sokol Kharkovsky(Ukraine), and others;
- high content of crude protein (15-18%): Sokol Kharkovsky (Ukraine), Ukro (Russia), Whitman (USA), OH - 1621 (China), Armadillo (Mexico), BreakWell (Australia) and others;
- the complex of agronomic characters: Uzor, Rubin (Belarus), Nagano (Poland), and others.

Along with the agronomic characters of spring triticale mentioned above, the best varieties of winter triticale and spring wheat are widely used in the hybridization providing significant increase in ear productivity and improving grain quality. For example, such high-yielding spring varieties as Lotas, Sadko, and Ruslo have been developed using winter triticale varieties.

Within the framework of the project of the "Innovative Biotechnology" EurAsEC interstate special-purpose programme, DNA gene markers of short stalkness and triticale grain quality are studied.

**FORMATION AND USE OF THE NATIONAL POOL OF PLANT  
GENETIC RESOURCES IN BELARUS**

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Plant genetic resources not only contribute to the sustainable development of the economy, but also are essential for the welfare of each country. Scientific researches in the field of biodiversity and its genetic potential in Belarus became possible due to "Gene pool" State program, which has been developed at the beginning of the XXI century, and became the basis for the formation of the National Pool of Plant Genetic Resources of the Republic of Belarus. RUE "Research and Practical Centre of NAS of Belarus for Arable Farming" is a leading research institution in the field of crop production in the country and has headed this work. Work collections of 11 research institutions of the National Academy of Sciences and two universities became the basis for the establishment of the National Pool of Plant Genetic Resources. "Gene pool" State program actively encourages the development of the studies on plant genetic resources both domestically and internationally. For these years, Belarus has joined ECPGR and AEGIS, gene pool exchange with foreign gene banks and international research centres has been organized.

In 2013, there were 40.5 thousand collection samples in the National Pool of Plant Genetic Resources. Among the CIS countries, Belarus is on the 5th place in the number of samples and on the 3rd one in the species diversity (1695 crop species and wild relatives). Among them, 9795 collection samples of 195 species are field crops. On the basis of the previously accumulated and newly drawn on gene pool, taking into account the existing world experience, for the first time in Belarus, purposeful character, genetic, primary and training collections of the most significant from the economic point of view agricultural field, fruit and small-fruit crops and forest forming species have been established. Genetic collections of SSI "Institute of Genetics and Cytology of NAS of Belarus" are of great importance for the use in the breeding process. Chromosomally-supplemented, substituted and translocation lines, polyploidy and aneuploidy, sources of self-fertility and cytoplasmic male sterility, mutants, recombinants and genetic testers are the most valuable of them. The established primary genetic collection of blue lupine constituting a system of 14 genes complementary to each other by many components is also noteworthy. The collections of *Solanum* species and interspecific hybrids deposited *in vitro* with more than 400 individual numbers including representatives of 48 species and the basic *in vitro* collection of potato varieties of Belarusian origin should be noted. The samples of working collections of field crops are the initial material in the breeding process for the development of new varieties and hybrids of agricultural crops. Using the National Pool of Plant Genetic Resources in the Republic of Belarus in 2000-2013, 530 field crop varieties were developed. In 2012, the collections of plant resources included in the structure of the gene pool of the Republic of Belarus were recognized as the objects of the national heritage.

The main objective of the researches in the nearest future is further replenishment of the gene pool, replenishment of character and genetic collections, more efficient use of the gene pool for practical breeding and the national economy of the republic.

**STUDY ON THE EFFECTS OF WATER STRESS ON FORAGE AND  
SEED YIELD OF 17 ANNUAL CLOVER GENOTYPES**

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In order to evaluate the water stress on forage yield of 17 annual clover, an experiment was conducted during 2011 growing season. Experimental design was with split plot, arrange completely randomized block design with three replications. Irrigation treatments (in both normal and stress), was main plots and 17 annual clover genotypes was sub plots. The plant treats such as leaf and stem weight and forage yield were studied. Results showed that, the water stress the effect of the water stress was significantly effects on forage yield (probability level 1%) and spike and seeds weight per plant (5% probability). Also, forage yield, spike and seed weight per plant, were significantly difference between genotypes (1% prob.). Interaction of water stress \* genotype treatments were significantly effects on seeds weight per plant( 5% prob.), forage yield and spike weight/ plant (1% prob.). According to the results of study we could introduce the genotypes No. 2 and No.11 (related to *Trifolium resupinatum* L.) as high products in water stress. One of the reasons for the superiority of these genotypes is ability to escape from the drought (early maturity) and avoid terminal drought stress.

**DIVERSITY OF ZINC UPTAKE AND EFFICIENCY IN DIFFERENT GENOTYPES OF *TRITICUM AESTIVUM* L.**

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Nutrient efficiency in wheat is very complex. It includes nutrient acquisition efficiency and nutrient use efficiency. 26 winter wheat genotypes were used to investigate the interactive effects between genotypes and the use efficiencies of the Zn micronutrient by the grain. The results obtained in this study indicate that nutrient use efficiency of the Zn varies widely within wheat genotypes. Some genotypes were identified as being Zn use efficiency. These are considered low-input genotypes. It appears that a special breeding programme of crop cultivars for low Zn nutrient and stress condition could be successful. Improved cultivar response to Zn nutrient will help to reduce inputs and hence protect the environment.

## GENETIC RESOURCES OF THE APRICOT IN THE CONDITIONS OF THE MANGYSHLAKSKY EXPERIMENTAL BOTANICAL GARDEN

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In the Mangyshlaksky experimental botanical garden the scientific material and a wealth of experience on attraction and introduktionny test the inorayonnykh of types and grades of fruit plants, to creation of collection plantings of fruit crops in arid conditions is saved up.

For the cultivar investigation of saplings were involved-the 16 sorts-clons (written by academician A. Džangaliev) of apricot usual (*Armeniaca vulgaris* L.): «Early Shymkent», «Issyk steady», «Beauty of Dzungaria», «Apricot grapes», «Small Carmine», «Maloalmatinski all», «Katyusha», «Macrocarpa ribbed», «Giant Koturbulaka», «Koturbulakski tender», «Belle Koturbulaka», «Record Belbulaka», «Satellite», and 3 apricot varieties of ordinary «Nikitin's Red-cheeked», «Collective farm» and «Dried apricots».

Nursery transplants were landed on nurseries and collection areas of Garden in an amount from 10 to 20 copies of every sort and sort-klon. A high transmit receive (80%) is marked at a sort Red-cheeked, sorts-clons of the beauty of Dzungaria, Koturbulakski tender and Belbulaka Record.

During realization of visual supervisions at sorts and sorts – clonals of apricot it is not marked damages of bark, wood, one-year escapes, floral buds from subzero temperatures, that the last years fully explainable, taking into account warm winters and high temperature of air during March - April.

Blooming of buds at the sorts of apricot was observed on the average from March, 27 for April, 3. The beginning of vegetation most earlier is noted at the apricot of sort «Nikitsky red-cheeked». Appearance of leaves at the sorts of apricot is marked from April, 10 for May, 15. Growth of escapes passed during the period since April 23 until the end of May – the beginning of June. The average gain of the central branch made 24 – 30 cm, the maximum gain is noted at apricots «Nikitsky red-cheeked» - 49 cm, «Issyksky steady» - 44 cm, «Beauty Kok-Bastau» - 41 cm. The minimum gain is noted at sorts «Macrocarpa ribbed» - 8 cm and "Katyusha" - 11 cm, on a collection site – at the sort of " Koturbulakski tender " - 11 cm. Flowering at apricots, from April 15 - 20 to May 5. On duration of blossoming it is observed, large variation, at the most of sorts – about 20 days.

Sorts and sorts-clons of apricot in the conditions of Mangistau differ the early entry into a fructification time – already in the 2nd – 3-year age on trees there are fruits. Maturing of fruits happened during the period from June 20 to June 25, subsidence of mature fruits began on June 24 - 26. Fruits shallow enough; weight of one fruit is from 10 to 18 grammes at different sorts. The most largefruits are marked at a sort – klon «Beauty Kok-Bastau».

The productivity was determined at 3th sorts and sorts - clonals of apricot: «Beauty of Dzungaria» is 12 kg from one tree at the middle-weight of fruit of a 7.5 g; «Red-cheeked» are 15.6 kg at the middle-weight of fruit of a 16 g; «Beauty Kok-Bastau» - 25.5 kg with an average weight of a fruit of 18 g.

Thus, the apricot gene pool in Mangyshlak experimental botanical to a garden possesses high potential therefore the main task is preservation of genetic resources of an apricot in collection sites for further studying and selection use.

**CLUSTER ANALYSIS IN COMMON BEAN GENOTYPES  
(*PHASEOLUS VULGARIS L.*)**

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Phenotypic observations in the real farm conditions have importance for the plant breeding programs. In the present study, the common bean genotypes that are widely grown in Turkey were subjected to cluster analysis according to their phenotypic evaluations. Cluster analysis for the field performance of 35 promising common bean genotypes showed 4 main groups. Distance was ranged from 0.99 to 9.05 values.

Hierarchical cluster analysis is a useful guide to evaluation of different genotypes. In the present study, analysis to determine distances among the used genotypes clearly separated into the bean groups. A dendrogram obtained which was based on the matrix of relationship between the genotypes. It can be concluded that cluster analyze can be useful to give information about selection of the promising genotypes for breeders.

**STUDY OF WILD RELATIVES OF CULTURAL PLANTS IN THE FLORA  
OF RIDGE KALBINSKY IN EAST KAZAKHSTAN REGION**

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Natural plant resources are some of the main asset and wealth of any state. Economic independence of each country is largely determined by the genetic diversity of plants, which together constitute the gene pool of plant resources. Comprehensive study of the problem, the mobilization and efficient use of world resources, the most important in terms of agricultural crop species was placed N.I. Vavilov in the late 20-ies of the last century. However, as the analysis of publications, experience in comprehensive studies of individual areas and territories and identify them on the diversity of wild relatives of culture plants with the aim of mobilizing and conserving plant genetic resources in Kazakhstan is not big.

The purpose of this researching it is identify wild relatives of culture plants in the flora of Range of Kalbinsky.

Ridge of Kalbinsky of East Kazakhstan was chosen for the study according to the following provisions: about the background of fairly well-studied floristic composition, wild relatives of culture plants (WRCP) for the area virtually unexplored.

To solve the problems on the study on the ridge of Kalbinsky study conducted in the following ecological and geographical areas: in the mountain forest in East Kalba and mountain-steppe of Western Kalba.

According to the results of actual inventory of botanical diversity in the territory WRCP Ridge of Kalbinsky established vegetation 58 species belonging to 37 kinds, 14 families. And in the mountain forest eastern part of the range of Kalbinsky recorded 166 locations WRCP, and in the mountain-steppe –27 western localities.

Florotsenotic core WRCP ridge of Kalbinsky it is fringe-meadow (family Poaceae Barnhart 36,8% and Fabaceaé Lindl. 12,8%), fringe -forest (family Rosaceae Juss. 18,4%) species of plants. Ecologically plants of WRCP of floras is represented by three major groups: mesophytes, mezopetrofits and xeromesophytes. By the nature of life forms herbaceous perennials constitute 63.9%, shrubs 30.5%, annuals –5.6%.

Identified the wild relatives of cultural plants on ridge of Kalbinsky on the results of our research are distributed in two groups. The first group includes species that does not produce industrial stocks, but the fact of their growth recorded during fieldwork in the said territory. The second group is WRCP that are the resources species of plants.

Species composition WRCP of ridge of Kalbinsky in the first group includes 36 species that are taxonomically included 13 families and 27 kinds. The greatest number of species represented families: *Poaceae* Barnhart – 9 (25%), *Rosaceae* Juss. –8 (22.2%), *Fabaceaé* Lindl. –7 (19.4%), *Cannabaceae* Endl. and *Asteraceae* Dumort. – 2 (11%). The share of these families account for 77.6%, other families are represented by a single species. The second group includes 22 species, among which the largest number found in the family *Poaceae* Barnhart.

Researches are executed within the theme of project "The botanical diversity of wild relatives of cultural plants of East Kazakhstan as a source of enrichment and preservation of gene pool of agrobiodiversity for realization of the food program".

## CRYOPRESERVATION AND COLD STORAGE OF FRUIT, BERRY CROPS AND GRAPE GERMPLASM IN KAZAKHSTAN

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Germplasm preservation of vegetatively propagated plants by biotechnological methods was implemented in two main directions: Cold storage, limiting the growth of *in vitro* culture, at +3-4°C, requires periodic subculturing and is effective for short and medium term storage. Cryopreservation, in conditions of ultra-low temperatures in liquid nitrogen or its vapor at a temperature of -165-196°C, allows indefinite preservation of viability and high regeneration potential and genetic stability. To date, medium-term cold storage *in vitro* and long-term tissue cryopreservation in liquid nitrogen are used in addition to field collections reliably preserve the gene pool of fruit and berry crops and grape in Kazakhstan. Medium-term cold storage of plants *in vitro* is conducted in a chamber under a 10-hour photoperiod ( $7 \text{ } \mu\text{mol m}^{-2} \text{ s}^{-1}$ ) at +4°C. Shoot cultures are stored in air-permeable plastic bag on Murashige and Skoog medium (MS), containing: 0.5 mg/l N6-benzylaminopurine (BAP), 0.1 mg/l  $\beta$ -indole-3- butyric acid (IBA) and 3% sucrose or 2% sucrose + 2% mannitol for fruit and berry crops; for grape,  $\frac{1}{2}$  MS containing: 0.1 mg/l BAP, 0.2 mg/l IBA, 3% sucrose. Cold-stored varieties, hybrids and wild forms of 183 drupaceous, 75 pomaceous, 142 berry crops and 30 grapes are in the collection. Cryopreserved germplasm is held using the methods of vitrification, encapsulation-dehydration, freezing of dormant and winter buds and direct immersion in liquid nitrogen. It is effective to freeze both dormant, winter buds and meristems in apple, pear, apricot, cherry, black currant, raspberry. For strawberries only meristematic tissues can be cryopreserved. The choice of cryopreservation method is carried out individually in each particular case. It is better to store meristematic tissues if *in vitro* materials are needed for the collection or use in aseptic conditions. For the reliable preservation of large amounts of woody field-grown plants, it is better to use the cheapest and easiest method, freezing the dormant buds. Seed and embryonic axes cryopreserved by direct immersion in liquid nitrogen can be used for wild species and selections. The cryopreserved collection consists of 126 apple, 21 pear, 42 tart cherry, 58 sweet cherry, 31 strawberry, 20 black currant, 31 raspberry and 4 wild forms of apricot (*Prunus armeniaca* L.) varieties and hybrids stored in liquid nitrogen.

## REGENERATIVE CAPACITIES OF SOME ENDEMIC SPECIES OF CENTRAL KAZAKHSTAN FLORA

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The aim of this study was to estimate regenerative capacities and optimization of cultivation conditions *in vitro* for endemic species of Kazakhstan flora: *Atrapaxis decipiens* Jaub. et Spach., *Artemisia kasakorum*, *Phalacrachena calva* (Ledeb.) Iljin., *Calatella bectauatensis*, *Centaurea bipinnatifida* (Trautv.) Tzvel., *Pyrethrum kelleri* (Kryl. et Plotn.).

The significant differences between species in callusogenesis frequency, biomass growth of callus as a result of influence of phytohormones during full cycle of cultivation have been identified.

It was found that *A. kasakorum*, *A. decipiens*, *C. bectauatensis*, *P. calva*, *P. kelleri*, *C. bipinnatifida*, *T. scopulorum* have high callusogenesis ability *in vitro*.

The leaf explants of *Artemisia kasakorum* formed callus tissue with growth index ranging from 2.37 to 4.98 depending on the hormonal composition of the medium. The explants *Pyrethrum kelleri* showed the lowest ability to form callus, 33-60% depending on the environmental conditions.

The greatest increase in callus biomass accumulation about 4 g from explants *Atrapaxis decipiens* cultured on medium with BAP and NAA were obtained.

Maximum callus biomass of *Phalacrachena calva* (3 g) and *Centaurea bipinnatifida* (6 g) accumulated on the medium MS supplemented 4.44 µM BAP and 4.52 µM 2,4 D.

For most species adding to the nutrient medium of 2.4 D or NAA, or in combination with BAP induced callusogenesis and biomass accumulation. Influence of nutrient medium hormones on callus morphological parameters (color, density) was identified.

The evaluation of regeneration potential of endemic species showed the possibility of micropropagation for *Artemisia kasakorum*, *Centaurea bipinnatifida*, *Pyrethrum kelleri*, *Phalacrachena calva*. The lowest regenerative abilities at explants of *Atrapaxis decipiens*, *Calatella bectauatensis*, *Pyrethrum kelleri* were revealed.

*Acknowledgement:* This study was supported by PFI «Search for new natural compounds in plants. Isolation, identification of components, the structure of molecules and their biological activity».

**STUDY OF ANTIOXIDANT ACTIVITY OF *CROCUS ALATAVICUS***

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Phytochemical study of the genus *Crocus* L. is promising because some *crocus* species are the source of biologically active substances (phenols, flavonoids, xanthones, fatty acids, carotenoids, etc.), which have a high biological activity (antibacterial, anti-inflammatory, antiviral, etc.).

The aim of researcher is a quantitative determination of phenols in extracts of *C. alatavicus* Regel et Semen. and studying the antioxidant activity (AOA) using various model systems *in vitro*.

Initial samples of flowering plants *C. alatavicus* were collected in Mart 2013 in Almaty region and cleaned to remove any residual compost and dried in the shadow for extraction. The air-dried tubers and leaves were stored in an air-tight container until further use.

Dry plant material was extracted with 50% ethanol and benzole (1:4). The dry extracts were obtained by evaporation. The total phenolic content in all extracts *C. alatavicus* were determined with Folin-Ciocalteu reagent (FCR) according to the method of Slinkard and Singleton. The total phenolic contents in all extracts of tubers and aerial parts were expressed as microgram of gallic acid equivalents/mg of extracts.

Antioxidant activity was determined on the basis of its scavenging activity on the stable DPPH free radical (Amin I. et al., 2002) and using  $\beta$ -carotene-linoleic model systems (Hossein S. A. et al., 2012). In  $\beta$ -carotene bleaching assay antioxidant capacity was determined by measuring the inhibition of the volatile organic compounds and the conjugated diene hydroperoxides arising from linoleic acid oxidation.

We found that the phenolic contents in extracts depended on parts of plants used for extraction. Total phenolic content of aerial part was measured in both extracts: in water-ethanol extract 4.07  $\mu$ g GAE/mg were detected, in the benzene extract 5.08  $\mu$ g GAE/mg were detected. Water-ethanol extracts of corms contained less than twice (2.05  $\mu$ g GAE/mg).

A direct relationship between the phenolic content and antioxidant capacity of plants *C. alatavicus* was found. Benzene and ethanol extracts of aerial parts showed the highest antioxidant activity (39.9% and 37.7%) in  $\beta$ -carotene-linoleic model systems. The results of DPPH assay also showed that the radical scavenging activity of aerial part higher than the tuber's. The biological activity of the benzene extract was two times higher than the ethanol extract.

Thus, our studies suggest that ethanol and benzene extracts of aerial parts that characterized by a relatively high phenols content, possess high antioxidant activity that allows us to recommend them as a basis for therapeutic agents with high antioxidant activity.

**POSSIBILITY OF APOMIXIS IN *TARAXACUM KOK-SAGHYZ* RODIN.**

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In accordance with the geographical parthenogenesis theory, apomixes species are common to the northern longitudes and high elevations. In researched populations, depending on environmental conditions, with increased elevation (from 1,794 to 1,961 meters above sea level) it was explored that genotypes with apomixes traits increase.

Typical traits of apomixes are polyploidy, wide interspecies polymorphism, abnormal pollen. Our research revealed wide interfamily polymorphism of kok-saghyz plants in several traits – leaf form, number of flower stems. This indicates presence of genotypes, inclined to apomixes reproduction.

In order to expedite exploration of apomixes traits, cytoembryological methods are used. Even in cases, when apomixes is not a regular reproduction method, plants, having generic or species predisposition could have abnormal pollen. Abnormal pollen grains, with different size and form were discovered in researched genotypes of kok-saghyz. Morphologically normal pollen has distinct structure, pollen cover with spikes and three pores, abnormal pollen does not have distinctive structure, pollen cover and is characterized by lack of pores. Pollen grains also differ by intensity of iodine solution coloration. Abnormal pollen grains did not get intensive coloration in iodine solution and had yellowish color, when normal pollen grains got intensive coloration and became brown in color.

Additional confirmation of presence of apomixes inclinations of kok-saghyz is ability to form seeds in pollenless regime. In order to create pollenless regime, inflorescence were mechanically castrated during flower bud stage, by cutting of the top part of the inflorescence with covers on the level of transition of corona to the set.

In accordance with evaluation criteria “defective pollen”, pollen is considered defective if there are more than 11% of defective pollen grain in total volume, thus plants with over 11% defective pollen are prone to apomixes.

We discovered that in examined populations average percentage of discovered abnormal pollen grains is 23.8%, which indicates potential presence of apomixes kok-saghyz plants in such populations.

Discovered genotypes with apomixes traits will be used for stabilization of high productivity traits of the first local kok-saghyz breed.

This publication is produced as a part of "Obtaining High Productivity Forms of *Taraxacum kok-saghyz* Rodin. - Domestic Producer of Rubber" project, funded by Technology Commercialization Project, supported by the World Bank and the Government of the Republic of Kazakhstan. Statements contained herein do not necessarily reflect the official views of the World Bank and the Government of the Republic of Kazakhstan.

**GENETIC DIVERSITY AND POPULATION STRUCTURE  
IN WILD APPLES OF KAZAKHSTAN**

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Apple is one of the most important species among the temperate fruit crops. According to Vavilov (1987), territory of Kazakhstan is one of the centers of origin for domesticated apples. Several species of *Malus* genus were described in Kazakhstan including *M. domestica* (Flora of Kazakhstan, 1961). One of them is wild apple *Malus sieversii*, which is recognized as a major progenitor and rootstock to the cultivated apple. Wild populations of *M. sieversii* have an exceptional level of polymorphism resulting from different ecological and environmental growth conditions and interspecies hybridization. They represent a much broader genetic pool of important horticultural traits than the domesticated apples currently used in breeding programs. *M. sieversii* with *M. niedzwetzkyana* included in Red Book of Kazakhstan. Evaluation of genetic diversity in wild apple populations provides the basis for preservation of biodiversity.

In this study, we have established wild apple populations based on analysis of almost 300 leaf samples collected in South and East Kazakhstan that were grouped in 9 populations. During collection of the samples position of each tree was recorded for further environmental monitoring. Harvested leaves and extracted genomic DNA were stored frozen at -80°C, leaves also stored at the room temperature after drying with silica gel. Thus, genomic DNA bank of wild apple populations from two regions of Kazakhstan was established. For assessment of polymorphism in the populations seven microsatellite markers were used. To identify accurate size of alleles 3 different approaches in PCR were compared. In result the most cost-effective method with high reproducibility was selected. All 7 markers showed 100% polymorphism. With their help, 87 alleles with different frequencies of occurrence were revealed. Molecular genetic analysis of populations of the two regions showed a high level of heterozygosity ( $H_o = 0.707 \pm 0.024$ ). Other parameters of genetic diversity also as high: average value of PIC = 0.786; Shannon index, which reflects the contribution of rare alleles,  $I = 1.567 \pm 0.039$ .

Results of analysis of the wild apple populations using the AMOVA (analysis of molecular variance) showed 10% of geographic variation between the regions of the South and East Kazakhstan, higher than index within each of the regions. An intrapopulation variability accounts for 83%, such a high level is typical for cross-pollinating apple. Results of AMOVA are also confirmed by dendrogram based on genetic distance by Nei. Clear segregation of the populations by region can be observed. Mantel test correlation coefficient was  $R^2 = 0.510$  ( $P < 0.001$ ), which confirms the connection between genetic and geographic distances. Also, characteristic pool of rare alleles was determined for each of the regions. Five populations of southern Kazakhstan had the greatest number of rare alleles:  $P_o = 14$ , in turn, for the eastern region  $P_o = 9$ . Thus, it is possible to determine relation of a sample of wild apple to a particular population or to the region.

Genotyping with use of the seven microsatellite markers was tested on some varieties of *M. domestica*. It revealed differences between the genotype of Golden Delicious imported from France and the same variety, taken from the nursery in Almaty. Such mismatches were also shown for other varieties.

**ESSENTIAL OIL COMPOSITION OF *ARTEMISIA KOTUCHOVII* KUPR.,  
NARROW ENDEMIC FROM KAZAKHSTAN ALTAI**

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*Artemisia* L. is the largest genus of the tribe *Anthemideae* and one of the largest of the *Asteraceae*. The most important centre of diversity is temperate Asia [1]. Essential oils from various *Artemisia* species have been shown possess many types of biological activities: antibacterial, antifungal, antiviral, antioxidative and antiproliferative [2, 3].

A study was conducted to evaluate the chemical composition of the essential oils of *Artemisia kotuchovii* Kupr. (Asteraceae), endemic species from Altai region of Kazakhstan [4]. The plant material was collected in the end of blossoming stage in August 2013 in the southern Altai – Tarbagatai range, 1709 m above sea level. Two types of air dried material (inflorescence with leaves and stems) were separately subjected to hydrodistillation followed by analysis by GC-FID and GC/MS. Methyl chavicol (estragole) (74.2% and 75.5%) and methyl eugenol (4.3% and 4.6%), (Z)-β-ocimene (3.8% and 3.7%) and (E)-β-ocimene (5.2% and 4.4%) were detected as the major constituents in inflorescence with leaves and stem oils, subsequently. The present work is the first report about *A. kotuchovii* essential oils. It is of interest to mention that methyl chavicol is a natural constituent of a number of plants (e.g. tarragon, sweet basil and sweet fennel) and their essential oils have been widely used in foodstuffs as flavouring agents. Several studies have shown the insecticidal activity of estragole [5].

*Reference:*

- 1) Pellicer J., Garcia S., Garnatje T., Hidalgo O., Korobkov A.A., Dariimaa Sh., Valles J. Chromosome counts in Asian *Artemisia* L. (*Asteraceae*) species: from diploids to the first report of the highest polyploid in the genus // Bot. J. Linn. Soc. – 2007. – V. 153. – P. 301-310.
- 2) Kordali S., Kotan R., Mavi A., Cakir A., Ala A., Yildirim A., Determination of the chemical composition and antioxidant activity of the essential oil of *Artemisia dracunculus* and of the antifungal and antibacterial activities of Turkish *Artemisia absinthium*, *Artemisia dracunculus*, *Artemisia santonicum* and *Artemisia spicigera* essential oils // J. Agric. Food. Chem. – 2005. – V. 53. – P. 9452-9458.
- 3) Seidakhmetova R.B., Beisenbaeva A.A., Atazhanova G.A., Suleimenov E.M., Pak R.N., Kulyyasov A.T., Adekenov S.M., Chemical composition and biological activity of the essential oil from *Artemisia glabella* // Pharm.Chem. J. – 2002. – V. 36 (3). – P. 27-30.
- 4) Kupriyanov A.N. Bot. Zhurn. New species of *Artemisia* genus (*Asteraceae*) from Altai and Kazakhstan // 1999. – V. 84 (4). – P. 114-116 (in Russian).
- 5) Chiou Ling Chang, Il Kyu Cho, Qing X. Li. Insecticidal activity of basil oil, trans-anethole, estragole, and linalool to adult fruit flies of *Ceratitis capitata*, *Bactrocera dorsalis*, and *Bactrocera cucurbitae* // J. Econom. Entomol. – 2009. – V. 102 (1). – 203-209.

*Acknowledgement:* This study was supported by the grant #0504/GF3 from the Ministry of Education and Science, Republic of Kazakhstan.

## **THE CULTIVATION OF SORGHUM SEEDLING WAY**

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Improving food security in Tajikistan is becoming a strategic issue. Grain problem in the country continues to be relevant. Of particular importance in the increase of grain harvest has preservation mix of traditional crops. In conditions of Central Asia Tajikistan sorghum is drought sustainable, productive culture of universal use. The purpose of research, Studying and scientific substantiation of the features of cultivation of sorghum, establishment of the optimal ways and density of standing of plants, the efficiency of fractional making fertilizing with nitrogen providing reception of a high crop of grain and silage crop sorghum in the conditions of the Gissar valley.

The research program includes a study of receptions of technology of cultivation of sorghum crop seedlings and study of methods of sowing. Experimental studies were conducted in the Gissar valley at the farm Melikmurodova Gissar district methodology B.A. Dospehova (1985), in a 4 – fold repetition, plot area of 36 m squared (row length 13 m) accommodation. Predecessor-wheat autumn sowing. In all the experiments, for plowing made at the rate of 10 t/ha of manure, 60 kg of phosphorus and 40 kg/ha of potassium. In the period of vegetation in the first and second dressing experience made N<sub>35</sub>P<sub>20</sub> in the tailoring stage and H35 in the phase of the tube. In experiment 3, in the phase of bushing made N<sub>20</sub>P<sub>20</sub> in the phase of the tube N<sub>30</sub> and at the beginning of the release of flag leaf-N<sub>20</sub>.

Sowing and planting seedlings sorghum held in June 24, at the rate of 10-12 kg/ha, seeds before sowing against a range of diseases treated by TMTD, 80% (2 kg/t of seeds). Due to 37 days before landing with the purpose of preparation of seedlings were planted sorghum seeds.

When sowing seeds vegetation period sorghum varieties Gissar 45 amounted to 113-117 days, and in the experiments with the planting of seedlings 30 days of age in the same period of sowing 91-96 days on 20-21 shorter. The accelerated growth of the stem sorghum was observed after elongation, reaching a maximum height (to 350.1-356.1cm) at the end of vegetation. Taller plants were formed on raised crops at the density of plants up to 90 thousand/ha and making top dressing in the beginning of the release of flag leaf. The maximum size of the leaves is marked in the phase of flowering plants, which, depending on the options amounted to 42.0-49.8 thousand m<sup>2</sup>/ha. A greater number of grains per panicle, with a large mass formed in bed method of cultivation, density of standing of 70 thousand/ha plants and making fertilizer nitrogen in the beginning of the tube (46.1-47.7 g, and options density 70 thousand/ha – 45.7-47.1 g). The yield increase is noted in the options trough the cultivation of sorghum (29.8 to 33.2 c/ha), and increasing density of plants from 70 thousand to 80 thousand/ha grain yield increase (2.3 t/ha) is observed in experiment 3, and on the options density of standing of plants she was 4.2-6.8 kg/ha.

The advantage of the method of growing sorghum is the following:

- vegetation period is reduced, resulting on 25-26 days the grain ripens earlier before the onset of autumn frosts;

- fields in the autumn of previously released, and meet for the timely conduct of autumn plowing;

-contributes to the economical use of irrigation water and seeds;

Planting method of growing sorghum crop is particularly important in saline lands, where obtaining simultaneous sprouting difficult.

Thus, it is proved the possibility of crop growing sorghum seedling way in the conditions of the Gissar valley of Central Tajikistan, providing the full harvest of grain and dry biomass.

Thus, it is proved the possibility of crop growing sorghum seedling way in the conditions of the Gissar valley of Central Tajikistan, providing the full harvest of grain and dry biomass.

**CREATION OF *IN VITRO* COLLECTION OF *MALUS* VARIETIES,  
WILD FORMS AND CLONAL ROOTSTOCKS**

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Apple – one of the most important fruit crops in the world. In recent times, unique forms of Zailiyskiy and Dzhungar Alatau that have a complex of valuable qualities: high resistance to many diseases, high frost-resistance, wide ecological plasticity are endangered. In this respect, it is important task to maintain and restore populations of wild fruit forests of Kazakhstan, as a source of the gene pool of apple culture of global value.

One of solutions for this task is the preservation of *Malus* germplasm by *in vitro* collection and cryopreservation. It is necessary to improve the nutrient medium composition for clonal propagation depending on genotype used. Optimization of nutrient medium was carried out for wild forms (*Malus sieversii*) (Lebed.) M. Roem. KG4, KG7, KG13 from the nursery of Ile-Alatau National Park. Various concentrations and combinations of phytohormones: 6-benzylaminopurine (BAP), indole-3-butyric acid (IBA) and gibberellic acid (GA) have been tested: 1) 0.5 mg/l BAP, 0.1 mg/l IBA and 0.1 mg/l GA; 2) 0.5 mg/l BAP, 0.01 mg/l IBA and 0.1 mg/l GA; 3) 0.5 mg/l BAP, 0.01 mg/l IBA; 4) 1.0 mg/l BAP, 0.1 mg/l IBA and 0.1 mg/l GA; 5) 1.0 mg/l BAP, 0.01 mg/l IBA and 0.1 mg/l GA; 6) 1.0 mg/l BAP, 0.01 mg/l IBA. The experiment was carried out in three replications, the number of newly formed shoots within three passages was determined.

It has been shown that GA enhanced apical shoot growth, and reduced plant tillering, so lowering the multiplication ratio (MR). Therefore GA was used only at the stage of *in vitro* initiation. Increasing the IBA concentration stimulated swelling of *in vitro* shoot and occasionally roots and callus were formed. Accordingly, the MS medium with reduced IBA (0.01 mg/l) and without GA was suitable for micropropagation of wild *Malus* accessions. In paper of Matushkina O.V. et al., 2008, MR of *Malus* varieties and clonal rootstocks was 3.9-5.1 on MS with 2 mg/l BAP. However, the authors noted a large number of vitrified shoots (24.4%), that could affected adversely the efficiency of cryopreservation. In two media tested: with 0.5 mg/l BAP + 0.01 mg/l IBA and 1.0 mg/l BAP + 0.01 mg/l IBA the MR varied from 2.9 to 3.1 and the number of vitrified shoots was insignificant – from 3.3 to 4.4%. Therefore MS medium with a lower concentration of BAP (0.5 mg/l) was used for *in vitro* shoots propagation. In our early paper we have shown that the same medium was optimal for *Malus* varieties, but MR was higher (3.7) than MR of *Malus* wild forms (Romadanova N.V. et al., 2006). The further study on the creation of *in vitro* collection is being continued for apple clonal rootstocks.

Obtained accessions of *in vitro Malus* germplasm will be stored in cryobank at -196°C, can be used in the breeding process and to setting up elite nurseries, as well as for the international exchange of genetic resources.

*Acknowledgement:* This study was supported by the grant #0491/GF3 “Establishment of the cryogenic bank for perspective apple varieties and rootstocks on the base of biotechnological methods” from the Ministry of Education and Science, Republic of Kazakhstan.

**USE OF BIOTECHNOLOGY METHODS TO RESTORE THE  
GERMINATION OF COLORED RICE SEEDS**

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In Kazakhstan, the research on rice with colored pericarp was not investigated resulting in a lack of domestic varieties of red and black rice. Unlike white polished rice grains, colored rice husks are rich in biologically active substances, antioxidants, vitamins, and macro-and micronutrients. These valuable components reduce the risk of heart disease, cancer and other diseases.

Storage period of rice seeds is usually 2 to 3 years, after which seed germination declines. Some samples of rice with colored pericarp from the Institute of Plant Biology and Biotechnology collection were in limited quantities and had low germination rate.

The objective of study was to recover seed germination using biotechnological methods to further replenish the collection and use in rice breeding with colored pericarp.

Two genotypes of rice with zero laboratory and field germination were used in this study: black rice seeds with a long shelf life and a hybrid F1 ( $\text{♀ Rubin} \times \text{♂ VNIIR 10178}$ ) with a puny kernel and underdeveloped endosperm. To restore germination black rice seeds were placed in the cryovials and immersed in liquid nitrogen (LN) for an hour. Control seeds were not subjected to stress. The rice kernels were pretreated with various sterilizing agents before freezing in LN and they were germinated *in vitro* in two culture media types: MS without hormones and MS supplemented with BAP 2 mg/l, NAA, 0,5 mg/l, and HA -5.0 mg/l. Two optimal sterilizing agents, 75 % solution of bleach and 3% solution of TWEEN 20 (exposure 20 min) were identified. Germination of Black rice seeds were positively effected when frozen in HA, showing 30.0 % on MS medium supplemented with hormones. Regenerant plants were further transplanted into soil and turf mixture to obtain rice grains.

To increase seed germination and obtain F1 hybrid of  $\text{♀ Rubin} \times \text{♂ VNIIR 10178}$ , they were placed on MS medium supplemented with 0.5 mg/l BAP, 0.5 mg/L HA and 0.2 mg/l IBA; and 100% germination was achieved. Further seedlings were transplanted to agar medium MS with no hormones and cultured until they had 2-3 leaves and roots. Subsequently, seedlings were placed in a solution with IAA -1.0 mg/l to increase root mass. After 3-4 days plants were transplanted into pots and grown to full maturity.

As a results of the study, the conditions to restore rice seed germination was optimized; sterilizing agents and medium for *in vitro* germination and for full plant regeneration were identified; starting rice material with low germination was restored; the collection with colored rice pericarp was replenished.

**REGENERATIVE POTENTIAL OF *CROCUS ALATAVICUS* IN VITRO**

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*Crocus alatavicus* Regel et Semen is an endemic species of flora of Kazakhstan and has a high biological and economic potential as a source of valuable genes in breeding of new plant varieties and forms. Currently, as a result of human activities, the species is threatened with extinction and is included in the list " Rare and endangered plant species" by the Resolution of the Government of Kazakhstan.

In world practice tissue culture methods are widely used to recovery and conservation of rare, endemic and threatened plant species with small natural populations. The biological features of Kazakh crocus, small native populations of species, early flowering time and short period of vegetation make their conservation difficult by the traditional ways. Besides conventional methods of propagation, *in vitro* cultural methods can play an important role in the clonal propagation and conservation of small natural populations of rare crocus in Kazakhstan. Moreover, *in vitro* propagation of plants could help in raising disease free healthy clones on a large scale for the horticultural industry.

The aim of the research is to study the features of regeneration and to optimize hormonal composition of medium to induce different morphogenesis of *Crocus alatavicus*.

Plant materials were collected from wild populations in Almaty region. Segments of corms, floral buds, different parts of the flower, leaves, etc. were used as explants. The isolated tissues were cultured on Murashige and Skoog (MS) medium containing phytohormones (6-benzylaminopurine (BAP), naphthalene acetic acid (NAA), 2,4-dichlorophenoxyacetic acid (2,4-D), indolebutyric acid (IBA), kinetin) in different compositions and concentrations.

The explants isolated from young formed corms tended to callusogenesis. The simultaneous callus formation and development of additional shoots on corms explants were noticed. Direct regeneration by the growth of axillary buds localized on the corm surface as a result of inducing action of BAP was occurred.

Number of shoots produced by primary explant during the first passage depended on the hormonal composition of medium. A maximum number of shoots (14) was obtained on the medium supplemented with 8.88  $\mu\text{M}$  BAP and 2.55  $\mu\text{M}$  2,4-D. The same effect was detected on the medium supplemented with 8.88  $\mu\text{M}$  BAP + 0.51  $\mu\text{M}$  2,4 D and 4.44  $\mu\text{M}$  BAP + 1.3  $\mu\text{M}$  2,4 D.

Callus formation on the cut surface of explants cultured during three weeks on the medium containing BAP and 2,4 D were occurred. Formation of adventitious shoots in callus tissue was noticed after passaging callus on the same medium.

Thus, the regenerative potential of *C. alatavicus* is determined by the initial stage of plant, the physiological state of the primary explant and hormonal composition of nutrient medium. Induction of growth of axillary buds, adventitious shoot formation at the base of shoots, morphogenetic callusogenesis can be induced using the explants of newly-formed corms isolated at the first stage of their development, when vegetative and generative primordia are formed at the apical bud.

**FLORISTIC DIVERSITY OF VALUABLE GENEPOOL OF WILD  
CONGENERS OF CULTIVATED PLANTS OF EASTERN, WESTERN  
AND CENTRAL KAZAKHSTAN**

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The Scientific and technical program "Botanical variety of Kazakhstan wild congeners of cultivated plants as a source of enrichment and preservation of gene pool of agrobiodiversity for realization of Food programme" for 2013-2015 are being realized by Botanical Gardens of Republic of Kazakhstan. As starting points for Program formation had served State acts and already available scientific elaborations in this direction (Sitpayeva, Yessimbekova, Morgounov, Karabayev, 2004; Sitpayeva, Lammer, Khusainova, 2004; 2006). The developer and main executor of the Program is RSE "Institute of Botany and Phytointroduction" SC MES RK. Co-executors of this Program are Ili Botanical Garden, Altai Botanical Garden, Mangyshlak experimental and Zhezkazgan Botanical Gardens.

By results of expedition departures in East Kazakhstan (Altai (floristic areas: Kalbinsky ridge) and Semipalatinsk pine-forest) the following species growth was established: 1) Kalbinsky ridge – 58 species of 37 genera of 14 families; 2) Semipalatinsk pine-forest – 18 species of 15 genera of 7 families. In the territory of Western Kazakhstan (floristic areas: the Buzachi peninsula, the Mangyshlak peninsula, the Northern Ustyurt and the Southern Ustyurt) 118 types of WCCP relating to 62 genera and 21 families were allocated. The greatest species variety of WCCP is marked in the territory of the Mangyshlak peninsula of (53 species, 42 genera and 19 families). The smallest species variety of WCCP was marked in the territory of the Buzachi peninsula (21 species, 19 genera, 10 families). Among WCCP of the Buzachi peninsula Cereals were presented by 7 species (33.3%, the greatest number of species) and Goosefoots were presented by 5 species (23.8%).

For Mangyshlak the greatest variety of WCCP was concentrated in Goosefoots (13 species), Cereals (8 species) and Legumes (6 species) families; for the Northern Ustyurt – in Goosefoots (6 species), Cereals (5 species) families; for the Southern Ustyurt – Goosefoots (7 species), Cereals (3 species) and Legumes (3 species) families. In the territory of Central Kazakhstan the following floristic regions were investigated: desert Betpak-Dala (16<sup>th</sup> floristic area), the Western Uplands (10<sup>th</sup>), the Ulytau Mountains (10a<sup>th</sup>), the East Uplands (11<sup>th</sup>), Karkaraly (11a<sup>th</sup>) and Turgay (9<sup>th</sup>) floristic areas. As a result of expedition departures in Betpak-Dala habitations of 9 species of WCCP were revealed, among them *Elytrigia repens*, *Leymus angustus* act as dominants of vegetable communities. In the Western Uplands the number of WCCP species reaches 28, among them 14 species are dominants.

In the territory of the Ulytau Mountains 17 communities were described, including 10 communities in which 8 species of relatives are dominants. In Eastern Uplands 14 species of WCCP inhabiting in 11 communities were revealed in which 2 species are dominants: *Festuca valesiaca* in herb-cereal community and *Medicago falcate* in herb-leguminous community. In the Karkaraly Mountains 2 communities with prevalence of 3 dominant species of WCCP were described: herb-cereal community with *Elytrigia repens* and *Festuca valesiaca*, and also herb-leguminous community with *Trifolium pratense*. In the eastern part of the Turgai floristic area 10 species of WCCP were revealed in 3 vegetable communities.

**GEOGRAPHICAL REGULARITIES AND PHYTOCOENOTIC  
DIVERSITY OF CROP WILD RELATIVES AT THE SOUTH-EAST  
OF KAZAKHSTAN**

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The spatial distribution of vegetation in mountains of the South-East Kazakhstan was assessed within the altitudinal belts. The vegetation of mountain systems is characterized by high phytocoenotic diversity, stipulated by geological, climatic and ecological conditions. The diversity of habitats contributes to formation of plant communities with participation and sometimes with domination of crop wild relatives (CWR). One of the survey tasks was to compile the maps of geographic distribution of species.

For mountain ridges of West Tien Shan, Kirgizskiy Alatau and Syrdarya Karatau, the highest floristic and phytocoenotic diversity is recorded in intermountain plains and river valleys where meadow vegetation is formed with high abundance of forage plants such as (*Elytrigia repens*, *E. trichophora*, *Bromopsis inermis*, *Lathyrus pratensis*, *Vicia cracca*, *Dactylis glomerata*, *Trifolium repens*, etc.), and resource important plants (*Mentha longifolia*, *Hypericum perforatum*, *Allium* spp). The diversity of wild fruit plants as *Malus sieversii*, *Pirus regelii*, *Armeniaca vulgaris*, *Crataegus* spp, *Sorbus tianschanica* and singly encountered *Morus alba*, *Padellus mahaleb* is concentrated in the gallery forests. Such species as *Hippophae rhamnoides*, *Rubus caesius*, *Rosa* spp form the standing bushes.

CWR of cereals (*Taeniatherum crinitum*, *Aegilops cylindrica*, *Bromus macrostachys*, *B. japonicus*, *Hordeum leporinum*) in the Tien Shan mountains are confined to dry steppe slopes in low piedmont belt. In the Syrdarya Karatau mountains, the populations of goatgrass (*Aegilops cylindrica*, *A. triuncialis*) of high coverage are distributed as part of ephemeral-grass-sagebrush communities (*Artemisia karatavica*, *Stipa hohenackeriana*, *Poa bulbosa*), as well as in herbal layer of maple-ash woodlands (*Fraxinus potamophila*, *Acer semenovii*). The populations of almond and plum (*Amygdalus petunnikovi*, *A. spinosissima*, *Prunus sogdiana*) occupy small areas in wood-shrub stands of the West Tien Shan. *Amygdalus spinosissima*, *Cerasus erythrocarpa*, *Ephedra equisetina* dominate in shrub communities at rock habitats of the Syrdarya Karatau. The sparse woodlands of pistachio (*Pistacea vera*) were recorded at dry south-east and south-west slopes of low mountain belt of the West Tien Shan; the northernmost habitat was detected at the west part of Kirgizskiy Alatau.

The main CWR diversity in Turkestan floristic region is concentrated in a valley of the Syrdarya River where the regularities of phytocoenoses distribution are determined by water regime, salinity of the ground and soil texture. In multilayer tugai (flood plain forest) there were recorded forage species of grasses such as *Leymus multicaulis*, *L. angustus*, *Elytrigia repens*, and camel's thorn (*Alhagi pseudalhagi*). Licorice (*Glycyrrhiza glabra*) was found as subdominant species of a herbal layer. Reed stand was widely distributed. In tugai forest with prevalence of *Populus diversifolia*, *P. pruinosa* quite often oleaster (*Eleagnus oxyacarpa*) plays subdominant role. In sandy and clayey deserts of the left bank of the Syrdarya River, the predominant part of CWR is referred to forage plants (*Haloxylon persicum*, *H. aphyllum*, *Carex pachystylis*, *C. physodes*, *Salsola orientalis*, *Stipa hohenackeriana*), which are dominants and subdominants of plant communities.

**ASSESSMENT OF RESOURCE POTENTIAL OF WILD CONGENERS  
OF CULTIVATED PLANTS AT THE SOUTH OF KAZAKHSTAN**

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The natural vegetation resources are one of the main assets of any country whose economic independence in significant measure is determined by genetic diversity of plants making up the gene pool of plant resources.

One of the tasks of developed “Strategy of genetic resources development of Kazakhstan plants” is focused on survey and inventory of plants’ genetic resources (PGR), search and collection of seed collection of wild, rare endemic species and congeners of cultivated plants.

Within the framework of purposeful state program «Botanic diversity of wild congeners of Kazakhstan cultivated plants as a source of enrichment and preservation of gene pool of agricultural biodiversity for implementation of Food Program» (2013-2015), the inventory and assessment of resource potential of wild congeners of cultivated plants (WCCP) of Kazakhstan flora was carried out for the first time among which there were officinal, food, forage and other groups of useful plants.

As a result of route-reconnaissance survey of Zhambyl and South-Kazakhstan regions within Turkestan floristic region and mountain ridges of Karatau, West Tien Shan and KirgizskiyAlatau, distribution of nearly 200 species of Kazakhstan WCCP was recorded. In spite of species diversity and distribution of WCCP per surveyed floristic regions of South Kazakhstan, only a certain portion of detected species was recorded as having the areas of commercial significance.

The reserves of air-dry raw material of 17 WCCP species of seven families of which only one species was presented in the family: *Capparaceae*, *Caryophyllaceae*, *Elaeagnaceae*, in the rest families: *Hypericaceae* and *Lamiaceae* – per two species, *Fabaceae* – 3, *Rosaceae* – 7 species.

The industrial reserves of such species recorded at the territory of Turkestan floristic region as *Glycyrrhiza glabra* L., *Elaeagnus oxycarpa* Schlecht., *Alhagi pseudalhagi* (M. Bieb.) Fisch., *Capparis herbacea* Willd. are perspective for commercial harvesting. For *Allocrusa gypsophiloides* (Regel) Schischk., the annual volume of raw stock harvesting shall not exceed 100 tons of dry roots. At piedmont plain of the KirgizskiyAlatau, only *Glycyrrhiza uralensis* Fisch. can be harvested on commercial scale.

For harvesting in limited quantity and needs of local drugstore network the following species can be recommended which were detected at the territory of KirgizskiyAlatau, Karatau and Karzhantau such as *Rosa* L., *Crataegus* L., *Hypericum* L., as well as *Sorbus tianschanica* Rupr., *Mentha longifolia* (L.) Huds., *Origanum vulgare* L., *Ziziphora clinopodioides* Lam.

Thus, of 17 detected WCCP resource species recorded in the South Kazakhstan at least 35% species are provided with raw stock base and fit for commercial harvesting.

The rest 65% WCCP species even with limited reserves of raw stock base within the small area represent the unique genetic resources formed in peculiar and exceptional conditions of surveyed floristic regions of the South Kazakhstan requiring preservation and rational use in order to meet the needs of currently living and future generations.

SPECIES DIVERSITY OF CROPS WILD RELATIVES  
OF SOUTH AND EAST-SOUTH KAZAKHSTAN

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The genepull of crops wild relatives is genetical potential of agriculture. For long time the question of protection and using of this Kazakhstan's genepull was established [Sitpaeva, 2006]. The question is deciding now by scientific-thechnical programm "Botanical diversity of crops wild relatives is the spring for protection and development of genepull of agrobiodiversity for realization of Kazakhstan's food Program".

In 2013 the investigations were done in South and East-South Kazakhstan. The South Kazakhstan were investigated by expeditions in total. It is shown, that there are 185 crops wild relatives from 94 genus of 30 families. More numbers of species are from families *Poaceae* Bernhart (58), *Rosaceae* Juss (39), *Fabaceae* Lindl. (18), *Alliaceae* J. Agardh (8), *Asteraceae* Dumort (11), *Lamiaceae* Lindl (9). The most big in relatives are genus *Allium* L., *Rosa* L., *Crataegus* L., *Bromus* L. The number of crops wild relatives is different in different floral regions. There are 103 species in West Tian-Chan, 93 species in Karatau, 75 species in Kirgiskiy Alatay and 39 species in Turkestanskiy floral region. There are 9 species from Kazakhstan's Red Book among crops wild relatives (*Allium microdictyon* Prokh., *Allium pskemense* B. Fedtsch., *Pistacia vera* L., *Allocrusa gypsophiloides* (Regel) Schischk., *Armeniaca vulgaris* Lam., *Malus sieversii* (Ledeb.) M. Roem., *Sorbus persica* Hedl., *Vitis vinifera* L., *Artemisia cina* Berg ex Poljak.).

In East-South Kazakhstan was investigated the forests near Ile-river only. It was shown, that in such forests there are 23 arboreal species. 11 of them (47.8 %) are wild relatives fruit crops. 8 species (*Elaeagnus oxycarpa* Schlecht, *Hippophae rhamnoides* L., *Berberis iliensis* M.Pop., *Berberis sphaerocarpa* Kar. Et Kir., *Berberis sphaerocarpa* X B. iliensis, *Lonicera iliensis* Pojark., *Nitraria sibirica* Pall., *Nitraria schoberi* L.) are autochtonic. Other 3 species (*Elaeagnus angustifolia* L., *Morus alba* L., *Armeniaca vulgaris* Lam.) are looking to be naturalized from the culture.

The seeds of all crops wild relatives were taken for long protection in the special seed bank.

**WILD CONGENERS OF CULTIVATED PLANTS IN FLORA OF  
PROTECTED TERRITORIES OF SOUTHERN KAZAKHSTAN**

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Actual problem not only of the present but even of the future is keeping balance between necessity of human welfare provision and biodiversity preservation. Resolution of a problem of natural plant resources recovery is an indispensable condition of preservation of Republic gene fund. In this respect for Kazakhstan cereals is the most priority group (Sitpayeva, 2006; 2010).

In Republican State Enterprise "Institute of botany and phytointroduction" from 2013 the program "Botanical variety of Kazakhstan wild congeners of cultivated plants as a source of enrichment and preservation of gene pool of agrobiodiversity for realization of Food programme" for 2013-2015 directed on study and preservation of genetic recourses of the state is being realized. Program implementation provides not only search of concrete growth places of wild congeners of cultivated plants (WCCP) but even ascertainment of representative territories of their preservation in natural inhabitations.

*In-situ* preservation is the most preferable variant for optimal preservation of WCCP gene pool as evolution of species takes place in biocenosis that is why their preservation in protected biocenosis possesses the largest reliability guaranteeing the gene pool safety, their effective support and use availability.

Special protected natural territories (SPNT) such as reserves, preserves, national parks, nature sanctuaries, etc. are concerned to a number of the basic objects where preservation of biological variety components is supposed.

Within the framework of the Program during the field season 4 floristic regions of Southern Kazakhstan were explored. They are Turkestan Alatau, Kirgiz Alatau, Karatau (Syr Darya Tien Shan) and Western Tien Shan. 185 species of wild congeners of cultivated plants were revealed.

Share of WCCP participation in flora of the investigated territories is not unambiguous. 3 SPNT: 2 State natural wildlife reserves, Aksu-Zhabagly, Karatau, and Sairam-Ugam State National Nature Park.

The greatest number of the revealed congeners of wild plants is marked in Aksu-Zhabagly reserve, 102 species (47.7 % from number of congener species). The least number of the revealed congeners of wild plants is marked in the Karatau wildlife reserve, 33 (15.43 %). Share of Sairam-Ugam State National Nature Park (SNNP) is 67 species (31.1%).

8 species were marked only in Karatau wildlife reserve, 15 species were marked in Sairam-Ugam SNNP, 36 species were revealed in Aksu-Zhabagly wildlife reserve.

It is necessary to note, that the part of WCCP is occurred in territories of several protected wildlife preserves. So, 4 species are protected in Karatau wildlife reserve and Sairam-Ugam SNNP. 40 species of vascular plants are occurred in Aksu-Zhabagly wildlife reserve and Sairam-Ugam SNNP, only 8 general species were occurred in all three protected territories.

Crop wild relatives such as: *Malus sieversii* (Ledeb.) M. Roem., *Pistacia vera* L., *Armeniaca vulgaris* Lam., *Sorbus persica* Hedl., *Vitis vinifera* L., etc. are included into regional and national Red Data Books and conserved in the nature protected areas of different status.

**TEMPERATURE AND PHOTOSYNTHETIC PRODUCTIVITY  
ON SUGAR BEET AGROBIOCENOSIS**

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From the temperature of environment depends all vital processes of plants. Sum of temperature is a measure of the thermal resource level which determines the degree of plant growth and development, the intensity of photosynthesis and the production process.

In this context, the task of our research was to determine the effect of temperature on decreasing of photosynthetic efficiency and the harvest of sugar beet roots. To solve this problem were laid experiments where seeding temperature conditions were imitated by sowing time: early, optimal (recommended) and late.

It should be noted that the sugar beet is relatively cold resistant culture and optimum photosynthesis it is in the range of from 15 to 30°C. However, when sown in the early period (April 6), often in the area of its cultivation (southeastern Kazakhstan) marks a return of cold weather, frost that slows down the process of photosynthesis. On such systems is formed photosynthetic of the assimilation apparatus area size (45.9 thousand m<sup>2</sup>/ha) which is able to function with the intensity of photosynthetic productivity of the order of 4.98 g / m<sup>2</sup> day. This level of the amount of net photosynthetic productivity ensures the formation of sugar beet yields - 538 kg / ha.

When sowing of sugar beet in the optimum time (III decade of April) provided active plant growth and development from the early stages of ontogenesis. In the context of a favorable combination of thermal, radiation regime of the environment and the soil water regime, sugar beet plant for 55-60 days develop greater photosynthetic apparatus in size - 49.6 thousand m<sup>2</sup>/ha, total aboveground biomass (tops), working actively and productively - 5.18 g/m<sup>2</sup>day, which contributes to the formation of the highest experience of sugar beet harvest - 600kg / ha. However, sugar beet as no culture of irrigated agriculture, it is difficult to adapt to the impact of higher temperatures the spring-summer period during late sowing (May 6). Proof of this is education on crops foliage area of limited size - 41.6 thousand m<sup>2</sup>/ha. The relatively small size of the photosynthetic apparatus in the later stages of sowing of sugar beet caused by the short period of growth and vegetation. These sowing in one period (sowing - June 15) the growth of sugar beet artificially reduced, which is reflected in the total leaf area and photosynthetic efficiency, respectively, in the late sowing high ambient temperatures accompanied by air and soil drought adversely affect not only the size of the sheet. But also weaken the productivity of photosynthesis to 4.70 g/m<sup>2</sup> day, hindering growth, but accelerating the growth of plants. Under these ambient conditions in the later stages of crop sugar beet crop roots formed - 383 kg / ha.

From this we see that only at the optimal planting dates sugar beet can be without any additional material and labor costs, increase productivity of photosynthesis is at 0.20 g/m<sup>2</sup> day compared with early and 0.48 g/m<sup>2</sup> day late planting dates and get more productivity root 62 and 217 t /ha, respectively.

**CRYOPRESERVATION TECHNIQUES FOR ANTERS  
AND POLLEN GRAINS OF RICE**

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An effective way of improving the yield and quality of crops, including rice, is the breeding. Principally an existing plant collections need to be stored reliably for developing new varieties. Along with the traditional ways of conservation of genetic material the cryopreservation techniques are used in liquid nitrogen (-196°C) in world practice. Anther and pollen culture *in vitro* is of interest as a backup method of multiplication whereas in consequence of the development program switching from gametophytic phase to sporophytic phase we raise the possibility to get the regenerated plants (Batygina T.B., 1994). While working with anther culture it should be noted that regenerated plants derived from microspores of heterozygous hybrids are immediate candidates for the varieties (Bobkov S.V., 2007). Pollen stored in germplasm banks can be used in biotechnological studies as well as in breeding programs (Alba E. et al., 2000). There are reports on cryopreservation of viable pollen of sugar beet, potato, apple and cherry (Chang Y. et al., 1999; Panella L. et al., 2009; Saphina G.F. 2005; Manzhulin A.B. 1986). However, the results of cryopreservation of rice pollen and anthers are not available in the literature. The purpose of this research was to study the cryopreservation environment for anthers and pollen grains of rice.

The study subjects were the following varieties: Anait, Bakanassky, Barakat, Violetta, Leader, Madina and Marzhan. The pollen grains were dried for 1 hour over silica gel before freezing, and cryopreservation was performed by direct immersion in liquid nitrogen (-196°C). The vitrification method with 0.3 M sucrose (Niino T. et al., 1992), PVS2 cryoprotectants or 50% glycerol + 50% glucose was used in liquid MS medium for cryopreservation of anthers. Anthers were thawed in a water bath (20°C) for 1 min, and pollen grains – at room temperature for 60 min. Anther and pollen grains viability were determined by staining with acetocarmine in glycerol (Barykina R.P. et al., 2004), and pollen grain fertility –by pollination of randomly selected genotypes.

Research results have shown that the viability of non-frozen rice pollen grains did not change before and after drying and was 92.89-100%. Pollen grains did not survive after cryopreservation at a natural moisture, although the viability of dried pollen grains was high (92.27-100%). Seed set after pollination with unfrozen pollen was 30.1%, and with cryofrozen pollen was – 15.0%. The differences in anther survival after cryopreservation were identified depending on the used cryoprotectant and genotype. The viability in MS medium while at a cryopreservation with cryoprotectant – 50% glucose + 50% glycerol was 91.48-98.54%, and with PVS2 – 75.46-95.23%. There was observed plasmolysis in Bakanassky, Violetta, Leader, Madina and Marzhan varieties when using a PVS2 cryoprotectant.

Thus, above matter refers that the optimum technique for cryopreservation of rice pollen grains is drying them for 1 hour over silica gel with direct immersion in liquid nitrogen. For cryopreservation of anthers the best is vitrification with 0.3 M sucrose with a cryoprotectant of 50% glycerol + 50% glucose in liquid MS medium.

**DISTRIBUTION AREAS AND GENETIC DIVERSITY OF WILD BARLEY  
FROM KAZAKHSTAN**

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Wild species *Hordeum spontaneum* K. is a direct precursor of cultivated barley and an important source of increasing diversity of cultural forms, including for increasing plant resistance to stress factors. According to the modern classification the wild two-rowed barley is classified as a subspecies to the species *H. vulgare* (*H. vulgare* ssp. *spontaneum* K.). One of the objectives of our research was to study the areas of distribution of annual species *Hordeum spontaneum* K., for which Kazakhstan is a peripheral zone.

Results of the analysis of collecting 209 samples 14 populations collected in 2008-2012 allowed us to establish the area distribution of *H. spontaneum* in Kazakhstan - South Kazakhstan region (Saryagash, Kazygurt and Tolebi areas). The results of expeditionary works in Tyulkubas, Maktaral and Shardara areas gave us bases to assume that *H. spontaneum* doesn't grow in these regions of South Kazakhstan.

To study the agronomic traits of wild barley from Kazakhstan the seed material of all populations *H. spontaneum* was grown in winter sowing in experimental plots of the Kazakh Research Institute of agriculture and crop production (Almaty region).

For implementation genetic analysis 96 DNA samples of wild barley was isolated and purified. PCR conditions have been optimized for the 18 SSR-markers which evenly localized in all seven chromosomes of barley genome. All 18 SSR primer pairs were divided into three groups depending on the annealing temperature - 50°C, 55°C and 60°C, which were selected during primer screening and optimization of the PCR.

As a result of statistical analysis of polymorphic SSR-18 loci were identified 58 alleles, with a mean of 3.1 alleles per locus. The number of effective alleles ranged from 1.2 to 3.9. Shannon genetic diversity index ranged from 0.606 to 0.867, Nei's diversity index from 0.364 to 0.497, PIC from 0.219 to 0.710.

This work is one of the stages of research in the field of molecular systematics of wild species of cereal Kazakhstan. The relevance of using this approach for the development of genetics and breeding of crops in general, and for the formation and preservation of collections of plant genetic resources, documentation, creating a data bank, storage organization of the gene pool is that a comprehensive study and characterization of barley genetic resources, and including the use of methods of molecular markers for efficient replenishment, assessment, maintenance and rational use of genetic collections.

# **Session 2.**

# **Genetics, Breeding, and**

# **Phytopathology**



**MARKER ASSISTED SELECTION OF PLANTS****A.M. Kudryavtsev**

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Rapid evolution and growths of the molecular genetics methods (including sequencing technologies and PCR based approaches) in the last decades resulted in the development of a new breeding strategy now known as Marker assisted selection (MAS). MAS is a method of breeding which allows to trace desirable agronomical traits during selection based on genomic rather than morphological analyses. The basic approach of the MAS is simple. If one knows the position of a gene(s) controlling any trait of interest, it is possible to monitor the inheritance of such trait in breeding populations based on the gene-linked genetic markers instead of the trait itself. Such type of selection most effective in work with agronomic characters controlled by not completely penetrant genes or with quantity traits controlled by groups of genes where each gene has well expressed effect on the trait. All MAS works are always realized in close collaboration of the molecular geneticists and breeders. The distinct specialization and labor division are typical in such collaboration. The geneticists usually establish genetic control of a trait of interest, they have to find, map and annotate genes and to fit appropriate genetic markers for key alleles. The breeders should apply these markers integrating ones in conventional breeding schemes in order to optimize the selection. The MAS methods are developing continually and now there are many new plant varieties created by means of such approach. However it should be noted that the MAS methods are mostly effective to monitor and select traits having monogenic control. There are a little of practical examples of working markers for quantitative traits in spite of very intensive worldwide researches in the field of so called QTLs. It seems that the MAS approaches would be extremely demanded in the selection of plants with altered biochemical properties which practically impossible achieve by means of conventional breeding. First of all that goes for polyploid cultivars. Also the MAS methods have good practical potential in fruit trees breeding where due to long ontogenesis of these plants the breeding process usually requires many years. The MAS approaches in this case allow perform the selection on the first stages of breeding process saving plots and times. Along with obvious merits the MAS approaches have certain demerits and the main one is the high price of the molecular diagnostics.

## INTERNATIONAL PROGRAM FOR IMPROVEMENT OF WINTER WHEAT – RESULTS AND PERSPECTIVES

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International winter wheat improvement program ([www.iwwip.org](http://www.iwwip.org)) is a partnership between Ministry of Food, Agriculture and Livestock of Turkey, CIMMYT and ICARDA to develop new winter wheat varieties for the region of Western and Central Asia. IWWIP also serves as a vehicle of global winter wheat exchange for the breeding program. The main breeding priorities are broad adaptation, yellow, leaf and stem rust resistance, grain quality. There are three major germplasm breeding directions: full irrigation (>5 t/ha); supplementary irrigation (2.5-5 t/ha) and semi-arid (< 2.5 t/ha). Annually 800-1000 crosses are made which are subjected to conventional multi-lokalional breeding framework in Turkey. Around 500 new varieties and breeding lines are submitted to IWWIP by its collaborators for evaluation in Turkey and distribution through the international nurseries. The best advanced lines as well as the best introduced lines are annually distributed through FAWWON (Facultative and Winter Wheat Observation Nursery) to more than 120 cooperators in around 50 countries. The program started in the 1970s and till now around 60 varieties were released in the region occupying more than 2 mln ha.

Diseases represent high priority for IWWIP breeding across environments due to the fact that many famers in the region do not utilize certified treated seed and fungicide protection. The crosses are made utilizing IWWIP or introduced resistance sources. Simple crosses winter x spring or winter x winter are normally top-crossed by well adapted winter germplasm preferably resistant to common bunt. The main site for selection for common bunt resistance is Transitional Zone Agricultural Research Institute in Eskisehir with relatively high natural infection of common bunt. The main site for yellow rust evaluation is Haymana new Ankara, for leaf rust – Edirne and Adapazari and for stem rust – Kenya and Kastamonu province in Turkey. Resistance to soil born pathogens (nematodes and root rots) is evaluated in Eskisehir. This systematic screening procedure resulted in identification several sets of genotypes with resistance to different diseases and they are available to global cooperators upon request.

In 2009 IWWIP initiated Turkey landrace inventory and within five years landraces were located and collected in more than 60 provinces of the country. In total, around 200 landraces (by name) were collected, evaluated and characterized following pedigree approach. Socio-economic data on these collections was also gathered from 1700 farmers. There are two main objectives of the landrace work: utilizing them for modern germplasm improvement and improvement of the landraces themselves to be transferred back to farmers. In the second breeding approach common bunt represents an important trait. Individual selection from the landraces and evaluation of the progenies for a number of traits has been conducted on a wide scale (30,000 headrows). Simple selection from diverse landraces has potential for their improvement. Crosses between the landraces and modern varieties targeting common bunt resistance have been conducted as well and the F1s were either backcrossed or top-crossed by another landrace.

IWWIP undertakes systematic efforts to breed winter wheat synthetics for utilization as parents. The potential of synthetics has been proven for a number of traits. IWWIP work started in 2009 with the F3 populations originating from crosses between winter Durum varieties from Odessa (Ukraine) and *Ae. squarossa* which were received from CIMMYT-Mexico. The populations demonstrated wide segregation and within four years pedigree method were applied to select disease resistant agronomically more acceptable progenies. In 2013 more than 120 hard-threshing synthetic lines were selected and entered multilocalional testing for a number of traits. They have been also inoculated by common bunt and there is a possibility of selection of resistant genotypes which would diversify the genetic basis of resistance to this pathogen as well as other diseases.

## **GENETICS-LED WHEAT BREEDING IN THE 21<sup>st</sup> CENTURY**

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The challenges of World Food Security demands that overall World wheat production will need to be dramatically increased. Alongside this is the challenge of climate change making crop production more vulnerable to weather extremes. Thus, to maintain supply meeting demand, the rate of genetic gain obtained by wheat breeders, per year, in newly released varieties, must be doubled compared to current trends. Additionally, crops need to be ‘climate proofed’ by better adaptation to average and extreme conditions.

Since the development of directed wheat breeding at the beginning of the 20<sup>th</sup> century, wheat improvement had been led by empirical approaches. These rely on the skill, experience and ‘eye’ of the plant breeding, rather than on the application of precise objective scientific approaches. Only at the end of the 20<sup>th</sup> century did genetics-driven approaches start to impact because of the advances in molecular biology, genetics, genomics, molecular pathology, statistics and bioinformatics. However, in the first decade of the 21<sup>st</sup> century, developments in wheat genomics and genetics have led to much greater understanding of the wheat genome, leading to new tools and approaches.

This paper will discuss these developments in terms of how genetic and genomic analysis has led to marker-assisted germplasm selection, marker assisted- breeding, better macro and micro-adaptation, and the promises of better breeding technologies through genomic selection and genetic modification.

**APPLICATION OF SNP GENOTYPING IN GENETICS  
AND BREEDING OF CEREAL SPECIES****Yerlan Turuspekov***Institute of Plant Biology and Biotechnology, Almaty, Kazakhstan  
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One of the major modern trends in genomics of cereals is widespread application of SNP genotyping approaches. Wide use of SNP genotyping in many projects around the world is influencing by developments of second and third generation DNA analyzers, which is consequently increasing number of informative DNA markers per genome, speed of the experiments, and decreasing the price of the experiments. One of the new products in this area in cereals is development of 90K SNP chip for hexaploid wheat from Illumina Ltd. The array was developed based on results of international effort in identification of informative SNP markers for wheat genomes. Thousands of wheat samples were successfully genotyped in genomic centers of North America, Australia and Europe. Among those studied samples there are 90 spring wheat cultivars from Kazakhstan that registered at State Commission of Seed Testing of the Ministry of Agriculture of Kazakhstan. As a result of the test 35K polymorphic SNP markers were identified. Those 90 cultivars were also studied in field conditions of experimental stations in Northern, Central, and Southern Kazakhstan. The collection was studied by 20 physiological, morphological and agronomical traits, including grain yield and yield components. Therefore, generated genotyping and phenotyping data is opening wide possibilities for development of genomic breeding of wheat in Kazakhstan. Similar studies with less number of SNP markers were done for collection of 96 perspective lines and cultivars of barley and rice. Other examples of widespread application of SNP genotyping is KASP technology developed by LGC Genomics Ltd., UK. KASP is based on fluorescent scanning instead of use of electrophoresis and labeled primers and characterized by high accuracy of the experiment, high throughput, and low price for the unit of information. By using KASP the collection of 90 spring wheat cultivars were tested for specific genes and markers such as *Vrn*, *Ppd*, and *Rht* genes and DNA marker for 1RS:1BL wheat-rye translocation. As a result the allelic conditions for all studied genes and markers were established. Obtained results were actively used for identification of new genes associated with stress abiotic resistance, search of new resistance genotypes, and studies for genotype x environment interaction patterns.

*Acknowledgements:* The research was done within grant FP7-KBBE-2011-5-289842 ADAPTAWHEAT supported by 7<sup>th</sup> European Framework Program; grants #0049 and #0084 supported by the Ministry of Education and Science of the Republic of Kazakhstan (2012-2014).

**GENETIC AND PHENOTYPIC VARIATION IN COLLECTIONS  
OF CULTIVATED WHEAT AND BARLEY FROM KAZAKHSTAN**

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Wheat (*Triticum aestivum* L.) and barley (*Hordeum spontaneum* L.) are major cereal crops in the world, including Kazakhstan.

Genetic diversity studies are important in order to study molecular phylogeny and identify important genes and QTLs (quantitative trait loci) in germplasm collections. Informative DNA markers are effective instruments in order to evaluate genetic material on early stages of breeding studies and identification and mapping of valuable QTLs that associated with grain yield and yield components, plant resistance and grain quality.

In studies of wheat genetic diversity in collection of 92 spring wheat cultivars from Kazakhstan we used 15K SNP (single nucleotide polymorphism) markers, 42 SSR (simple sequence repeats) markers, and specific genes and markers, such as *Vrn*, *Ppd*, *Rht*, *Pin*, *Gli-2*, 1RS/1BL (Abugalieva S., Turuspekov, 2010; Abugalieva S. *et al* 2012; Turuspekov *et al* 2013a). The collection is also analyzed in field conditions of Northern, Central, and Southern Kazakhstan in 2012-2013 years in order to study genetics and physiology of adaptation of wheat to different ecological niches within ADAPTAWHEAT project supported by European Union (Turuspekov *et al* 2013a).

The collection of 96 spring barley cultivars and perspective lines of Kazakhstan were grown in 2009-2011 in 3 randomised replications in 5 breeding organizations of Kazakhstan located in Kostanai, Karaganda, Aktobe, Almaty, and Kyzylorda regions. The collection was studied with more than 20 agronomic traits (Turuspekov *et al* 2010; 2012; 2013b), 11 grain quality parameters (Abugalieva A. *et al* 2014), and for resistance to leaf rust and spot blotch diseases (Rsaliev *et al* 2014). The barley collection was studied by use of 384 SNP markers, 60 SSR markers, and by specific genes, such as *Hina*, *Hinb-1* *Hinb-2*, and *Rpg-1*.

As a result of this research the collection of wheat and barley was genotyped by different classes of DNA-markers. The established genetic distances among the cultivars were used to construct phylogenetic trees, identify cluster patterns both in wheat and barley, and develop genetic passports for all evaluated commercial cultivars. Also, the data were used for association studies to map important QTL for yield and yield components, grain quality, and disease resistance.

One wheat and four barley cultivars were developed based on collaboration with breeding organizations from the Ministry of Agriculture of the Republic of Kazakhstan.

*Acknowledgements:* The research was supported by the projects 0327 and 00329 of national program #O.0492 (2009-2011) and projects #0049 and #0518 provided by the Ministry of Education and Sciences of the Republic of Kazakhstan (2012-2014; 2013-2015) as well as ADAPTAWHEAT project supported by European Union.

**Keynote****ACHIEVEMENTS IN SELECTION OF POTATOES VEGETABLES  
AND MELONS IN KAZAKHSTAN****T.E. Aitbayev**

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Kazakh Research Institute of Potato and Vegetable Crops (KRIPVC) is a national scientific center that coordinates the activities of 15 scientific institutions of potatoes, vegetables and melons. The main objective is to provide scientific support of these industries. Priority direction of KRIPVC is breeding and seed.

Selection is carried out over 25 types of crops: potatoes, onions, shallots, garlic, tomato (open and protected ground), cabbage, peppers and spicy eggplant, cucumber (open and protected ground), pumpkin, squash, carrots, beets, dill, radishes, green vegetables and beans, watermelon and melon. Research focuses on the creation of cultivars and hybrids of different maturity groups, with distinct adaptive properties, resistance to environmental stress factors, widespread diseases, with a high yield, better biochemical composition, ecology, marketability, persistence during prolonged storage (7-9 months), and suitability for industrial processing.

In breeding selection a rich gene pool of KRIPVC is used: 10750 varieties of melons from 97 countries and 1860 of potatoes from 35 countries.

Efficiency of breeding for years of independence of Kazakhstan has increased 10 times; the species composition of crops has greatly expanded. In 1991 there were only 12 local varieties in 8 kinds of crops, but in 2013 there are more than 120 varieties of 25 types. Only in the last 3 years (2011-2013) 45 new varieties and hybrids were created by breeders of Kazakh research institute of potato and vegetable crops, 41 of them are zoned. During the years of their activities about 10 varieties (mostly - potatoes) are zoned by regional scientific institutions of the republic

114 varieties and hybrids of research institute's selection are included in "State register of breeding achievements of Kazakhstan", including: potato - 35, onion - 11, shallot - 2, garlic - 5, tomato – 10 for open ground, greenhouse tomato - 8, cucumber - 6, pumpkin - 3, squash - 2, radishes - 1, cabbage- 2, dill - 1, watermelon - 8, melons - 9, sweet pepper - 3, chilies - 2, carrots - 2, beet - 1, vegetable bean - 1, mung bean vegetable - 1, vegetable soybean - 1.

More than 20 new varieties and hybrids, including first domestic varieties of eggplant, lettuce, celery, squash, basil, pea, and greenhouse cucumber are on the state strain testing.

Varieties of potatoes, vegetables and melons in Kazakhstan are competitive on the domestic market and characterized by high productivity, better quality characteristics, resistance to adverse weather conditions (heat, drought, etc.) and disease severity, its suitability for long-term storage and industrial processing and they occupy from 25 to 100% in "State Register". Thanks to high economic value-added features, the new varieties of research institute are in high demand from farmers and growers enthusiasts.

Selection achievements of scientists of Kazakh research institute of potato and vegetable crops provide varietal independence of Kazakhstan. Accelerated breeding and introduction of new varieties and hybrids will contribute to sustainable development in high-profitability of potato, vegetable, and melon growing branches of Kazakhstan.

**WHEAT BREEDING AT KARABALYK EXPERIMENTAL STATION**

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Wheat is the main cereal crop in Kazakhstan. Breeding remains the most effective method of increasing the productivity and potential of the crop and export.

At Karabalyk Experiment Station the breeding research is conducted on three types of wheat: spring soft and hard, and soft winter wheat.

Development of new varieties is conducted by traditional breeding, shuttle breeding and environmental testing. Our priority selections are productivity, quality, and resistance to stressful environmental factors (drought, lodging, sprouting grain on the vine), disease resistance (brown leaf and stem rust, septoria).

The main method is the traditional breeding hybridization carried out using both local material and with the involvement of remote forms of environmentally -wide collection and CIMMYT. It is held annually from 150 to 200 combinations of crosses. In breeding nurseries annual study is conducted by 50 000 sort samples of three kinds of wheat.

During the period 2010 to 2013 there were given to the state variety testing the varieties of spring wheat Karabalykskiy 20 Tumar Galatea, fantasy, hard spring wheat Asangali 20 Nurly, Karabalykskiy chernokolosaya 20; winter wheat Ayaz. In the State register of breeding achievements there were permitted a variety of spring durum wheat Altyn Dala for utilization in 2012.

Shuttle breeding method is based on obtaining hybrid populations of the international center Maize and Wheat Improvement CIMMYT. Work is being done on a «Karabalik - CIMMYT - Karabalik.» From these combinations CIMMYT conducted on the basis of our material world and the gene pool, and individual selection is conducted further testing on the overall scheme of the selection process. Annually tested to 3000 populations. The studies by the method of shuttle breeding in the state strain testing a variety of spring wheat SimKar 20 was transferred.

Environmental strain testing is conducted as in conjunction with breeding institutions of Kazakhstan and with NIU near abroad. The purpose of the test is to allocate environmental adapted to local agro-climatic conditions of wheat varieties. To this end, the station is a member of the network KASIB (Kazakh Siberian wheat nursery) which includes leading breeding establishments of Kazakhstan and Russia.

**ENVIRONMENTAL TEST RESULTS OF SPRING BARLEY AT  
KARABALYK AGRICULTURAL RESEARCH STATION****V.A. Chudinov**

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In the state register of breeding achievements of the republic there are more than 30 cultivars of spring barley approved for use in different regions of Kazakhstan. At the same time, new varieties are introduced into production culture and find their spread mainly in those regions where there are breeding agencies involved in the creation of new varieties of spring barley. In regions where barley breeding is not conducted, and are still occupied by large acreage, such as Donetsk 8, Donetsk 9, Medicum 85 or foreign breeding new varieties. The current situation on creation and introduction of new varieties requires breeding institutions develop varieties with high adaptive capacity which may reach through an environmental selection. The essence of which is to estimate the parameters of varieties in different climatic conditions. Currently, the functions of environmental tests are performed by the State variety testing varieties, having a large number of test areas located in all agro-ecological points of the republic, it is the most extensive collection of habitats to evaluate genotypes.

However, the evaluation grades adaptability according to the State variety testing has some drawbacks. As a rule, state variety trials has varieties selected from nurseries competitive variety trials which are in agro-climatic zone of selection center location, and therefore the probability of high productivity grade in other environmental points is not great. In order to determine the suitability of cultivation of new varieties in a particular region of the country we are carrying out research on environmental Variety Testing produced varieties and lines of spring barley.

This work was started by us in 2009 to test varieties and strains of competitive variety trials under Ural agricultural station (Western Kazakhstan). As a result of the research was highlighted the line 40-177-01 excess grain productivity which, on a standard 3-year was 1.6 dt / ha at HCP05-0.8ts/ha (according G.Shektybaeva). This line named Zhaik-2 was assigned to the State variety trials from 2012.

Starting since 2011 on the initiative of scientific coordinator of barley breeding B.Sariev, there was established nursery of environmental testing of the best lines of spring barley breeding from all institutions in Kazakhstan. The nursery included 40 varieties and lines. After two years of testing, in Pavlodar NIISKh the line 31-44-72 was found out which exceed the standard grade of Tselinny 91 4.2 dt/ha (according to D.Mergalimov). Line is being prepared to transfer to the CIO in 2014.

As part of activities for environmental testing, together with the Institute of Plant Biology and Biotechnology (IPBB) we carried out trials of 97 lines of spring barley breeding USA. The samples were obtained from Dr.Ye.Turuspekov and Dr.S. Abugaliyeva, who provide common scientific leadership of the project. The nursery consists of 55 lines of two-rowed and 42 lines of multi-rowed barley. As a result, among the two-rowed lines they highlighted the number 2386, among multi-rowed - 2700. According to the results of tests in 2014 the line 2386 will be transferred to the state variety testing.

During the period from 2011 to 2014 Karabalyk agricultural station together with other participants NRU environmental testing (IPBB, Ural agricultural station, Pavlodar Agricultural Research Institute) the first sort was given to the State testing and the second is being prepared to transfer of spring barley with a higher chance of adoption and diffusion in the areas of testing.

This indicates a high efficiency of research in terms of environmental tests as measures for the creation and introduction of new varieties of spring barley as other crops.

**APPLICATION OF NEXT-GENERATION SEQUENCING TECHNOLOGY  
TO STUDY GENETIC DIVERSITY AND UNIQUE SNP MARKERS IN  
BREAD WHEAT FROM KAZAKHSTAN**

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Application of 9K Infinum SNP-markers from next-generation sequencing technology to study 10 cultivars of bread wheat from Kazakhstan revealed 5,898 polymorphic markers, of which 2,730 were mapped in the consensus genetic map. Mapped SNP-markers were distributed almost equally between A and B genomes with a range of 279-484 markers among individual chromosomes but about a 10-fold less in the D genome. There were only 863 unique SNP-markers, and their clusters (more than three SNPs) showed specific patterns in the consensus genetic map for all cultivars. They can be used for the preparation of 'genetic passports' for the studied germplasms. Significant intra-varietal genetic polymorphism has been identified in three cultivars (Tzelinnaya 3C, Kazakhstanskaya rannespelya and Kazakhstanskaya 15) using a total of 5,898 polymorphic SNP-markers. Phylogenetic analysis based on inter-varietal polymorphism showed that the very old cultivar Erythrospermum 841 and Kazakhstanskaya 19 were the most genetically distanced from others categorised in six cluster-groups in total.

**RESISTANCE TO FUNGAL DISEASES OF CEDAR PINE  
(*PINUS SIBIRICA* DU TOUR AND *PINUS KORAIENSIS* SIEBOLD  
ET ZUCC.) IN THE PROVENANCE TRIALS IN THE SOUTH  
OF THE KRASNOYARSK TERRITORY**

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The creation of provenance trials (cultivation and comparative evaluation of seed progeny of different origin) is the main method of studying the geographic variation of different populations of woody plants. One of the problems of the artificial cultivation of the provenance trials is their preservation and the identification of infectious diseases at all stages of development. The evaluation of the seed material sustainability to phytopathogenic loads is an important task for getting a healthy stable gene pool, which is, in turn, an indicator of the expediency to grow it in different regions.

The long-term studies of the provenance trials growth and security of cedar pines of different populations, organized in the South of the Krasnoyarsk territory (Yermakovsk forestry) in 1983 were conducted, with the aim of adjusting their forest seed zoning. The provenance trials phenology and the phytopatological condition of the Siberian (*Pinus sibirica* Du Tour) and Korean (*Pinus koraiensis* Siebold et Zucc) cedars, presented in the following climatypes: Siberian – Tashtagolskii (Kemerovo region), Shegarskii (Tomsk region) and Ermakovskii (Krasnoyarsk territory); the Korean cedar - Obluchenskii (JAR, Jewish Autonomous region) and Chuguevskii (Primorsky territory) were studied.

For the period of 2005-2012 the powerful epiphytoty in the provenance trials of the cedar pines was registered. The phytopathologic inspection of all climatypes in August, 2013 very well revealed abundant resin secretion on most of the recovered trees. The annual inspection of different populations of the Siberian and Korean cedar condition showed that the Siberian cedar Tashtagolskii climatype generation was exposed to mostly infectious diseases. It was shown that in new conditions the growth rate of the cedar pines was determined not only by the hereditary peculiarities, but by the adaptation to the weather conditions. After 20 years the average growth of the Siberian cedar populations almost levelled off, but the resistance to fungal diseases of the Tashtagolskii climatype remained low. The mass defeat on the Tashtagolskii climatype trees was noted in 10 and 26 year trees.

The needle of the Siberian cedar of Yermakovskii and Shegarskii climatypes was damaged to a small degree. The first focal diseases were found in the Korean pine generation in the trees aged over 25 years. In the conditions of relatively humid climate of the study area the contamination of the assimilation apparatus and the development of the disease occurred during the spring melt. The dead plants were the allocated patches of reddish color due to dead pine needles, where subsequently, the fruiting bodies of the fungus (apothecia) developed and needles became ash-grey, remaining on the branches for quite a long time. The pathogenic organism that damaged the cedar needles was microscopical fungi *Lophodermella sulcigena* (Link) Höhn.1917 (Ascomycota), causing the disease of grey pine-leaf cast. It is established that the Siberian cedar Tashtagolskii climatype had the least resistance to this disease (from 4% to 22%), while the highest one was characteristic of the Korean cedar Chuguevsky climatype - about 1%.

*Acknowledgements:* this Work was supported by RFBR project no 13-04-01671

**Keynote****ADVANCES AND PROBLEMS OF COMMON WHEAT BREEDING  
FOR LEAF RUST RESISTANCE IN RUSSIA****E.I. Gulyaeva***All-Russian Institute for Plant Protection (VIZR), St. Petersburg-Pushkin, Russia  
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In RF the breeding for leaf rust resistance (caused agent *Puccinia triticina* Erikss.) has been conducted during the long time but the disease remains important on wheat now as before. While testing of wheat cultivars recommended for growing in RF it was determined the significant increasing of spring cultivars number with seedling's resistance in 2005 compared with 1995 and this tendency keeps next 2005-2013 (Novozhilov et al., 1998; Gulyaeva, 2012; Gulyaeva et al., 2014). Adult resistance evaluating showed that more than 40% of winter commercial cultivars included into the State Registry of Russian Federation for Selection Achievements since 2005 characterized by high or moderated level of field resistance (with the disease development up to 15%). For the most winter cultivars the results of leaf rust resistance field scorings conducted in the North-West Russia correlated with their resistance characteristics presented in the State Registry.

For genetic protection improving the *Lr*-genes diversity is of main importance. With phytopathological and molecular methods it was determined that the spring cultivars' majority with seedling's resistance contains the *Lr9* and *Lr19* genes and mainly concentrates in Volga, West Siberian and Ural regions where these genes have lost their effectiveness. Despite the fact, in the State Registry the annual increasing of cultivars with the *Lr9* recommended for growing in West Siberia is determined (Gulyaeva, 2012, Gulyaeva et al., 2014).

The *Lr*-gene (*Lr19*, *Lr24*, *Lr29*) transferred from *Agropyron elongatum* were not determined in the resistant spring wheat cultivars Belyanka, Voevoda, Favorit, Tulaikovskaya 5, Tulaikovskaya 10, Tulaikovskaya 100, Tulaikovskaya 110, Tulaikovskaya zolotistaya, developed with *Agropyron intermedium* and winter wheat cultivar Poema. Genes *Lr28*, *Lr35*, *Lr47* were not determined in cv. Chelyaba 75 developed with cuckoo-line having resistance from *Aegilops speltoides* but using 16-S13 marker of *Lr66*-gene the one showed the positive result.

By the field evaluation of winter wheat cultivars recommended for growing in North-Caucasus the tendency of increasing the high or moderate resistant to leaf rust was determined. Using PCR-markers the known effective adult plant resistance genes were not revealed but the ineffective genes (*Lr1*, *Lr3a*, *Lr10*, *Lr34* e.t.) high occurrence was observed. Evidently the resistance of these cultivars at the adult plant stage is provided by ineffective *Lr*-genes combination but the molecular markers' lacking for all *Lr*-genes does not permit determining which *Lr*-genes' combinations are responsible for the high level of adult plant resistance in these cultivars.

Russian wheat cultivars analysis opens significant advances and some problems in leaf rust resistance wheat breeding for last ten years. Our genetic diversity analysis of Russian varieties demonstrates the significance of *Lr*-genes screening for the used resistance donors and wheat varieties and the necessity of the information using in cultivation practice.

**MOLECULAR GENOTYPING OF SPECIES OF *AEGILOPS* L.  
GROWING IN TAJIKISTAN**

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Now in the field of comparative genetics of wheat and their wild relatives are intensively conducted experiments using molecular markers. Result from such research, or are based almost devoid of functional genes card, or is «comparative binding» of a gene different species of the same molecular markers.

According to some authors, in "creating" soft wheat "nature has used the genetic potential of the genus *Aegilops* L.". The study of almost all species of the genus *Aegilops* L., developed and developing periodically - only due to their high resistance to a number of fungal diseases and some pests. Regarding the study of this kind with the latest molecular techniques, we can not speak about the achievements; since there are still molecular analysis affected only some regions of the genome or particular species of these genera.

In the middle of the 80s year of XX century discovery of the polymerase chain reaction (PCR) has been a major factor in the development of molecular genetics. Modern methods based on the use of molecular markers allow for an examination of the organization and variability of the genome at the level of DNA polymorphism. The use of different types of molecular markers is becoming more common in genetic research and the establishment of the genetic similarity of different species of living organisms. Different types of molecular markers have different resolution, certain markers are used to solve certain issues.

For achievement of the tasks used RAPD and SSR molecular markers for genomic analysis of species of the genus *Aegilops* L., based on the analysis of PCR products. Identified intraspecific polymorphism 4 species of *Aegilops* L., RAPD markers, and also conducted an analysis using microsatellites (SSR markers for detection of phylogenetic relationships and polymorphism between various species of the genera *Aegilops* L. On the basis of the obtained data was built dendrogram and determined the degree of genetic similarity and differences based on the use of SSR and RAPD markers.

The use of the data markers in genotyping wild species of *Aegilops* L., revealed certain regularities. So, RAPD markers allow to reveal interspecies differences in DNA polymorphism. At the same time as SSR markers were informative for the establishment of intraspecific differences. Results can be used for certification of species, varieties, lines that need to be considered in selection work. The report will detail analyzed the results obtained by molecular markers species of the genus *Aegilops* L., growing in Tajikistan.

**EVALUATION OF EFFECTIVENESS IRAP-MARKERS FOR  
MOLECULAR GENETIC IDENTIFICATION OF WHEAT VARIETY**

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Recently, for genotyping and identification of varieties and forms of plants widely used methods of genomic fingerprint - IRAP (Inter-Retrotransposon Amplified Polymorphism) and REMAP (Retrotransposon-Microsatellite Amplification Polymorphism) based on the polymorphism of retrotransposons - mobile elements of the genome. Among main advantages of *IRAP*- and *REMAP*-methods are their capabilities to generate highly informative fingerprints, the ability to detect polymorphisms at the intra- and inter-species level. Importantly, both methods are relatively easy to implement, have high reproducibility and efficiency. This is due to the fact that retrotransposons are unevenly distributed over the genome, demonstrating higher speed of molecular evolution than the constitutive elements of the genome. Because retrotransposons are highly polymorphic loci, they can be used to identify genetic differences between the genera and species, as well as forms of one species (subspecies, races, etc.) that is extremely valuable in plant breeding.

The aim of the research was to find the most informative IRAP - genetic markers to identify the originality of wheat varieties. As objects of research we used the seeds of spring wheat of different varieties of Kazakh and foreign selection. As the primers used were universal and species-specific primers to LTR retrotransposons of wheat. For carrying out the PCR amplification using the mixture of the following composition: 25 ng DNA; Tris HCl - 20 mM (pH 8,8); 2 mM MgSO<sub>4</sub>; 10 mM KCl; 10 mM (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>; 0,5 µM primers, 200 uM dNTP , 1 ea polymerase. Optimization of amplification conditions for each primer was performed empirically or using FastPCR (<http://www.primerdigital.com>).

As a result of researches of polymorphism of DNA of 44 grades of soft wheat with use of 19 primers it was received 217 amplicons which size varied from 100 bp to 3000 bp. By using universal IRAP-primers most number of the amplicons (12) was detected in the primer Sukkula, wherein the amount of polymorphic fragments was 83,3%. Species-specific primers had low levels of polymorphism (14.3% - 58.1%). Of this group of primers the most effective was the primer 2109 Daniela, which allowed to generate 26 amplicons, 15 of which were polymorphic.

As a result we were identified most informative primers having the highest values of the index of polymorphism 2109 Daniela (PIC 0,875), Sukkula (PIC 0,731), and 1095 (PIC 0,718). These primers will be used for further researches on identification of genotypes of wheat. Score resolution of each primer showed that this parameter is in direct correlation to the index polymorphism PIC.

**Keynote**

**THE GENETIC BASIS OF THE FLAVONOID BIOSYNTHESIS  
IN WHEAT**

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Flavonoids are a broad spectra of phenolic compounds synthesized in plant cells. Flavonoids are involved in many processes, including protection of plants from various biotic and abiotic stress factors. They also affect plant growth and development. In our studies, the main components of the flavonoid biosynthesis gene network were isolated and characterized. Some peculiarities of the regulation of flavonoid biosynthesis in wheat in comparison with other plant species were revealed. Alien substitution and introgression lines were intensively used in our studies, thereby besides wheat genes some of their orthologues from *Aegilops*, rye and barley were also investigated. Particular attention was paid to the study of gene expression at the foreign genetic background. Relationship between the expression of some of the isolated flavonoid biosynthesis genes and such traits as drought tolerance and seed longevity was investigated in wheat.

**MARKER-ASSISTED SELECTION FOR RESISTANCE  
TO WHEAT LEAF RUST RESISTANCE**

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Central Asia and Kazakhstan are one of the world's major producers of wheat, which is grown on an area of 15 million hectares. In this area in recent years has spread wheat leaf rust *Puccinia recondita* f. sp. *tritici*, which causes serious economic damage, reducing by 30-50% yield and grain quality. Special hazards caused by leaf rust pathogen ability to mutate and rapid change of generations, which accelerates the process race development. Methods for DNA-genotyping and breeding using molecular markers (Marker Assisted Selection) can accelerate the transfer of valuable genes and quantitative trait loci in the selection process and provide the development of new varieties with a set of useful properties. Genetic, breeding and phytopathological study of wheat samples showed that the most resistant to leaf rust were Belarusian promising lines KSI 2/12, KSI 8/12 and KSI 21/12. Among commercial varieties high rust resistance were observed in Kazakh varieties Yrym, Samad, Zhenis and in Belarusian varieties Visa, Dawn, Rostan, Sabina and Toma. Using molecular markers the carriers of leaf rust resistance genes in wheat breeding material were identified. Two lines from Kazakhstan (1026 and 1207) produced the DNA fragment associated with *Lr29* when amplified with primer Lr29F/R18. Three Kazakh lines assessed with marker generated DNA fragment with size 300 bp associated with *Lr10* when amplified with primer to the locus F1.2245/Lr10-6/r2: Babax 1 x 133-3-2006/2, Babax1x137.2006/3 and BEZOSTAYA1/6/BHR\*5/AGA/TRK13/4/ PEHLIVAN /5/F6038W12-1. 35 wheat entries including 20 Belarusian varieties and lines, 2 Kazakh varieties, 6 Turkish and 7 Russian lines assessed with marker generated DNA fragment associated with *Lr35/Sr39* when amplified with primer Sr39#50R/F. Using STS marker Sr24 # 12 DNA fragments that are typical for gene complex carriers *Lr24/Sr24* were identified in varieties Sudarynya and Eagle. Molecular screening has shown that two out of 26 Belarusian genotypes assessed with markers generated the DNA fragment associated with *Lr26* (KSI 4/12 and KSI 5/12). Twelve lines produced the DNA fragment associated with rye translocation and gene complex *Sr31/Lr26/Yr9/Pm8* when amplified with marker Iag95. Hybrids with these lines are being studied in junior breeding nurseries. To accelerate the breeding process, we will continue selection of lines that are resistant to disease using molecular markers linked with this trait. The results of our study create opportunities for transfer of breeding process in Kazakhstan to a new scientific level due to the application of molecular genetics methods.

This work was financially supported by the Ministry of Education and Science Republic of Kazakhstan, research project grant funding № 0053.

**RELATIONSHIP BETWEEN CLIMATIC FACTORS (TEMPERATURE AND PRECIPITATION) IN DIFFERENT MONTHS AND WINTER WHEAT PRODUCTIVITY IN UZBEKISTAN**

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Winter wheat (*Triticum aestivum* L.) production is directly linked to food security in Central Asia. Variations in climatic factors, temperature and precipitation in particular, strongly influence wheat production. This study was conducted to examine the effect of temperature and precipitation on national wheat productivity using data from 16 years (1996-2011). Temperature and precipitation data for the months of November, February, March, April and May from two contrasting sites (Tashkent and Karshi) in Uzbekistan were used in the study. Wheat grain yield in Uzbekistan increased annually at the rate of 0.2 t/ha between 1996 and 2011. Both temperature and precipitation were positively associated with grain yield. However, the degree of association between temperature and grain yield varied for different months in the wheat crop cycle. The temperatures during the month of March showed significant positive association with grain yield at both sites. The total precipitation during the wheat crop cycle showed significant positive relationship with yield in Tashkent only. The results of this study provide important information which could be used in developing wheat improvement strategy for Uzbekistan and other countries in Central Asia in the context of climate change.

**DETERMINATION OF THE SOYBEAN (*Glycine max* L. Merr.)  
VARIETIES FOR FAVORABLE YIELD AND QUALITY  
IN CENTRAL ANATOLIAN CONDITIONS**

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This research was conducted to determine the soybean varieties which are favorable to Central Anatolian Conditions. Field trials were made for two years (2010 and 2011) in Selcuk University, Sarayönü Vocational High School. A total of seven soybean varieties (Defiance, Nova, NE3399, Arısoy, A 3935, Ataem 7 and Ataklısı) were used as material, trials were set up with 3 replications under watery conditions. The following characteristics of the varieties were determined: plant height, number of branch per plant, first pod height, number of pod per plant, first pod height, pod length, number of seed per pod, thousand seed weight, seed yield, protein ratio, ash and oil ratio. According to the results, the investigated characteristics of the varieties showed statistically significance ( $p<0.05$ ) for plant height, number of branch per plant and seed yield. The remaining characteristics were not showed statistically importance. The variety of Ataem 7 had the highest plant height (87.4 cm) while the Defiance variety had the lowest plant height value (62.0 cm). For the first pod height, the Ataem 7 variety (1,6 cm) was in the second group while the other varieties were in the first group. Thousand seed weight was the highest in the Defiance (129,3 g) and NE3399 (129,1 g) varieties, while the varieties of Ataem 7 (116,5 g) and Ataklısı (113,3 g) shoed the lowest values. The highest protein ratio was shown on the Defiance (40,2%) variety and, the A 3935 variety had the highest oil ratio (14.2%).

*Keywords:* Central Anatolian, quality, soybean, variety, yield, yield components.

**CHARACTERISTIC OF THE FOREIGN VARIETIES OF WHEAT WITH SR-GENES OF RESISTANCE TO STEM RUST IN KAZAKHSTAN**

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In recent years in many grain countries of the world, including Kazakhstan, the phytosanitary situation with appearance and spreading of new virulence *Puccinia graminis* f.sp. *tritici* pathotypes are aggravated. It is conventional that for decrease of rates of evolution of pathogens is more use varieties with various genes of resistance protected by different immunity mechanisms. Many researches with using the traditional methods of selection and molecular and genetic markers were developed wheat varieties with known genetic control of resistance to disease. However the success of the selection using of resistance genes depends on the studied carriers of these genes. In this connection, we are studied the collection and new foreign varieties of spring wheat with Sr-genes resistance to stem rust in the field conditions on artificial infectious phone of fungi.

As the result of researches sources of resistance having several genes which is present wheat varieties from USA, Mexico and Australia and are showed the resistance types of reaction to phatogene population during plant vegetation: Line S with Sr13, 17 genes; W2402 - Sr7b, 9b; Renown - Sr7b, 17; Gatcher - Sr2, 5, 6, 8a, 12; Comb X - Sr5, 7b, 9b; Cook - Sr5, 6, 8a, 36; Banks - Sr5, 8a, 9b, 12; Egret - Sr5, 8a, 9b, 12; Mendos - Sr11, 17, 36. It is well that resistance genes Sr5, Sr6, Sr7a, Sr8a, Sr9b, Sr12 and Sr23 in the tested varieties in the conditions of Kazakhstan are not effective, because in separately they are not provided the most resistance to stem rust. This case of control of resistance genes in varieties with weak effectiveness are result of a cumulative effect of their interaction. The cumulative effect is showed that two or several genes in total provide the high resistance than every gene in separately. Due to presence of several genes resistance the selected varieties effectively are protected from local populations of stem rust. The wheat varieties of far abroad (Kite gene carrier Sr26, Timson - Sr36, McMurachy - Sr6, Barleta - Sr8) having high resistance to stem rust are detected during experiments. It is necessary to note that high resistance of McMurachy and Barleta varieties cannot be controlled by only single genes (Sr6 and Sr8), because these varieties are infected by stem rust more weakly than isogenic lines ISr6-Ra and ISr8-Ra. May be, it is connected with that in genome of these varieties have 1 or 2 unidentified additional genes providing protection from disease in a phase of adult plants.

The varieties of Norka (Sr15), Trident (Sr38), Spelmar (Sr22), Arnautka (Sr9d) and Kubanka (Sr9g) had the high type of susceptibility (3 and 4 points), fungi pustules during grain forming had 30-50 % of leaves and stems areas. The reason of susceptibility of the mentioned sources, maybe, is single ineffective resistance genes in genotype.

Thus, the obtained results are confirmed that it is necessary to create and introduce new wheat varieties with several resistance genes to disease for prevention disease on the productive sowing.

**PHYTOPATHOGENIC FUNGI OF CONIFEROUS NEEDLES  
IN THE MIDDLE SIBERIA AND THEIR ROLE  
IN THE “PLANT-PATHOGEN” SYSTEM**

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Our work is devoted to the study of the species diversity of fungal organisms that develop in the tissues of the needles and cause their defoliation in forest nurseries, plantations and natural forests in Middle Siberia.

Considering the tree, as a system of «epiphytic microorganisms - host plant – pathogen» our attention was focused on the mutual development of these components through the interaction of phytopathogens, casual epiphytes and volatile compounds of plants.

The following 21 species of micromycetes were identified identified *Lophodermium pinastri* (Schard.) Chev., *L. seditiosum* Mint. Stal., *L. abietis* Rostr., *L. macrosporum* Hart. (=*Lirula macrospore* (R. Hartig) Darker), *L. juniperinum* Fr. de Not, *Hypodermella laricis* Tubeuf., *Lophodermella sulcigena* (Link) Tubeuf (=*Hypodermella sulcigena* (Rostr.) Tub.), *Cyclaneusma minus* (Butin) Di Cosmo, Peredo & Minter, *Phacidium infestans* Karst. *Chrysomyxa abietis* Wint., *Ch. ledi* DB., *Melampsorella caryophyllacearum* Chroet., *Coleosporium* sp., *Pucciniastrum* sp. *Melampsora larici-populina* Kleb., *Meria laricis* Vuill., *Rhizosphaera pini* (Corda) Maub, *Pestalotia hartigii* Tubeuf Sacc. Syll. (=*Truncatella hartigii* (Tubeuf) Steyaert), *Sclerophoma pithyophila* (Corda) Hohn. (anamorph of *Sydowia polyspora* (Bref. & Tavel) E. Müll.), *Hendersonia acicola* Munch. et Tub.

The quantitative composition and the major groups of microorganisms of the epiphytic complex of healthy and damaged by phytopathogenic fungi seedlings and trees in the Middle Siberia were studied. It was found that the healthy phyllosphere of each plant species had a unique epiphytic community. During the infectious process the differences disappeared: the epiphytic complexes had similar microbial composition in the quantitative and qualitative aspects. Therefore, the epiphytic community may be used as an indicator of the plant health.

On the example of *M. caryophyllacearum* the influence of an obligate pest on the component composition of the volatile compounds secreted by a phyllosphere was shown. This pathogen causes fir needle rust, the formation of «witches brooms» and cancerous overgrowth. During the period from May to September inclusive we identified 75 compounds in the samples of healthy needles and 47 compounds in the samples of fir needles, infected by rust. 24 substances were found that were common to both the control and the experimental samples: monoterpenes (tricycles,  $\alpha$ -pinene,  $\beta$ -pinene,  $\alpha$ -phellandrene,  $\beta$ -phellandrene, camphene, 3-carene,  $\alpha$ -cymene, limonene, terpinolene), sesquiterpenes (junipen, caryophyllene,  $\alpha$ -caryophyllene,  $\alpha$ -longipinen,  $\alpha$ -himachal,  $\delta$ -celine,  $\beta$ -bisabolen), alcohols (borneol, phytol,  $\alpha$ -bisabolol, trans-nerolidol), esters (bornyl acetate, geranilatsetat) and alkane (eicosane). In the sample with rust the percentage of the most volatile compounds decreased compared to the control. The compounds characteristic only for a healthy and a diseased needle were identified. Among the specific compounds of healthy needles  $\beta$ -myrcene prevailed, while for the needles from the «witches brooms» biformen dominated.

The differences in the content of polymeric phenolic compounds (proanthocyanidins) in the bound and free forms in the tissues of healthy and needles infected by *M.caryophyllacearum* were detected. It was revealed that the fir needles with rust, had a reduced deterrent effect on the growth of the epiphytic micromycetes, but had a strong bacteriostatic effect against bacteria (including actinomycetes).

**CHALCONE-FLAVANONE ISOMERASE GENE FAMILY  
IN TRITICEAE SPECIES**

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Chalcone-flavanone isomerase (CHI; EC 5.5.1.6.) catalyzing cyclization of chalcone into (2S)-naringenin participates in synthesis of nine major classes of flavonoid compounds. Although flavonoids have a well-recognized role in the stress response of bread wheat (*Triticum aestivum*,  $2n = 6x = 42$ ), the sequences encoding CHI in wheat have not been determined yet, and their expression has been not studied under stress conditions.

In the current investigation, we isolated three full-length sequences of the wheat *Chi* genes and their orthologs from *T. timopheevii* ( $2n = 4x = 28$ , GGAA), *T. urartu* ( $2n = 2x = 14$ , AA), *Aegilops speltoides* ( $2n = 2x = 14$ , SS), *Ae. tauschii* ( $2n = 2x = 14$ , DD), and *Secale cereale* ( $2n = 2x = 14$ , RR). The *Chi* genes were mapped in highly comparable positions in long arms of orthologous chromosomes 5. All Triticeae species studied have highly identical coding nucleotide and deduced amino acid *Chi* sequences. According to the 3D-structure modeling the *Chi* orthologs encode functional CHI enzymes. Some differences were observed in regulatory regions of the wheat *Chi* genes, what can predispose observed variation in transcriptional activity among the *Chi* gene copies in some wheat tissues. Moreover, the three *Chi* copies demonstrated different response to salinity: *Chi-D1* was up-regulated, *Chi-A1* responds medially, whereas *Chi-B1* was not activated at all.

Wide comparative *Chi* gene structure analysis including more than 15 monocot and dicot plant species revealed intron-loss events during evolution of the *Chi* genes in Triticeae tribe. Most plant species have 4 exons – 3 introns *Chi* gene architecture, whereas the third intron was absent in Triticeae species. In *S. cereale*, the second intron has been also lost during evolution. The observed intron-loss polymorphism in rye was used to develop rye-specific marker efficient for distinguishing rye genetic material in a wide range of Triticeae intergenera hybrids.

This study was partially supported by RFBR (grant no 14-04-31637), RAS (MCB Programme) and a grant from the President of the Russian Federation (MD-2615.2013.4).

**RESISTANCE OF TETRAPLOID TYPE VARIETY SAMPLES OF  
*TRITICUM CARTHLCUM NEVSKI. (T. PERSICUM VAV.)* TO MILDEW**

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Gene resistance transgression of wild and allied wheat types into cultivated varieties is one of the ways to evolve disease and best resistant wheat varieties. One of the sources of such genes *Triticum carthlicum* Nevski. (= *T. persicum*Vav). Studies carried out by N.I. Vavilov in 1912-1913 showed that wheat later named by him *Triticum persicum* Vav., was absolutely not affected with mildew (*Erysiphe graminis*).

The immunological sample analysis of different wheat types carried out at VIR Immune Department in 1968-1973 by V.I.Krivchenko, V.F. Dorofeev, O.G. Grigorjeva et.al also showed that Triticumpersicum variety samples practically were not affected with mildew. Most of them were resistant to races 14, 16, 32, 34 and 35.

The aim of our research was to study the resistance of tetraploid type variety samples of *T. carthlicum* wheat to mildew in the northern forest-steppe zone of the Tyumen Region to select the most promising forms.

Monitoring of disease development in wheat gowingsin Tyumen Region from 1995 to 2012 showed that septoriose, wheat scab and mildew were widely spread. The threshold of harmfulness on mildew was higher only in 2000 (19,0 per cent). In other years the percentage of disease development ranged from 0 per cent to 10 per cent in 2006, the development of disease was 4,7 per cent on the average.

Disease records in Kartalinskaya wheat variety samples were carried out in field experiments in 1992-2009 according to the generally accepted procedure. Favourable weather conditions allowed to evaluate the collection of Kartalinskaya wheat more completely.

The electrophoresis of gliadin in polyacrilamid gel (PAAG) was done for biochemical marking according to the accepted procedure (Bushuk, Zillman, 1978) with modifications by (Metakovskiy, Novoselskaya, 1991).

The highest index of resistance to mildew in Kartalinskaya wheat variety samples was 8.2 (Cv = 11,9 per cent) in 1995, and 8.4 (Cv = 11,2 per cent) in 2002.

High pathogenic epiphytoty load in 2000 and in 2006 influenced on field resistance which was reduced to 7.7-7.6 respectively.

Samples K-36064 (var. *stramineum*) – 8.8 scores (Cv = 8,1 per cent); K-13815 (var. *rubiginosum*), K-18621 (var. *stramineum*), K-18771 (var. *rubiginosum*) – 8.5 scores; K-13882 (var. *stramineum*) – 8.4 scores (Cv = 11,5 per cent) practically were not affected with mildew.

The comparative analysis of gliadinelectrophoregrams of single kernels of variety samples showed that they differ in number and components intensity. Variety samples with high resistance to mildew have almost identical components in spectrum.

Therefore to evolve wheat varieties resistant to mildew the use of gliadin electrophoretic spectrum as a biochemical marker in the early stages of selection is possible.

**Keynote**

**THE RESULTS AND PERSPECTIVES OF BARLEY BREEDING  
UNDER THE SOIL SALINITY OF PRI-ARAL REGION**

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The salinity of soil is the basic problem of agriculture, limiting the height and productivity of plants on the whole world. Considering that high content of salts in soil (0,68 - 1,2 %), drought climate which is main limiting factors of Kyzylorda regions, and plant-breeding-genetic is the most effective and economical method of reduction their negative affecting on cultural vegetation, that research works on creation of new resistance varieties of barley with economic-valuable signs, high adaptivity to the stress factors allow to involve in agricultural practice new earth and reduce the losses of harvest from unfavorable climatic conditions.

Conforming of ecological conditions to the biological requirements of genotype is most full exposed him the genetically conditioned potential of the productivity, so adaptation of sorts to the certain agro ecological terms is important. One of examples of such work is creation new cultivars of spring barley - Syr Aruy and Incar with resistance to salinity. For the first time under the Pry-Aral Kazakhstan region were developed selection work on barley and nurseries in consecutive parts of selection process generated. These sorts are characterized the high productivity (1,5 – 1,9 t/ha), forming the even growth, possess tolerance to salinity, atmospheric drought and late spring frosts, and also the good quality of grain for feed direction (protein higher than 15%). Was created working collection from 250 samples with complete economic-biological characteristic. Annual conducted of topcross crossing that allows to create new forms and to determine donor properties of perspective genotypes. In the initial links of breeding process annually studied 3000 lines, on the field and laboratory terms we are conducted hard selection (85 %), and further studied in subsequent nurseries. Researches showed that sign "protein content" is one of the most important parameters of adaptability to the unfavorable environment factors and most effective at creation of sorts with high grain quality of barley with feed direction is determination of genetic structure of sign and ecological-geographical principle selection of the paternal forms used in hybridization. Were created new valuable forms with high protein, high values of general combination ability and using in the selection like donors for creating sorts of feed barley. It is known that different on composition, but the aligned to the osmotic pressure salinization components identically affect on the productivity of plants, so in plant-breeding and agrochemical work the estimation plants to salt resistance can be conducted on some one type of salinization.

In this connection, cultivation of new varieties of barley is not limited to one Pri-Aral region and will find their application in other ecologically unfavorable regions of Kazakhstan.

**BREEDING RICE VARIETIES, RESISTANT TO BLAST****G.L. Zelensky, A.G. Zelensky***All-Russian Rice Research Institute, Krasnodar, Russia**Email: zelensky08mail.ru*

For the population of Russia rice grain is a valuable food, dietary and wholesome product. The main rice-growing area in the country is the Krasnodar Territory. It produces more than 80 % of Russian rice. In the last 5–7 years, rice growing dynamically develops every year increasing the yield capacity and rice paddy. In 2012 the rice farms of Krasnodar Territory got the record yield of 7,11 t/ha from 133,300 ha of the rice sown area. This is made possible through the introduction of new high-yielding rice varieties and improvement of rice cultivation including harvesting with modern rotary combines.

A further increase in rice production is constrained by several factors, one of them being rice diseases and, above all, rice blast frequent in the majority of the rice-growing countries.

Blast is the most noxious and common in the world among rice diseases. It is caused by imperfect fungus *Pyricularia oryzae* Cav. Rice is susceptible to blast at all vegetation stages and all above ground plant organs (leaves, stem nodes and panicles) are affected.

Practically in all rice growing countries the yield losses according to different estimates reach 3 % to 25 % during normal years; up to 60 % and even 100 % during years with blast epiphytoty. The damage caused by blast increases significantly due poor grain quality received from affected plants. The most effective way to combat the disease is to create and release to farmers rice varieties resistant to blast.

In the Russia rice breeding aimed at immunity to rice blast began in 1982.

Many years of research of *P. oryzae* population structure showed that pathogen races differed in virulence genes. Thus it was discovered that in the European part of Russia the most efficient resistance genes for these populations are *Pi-z*, *Pi-zt*, *Pi-ta2*, *Pi-b*.

All the past 30 years the breeding of the blast resistant varieties is ongoing at the All-Russian Rice Research Institute of Rice. The best of varieties are listed in the State Register and are re-leased for commercial use: Slavyanets (1991), Pavlovsky (1995), Sprint (1996), Kurchanka (1997), Leader (1999), Viola (2001), Snezhinka (2003), Violetta (2007), Atlant (2007), Kumir (2009), Yuzhny (2009), Gamma (2010).

These varieties are blast resistant and do not require chemical treatment against the disease. Of these varieties Leader stands out; it is registered in the State Register of Russia and Kazakhstan, where it shows excellent results in terms of yield and grain quality on the saline soils with rice plants growing shoots through a water layer.

The further joint research of the VNIIR specialists in biotechnology and rice breeders is aimed at pyramid escalation of blast resistance genes in local rice varieties.

## PRODUCTIVITY AND RESISTANCE OF DOMESTIC WINTER WHEAT VARIETIES TO YELLOW RUST

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Injuriousness of yellow rust of wheat (pathogen – *Puccinia striiformis f.sp. tritici*) in Kazakhstan is very high and at times it is holding steadfastly on sowing areas of the southern regions. One of the most important tasks is to create a selection of resistant varieties, forming the high yields in favorable growing conditions and characterizing sufficiently high characteristics of productivity under the stress conditions (Koishybayev M., 2003, Volkova G.V., 2006). In this regard, the aim of our research was to identify the high-yielding and resistant wheat varieties to the yellow rust. In the field conditions on artificially-infectious background of yellow rust were studied 30 winter wheat varieties recommended in production, from them 10 are allowed to be used from 2002 to 2011.

The experimental results showed that the majority of cultivated of winter wheat in Kazakhstan strongly affected the local population of yellow rust. At the same time the leaves of Aktereckaya, Aliya, Naz and Rasad varieties in mid-May marked susceptible reaction types of the disease and after 10 days the flag leaves were covered with fungus pustules by 30-70 %. By the end of the first decade of June on these varieties due to the strong development of the disease the flag leaves were drying out. Such a strong development of infection may have contributed to favorable conditions (frequent rains, cool night and a long period of dew), which was formed in the spring of 2013.

Among the studied sorts on the strong fungus development background were separated the resistant varieties of Kazakhstan's selection Egemen, Ramin and Mereke 70. It is known that the formation of plants biomass has a great development of the flag leaf, which is the main source of assimilates to the ear and delivers about 60% of the products of photosynthesis to form the grains. Consequently, in our experiments focused on the flag leaf, because it is formed by 40% of the grain yield (Yusov V.S. et al, 2011). The high values of this attribute are marked mainly in resistant varieties Egemen, Ramin and Mereke 70, and they had enough large leaves and formed a high flag leaf area (25,7-30,6 sm<sup>2</sup>). The separated varieties on resistance and the basis of the flag leaf also distinguished in terms of productivity (216,4-289,1 g/m<sup>2</sup>), and outperformed the standard variety of Glassy 24 (173.0 g/m<sup>2</sup>). Among the studied varieties the lowest grain yield realized Naz and Rasad, whose indicator was 116.4 and 158.4 g/m<sup>2</sup>. The experiments revealed the tolerant forms of wheat, these include the varieties Aktereckaya, Almaly and Aliya, who gave stable yield irrespective of the lesions of flag leaf yellow rust.

Thus, on the background of the strong development of yellow rust in the conditions of the southeast were decided the resistant varieties (Egemen, Ramin and Mereke 70). These varieties in morphophysiological characteristics correspond to advanced types of plants with optimal dynamics of growth processes, a well-developed foliage and increased grain productivity. Also were highlighted the tolerant wheat varieties Aktereckaya, Almaly and Aliya, who excelled in terms of productivity and they are a valuable source material for breeding.

**ASSESSMENT OF BREEDING MATERIAL TO SUNFLOWER  
PRINCIPAL DISEASES IN THE EASTERN-KAZAKHSTAN OBLAST  
CONDITIONS**

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Diseases of plants in modern agricultural manufacture represent a serious obstacle in order to receive expected yields. In some degree it is agrarians' fault, which can break the crop rotation, agrotechnologies. But also it depends considerably on other factors. In particular, such factor as the strong falling under different pathogens influence.. Affection of sunflower by diseases leads not only to considerable yield decrease, but also to deterioration of its quality. Field germination of seeds, mass and oil content of cypselae falls, acid amount of oil increases and as a result its usage for food aims must be limited. Therefore our investigations were devoted to identification of sunflower pathogens specific composition and primary on seeds as they are the main source of infection. Analysis of seeds and plants was held by methods of pathologic examination. Fungi detection was implemented by a number of determiners of corresponded fungi classes.

We analyzed seeds of the four farms for plants trials. The number of analyzed seeds were 149 samples (breeding farm (BF) – 64 samples, preliminary hybrids trials (PHT) – 25 samples, competitive kinds trials (CKT) – 14 samples, ecological kinds trials (EKT) – 46 samples). According to mycological analysis in laboratory terms there were detected five kinds of pathogens, they are *Whetzelinia sclerotiozum* – white rot, *Botritis cinerea Pers.* – gray rot, *Alternaria tenuis Nees* – blackspot, *Plasmopara helianthi Novot.* – mildew and *Fusarium sp.* – pink dry fusariosus rot. There was observed the biggest development of *Alternaria* fungus on all investigated samples. Its influence reached till 60%. Grey rot development varied from 5% till 50% of seeds in a sample. White rot was observed at 1-25% of seeds and affected samples made up till 10-15%. *Fusarium sp.* affection was not considerable. From all investigated by us material, there can be sorted out 48 samples as more stable (BF – 12 samples, PHT – 8 samples, CKT – 6 samples, EKT – 22 samples), where the degree of different pathogens affection didn't exceed 20%.

All seeds affected by white and grey rot lost their germination and owing to this all the material was rejected. *Alternaria tenuis Nees.* presence on seeds didn't decrease their germination. As a result the main and the most harmful agents, decreasing as the whole yield and its quality as seeds quality are grey and white rot.

Thereby, the more prevailing sunflower diseases in terms of the Eastern Kazakhstan oblast are *Whetzelinia sclerotiozum* (dBy) – white rot, *Botritis cinerea Pers.* – grey rot, *Alternaria tenuis Nees* – blackspot, *Plasmopara helianthi Novot.* – mildew.

**BREEDING OF THE WINTER WHEAT ON ITS DROUGHT RESISTANCE, PRODUCTIVITY AND QUALITY OF THE GRAIN****A.T. Alshoraz, I.P. Alshorazova***Krasnovodopadskaya experimental breeding station, Kazakhstan**E-mail: alshorazov\_53@mail.ru*

There are increasing problems of drought and hot resistance, improvement of the grain quality and productivity for the poor rainfall, high temperature climatic conditions of South Kazakhstan region.

They become more relevant according to the global warming during the recent years. The climate of the South Kazakhstan is characterized by sharp fluctuations in daily, seasonal and annual temperatures, dry air and uneven distribution of precipitation. The precipitations of Krasnovodopadskaya breeding station which is located in semiarid zone, the annual rainfall ranged from 420 to 450 mm in average during the period of many years: 160 mm in winter, 172 mm in spring, 15 mm in summer, and 74 mm in autumn. Typically the distribution of rainfall on month usually isn't optimal for spring vegetation of winter crops, which limits their productivity under dry land background. Lack of the rainfalls, high temperatures, low humidity, hot winds accelerate the loss of soil moisture which exacerbates air-soil drought. According to these problem the development of new more productive and drought tolerant winter wheat cultivars, combining earliness, hot resistance, productivity, grain quality, which meet the requirements of processing industry, are still relevant for rainfed agriculture of the South Kazakhstan region. To solve these problems we have been studying more than a thousand winter wheat entries from different countries of the world during many years. For targeted hybridization there where picked initial forms, hybrid populations were obtained, constant lines were selected and passed through the competitive testing in rainfed conditions. As a result of this work in recent 5 years there were developed and given to the State Variety Testing the unique in precocity and drought cultivars with strong grain such as Dastan, Dala and Shol. The new varieties Dala, Shol, Dastan during three years of the test in SVT significantly exceed in the yield standard Krasnovodopadskaya 210 from 1,1 to 3,3 centner/ha. They also exceed the standard by the numbers of wet gluten (32,9 – 36,6 %) and kind of grain (793,7-805,6 g/l). The cultivar Dala was found as perspective for dry land cultivation in South Kazakhstan region in 2012. Cultivar Dastan succeed passing SVT, cultivar Shol was transferred to the State Variety Trials in 2013. Due their earliness the new cultivars that belong to the rainfed ecotype have a time for forming full grain until the spring-summer drought and as a result consistently show high yields.

**MOLECULAR ANALYSIS OF SOMACLONAL LINES OF SPRING WHEAT USING IRAP AND REMAP MARKERS**

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New forms of plants with valuable technological traits created by the use of biotechnology methods represent an unique combination of genes alleles which could not be gained by the traditional breeding. Genetic differentiation of new generated unique lines from the initial variety on the molecular level allows to draw up the “passport” of material to make shure the author rights protection.

New technologies as IRAP and REMAP-analysis are being successfully used recently for the study of DNA polymorphism of the original varieties and new lines obtained by biotechnology methods because of easy detection and reproducibility of results (Sozinova et al., 2008). These marker systems based on the analysis of polymorphism of most variable DNA fragments which are flanked by LTR- retrotransposons' fragment and its inverted repeat or microsatellite regions (Brik et al., 2006).

Earlier, by the use of long-term plant regeneration technology we have got the wheat somaclonal lines different from prototype – on the time of maturation, on the quantitative (length of main ear, quantity of grains and grain mass per ear, productive tillering) and qualitative traits (grain colour, glumes' colour and shape, awnity) (Bishimbayeva et al., 2005).

For the certification of new lines DNA of wheat somaclonal lines and initial cultivars have been isolated and PCR analysis has been carried out by the use of IRAP and REMAP markers. The following IRAP markers combinations were used for genetic differentiation of soft spring wheat somaclonal lines: PawS 5 + PawS 16, PawS 6 + PawS 17, NikitaC0699 + Sabrina C0945, Nikita C0699 + Sukkula 9900. IRAP markers primer combinations PawS 5 + PawS 16 and Nikita C0699 + Sabrina C0945 have been identified as a most polymorphic.

The following primer combinations were used for the REMAP analysis: PawS5 + (CT) 9G; PawS6 + (CT) 9G; NikitaCO699 + (CA) 9G. The primer combination PawS5 + (CT) 9G have been selected as the most polymorphic and suitable for molecular-genetic characterization of precocious wheat somaclonal lines among the investigated REMAP markers.

It was shown that the precocious somaclonal lines of cv. Otan and Celinnaya 3S of R8 generation differ from initial cultivars by 2-4 amplicones. The differences of somaclonal lines in comparison with the initial forms and with each other have been revealed by molecular biological analysis using IRAP and REMAP markers.

This work performed under the project 1911 of GF1 programm, MES RK (2012-2014).

**SPECIAL ASPECTS OF ITALIAN MILLET BREEDING IN BELARUS**

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Climate changes the nature of which is widely debated in the scientific literature suggest some adjustments in plant growing including the area expansion of new, enough promising crops, particularly millet and sorghum crops. Among these crops, Italian millet is distinguished by the fact that its grain can be regarded as a concentrate of vitamin F, which gives the properties of a protein and fat exchange stimulator to products. However, the introduction of foreign varieties has given no positive results.

The complexity of Italian millet breeding process is, mainly, in the limitations of the crop initial material and the lack of knowledge on it. It is typical for Russia and Ukraine, where breeding work with this crop began more than a century ago, and in the Republic of Belarus, it has been conducted only for the second decade.

The main disadvantage of Italian millet variety samples which are in breeding development now, is the instability of the grain yield formation, which essentially depends on the existing weather conditions. The range of variation of this index ranged from 33.9 to 66.3% with the average yield of 2.0-2.3 t/ha.

One of the simplest ways to increase grain yield in the breeding process is the lengthening of the growing season. The analysis of early ripeness character in the Italian millet samples revealed that their late ripeness was significantly higher as compared to millet. The comparison of the interstage period of ear emergence-ripening showed that the grain formation in Italian millet was the same as that in millet, but took place in the less favourable period of the end of August-the beginning of September, which was characterized by the possibility of early autumn frosts. That could lead to deterioration in the quality of grain for groats and seeds. However, thanks to the longer duration of the interstage period of shoots-ear emergence, Italian millet formed a relatively high herbage yield which made up on average 52.5 t/ha at low range of variation of 15.1% regardless of weather conditions. The main difficulty in the Italian millet breeding is to find the optimal balance between the yield of herbage and grain.

The use of intra-population breeding method using different analyzing backgrounds (sowing terms, the level of nitrogen nutrition and their combination) allowed to isolate genotypes forming the grain yield of 4.0-4.5 t/ha with satisfactory grain quality. Thousand-kernel weight was 3.1-3.2 g that by 10.7-18.9% higher than in the initial populations. Increasing of the grain size with maintaining its resistance to fragmentation in the process of groats production is one of the main valuable characters of raw materials for the processing industry.

Using breeding modifications with multiple evaluation of Italian millet samples by progeny under the conditions of Belarus allowed to isolate the initial material with the enhanced adaptability to the conditions of the republic, and from the selected lines form several varietal populations one of which (Zolushka) has been already zoned and the other (Krasunya) is in the State Variety Testing of the Republic of Belarus. 3 populations are in the breeding development now to improve the complex of agricultural characters.

**GENETIC POLYMORPHISM IN COLLECTIONS OF CHICKPEA AND PEA**

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Legumes (soybean, peas, chickpea, etc.) species, along with cereals, are the most important Legumes (soybean, peas, chickpea, etc.) species, along with cereals, are the most important cultivated genetic resources of plants (GRP) in Kazakhstan and widely cultivated in many countries.

Studying, preservation and rational use of genetic resources of plants are important aspects in world research community. Genetic variation of valuable accessions of important crops is indispensable terms of successful preservation and use of various varieties of agricultural species of plants.

The collection of a gene pool of legumes in the laboratory of molecular genetics of the IPBB formed within the project of EurAsEC. The collection is consisting from 39 chickpea accessions (*Cicer arietinum* L.) and 36 pea cultivars (*Pisum sativum* L.) from Kazakhstan, Russia and many other countries.

The goal of this work was to determine genetic diversity level in available collections of pea and chickpea by using microsatellite DNA markers.

Pea and chickpea cultivars were analyzed by using 14 and 15 microsatellite markers, respectfully. It was revealed from 2 (ICCM0123a) to 6 (TA64) alleles on a locus on chickpea, and from 2 (Pr 1188) to 5 (Pr 636) of alleles on a locus in pea microsatellite analysis. Frequencies of the alleles per microsatellite locus, indices of genetic diversity of analyzed collections by Nei and PIC (polymorphic information content) were determined. Genetic distances between analyzed cultivars, dendrograms based on the UPGMA method, reflecting phylogenetic similarities and distinctions of analyzed accessions both peas and chickpea from Kazakhstan and Russia have been established. Genetic passports for each commercial cultivar of pea and chickpea from Kazakhstan have been developed on the basis of use of informative SSR markers. Results can be used in breeding and genetic programs and for protection of the rights of breeders and breeding achievements.

This work was done within the project on the framework of EurAsEC Program MG.0591 "Innovative biotechnologies" (2012-2014).

**THE SEARCH FOR SOURCES OF WHEAT SR RESISTANCE GENES****M.N. Atishova, A.M. Kokhmetova, D.K. Zhanuzak***Institute of Plant Biology and Biotechnology SC MES RK, Almaty, Kazakhstan**Email: Maki\_87@mail.ru*

Wheat is the main export culture in Kazakhstan. A further increase in grain production in the country is can be reached, mainly due to higher yields. Wheat rusts are the one of the major factors reducing the productivity of this crop. Stem rust, *Puccinia graminis Pers.f.sp.tritici*- one of the most harmful diseases of wheat (Voronkov, 1974). Wheat rust is spread on all continents of the world (Koishibayev, 2002). Rust diseases of wheat caused a serious economic damage to agriculture.

In breeding for resistance to pathogens it is important to have the genetic markers associated with this trait allowing to select resistant entries in the early stages of the selection process. The most effective way to protect plants is to use disease-resistant varieties. Application of molecular genetic markers allows the identification of effective resistance genes in varieties and hybrids, which speeds up the selection of target genotypes and increases the efficiency of the selection process (Kokhmetova, 2012). The aim of this work is to identify of sources with effective resistance genes to stem rust of wheat.

The objects of study were 38 entries of wheat, including local and the Belarusian promising lines. To identify sources of *Sr* resistance genes PCR analysis was performed. The purpose of this study was identification of carriers of an effective gene *Sr22*. The gene of *Sr22* is localized on the short arm of chromosome 7A. In this study SSR primers (Simple Sequence Repeats) were used. For separation of amplified DNA fragments electrophoresis was conducted in 2% agarose gel, staining was performed using ethidium bromide. PCR analysis with primers to the *Xcfa2123* SSR locus located at a distance 6 of cM from the *Sr22* gene was done for identification of the *Sr22* carriers (Khan et al., 2005).PCR analysis showed that of 38 studied entries, the fragment of DNA associated with gene *Sr22*with size 245bp in 13 samples wheat was observed. Gene *Sr22*was identified in 5 Kazakhstani F<sub>4</sub>lines and in 8 Belarusian wheat entries.These genotypes are offered as donors for Marker Assisted Selection (MAS) programs to improve the resistance of wheat to stem rust.

This work was financially supported by the Ministry of Education and Science Republic of Kazakhstan, research project, grant funding № 0086.

**ECOLOGICAL TEST OF WHEAT PRECOCIOUS  
LINES OBTAINED BY BIOTECHNOLOGY METHODS**

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The main areas of spring wheat cultivation are the northern regions of Kazakhstan, characterized by late spring, early autumn, short and dry summer. Due to an extended period of vegetation in these conditions most commercial cultivars fall under the autumn rain and misery (early frosts, etc.), whereby a significant part of yield has high humidity and usually rots that brings huge economic losses. Therefore the creation of precocious lines and cultivars of main agricultural crop - spring wheat, is a very actual task.

Ecological tests of precocious somaclonal lines of cv. Celinnaya 3S and cv. Otan previously obtained in IPPB on the base of long-term plant regeneration technology in conditions of the South-East Kazakhstan showed the outrunning on time of ripening. Thus, phenological observations of lines in nursery competitive variety trials showed that vegetation period of somaclonal lines (91-93 days) for 2-7 days shorter in comparison with standard cultivar Kazakhstanskaya early ripening (98 days) and initial cultivars Celinnaya 3S (96 days) and Otan (95 days). In North and Central Kazakhstan the test of same lines showed the outrunning in ripening time: in Kustanai region lines of cv. Otan outstrip for 2-4 days, lines of cv. Celinnaya 3S – for 7 days in comparison with initial cultivars and standard cv. Kazakhstanskaya early ripening; in Karaganda region – for 1 day compared with initial cultivars (2013 y.). In 2012 year these lines have shown as early maturing (2-5 days) in Karaganda region, which suggests that the sign of precociousness depends from the specific weather conditions. Differences in time of maturation for 3-4 days have identified by testing of wheat somaclonal lines of cv. Celinnaya 3S in North Kazakhstan. In Pavlodar region two somaclonal lines of Otan outstrip the initial cultivar by ripening time for 2 and 4 days, two lines of cv. Celinnaya 3S – for 2 days. By high grain quality the leveled line of cv. Otan and precocity line of cv. Celinnaya 3S which exceeds the standard cv. Kazakhstan early ripening (752 g/l) and by protein content the short stem and glassy grained line of cv. Otan were selected. It was shown the same somaclonal lines exhibit the different signs of productivity, precocity and grain quality depending of the weather conditions in each particular region that indicate the interaction of "genotype-environment".

Overall, preliminary ecological test in Central and Northern Kazakhstan showed that precocious lines of Celinnaya 3S can be classified as medium-early ripening and perspective for cropping in northern regions of Kazakhstan. The one of positive results of test is the maintenance of higher biological productivity of precocious lines in comparison with the initial cultivars and high quality of grain on the level of "strong wheat". All wheat cropped in North Kazakhstan are classified as medium-early, medium and medium-late ripening, from this point obtained precocious forms are of interest.

This work performed under the project GF1 program of MES RK (2012-2014).

**ANALYSIS OF GENETIC DIVERSITY OF *GAGEA KURAMINICA*  
BY USING METHOD AFLP FINGERPRINTING**

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Reproduction is one of the basic characteristic of life. Genetic diversity is mainly generated through recombination processes in sexual (generative) reproduction, which is, hence, a process of fundamental importance for population and species biology. However, many higher plants also have elaborate means of vegetative reproduction. Some species of the genus *Gagea* are able to combine sexual reproduction with one from form vegetative reproduction. One of these species is *Gagea kuraminica*, this taxon is spring geophytes, characterized by mixed reproductive strategies.

Our aims were to analyse and compare patterns of genetic diversity *G. kuraminica* within populations using AFLP (*Amplified Fragment Length Polymorphism*) fingerprinting. We tested whether genetic diversity and genet distribution correlated with the observed reproductive strategies: in *G. kuraminica* with a mixed sexual and vegetative strategy, genotypic diversity is expected to be much higher.

Plant material was collected from two populations of *G. kuraminica* in Almaty region, Kazakhstan, in spring of the 2013 year. To assess patterns of genetic diversity, we used a grid sampling strategy on the patch and the transect scale. In all populations, pairs of plants located at a maximum distance of 0.1 m (patch scale) were sampled over a distance of at least 2 m between two such pairs, resulting in transects of at least 50 m length (transect scale). A total of 30 patches per transect was sampled.

Total genomic DNA was isolated from leaves of plant. Approximately 500 ng DNA template was used in the AFLP fingerprinting. A total of 120 *G. kuraminica* samples were analysed with AFLP fingerprinting using the primer combinations *EcoRI* + AGCC /*MseI* + GTAC. AFLP fragments were scored with GeneMapper v3.7 (Applied Biosystems) in an automated fashion. The resulting AFLP profiles were exported as binary matrices for further analyses. For identification of genets based on pairwise distances between samples, an algorithm was programmed in Excel that allowed to set a threshold for genotype identity to compensate for genotyping (biological, experimental, and scoring) errors.

Analyses of two populations showed the following results: in the first population of *G. kuraminica* 49 (90,7%) of the detected 54 genets were unique genets occurring only once, the others formed clones of up to two analysed samples extending over distances up to 38 m. In the second population, 44 (88%) singular and 6 (12%) clonal genets (with 2-4 samples), the latter reaching a maximum of 50 m, were encountered. For some samples, repeat runs were conducted to calculate experimental error rates. These values are much lower than the threshold.

Therefore, in *G. kuraminica*, most of the analysed fragments were polymorphic in all two populations. It can only be explained by that in most cases *G. kuraminica* reproduce sexually. Vegetative reproduction is of special importance only in younger establishment phases of genets, because older plants switch to sexual reproduction and stop forming bulbils once they start flowering. This only partially clonal strategy is reflected by the comparatively high genotypic richness within populations and the low numbers of samples per clone.

**ANALYSIS OF WHEAT PRECOCIOUS SOMACLONAL LINES  
USING ALLELE-SPECIFIC PRIMERS TO PPD AND VRN GENES**

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One of the key genes that determine the main economically valuable traits of cereals are the *Ppd* (Photoperiod response) and *Vrn* (Vernalization response) genes responsible for the reactions of plants to photoperiod and vernalization, that control plant growth and developmental phases (Stelmah et al., 1987). It is known that the combination of *Ppd* and *Vrn* genes' alleles influence on plant development rate (time of earing and maturation), crop structure, frost and winter hardiness, requirement to vernalization, drought and disease resistance, avoiding of high summer temperatures (Potokina et al., 2012).

In this work precocious somaclonal lines of soft spring wheat generated earlier in our laboratory have been analysed on the presence of *Ppd* and *Vrn* genes' alleles. No any one differences have been identified between the somaclonal lines and their original varieties (Celinnaya 3S and Otan cvs.) in the result of molecular analysis of the alleles of *Ppd-D1* gene, representing a key locus of photoperiodic responses of hexaploid wheats. The presence of PCR product 414 b.p. corresponding to allele *Ppd-D1b* and the absence of amplicon 288 b.p. corresponding to allele *Ppd-D1a* have been shown in all investigated somaclonal lines and initial varieties.

PCR analysis of wheat somaclonal lines and their original varieties on the presence of three major genes responsible for vernalization reactions - *Vrn-A1*, *Vrn-B1* and *Vrn-D*, have been carried in the course of investigation. As a result we identified the existence of two biotypes of Otan variety: a biotype that contains two dominant alleles *Vrn-A1a* and *Vrn-B1* and a biotype that contains one dominant allele of *Vrn-A1b*. Somaclonal lines of the Otan cv. differs from the initial variety Otan by the presence of allele *Vrn-A1a* and by the absence of allele *Vrn-B1*.

We have revealed the identity between the initial variety Celinnaya 3C and precocious resistant to lodging line of Celinnaya 3C on the presence of dominant allele *Vrn-A1a* and the difference in dominant allele *Vrn-B1*. Thus, we determined the presence of dominant allele *Vrn-B1* (709 b.p.) in precocious resistant to lodging line of Celinnaya 3C variety, which is absent in the initial variety Celinnaya 3C. This line differs from the initial Celinnaya 3C variety by early terms of earing and maturation. Recessive allele *vrn-B1* (1149 b.p.) was not identified in any one of investigated varieties and somaclonal lines.

For all analyzed initial varieties and somaclonal lines we determined the presence of recessive allele *Vrn-D* and the absence of dominant allele *Vrn-D1*.

Generally, it was revealed, that precocious somaclonal lines differ from the original varieties by the presence or absence of dominant allele *Vrn-B1* which allow to select primers specific to this allele for further molecular-genetic characterization of precocious forms. These data suggest that changes caused by in vitro cultivation of tissues *in vitro* are genetically determined.

This work performed under the project 1911 of GF1 programm, MES RK (2012-2014).

**SCREENING OF WHEAT COMMERCIAL VARIETIES USING SSR  
MARKER TO FUSARIUM HEAD BLIGHT RESISTANCE**

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Fusarium head blight (scab) is one of the most dangerous cereal diseases worldwide. Along with the yield reduction, caused by decrease of seed germination, weight of grains and their number in the spike, inoculation leads to worse baking and brewing qualities of the grain. This disease is recorded for wheat and rye mainly in Northern Kazakhstan in moist years with low temperature, which makes grain ripening period longer. Causal agent of scab are fungi of *Fusarium* genus, most often represented by *F. graminearum* Schw. and *F. avenaceum* Sacc. When the grain is ripening, the fungi start conidial sporulation observed as reddish pads not only on spike and grain, but also in leaf sheaths, nodes and rarely at the base of the stem. During seed germination *Fusarium* mycelium may enter the stem and develop there, but outside of the conducting system. Fusarium head blight may be the reason for grain hollowness and germination loss. *F. graminearum* and *F. culmorum* are very dangerous since they produce toxins in inoculated grains, such as deoxynivalenol, zearalenone, etc., which pose a big threat to humans and animals.

The goal of the given research was to analyze a collection of commercial varieties for the presence of scab resistance genes, using microsatellite marker *Xgwm533-3B*. The study analyzed 81 commercial wheat varieties with different level of resistance to fungal diseases. The results revealed seven specific allele variations (98, 118, 120, 130, 140, 145 and 175) for the given marker in the studied varieties. A non specific allele 300 (300 bp) was found in four varieties: two of them were brought from «Septmon» nursery, another two lines had *Lr*-genes in their genome. Allele 130 was most frequent, it was found in 71 varieties both in homozygous state and in combination with other alleles. A special interest was drawn to finding the varieties that have alleles 98 and 145 in their genome; these alleles represent most perspective resistance markers to fusarium head blight. Allele variation 98 was found in 16 varieties; in 4 of those it was homozygous. Regarding allele 145, it was registered only in one variety/line – LR23. Another rare allele variation was allele 118 (in four varieties), as well as alleles 120 and 140 in two separate varieties. These alleles were recorded both in homozygous and heterozygous state in the studied varieties. Most of the varieties (66) have only one allele, mainly allele 130. In other fifteen varieties there were various allele variations. In Kazakhstan varieties target allele 98 was found in the following varieties: Progress, Zhenis, Akmola 2, Tselinnaya – Yubileinaya, Karabalykskaya 19, Derbes and Sapaly.

## MARKER ASSISTED SELECTION OF TRITICALE FOR LODGING RESISTANCE

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Crop lodging is considered one of the main causes of cereals yield shortage, including triticale. It results in photosynthesis disorder, worsens seed ripening, increases disease affection and substantially hampers harvesting. Breeding for developing semi-dwarf cultivars is a priority trend to eliminate the tendency to lodging.

The article presents the screening results of allelic composition of dwarfing genes of triticale cultivars from various breeding centres and variety accessions developed at the Scientific and Practical Centre of the National Academy of Sciences of Belarus for Agriculture and KazSRI for Agriculture and Plant-Growing as well as triticale recombinant forms with introgression of chromosomes 2D and 4D synthesized at the Institute of Genetics and Cytology of the National Academy of Sciences of Belarus. Inclusion of these forms in crosses allows involvement of dwarfing genes *Rht8* and *Rht-D1*, localized in the above chromosomes, in triticale breeding.

The presence of D-genome chromosomes in karyotypes of triticale recombinant forms was verified by us by the C-banding method. Proceeding from the fact that majority of triticale modern cultivars have the secondary hybrid origin, the chromosome composition was analysed in all the accessions included in the experiment. The cultivars and the majority of Belarusian variety accessions were revealed to have complete sets of chromosomes of A-, B-, and R-genomes. 6D(6A)-chromosome substitution was detected in karyotypes of two spring variety accessions. There was similar intergenomic substitution in all the Kazakh winter variety accessions.

Primers in modification of Zhang et al. (2006) were used for identifying the allelic composition of dwarfing genes. When analysing the allelic composition of gene *Rht-B1*, the presence of mutant allele *Rht-B1b* in homozygous condition ensuring reduction in plant height was revealed in 6 cultivars out of 9 analysed, 8 out of 10 Belarusian spring and 11 out of 14 winter variety accessions, 14 out of 20 Kazakh winter variety accessions and in one triticale recombinant form. As to genes *Rht8* and *Rht-D1*, unfortunately, it became clear that all the recombinant forms developed by us contain wild alleles of the given genes. In this connection the work was initiated for introgressing mutant alleles of genes *Rht8* and *Rht-D1* into recombinant forms by their hybridization with common wheat cultivars carrying target alleles.

Triticale cultivars and accessions with the presence of mutant allele of dwarfing gene *Rht-B1* were included in the breeding process.

The research work was performed with a partial financial support of the Belarus Republican Foundation for Fundamental Studies (grant № B12-042).

**INITIAL MATERIAL OF TETRAPLOID BUCKWHEAT FOR  
DEVELOPMENT OF INTENSIVE TYPE VARIETIES WITH HIGH  
TECHNOLOGICAL GRAIN QUALITIES**

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In Poligonacea family, several species have both diploid and tetraploid forms. This is also typical for common buckwheat. Involving of common buckwheat polyploid forms into the breeding process allows to solve the issues related to crop productivity differently than at the diploid level, since artificial polyploidization in buckwheat is an effective way of obtaining important breeding forms. Basing on the experience of Belarusian buckwheat breeding, it can be concluded that autotetraploid breeding can be regarded as a stage in the following logical scheme of breeding methods of initial material development: formation of morphological features by phenotypic selection – improvement of yield properties of a varietal population or a hybrid using analyzing backgrounds – polyploidization. However, the use of polyploids in breeding has shown that their potential, to the greatest extent, is implemented at sufficient soil moisture and high level of plant cultivation, both in Belarus and abroad.

It has been established that significant increase in buckwheat yield is not possible without introducing genetic control over unlimited growth processes typical to the crop into buckwheat varietal populations. Therefore, further improvements should include changes from the traditional morphotype (indeterminate) to determinate one.

Limitation of growth processes in tetraploid buckwheat plants influences not only the absolute values of characters that determine yield and grain size but also their response to changing environmental conditions. Specific weight of grain fractions under the influence of the external conditions changes by no more than 10%. Under the favourable conditions for the formation of large-sized grain (5.5 mm), increasing goes uniformly due to the reduction of smaller fractions (4.0 and 4.5 mm).

The ability to stabilizing grain size under the changing environmental conditions is decreased with increasing grain size. Changes in the specific weight of the largest fraction are more expressed and can be provided not by the increase of cores but by the increase of hulls. Therefore, in the breeding process of large-sized grain forms including tetraploid buckwheat samples, more attention should be paid to the elaboration of technological grain characters.

Hull content in tetraploid buckwheat changes a little under the influence of external factors, but there is a tendency to the increase of this character under the conditions causing the reduction of thousand-kernel weight; and much stronger this character is manifested in the forms with a limited type of growth.

Adding of limitations to tetraploid buckwheat genotypes both by the determination of apical meristems and by decreasing the number of nodes in the area of stem branching leads to similar responses to growing conditions by the character of thousand-kernel weight. With yield increasing to the level of 32-33 c/ha in the forms with limited growth processes, thousand-kernel weight increases slower than in the forms without growing limits, and then, with further yield increase, it declines more rapidly than in the samples of the morphotype with no growing limits.

**THE SCREENING OF WINTER WHEAT RESISTANCE TO LEAF RUST**

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Wheat is one of the important food grains in Kazakhstan. Wheat has the biggest arable land volume in the world. The wide usage of the wheat is due to the high nutrition value and diverse usage. We can reach the increased production of wheat by reducing the loss caused by disease. Nowadays spreading of the dangerous race of the leaf rust is one of the main reasons of the reducing of the wheat production.

To bring variety of the wheat resistant to pathogens we should clearly define the ancestors which are effective in our regions. That is why in 2011-2013 years in arable lands of the Kazakh Research Institute of Agriculture and Plant Growing the resistance to the leaf rust of the 28 collections of wheat, taken from international nursery of Research Center ICARDA have been studied. In 2011 years all of the 28 wheat entries showed the resistance to the leaf rust, level of resistance was between O-R. The reason for that was in adverse weather conditions for the development of the leaf rust that year. In 2012 year the entry UIIAGEC-18 of wheat showed moderate susceptible resistance to the leaf rust with reaction 20MS, the degree of disease reached to 20%. In 2013 year the degree of disease was highest. That year we can say that wheat entries UIIAGEC-16 and UIIAGEC-18 were susceptible to the leaf rust. The degree of disease of these lines reached to 40-50 %. As a result of the research we can tell that 21 samples are the most resistant. They are: UIIAGEC-1, UIIAGEC-2, UIIAGEC-3, UIIAGEC-4, UIIAGEC-6, UIIAGEC-7, UIIAGEC-9, UIIAGEC-10, UIIAGEC-11, UIIAGEC-12, UIIAGEC-14, UIIAGEC-15, UIIAGEC-17, UIIAGEC-20, UIIAGEC-21, UIIAGEC-22, UIIAGEC-24, UIIAGEC-25, UIIAGEC-27, UIIAGEC-28 and UIIAGEC-29. Level of resistance of theses wheat was between O-R. 5 samples of the wheat were moderate resistant, their degree of disease were between 10-30 %. So we can propose 21 samples of the wheat resistant to the leaf rust as the donors for selection programmes.

This work was financially supported by the Ministry of Education and Science Republic of Kazakhstan, research project, grant funding № 0053.

**SELECTION OF THE MOST EFFECTIVE MOLECULAR  
MARKERS TO IDENTIFY GENOMIC DIFFERENCES IN POTATO  
SAMPLES**

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Recent years are characterized by extensive use of DNA markers in the selection process for a fast, efficient selection of the desired plant genotypes. With use of the DNA markers real practical achievements were obtained to help identification and state registration of varieties and forms of potato. Methods of molecular analysis can effectively compare genomes to assess a degree of genetic similarity/difference. Molecular markers allow identification of the promising breeding genotypes at the DNA level, precise varietal identification, control of genetic contamination and environmental monitoring.

In this work we used plant material (young leaves) and test-tube plants of the age-old and modern potato varieties and forms of domestic selection and foreign selection. Following methods we used: isolation and purification of DNA, quantification of the isolated DNA, testing of AFLP combinations (EcoRI/TruI primer/enzyme), SSR amplification, electrophoresis in polyacrylamide gels, statistical analysis.

42 varieties of *S.tuberosum* were studied in this work. Chosen varieties cover a wide geographical and ecologo-morphological and biological diversity within the species. DNA was extracted from 126 different samples obtained from potato plants of the said 42 varieties. Collection of DNA samples was utilized for molecular genetic analysis. Selection of the most informative SSR microsatellite loci resulted in 8 SSR loci. Also, 10 AFLP primer/enzyme combinations we selected for further work.

To select optimal microsatellite primers we tested 14 primer pairs on 10 potato genotypes. Eight primer pairs were chosen for the identification and genotyping of potato genotypes. SSR-amplified fragments ranged in length between 87-291 bp. The number of polymorphic fragments, depending on the primer pair, varied from 2 (for STG0010 and STI0012 loci) to 5 (for locus STI0033). Polymorphism was quite high and amounted to 90.6%.

We tested 20 combinations of AFLP primer/EcoRI/TruI enzyme combinations. Of these, 10 combinations were found informative. Reproducible spectra of polymorphic AFLP-fragments were obtained for the studied 42 potato varieties. AFLP-amplified fragments ranged in length between 80-450 bp. The number of polymorphic fragments, depending on the primer pair, ranged from 89 (for E12/T55G) to 106 (for E41/T61S).

Currently we conduct SSR- and AFLP-marking and genotyping of potato genotypes in large collection of potato varieties and forms cultivated in Kazakhstan.

**OBTAIMENT OF WHEAT PRECOCIOUS LINES  
USING THE CELL TECHNOLOGY**

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Previous generation of new precocious somaclonal lines from two wheat domestic varieties by the use of long-term regeneration (LTR) technology allowed us to suggest the possibility of implementation of this technology to obtain early forms for further commercially important cultivars. In this regard, the purpose of this research was to study the possibility of obtaining the precocious lines from commercially valuable domestic cultivars of soft spring wheat on the base of genotype independent LTR cell technology developed in our laboratory as well as the possibility to transfer precocity trait induced *in vitro* through the hybridization with the other genotypes.

We have obtained 196 regenerated plants from long-term tissue cultures of 4-5 passages from 26 commercially important soft spring wheat varieties of new generation (Samgau, Almaken, Kazakhstanskaya 75, Astana-2, Karabalykskaya 98, Bayterek, Novosibirskaya 15, Omskaya-36, Asar, Arai, Zhazira, Kazakhstanskaya 17, Kazakhstanskaya early ripening, Kazakhstanskaya 10, Kazakhstanskaya 15, Karagandinskaya 22, Karagandinskaya 30, Nadejda, Irtysh 7, Pavlodar 93, Pavlodarskaya 8, Seke, Bekzat, Conditorskaya spring, Pavlodarskaya Yubileinaya, Lutescens 90). In the result, seeds of R1 progeny from self-pollination have been obtained from 127 regenerated plants, seeds of R2 progeny from self-pollination, generated from 17 varieties. Phenological observation of 127 lines of R1 progeny allowed us to select 47 lines outstripping initial variety for ripening time on 2-7 days, from which 21 lines selected based on productivity traits and 7 lines - on the drought tolerance trait. In total, based on the complex of important traits - precociousness, yield productivity, drought tolerance - 4 somaclonal lines of R1 generation have been selected.

Seeds of F2 and F3 generation of 23 hybrid lines have been obtained by hybridization of previously created somaclonal lines of R8 generation of Celinnaya 3S and Otan cultivars with perspective and approved for use genotypes. From 23 hybrid lines 6 lines have been selected as outstripping for time of maturation in comparison with standart cv. Kazakhstanskaya early ripening (98 days) on 5-11 days, original cultivars - on 3-8 days, and parental somaclonal lines - on 1-6 days. Among them, two precocious lines have been selected as perspective on yield and drought tolerance and two lines - on productivity.

As a result, phenological observation of regenerated plants of R1 progeny revealed the principal possibility of the generation of precocious forms from a wide range of commercially important varieties using LTR cell technology elaborated in our laboratory. It was shown that the previously generated precocious somaclonal lines could serve as donors of the precociousness trait. Study of further development of this trait in plants' next generations will continue.

This work performed under the project 1911 of GF1programm, MES RK (2012-2014).

**EVALUATION OF WINTER TRITICALE INITIAL MATERIAL FOR GRAIN QUALITY**

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In triticale breeding, the evaluation of the initial material for grain quality (the content of crude protein and wet gluten and the estimation of its quality, falling number) is of great importance for the selection of the best samples for further breeding.

The researches were carried out in 2007-2009. The seeds of 100 winter hexaploid ( $2n=42$ ) triticale samples of domestic and foreign breeding were the object of the researches. Crude protein content using IR-analyzer NIRS 5000 (USA), falling number by Hagberg-Perten method on the Falling Number 1500 instrument (Sweden), wet gluten content in accordance with the present standard (GOST 13586.1), gluten quality using IDK-4 instrument (Russia) were determined.

Results. The average value of crude protein content in the samples studied was 13.8%. The maximum value of this index was observed in the Russian variety of Rondo (16.5%).

The average value of the "falling number" parameter was 82 s, which is typical for grain of low baking quality. The maximum value of the parameter was 147 s in the Polish variety of Viton, which did not correspond to high quality as well.

Wet gluten content, the value of GDI for all samples made up on average 16.8% and 81.4 units, respectively. The maximum wet gluten content was 24.8% in the Ukrainian variety of ADM 12. The best gluten was 66.7 units in the Polish variety of Voltario (the first quality group - good). The flour of this variety may be used in the confectionery industry.

"Crude protein content" (coefficient of variation V – 6.5%) and "GDI value" (V – 8.1%) are slightly varying characters formed mainly under the influence of a variety genotype rather than environmental conditions. "Falling number" (V – 25.8%) and "wet gluten content" (V – 32.3%) are greatly varying characters which form under the significant influence of environmental conditions rather than the variety genotype. In this case, the interaction of "genotype- environment" should be considered.

The varieties mentioned above with the best values of the studied characters can be recommended as the sources for further breeding.

**SCIENTIFIC BASIS OF SEED FARMING THE MNOGOBIOTIPNYKH  
OF GRADES OF THE SPRING-SOWN FIELD IN NORTHERN  
ZAURALYE**

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In 75 years of the State Trials on sortouchastka of the Tyumen region 1004 grades of a spring-sown field of domestic and foreign selection are tested. From them 38 grades (3,78 %) are included in the State register across the Tyumen region and are allowed to cultivation in production.

It should be noted that for noted period of time level of the standard of farming on sortouchastka increased much more strongly, than in production. Productivity of many examinees and standard grades of wheat on sortouchastka makes 6-7 t/hectare and more though in conditions of production is 3-4 times lower.

Studying of the allocated grades with use of a method of an electrophoresis of spare gliadinovy proteins showed that mainly they consist of one biotype and realize the potential opportunities in farms with high level of the standard of farming. Unfortunately, such farms in the field of 10-15%. Generally farms have average and below an average level of the standard of farming therefore grades of wheat of intensive type in such farms realize the potential opportunities for 30-40% and often concede to mnogobiotipny grades. The last grades have to occupy in the near future the considerable areas of crops of a spring-sown field in area.

Thus, mnogobiotipny grades of wheat – one of the main reserves of increase of productivity. For introduction of seed farming of such grades the new scientific methods one of which is the electrophoresis of spare protein in a zernovka are necessary. With use of noted method population grades of wheat display on biotypes and make multiple copies them in purity. By production of elite seeds, depending on feature of climatic conditions of a zone of cultivation and level of the standard of farming of farms unites biotypes in the ratio at which the grade provides obtaining high productivity. In comparison with a method of visual selection of elite plants which is considered the basic in seed farming of wheat and other grain crops, the method of an electrophoresis allows to supervise reliably stability of a genetic basis of grades and by that to prolong a usage time them in production.

In agronomical practice there are many examples of deterioration of mnogobiotipny grades. For example, in the Tyumen region it belongs to grades the Rock, Tyumen 80, Tyumen early, the Lutescent 70 which during traditional seed farming lost one-two biotype that led to decrease in their productivity in farms with average and low level of the standard of farming. From the grades zoned in the last decades, Iren who consists of two biotypes supplementing each other on biological properties can note. On morphological signs they practically don't differ therefore a method of visual selection of elite plants it isn't possible to keep a necessary ratio of biotypes in a grade.

With use in seed farming of a method of an electrophoresis we managed to restore a genetic basis of grades the Rock and Tyumen 80. The updated grades give productivity in ordinary farms 25-30% higher. In this regard it is necessary to draw a conclusion that there came time to transfer wheat seed farming to a new scientific basis. In Siberia three laboratories with use of a method of an electrophoresis of spare gliadinovy proteins, including in GAU of Northern Zauralye (Tyumen) function. Besides, in the State sortoispytaniye, along with a high background of a food of plants, it is necessary to test grades on a rigid background, approximate to working conditions, and also to resume production test of the best grades allocated on sortouchastka. By the time of inclusion of a new grade in the Register of selection achievements it is desirable to have data on its biotipny structure.

The experimental material will be given in the report on production of elite seeds of a mnogobiotipny grade Tyumen 80 for 28 summer period with use of a method of an electrophoresis.

## GRAIN GLASSINESS AT CULTIVARS, SPECIES AND INTERSPECIFIC HYBRIDS OF WHEAT

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The glassiness of wheat is one of important signs of grain quality. It characterizes milling advantages of wheat — ability forms of groats and an exit of high grades of a flour.

Glassiness of grain its characterizes of endosperm a consistence. The glassiness indicates on proteinaceous or amylaceous character of grain. The index of a glassiness along with color is the basis for division of wheat on subtypes. According to the standard on wheat food made in I and the IV types, the subtype, the higher it a glassiness is higher: in the 1st subtype - not less than 75%, in the 2nd - not less than 60%, in the 3rd and the 4th - not less than 40% and in the 5th - less than 40%. Wheat with a dominance of glassy grains usually differs rather high protein content, glutens and high baking qualities. Wheat consisting generally of amylaceous grains, is poor in protein, and it is better to use it for bread baking in subsorting to other more protein-rich wheat.

The common glassiness of grain ( $C_g$ ) as a percentage calculates on a formula:

$$(C_g) = C_{gg} + P_{gg}/2,$$

where:

$C_{gg}$  – amount of completely glassy grains, piece;

$P_{gg}$  – amount of partially glassy grains, piece

The common glassiness calculates to the first decimal sign with the subsequent rounding of result to an integral number.

In our experiences species of *Triticum turgidum* L. ( $A^uA^uBB$ ), *Triticum macha* Dek.et.Men. ( $A^uA^uBBDD$ ) and *Triticum compactum* Host. ( $A^uA^uBBDD$ ) applies to different subtypes of wheat according to the standard – from I to V, and cultivars Saratovskaya-29, Mironovskaya-808 and Leningradka - a type of *Triticum aestivum* L. ( $A^uA^uBBDD$ ) - applies to the I subtype, i.e. have high quality of grain.

The highest percent of the common glassiness – 97% was in *T. turgidum* L. x Mironovskaya-808 combination (self-pollination), 1 type (on splitting of morphological signs),  $F_4$ , and the lowest – at species *T. turgidum* L. – 26%. However when crossing species *T. turgidum* L. with species *T. aestivum* L. – cultivars Saratovskaya -29, Leningradka, Mironovskaya-808, percent of the common glassiness was high, it fluctuated from 43% to 96%, with a advantage towards of glassy grains.

In combinations (*T. turgidum* x Saratovskaya -29) x the free pollination,  $F_2$ , *T. turgidum* x Leningradka (self-pollination),  $F_4BC_1$ , *T. turgidum* x Mironovskaya-808 (self-pollination),  $F_4$ , (*T. turgidum* x *T. macha*) x self-pollination,  $F_6BC_1$  grain applies to I subtype, i.e. has high quality that does work with it perspective. Besides, posterities from crossing of cultivars with wild-growing forms of wheat, as a rule, are steady against mushroom diseases that in combination with high productivity and high quality of grain does them by perspective donors of new cultivars of wheat.

Poor quality of grain was in combinations of *T. turgidum* x Leningradka (self-pollination), the 3rd type (on splitting),  $F_4BC_1$  and *T. compactum* x Leningradka, the 2nd type (on splitting),  $F_4BC_2$  – grain according to the standard applies to with III or IV subtypes. However and such grain was on appearance excellent, productivity of plants high, and, thus, these posterities can be used with success for receiving fodder cultivars of wheat.

**LABORATORY METHODS FOR EVALUATION OF WHEAT  
RESISTANCE TO LEAF RUST**

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In the Northern region of Kazakhstan - the main area of Cereal crops, Leaf or Brown rust (*Puccinia recondita* Desm.) is the most common disease of spring wheat. In the period 2000-2013 moderate and epiphytic development of Leaf rust separately or together with *Septoria* sp. occurred 5 times while decreased the grain yield of 7-10 to 20-25%. Among permitted to using varieties of bread wheat (*Triticum aestivum*) almost no resistance to Leaf rust. For create a resistant varieties to rusts have to widely use sources or donors of resistance for crosses with local varieties and to evaluate and selection of hybrid populations on infection background. In the field is not always possible objective evaluation of breeding material due to adverse weather conditions for the pathogen, especially in July, when it is most vulnerable phase of plant development.

In this connection, in the period of 2012-2013 conducted research to improve laboratory methods for evaluation of wheat resistance to Leaf rust. Varieties, collected samples and wheat lines were seeded on plastic dishes (15 seeds in each) filled with soil. Determined the effect of inoculation of seedlings (in the 2-3 leaf stage and stooling stage), temperature and lighting modes (naturally and artificially) in incubation period of disease. For the experiment used commercial varieties Akmola 2, Astana, Kazakhstanskaya rannespelaya which are susceptible to Leaf rust and as inoculum used urediniospores which washed from leaves collected from the North Kazakhstan. After inoculation, the plants were kept in a moist chamber 14-16 hours. At a temperature of 25-28°C incubation period of Leaf rust was 7-8 days, and at 19-23°C - lengthened to 10-12 days. Varieties tested as a standard were infected by disease to 25-50%, which indicates a high infectious background.

Tested the possibility of laboratory evaluation of the resistance of collection samples and breeding lines of spring wheat to Leaf rust on cut leaf segments which placed in a solution of benzimidazole. Leaf segments were incubated in the laboratory under natural light or under fluorescent lights. Leaves kept green color up to 15 days. Lines noticeably different from level of susceptibility to Leaf rust and reaction to pathogen. In the tested lines appeared clear reaction to the pathogen from complete (R) or an intermediate resistance (MR) to a high susceptibility (S). On inoculated leaf segments of hybrid populations uredinii of Leaf rust developed to 62,2-72,7% and standard varieties of up to 100%. Using benzimidazole methods were selected 25 resistant samples to Leaf rust, and from 70 hybrid populations of F<sub>5</sub>, F<sub>6</sub> and F<sub>7</sub> - 22 lines from International nurseries Septon and TSRM.

**MICROSATELLITE MARKERS POLYMORPHISM IN RICE  
COLLECTION**

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Rice is one of the major strategic crops in Kazakhstan. The purpose of this work was to study genetic diversity of rice collection based on use of DNA microsatellite markers. The collection is consisted from 96 cultivars and lines where 64 of them were from Kazakhstan and other samples from Europe, Middle East, Central and South-East Asia. In total 39 microsatellite markers evenly distributed in 12 chromosomes of rice genome. As a result of investigation the genetic diversity level was studied, the genetic distances among cultivars were identified, informative DNA markers were selected for further research, and genetic passports of each commercial cultivars of Kazakhstan were developed. Based on obtained results the phylogenetic tree was constructed and major rice clusters were determined. Also, the intravarietal heterogeneity of each commercial cultivar of rice from Kazakhstan was established. The results can be used in genetic and breeding projects that aim construction of new rice cultivars in Kazakhstan.

The research was done within project “The study of the genetic diversity and search for the associations between DNA markers and agronomic traits in collection of cultivars and lines of rice from Kazakhstan” supported by the Ministry of Education and Sciences of the Republic of Kazakhstan.

**GENOTYPING OF POTATO GERMPLASM COLLECTION  
BY MEANS OF SSR- AND SCAR-ANALYSIS**

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Over 400 accessions of wild potato species, somatic hybrids, *Solanum tuberosum* dihaploids and their progenies, *Solanum tuberosum* (4x) hybrids and potato cultivars are preserved currently in the *in vitro* potato germplasm collection of the Laboratory of Biotechnology (RUE “Research and Practical center of NAS of Belarus for Potato, Fruit and Vegetable Growing”).

Microsatellite analysis has been carried out to evaluate genetic diversity and to genotype 41 accessions of 21 wild potato species, belonging to 16 series according to S.M. Bukasov (1971) and 10 series according to J.G. Hawkes (1990). 11 the most polymorphic SSR-markers were chosen from literature, locating on all 12 potato chromosomes: STI005 (III and VIII), STI009 (I), STI004 (VI), STI046 (XI), STI058 (V), STM 1106 (X), STI033 (VII), STI030 (XII), STM3023 (IV), STM1052 (IX), STM1064 (II) (Feingold et al., 2005; Ghislain et al., 2004, Milbourne et al., 1998). 117 alleles in total were visualized over the range 70 to 284 b.p., including 24 rare and 18 unique. The most polymorphic was STM1106 (19 alleles), the least - STM1052 (4 alleles). Most rare and unique alleles were revealed with STM1106 (5 alleles each). The quantity of samples, that can be distinguished with the only marker, ranged from 29 (for STI005) to 2 (STM1052). The minimal marker set to fingerprint unambiguously all samples of the group was STI005, STM1106 и STI046. The only STI005 marker was sufficient to distinguish samples, which didn't belong to the progeny from one crossing. The exception was two unrelated *S. simplicifolium* accessions.

SSR techniques proved useful in germplasm managing for assessing genetic relationships. They can be employed also for determination of hybridity of plants regenerated after protoplasts fusion procedure. The same eleven SSR markers and STM037 (XI) additionally have been used for somatic hybrid identification in products of three fusion combinations: 7D, 8D, 12D. It was shown that genome of plants regenerated was quite unstable but none of 36 plants had hybrid nature, all of them proved to be protoclones of one of parent forms.

If linkages are established between a heritable agronomic trait and some SCAR-marker, markers can be used to identify the presence of genes and trait germplasm collection can be organized. 90 samples of 23 wild species have been screened with 8 SCAR-markers to sequences that control resistance to golden potato cyst nematode (SCAR-marker TG689 (Biryukova. et al, 2008), Gro-1-4 (Paal et al, 2004)), pale potato cyst nematode (Gpa2 (van der Voort et al, 1997), SPUD1636 (Bryan et al, 2002), HC (Achenbach et al, 2007)), late blight (RB629 (Pankin et al., 2011)), PLRV (NL27 (Marczewski et al, 2001), UBC864 (Marczewski et al, 2004)).

**OBTAINING THE INITIAL LINES FOR THE BREEDING OF  
DOMESTIC RICE VARIETIES WITH COLORED PERICARP****B.I. Moshan, B.N. Ussenbekov, A.B. Rysbekova, L.K. Mamonov**

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So-termed "black rice" is different from other rice varieties in dark purple or almost black pericarp color. This rice has high nutritional value due to the fact that its pericarp contains a large amount of useful biologically active compounds (proanthocyanidins). Cellulose in its composition favorably contributes to the digestion process. It is very rich in vitamins (B, E, PP), minerals, antioxidants and proteins compared with white rice.

Antioxidants that are in the composition of black rice help to eliminate "free radicals" from the organs and Louisiana University scientists (USA) called them "elixir of youth" or "medicine for the elderly". In addition, proanthocyanidins reduce the concentration of cholesterol and triglycerides in the blood. Black rice is used for the therapy of anemia, hair loss and visual deterioration. Japanese scientists recommend consuming one to two spoons of black rice sprouts or flouring for breakfast.

The Register of crops cultivated in Kazakhstan, includes 27 rice varieties, but there are no varieties with colored pericarp among them. In addition, compared with white rice, in which starch composition dominates in the amylose, the black rice contains a large amount of amylopectine what is causing 5-6 fold increase in its market value. Such economic benefit shows the relevance of the research topic. Considering these problems, the aim of this study is to obtain the valuable baselines with a colored pericarp for breeding domestic black rice varieties by conventional breeding method.

The Institute of Plant Biology and Biotechnology held the experiments on accession hybridization of usual white and black rice varieties in a greenhouse using pneumocastration technique and the method of "Tvel" pollination. Accessions with colored pericarp of Russian variety "Mavr" and the Philippine variety "Black rice" were used as parental genotypes to improve the biochemical and technological properties. Parental genotypes were domestic usual rice varieties such as "Madina", "Marzhan", "Bakanassky", "Pak Lee" and white-grained Russian varieties adapted to the environmental conditions of rice-growing regions of Kazakhstan. There were carried out an artificial pollination in 1879 spikelets as a result of experiments on hybridization of 43 combinations. Hybrid seed formation was 30.1%, 607 hybrid seeds of F<sub>1</sub> generation were obtained.

One of the objectives of hybridization was to obtain the base glutinous forms with colored pericarp. For this purpose the reciprocal crossing of Violetta and Mavr glutinous varieties was conducted. The seed formation in combination ♀Mavr x ♂Violetta was – 27%, and in combination ♀Violetta x ♂Mavr – 16% as a result of hybridization

Obtained hybrid seeds of the conducted studies can be a valuable source material for breeding of rice with colored pericarp.

**COMPARATIVE ANALYSIS OF GENETIC DIVERSITY  
OF SOYBEAN *Glycine max* L. MERR. CULTIVARS  
FROM KAZAKHSTAN AND RUSSIA**

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Soybean is the most important leguminous food, fodder, and a commercial crop in the world. Main objective of this work was the comparative analysis of a genetic diversity of soybean cultivars from Kazakhstan and Russia. The collection of the soybean consisted from 15 cvs and 22 perspective lines of the Kazakhstan breeding program provided by Kazakh Research Institute for Agriculture and Farming and 35 Russian cvs provided by N.I. Vavilov Research Institute of Plant Industry. SSR analysis was conducted by using 29 polymorphic microsatellite (SSR) markers, localized in all 20 chromosomes of soybean genome. Indices of genetic variation by Nei and Shannon, and polymorphic information content of markers were determined. Genetic distances between Kazakhstan and Russian cultivars were established based on analysis of microsatellite markers. UPGMA dendograms for studied accessions was generated by using genetic distance indices. Genetic passports were developed for each soybean commercial cultivar of Kazakhstan by using SSR markers. The results will be used in local genetic and breeding projects of soybean.

This work was done within the project under the framework of EurAsEC Program MG.0591 "Innovative biotechnologies" for 2012-2014.

**ANALYSIS OF THE BLOCK COMPONENTS OF AVENIN OF OAT  
AND OATS BYZANTINE IN THE FOREST-STEPPE TRANS-URALS**

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Hexaploid species of oats have one karyotype and are characterized by having the same genome ACD.

Formation of hexaploid oat species occurred in the western Mediterranean, where was spread cultural species *Avena byzantina*. Moving eastward, it take up more space in the Central Asiatic Center where there were small berried form of wild species, which formed a large variety of wild and weedy forms of transition to the cultural forms of oats - *Avena sativa* (Loskutov, 2007).

Electrophoresis of grain storage protein - prolamin has been successfully used to analyze the genetic diversity of oats and identification biotypes composition of modern varieties. Electrophoretic spectrum of prolamin of oats - avenin highly polymorphic, that allows to use it to identify the species, intraspecific and varietal differentiation. In the study of the nature of inheritance and genetic control components electrophoretic spectrum of avenin by hybridological analysis, it was found that the selected components are inherited groups (units) and are controlled by three independent loci: *Avn A*, *Avn B*, *Avn C*. Supposedly avenincoding loci are located in three homeologous chromosomes cultural hexaploid genome (Portyanko, Pomortsev, 1987).

The aim of our studies was to investigate the genetic diversity varieties of oat (*Avena sativa* L.) and oats Byzantine (*Avena byzantina* C. Koch.) to component composition avenin by polyacrylamide gel electrophoresis and description electrophoregrams obtained in accordance with a catalog of genetic nomenclature.

For one-dimensional electrophoresis storage protein oats used a standard procedure (Bushuk, Zillman, 1978) with some modifications. As a standard used grains of oat variety Astor.

Comparative analysis of the electrophoregrams showed that all varieties were different from each other and from the standard variety and had individual spectrum of avenin. In 65.9% of the studied varieties of oat for the locus *Avn A* defined allele 2. Allele 1 was identified in four varieties, and allele 3 in one.

For the locus *Avn B* was the most common allele 1, which is found in 29 varieties. Allele 4 met in the spectrum at 43.9% oat varieties, allele 2 was detected in only six varieties.

Among the alleles of locus *Avn C* most often met in the spectrum of varieties allele 6. Allele 1 is defined in 14.6% of the studied varieties. Allele 2 was identified in varieties Monida, RA 8098-9033, R0 ABDH, Krasnoobskiy, SIG, Sprint 3, Tayojnik, Uran and Elbrus. Allele 3 is defined in the varieties RA 8098-9033, Avalanche, Riby A, Slawko, Sprint 2, Sprint 3, Universal 1, Dedal, Lgovskiy 9 and Fobos. Allele 5 is defined in the varieties Negrita, R0 ABDH, Argument, Kreol and Sprint 2.

Studied varieties of oats Byzantine had the same alleles as the oat varieties, but their frequency of occurrence differed appreciably. For the locus *Avn A* was identified only allele 2, which met in all varieties. For the locus *Avn B* of oats Byzantine definite same allele as that of the oat, but prevailed allele 2 (62.5% of the studied varieties) and allele 1 was identified only in the variety 69G04. The most widespread allele at locus *Avn C* was allele 3, which met in 75% of the samples. Allele 6 was detected in 60% of the varieties of oats Byzantine and allele 2 - at 12.5%.

Possibly derived differences in the electrophoretic spectrum avenin due to geographical isolation of occurrences in culture species *A.sativa* and *A.byzantina*.

**ANALYSES OF GENES AND ALLELES INFLUENCING GROWTH AND DEVELOPMENT, AND THE YIELD COMPONENTS OF WHEAT, WITH THE AIM TO DEFINE FAVOURABLE GENOTYPES IN CHANGING CLIMATE**

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Mapping populations have been produced with the aim to search for advantageous combinations of the genes and alleles of wheat influencing considerably the yield, mainly by controlling growth habit and flowering time, or resistances to the biotic and abiotic stress.

Two mapping populations based on substitutions of the 3B chromosome of Czech alternative landrace, Ceska Presivka carrying the flowering time gene/s *QFt.cri-3B* have been subjected to detailed analyses of the 3B chromosome region of interest where the gene had been genetically mapped. This region is spanning a large genetic distance between the markers Xgwm285 and Xcfa 2170, and we attempt to get closer to the gene locus using a detailed phenotyping combined with a continuous enlarging and genotyping the mapping populations. Updated genetic map of chromosome 3B was obtained with application of summarized FT results.

Based on crosses between three characteristic genotypes of wheat, representing wheat grown usually under the climate of the Czech republic, further three mapping populations have been produced to bring detailed characteristics of genes and alleles, and discover their combinations favourable in the country. These are being studied to evaluate the existing allelic variation, so as to discover the most favourable combinations of genes and alleles, for optimal growth and yield in the country.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n°289842 (ADAPTAWHEAT), from the Czech Science Foundation (P501/10/1778), and from the Ministry of Agriculture of the Czech Republic (project n°MZE002700604).

**DNA POLYMORPHISM IN APRICOT VARIETIES****P.S. Prudnikov, A.A. Popkova, E.N. Gigadlo***SSI All-Russia Research Institute of Fruit Crop Breeding, Orel, Russia**E-mail: prudnicov@inbox.ru; kostochkaabrikosa@mail.ru*

At present the solution of the contemporary genetic and breeding problems is connected with the development and use of the efficient methods of the genetic polymorphism analysis. RAPD-marker use is one of such methods for the identification of stone fruit varieties and hybrids. As V.A. Vysotsky, O.V. Arklis and I.A. Tzvetkova point out in their paper (2007), nowadays, the plant identification is built with the use of a number of genetic methods.

Molecular markers, the number of which is permanently being increased on the ground of the DNA-technology development, are widely used for study of the plant genetic diversity (Anisimov, 2005).

In the course of the experimental work under the comparison of two records of the extraction of nuclei acids on the base of CTAB method when extracting nuclei acids from the apricots according to the Thomas T.A. and 'Tanksley S.D. record (1990) it was determined that this method favoured obtaining "cleaner" DNA. The additional DNA purification was performed by lithium chloride (Forte et al., 2002).

Primers PawS5, PawS6, PawS11, PawS16 as well as their combinations PawS5+PawS6, PawS5+PawS11, PawS6+PawS11, PawS6+PawS16 and PawS11+PawS16 were used for the DNA amplification. As a result it was shown that the PawS5+PawS11 primer combination turned out to be the most efficient in the determination of the apricot DNA polymorphism. The polymorphism was weakly expressed or not determined with the use of the rest primers and their combinations.

The amplification rate for PawS5+PawS11 was as the following: 5 minutes under 94°C – the initial denaturation; 35 next cycles: 30 seconds DNA denaturation - 94°C; 30 seconds primer annealing - 54°C; 1 minute - synthesis of the complementary bond under 72°C; 7 minutes under 72°C – the last synthesis cycle.

The "PCR core" commercial set ("Biocom company") was used as a PCR mixture. It contained Taq DNA polymerase inhibited for "hot start", desoxynucleosidetriphosphates and magnesium chloride with finite concentrations, 1 $\mu$  200 mkM and 2,5 mM, respectively, as well as the optimized buffer system for performing one standard PCR. The electrophoresis of the amplification products was performed in 1,7% agar gel in the presence of bromous ethide. The visual observation of the electrophoresis results was performed in the ultraviolet.

On the basis of PawS5+PawS11 primers four apricot varieties were analyzed: Grafinya, Kunach, Sarovsky and Orlovchanin, as well as two selections: apricot №2 from Krasnoyarsk and 6-47 Baykalova.

In apricot varieties the basic fragments are in the zone of marker working from 200 to 1250 p.n. The presence of the fragments in 200-350 p.n. zone is typical for the majority of studied genotypes. In the Grafinya and Sarovsky varieties there no such fragments. Another characteristic feature is the fragment presence in 400-500 p.n. zone, except those standards taken from the 6-47 Baikalova selection, Kunach and Sarovsky. The similar fragments in all varieties and selections have been found in the 750 p.n. zone. In zone 1050 p.n. the fragment is present only in Sarovsky and Orlovchanin and in the 1150 p.n. zone – the 6-47 Baikalova selection and Sarovsky, Orlovchanin.

**MAIN DISEASES OF CROP WILD RELATIVES  
OF KARATAU RIDGE****Y.V. Rakhimova, G.A. Nam, B.D. Yermekova, U.K. Jetigenova**

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Receiving new highly productive and resistant cultivars of cultural plants requires studying pathogenic mycobiota their wild relatives used in selection. As material for the present publication results of revision of samples of Herbarium fund of Institute of Botany and Phytointroduction, the analysis of literary data and own collections of authors in the territory of Karatau ridge, executed according to the target program "A botanical diversity of crop wild relatives of Kazakhstan as a source of enrichment and preservation of a gene fund of an agrobiodiversity for realization of the food programme" served.

In the territory of Karatau ridge 9 most harmful diseases of crop wild relatives are noted.

For apple-trees in the territory of Karatau ridge powdery mildew (the disease agent - *Podosphaera leucotricha* (Ell. et Ev.) E.S.Salmon) is most harmful. Prevalence of powdery mildew in the gorge Itmuryn reaches 20% at intensity of infection 10-15%. On all species of plum trees so-called "pockets" caused by *Taphrina pruni* Tul. are noted. Prevalence of this disease makes 30,5% at intensity of infection from 20 to 40%. On fruits of Regel pear-trees the scab is observed (the disease agent - *Venturia pyrina* Aderh.) with prevalence of scab 20,5% and intensity of infection from 0 to 20%. The majority of examples of dewberry is infected by a rust (the disease agent - *Phragmidium bulbosum* (Fr.) Schltdl.). Prevalence of dewberry dewberry rust disease varyes from 35,5 to 60% with intensity of infection 25-45%. On representatives of the *Rosa* genus the rust infection which disease agents are three species of the *Phragmidium* genus (*Ph. devastatrix* Sorokin, *Ph. rosae-acicularis* Liro, *Ph. tuberculatum* Jul. Müll.) is everywhere observed. Among them *Ph. devastatrix* infection is easy to distinguish on being formed to dense panicle of short shoot, prevalence of this disease is 10-35,5% with intensity 1-5%. Other two agents of rose rust disease show similar symptoms, prevalence of disease is 35,5-40% with intensity of infection 10-15%. In the gorge Uzyn-Karakuyz single infection of a honeysuckle by black spottiness (the disease agent - *Rhytisma lonicerae* P. Henn.) is noted, in Keeshe-Karakuyz gorge (the natural boundary Tesiktas) the spottiness of honeysuckle leaves caused by two species of a rare genus of fungi is found: *Kabatia periclymeni* (Desm.) M. Morelet var. *periclymeni* и *K. persica* (Petr.) B. Sutton.

On numerous species of cereals powdery mildew (the disease agent - *Blumeria graminis* (DC.) Speer). is found. In Itmuryn and Koktal river gorges, in population of goat-grass, located in a dense shadow, prevalence of powdery mildew reaches 100% with intensity of infection from 60 to 100%. Prevalence of barley powdery mildew and meadow grass powdery mildew is 62,4% and 10-25% with intensity of infection 20-40% and 10-80%, respectively.

Infection of the flowers of Bermuda grass (creeping dog's-tooth grass) by smut fungus (the disease agent - *Ustilago cynodontis* (Pass.) Henn.) is noted in the natural boundary Kok-Bulak, Baidzhangsai gorge, the gorge of the Koshkar-ata river, of Kentau, prevalence of smut reaches 43,7% with intensity of infection 30-80%. Spott disease of meadow grass leaves (the disease agent - *Ascochyta graminicola* Sacc.) in Itmuryn and Keeshe-Karakuyz gorges is observed. Prevalence of this disease is no more than 10% with intensity of infection 10-50%. In the Itmuryn gorge white clover rust is found (the disease agent - *Uromyces trifolii-repentis* Liro), prevalence of white clover rust disease is 3,5% with intensity of infection from 5 to 50%.

**THE ECOLOGICAL TESTING OF BARLEY FROM MONTANA (USA)  
IN CONDITIONS OF ALMATY REGION****B.S. Sariev**

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N.I. Vavilov in the 30s of the twentieth century developed and implemented an environmental test of crops samples. The basic principle of environmental crops samples test in different soil and climatic conditions - the study of the same samples set of a particular culture using the same methodology and the selection of high-forms, adapted to specific soil-climatic zone.

Creation of new varieties for specific Kazakhstan regions due to the fact that they differ sharply on the soil and climatic conditions. Given the soil and climatic conditions characteristics of the Kazakhstan regions development of new barley varieties is an urgent problem.

The soils inpatient department of grain forage LLP "KazRIAPG" in Almaty region - light brown, loamy. The humus content in the plowing layer reaches 1.9-2.0%. The climate is extremely continental.

During the vegetative period (April to July), the development of barley plants in 2012, the average temperature during the growing season was 17.9 C, the relative air humidity 55%, rainfall for the whole growing season plant barley 263.0 mm, and in 2013 18,9° C, 54% moisture content, 369.4 mm, respectively.

According to the above data on the amount of rainfall and the temperature regime, and relative humidity during the growing season of barley there are sharp differences that significantly influenced the quantitative and qualitative features of the plant and in general on the yield of the studied numbers.

As a result of field and laboratory research, despite the sharp differences weather condition data, of the 96 lines barley consistently high tillering and high grain yield showed the following numbers: 2083, 2091, 2200, 2213, and 2217 that have a large practical value for use in breeding work.

**SCREENING OF SALT RESISTANT SAMPLES SOFT SPRING WHEAT**

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In Republic Kazakhstan in regions Priaralja, Prikaspja and Pribalchashja it is observed intensive salinization, that leads to increase in the area of saline deserts in internal-drainage pools and secondary salinization the irrigated earths. In this connection before country agriculture there is problem of increase of productivity of grain crops and introduction in cultural agriculture of salt resistant forms, including main food culture – wheat with use of achievements of modern biological science (Cramer, etc., 2002; Sharma, etc., 2013; Shahzad, etc., 2013).

Screening of perspective salt resistant samples of soft spring wheat spent at the samples who are at the final stages of breeding process. As material for research selected on productivity 77 perspective samples of soft spring wheat have served in breeding nurseries: CP, PCT, CCT. Though all growth stages of development of plants are sensitive to salinization, at the majority of kinds of plants the stage of sprouts (Udovenko, 1977; Munns, etc., 2002; Aripov etc., 2006; Terletskja, 2012).

In the work we used workings out VIR by an estimation of salt resistant samples – a method of estimation of energy of germination and percent definition of germination seeds at salt stress on solutions of salts NaCl and Na<sub>2</sub>SO<sub>4</sub>, defined a gain of a biomass of sprouts in the conditions of salt stress and have spent an estimation of germination perspective samples in field conditions on sites with the raised maintenance of salt in the conditions of Kysylorda.

In the conditions of salt stress took place both interhigh-quality and intrahigh-quality distinctions the Greatest suppression of growth processes is noted on chlorid type of salinization. Dependence of energy of germination and quantity of the sprouted grains on concentration of salts that testifies to degree salt resistant perspective samples is noticed.

In laboratory experiences and in the conditions of the raised maintenance of salt on field sites in Kysylorda of germination (80-100%) samples 363/975 (Mironovskaja-808 x Lutescens-719/99), 371/959 (Aktubinka x Saratov-42), 1841 (Steklovidnaja-24 x Saratov-29), 1844 (Mironovsky ubiliynaja x Zhenis), 1254/2341 (Лютесценс-782/153 x Omsk-18), 1880 (Mironovskaja-808 x Kazakhstan-10), 1851 (Mironovskaja-808 x Kazakhstan-10) have shown high percent. Samples from nursery competitive trials (227 (Целинная-60 x Zhenis), 222 (Целинная-3С x Zhenis), 289 (Целинная-3С x Lutescens -719/99) on a gain of a biomass of sprouts in the conditions of salt stress have exceeded standard grades Celinnaja-3C and Kazakhstan-10. The allocated samples it is possible to consider as potentially salt resistant.

As a result of the spent researches it is experimentally shown, that selection perspective salt resistant samples with use of laboratory methods, and then their field test in stressful conditions and an ecological estimation of the allocated samples allow to reach for short time of positive results and to create salt resistant wheat cultivars.

This work was financially supported by the Ministry of Education and Science Republic of Kazakhstan, research project grant funding № 0085.

**NONSPECIFIC RESISTANCE OF WINTER WHEAT CULTIVARS  
TO YELLOW AND STEM RUST PATHOGENS OF WHEAT**

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The cost-effective and environmentally friendly method for control of plant diseases is the selection and use of the cultivars that are protected by non-specific resistance which retain this character for a long time and have a positive effect on the stabilization of phytopathogen populations (Anpilogova et al, 2002).

The aim of our studies was to determine the resistance types of winter wheat promising cultivars to the yellow and stem rust pathogens under conditions of environmental chambers.

Resistance types of wheat cultivars to yellow and stem rust pathogens in conditions of environmental chambers were determined by the following criteria: duration of the latent period (day and night), share of manifested pustules per unit of leaf area (%) and the type of reaction (point) (Makarov et al, 1998).

On the basis of qualitative and quantitative field characteristics of cultivars, as well as literature data (Volkova, 2005; Volkova, Anpilogova, 2006; Volkova et al, 2008; 2009; 2012) 12 winter wheat cultivars (Zimnitsa, Irishka, Krasnodarskaya 99, Kremona, Lastochka, Pervitsa, Pobeda 50, Rostislav, Selyanka, Soratnitsa, Starshina and YUMPA) have been selected for further study of yellow rust in conditions of climatic chambers, and 9 winter wheat cultivars - for stem rust studies (Aksinit, Asket, Verta, Brule, Zolotko, Collega, Krasota, Pervitsa, Yunona). It has been found that the cultivars Zimnitsa, Irishka and Pervitsa are protected by the specific resistance type to yellow rust; the wheat cultivars Verta, Zolotko, Collega, Pervitsa and Brule – by the same resistance type to stem rust. These cultivars will not be affected by the pathogens as long as new phenotypes capable of affecting the cultivars occur in the population (an average of 3 – 5 years).

The cultivars Krasnodarskaya 99, Kremona, Lastochka, Pobeda 50, Rostislav, Selyanka, Soratnitsa, Starshina and YUMPA have non-specific resistance to yellow rust. The cultivars Asket, Aksinit, Krasota and Yunona have non-specific resistance to stem rust. These cultivars will reduce the epiphytoty risk of the studied pathogens and are recommended for use in agricultural production and in the breeding as sources of non-specific resistance.

**THE SELECTION OF RESISTANT VARIETIES OF COTTON  
TO BLACK ROOT ROT****Umbetaev I., Huseynov I.***Kazakh Scientific Research Institute of Cotton, Kazakhstan*  
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One of the solutions to the problem of sustainable forms of cotton is to increase the adaptive capacity of cotton, ie creating sustainable or slabovospriimchivyh varieties, which depends largely on the study of the interaction of genotype and environment, identify genetic and morphological and physiological mechanisms to ensure sustainability of the adaptive capacity to stressful environmental factor, donor search, or at least highly resistant cotton varieties slabovospriimchivyh existing range of cultivars, lines, patterns, hybrid populations and their inclusion in the selection process.

Resistance to black root rot varieties and hybrids of cotton determined by their degree of affection in the spring growing season. Involved in the experiment set varieties significantly differed in resistance to black root rot. Weak susceptibility of individual hybrid combinations: M-4007 x Myrzashel-80, Atakent-2010 x M-4007, though greater than parental figures, but the difference was within the NDS.

Out of the 15 direct hybrid combinations in 10 cases dominated high susceptibility of black root rot, in one case dominated the better parent and two hybrids showed negative heterozygosity that in our experience is positive for the stability of the donor.

The best varieties for ACS were M- 4007, Myrzashel-80, Atakent -2010, ie these sorts of absolute figures correspond effects of ACS. Ratio analysis of variance to the variance of ACS suggests that sustainability forms Atakent-2010 and M- 4007 is controlled by additive genes . The remaining varieties susceptibility to the disease is controlled by non-additive genes. Polygenic analysis conducted by model Hayman suggests that inheritance of resistance to black root rot is characterized by the phenomenon of incomplete dominance. The regression line axis of covariance above the origin, the ratio ND = < 1. In genotype varieties M -4005 and Bereke-07 located in the bottom of the chart Hayman , high susceptibility to the disease is controlled mainly by dominant alleles. In genotypes varieties Myrzashel-80, M-4007, prevail Atakent-2010 recessive alleles.

Thus, from the experimental data that the stability to black root rot is a recessive trait in F<sub>1</sub>, dominated susceptibility to black root rot.

In hybrid combinations involving varieties having stable resistance to black root rot, marked more frequent likelihood of subsequent selection of plants and families with elevated economically valuable traits and inherited in F<sub>2</sub> within 0.38-0.42 , and F<sub>3</sub> - 0 ,38 -0, 43. From which it is clear that there is indeed a possibility of identifying plants and families weakly susceptible to black root rot.

As a result, studies have provided more than 20 families and weak lines marvelling black root rot, both in spring and autumn. All these families and accessions can be used as a starting material for breeding varieties resistant to black root rot.

## MOLECULAR CHARACTERISATION OF APPLE MOSAIC VIRUS ISOLATES

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*Apple mosaic virus* (ApMV), a member of the genus *Ilarvirus*, is one of the major pathogens infecting apple trees. ApMV occurs worldwide and infects a number of woody plants of over 65 species in 19 families including *Fragaria* (strawberry), *Humulus lupulus* (hop), *Betula* (birch), *Corylus avellana* (hazelnut), *Malus sylvestris* (crab-apple tree), *Malus pumila* (apple), *Prunus armeniaca* (apricot), *Prunus avium* (sweet cherry), *Prunus amygdalus* (almond), *Ribes rubrum* (red currant), *Rubus idaeus* (raspberry) and *Rubus occidentalis* (black raspberry). ApMV can be transmitted by mechanical inoculation and by grafting but not through seeds.

An apple tree infected with the ApMV display symptoms of pale to bright cream spots on the leaves. The infected leaves may be depicted throughout the whole tree or only on a single tree limb. Most commercial cultivars are affected, but vary in severity of symptoms.

The ApMV genome consists of three molecules of single-stranded (ss) RNA. RNA 1 is 3,476 nucleotides long and RNA 2 is about 2,979 nucleotides long, both encode a single large open reading frame. RNA 3 complete sequence is about 2,056 nucleotides long and contains two genes encoding the movement protein (MP) and the coat protein (CP). The CP is expressed from a subgenomic RNA 4.

Many of the viruses infecting apple have not been characterized in detail and the knowledge on their genetic variability is over-all very limited. Additional sequence information for ApMV, including isolates from different countries, would help to improve the understanding of its genetic variability. The knowledge about virus diversity and the identification of conserved and variable regions inside the viral genome are important for virus detection, the prediction of appearance of resistance-breaking virus strains and the development of virus management strategies.

The aim of this study was characterization of the genetic variability of ApMV isolates obtained from different apple cultivars in Poland and Belarus. MP and CP genes of ApMV isolates were amplified, cloned and send for sequencing. On the base of RFLP analysis of MP and CP genes it was possible to distinguish studied virus isolates.

Phylogenetic analysis of CP gene sequences of ApMV isolates showed that there was no strong correlation between relationships of ApMV isolates and their geographical origin.

**FEATURES OF FORMATION SOURCE MATERIAL FOR  
CREATING DOMESTIC CULTIVARS OF SAFFLOWER**

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The initial material of a safflower was seeded in two regions of Kazakhstan – Almaty and Southern Kazakhstan areas. Sites were divided into two parts with watering and without watering in each region. As an initial material 9 cultivars were tested. It is defined that safflower cultivars accurately share as cultivation on intensive at which quantitative indices increase, and quality indicators improve at irrigation cultivation and extensive cultivars at which quantitative and quality indicators worsen when watering during vegetation of plants. Saffere and K-129 cultivars at which when watering increased not only growth of plants, but also mass of seeds from a plant, and also the mass of 1000 seeds belong to varieties of intensive type of cultivation. At the same time, practically at all other studied cultivars, intensive watering worsened quantitative indices. So at the K-129 line and a cultivar Akgul the mass of 1000 seeds is higher without watering, than by watering. In seeds of examinees of cultivars the content of four main fatty acids was considered: the unsaturated – linoleic and olein, and also saturated – stearin and palmitic. As one would expect the main fatty acid as a part of oil of seeds of studied cultivars is linoleic acid. Most rich oleic acid cultivars are Saffere (13.14%) and Center 70 (13.70%). Thus the content of oleic acid at a cultivar of Saffere and the K-129 line raises at cultivation in the conditions of watering. At the same time, the expected tendency when at increase in percentage of linoleic acid in conditions rainfed, the content of oleic acid decreased, regardless of the cultivation region was observed. Besides, the content of saturated acids, as a rule, goes down at cultivation of plants in the rainfed conditions, except for a cultivar Akmai at cultivation in the conditions of the Southern Kazakhstan area. The analysis of the data also showed high heterogeneity intra cultivar varieties in almost all of the studied parameters.

Hybridization of a safflower was carried out in field conditions. During preparation for hybridization chose parents who were self-pollination a current of 1-2 generations. In the first day of hybridization castration was carried out. Previously cleaned the outer shell of the corolla of each flower. Unripe boots in the center of a basket were removed by means of tweezers. Then baskets closed an insulator from polyethylene and paper, for comparison of influence of humidity on fertilization. On each bud was exposed to castration from 5 to 10 flowers. If the next day filaments significantly lengthened, this indicated that the stigma is receptive to pollination. In that case, a flower, on the second day, pollinated with paternal parent pollen. In total it was succeeded to receive seeds of 12 hybrid combinations. The fertilization percent in flowers closed by an insulator from paper was quite low and didn't exceed 10%. At the same time, flowers closed by an insulator from polyethylene, showed 80% of fertilization. Results of hybridization showed that humidity of air after castration is an important factor for a forming of hybrid seeds of a safflower.

**VARIABILITY OF HORDOINDOLINE GENES IN COLLECTION  
OF SPRING BARLEY FROM KAZAKHSTAN**

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Grain hardness is an important qualitative trait of cereals. In barley (*Hordeum vulgare* L.) this characteristic is related to the variations of the tryptophan-rich polypeptides, called hordoindolines (HIN). These proteins are synthesised by the hordoindoline (*Hin*) genes, orthologs of the puroindoline (*Pin*) genes of wheat, situated on the short arm of chromosome 7 (5H) of barley, which are known to play a key role in grain texture. The three specific genes have been named *Hina*, *Hinb1* and *Hinb2*. Variation of alleles in these genes affects expression of this trait.

In this study the variation of *Hin* genes has been characterized in barley collection of Kazakhstan. The sample set comprised ninety six genotypes including commercial varieties and breeding lines of spring barley developed by 5 breeding organizations of Kazakhstan. Direct sequencing of samples was carried out using Genetic Analyser 3130 (Applied Biosystems, USA). Genetic distances between cultivars by analyzing genes were calculated using Neighbor-Joining method (Saitou and Nei, 1987). Phylogenetic tree was produced using Neighbor-Joining method and MEGA, version 5 (Tamura K. et al., 2011).

The obtained results shows polymorphism of nucleotide sequences in all three *Hin* genes, involved in study. Comparative analysis of amino acid sequences of *Hin* genes in barley collection of Kazakhstan allowed revealing 10 isoforms. For *Hina* gene it was identified 4 alleles (*Hina-1*; *Hina-2*; *Hina-3*; *Hina-4*), for *Hinb1* – 3 alleles (*Hinb1-1*; *Hinb1-2*; *Hinb1-3*), and for *Hinb2* – 6 alleles, respectively. For *Hinb* genes we have identified 4 potentially unique alleles – 1 allele for *Hinb1* and 3 allele for *Hinb2*, respectively. On a combination of alleles of three genes, 58% of genotypes had similar haplotype - *Hina-1* / *Hinb1-1* / *Hinb2-1*.

This was first study on variability of hordoindoline genes *Hina*, *Hinb1* and *Hinb2* in collection of barley in Kazakhstan. The data allowed identifying potentially new alleles and haplotypes in studied cultivars and lines. The resulting information can be used in genetic and breeding studies for improvement of grain quality of barley cultivars.

The research was done within the grant # 0049/GF (2012-2014) supported by the Ministry of Education and Sciences of the Republic of Kazakhstan.

**IDENTIFICATION OF YR GENE RESISTANT TO YELLOW RUST  
(*Puccinia striiformis* West. f.sp. *tritici*) IN WINTER WHEAT LINES**

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Wheat is a main crop in South and South-East Kazakhstan regions where it covers about 800-850 thousands hectares of cultivated area. (Urazaliev R.A. 1999, 2008). During epyphitoties years yellow rust disease (*Puccinia striiformis* West. f.sp. *tritici*) can cause yeild losses up to 50-60% and so it leads to expenses in the national economy. The most effective way to control the yellow rust disease is creation of new cultivars that are resistant to the pathogen and to introduce them into production (Kokhmetova A., Rsaliev Sh., 2009). More than 80 genes that have official or temporary features of yellow rust resistance have been registered in the gene catalogue (McIntosh et al., 2012).

The objective of the study is to identify accessions of resistant to yellow rust and effective *Yr10* gene, localized in 1BS chromosome of wheat. Different wheat material was investigated by using SSR molecular marker. For identification of resistant to yellow rust *Yr10* gene was studied on 19 Kazakhstan cultivars, 17 Russia cultivars, 30 Uzbekistan wheat lines, 47 wheat lines of ICARDA International center. PCR was done with wheat DNA, which isolated by CTAB method. French cultivar is Moro and isogene line, which has *Yr10* from cultivar Avocet was taken as a positive control. The negative control was *ddH<sub>2</sub>O*. In order to reveal the mentioned gene the microsatellite SSR<sub>psp3000</sub> primer associated with effective *Yr10* gene was used. (<http://www.shigen.nig.ac.jp>). PCR products were separated on 1,5% agarose gel and colored by ethidium bromide. According to PCR protocol the PCR products with dominant *Yr10* gene were amplified at 260 b.p. and recessive *yr10* gene at 240 b.p. (Bariana, 2002). 2 Kazakh cultivars (Naz, Mereke), 11 lines of foreign samples, 2 Uzbek lines (U11AGEC-7, U11AGEC-23) and 2 Russian cultivars (Curant, Gorelform) were amplified at 260 b.p.

In 2005, A. Kokhmetova noted that according to genetic analysis of cultivar Naz it may have *Yr10* gene. In the result of molecular analysis it was proved that *Yr10* gene is present in the genotype of the cultivar Naz. Out of 178 lines of RILs Almaly/ *Yr10* combinations of recombinant inbreed lines the inducing of *Yr10* gene was revealed in genotypes of 86 lines. The results are being used in MAS in wheat breeding programs targeting yellow rust resistance.

This work was financially supported by the Ministry of Education and Science of the Republic of Kazakhstan in the framework of the program EuraZES MMP "Innovative Biotechnology" in 2012-2014.

**IDENTIFICATION OF RESISTANT LINES OF WILD BARLEY  
*Hordeum vulgare ssp. spontaneum* Koch. TO STEM RUST CAUSED  
BY *Puccinia graminis***

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Wild barley plants of *Hordeum vulgare ssp. spontaneum* Koch were collected in South-Kazakhstan region in 2009-2012. In total 250 plants were collected in 14 different places of Southern Kazakhstan. Out of those 250 plants, 96 plants representing all 14 populations were selected for field studies at the Kazakh Research Agricultural Institute (Almaty region) and greenhouse studies at the Institute for Biological Safety Problems (Otar city, Zhambul region). As a result all 96 lines were studied for grain yield and yield components and for resistance to stem rust (caused by *Puccinia graminis* f. sp. *tritici*), which is one of the most harmful diseases in Kazakhstan. The resistance to stem rust was studied in controlled greenhouse conditions based on analysis of plants in juvenile stage of growth. Local population of *Puccinia graminis* and highly virulent pathotype RRR/KH were used for the inoculations. As a result of field studies for grain yield and yield components and resistance to stem rust we identified 12 lines of wild barley that combine high productivity and resistance to *Puccinia graminis*. Those selected lines will be used for breeding projects towards resistance to stem rust. Also, as all those 96 lines were genotyped by 384 SNP markers (Illumina technology), they will be used for identification of potentially new genes conferring resistance to *Puccinia graminis*.

This work was partially supported by the grant # 0518 of the Ministry of Education and Science of Republic of Kazakhstan.

## **Session 3.**

# **Plant Physiology and Biochemistry**



**THE APURINIC/APYRIMIDINIC ENDONUCLEASE HOMOLOG  
OF *TRITICUM AESTIVUM*: ITS ROLE IN DNA REPAIR  
AND DNA FRAGMENTATION DURING ALEURONE  
PROGRAMMED CELL DEATH**

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Reactive oxygen intermediates are highly reactive and cause damage to nucleic acids, proteins, and lipids. Generation of abasic sites in DNA is a direct consequence of the radical attack, and such sites are formed during repair of oxidized DNA bases. Abasic sites are mutagenic at the level of DNA replication and repair, and they are a source of transcription errors. The survival of an organism depends on the timely repair of abasic sites by characteristic endonucleases. Here, we for the first time describe isolation of a *Triticum aestivum* cDNA homologous to human APE1, *E. coli* exonuclease III and yeast APN1 and detailed characterization of the purified protein's DNA substrate specificity and kinetic parameters, in addition possible role of this enzyme in the process of chromatin fragmentation during wheat aleurone programmed cell death.

**PECULIARITIES OF ISOPRENOID BIOSYNTHESIS IN PLANT  
CELL CULTURES**

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Plant cell culture is traditionally viewed as a unique artificially created biological system represented a heterogenous population of dedifferentiated cells. This system undergoes a continuous process of autoselection based on the intensity and stability of cell proliferation.

The specifics of formation and regulation of isoprenoid biosynthesis in plant cells *in vitro* based on literature survey and our research results has been discussed. Secondary metabolism in plant cell culture is likely to be differing from that in the intact plants. All the metabolites are to be formed and compartmentalized within a single heterotrophic proliferated cell with sparse or undeveloped vacuoles and plastids. For instance, MVA pathway for isoprenoid biosynthesis was found to be more active in plant cell cultures than plastid-localized MEP rout. It was hypothesized that cell cultures would preferably produce metabolites that promote cell proliferation and growth.

Indeed, cell cultures of *Dioscorea deltoidea* were demonstrated to accumulate only furostanol glycosides, which promoted cell division. Furostanol glycoside content of *Dioscorea* strain DM-0.5 was up to 6 - 12% by dry biomass. Plant cells *in vitro* synthesize both glycosides which are located in leaves (protodioscine) and rhizome (deltoside) of the intact plants. It should be note, that cultivated cells additionally contain 26-S isomers which are not found in the intact plants.

*Panax ginseng* and *Panax japonicus* plant cell cultures synthesize as minimum seven triterpene glycosides (ginsenosides), the productivity of these compounds was up to 6.0 – 8.0% on dry biomass. The ginsenosides in the plant cell cultures were represented mostly by Rg-group. Ginsenosides of Rb-group were mainly detected in the forms of malonyl-esters caused probably by their specific intracellular localization.

By contrast, the detectable synthesis of diterpene steviol-glycosides in cultivated cells of *Stevia rebaudiana* initiated in the mixotrophic cultures during chloroplast formation only.

Despite these differences, or mainly due to them, plant cell cultures have become an attractive source of phytochemicals in alternative to collecting wild plants. It provides a guideline to bioreactor-based production of isoprenoids using undifferentiated plant cell cultures.

## **ENZYMES, PROTEINS AND GENES IN HEAVY METAL DETOXIFICATION**

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Heavy metal pollution and contamination is wide spread in Asian and some eastern European countries and is dramatically increasing in India. Soil, water and air are the vital natural and non-regenerable resources. Potentially toxic metals are available to plants through: mining activities - smelting, river dredging, mine spoils and tailings, metal industries etc.; industries - plastics, textiles, microelectronics, wood preservatives, refineries etc.); atmospheric deposition - urban refuse disposal, pyrometallurgical industries, automobile exhausts, fossil fuel combustion etc.; excessive use of agrochemicals - fertilizers and pesticides and waste disposal - sewage sludge.

Heavy metal contamination and pollution is increasing due to technogenic and geogenic sources. The flux is increasing in the environment deteriorating the quality of environment. In order to be healthy physically and mentally, clean soil water and air is prerequisite. Use of plants well beyond food, is the beginning of environmental biogeotechnology (biodiesel, environmental cleanup and edible vaccines etc). In developed nations heavy metal contamination or pollution is often highly localized and the pressure to use contaminated land and water for agricultural food production or for human consumption is minimal. However, In order to contain heavy metal pollution in soil, phytoremediation approach (green technology) is being followed in developed nations. Self-cleaning of soils does not takes place or rather extremely slow. The toxic metals in top soil, thus get accumulated in plants. Plants can remediate metal pollutants in many ways such as phytofiltration, rhizofiltration, phytostabilization, phytovolatilization etc.

Green technologies involve a range of plant operated processes that lead to the amelioration, removal, containment and/or render toxic heavy metals harmless. This is evolving very rapidly and operates on the principles of biogeochemical cycling. Wide variety of plants viz, ornamentals, tree crops, environmental and industrial crops are being tested for this application. This presentation would focus on the following: a) Metal biomolecule complexes, b) Adaptive ecophysiological, biochemical and molecular basis, c) Selected examples of plants modified by genetic engineering for possible application in phytotechnologies and their significance, d) metallothionein genes and their use and e) biodiversity prospecting are presented.

Metal biomolecule complexes, some of the reported metallothionein genes in plants, prospects of plant molecular breeding and genetic engineering of plants for phytoremediation of toxic metals, evidence of trace metal transporters in higher plants similar to those found in bacteria and yeasts are summarized in this lecture highlighting the involvement enzymes, proteins and genes in green technologies.

*Keywords:* Metal biomolecule complexes, Heavy Metals, Phytoremediation

**GENOTYPES EVALUATION AND SELECTION SYSTEM ON WHEAT  
GRAIN QUALITY: GENETIC, BIOCHEMICAL AND  
TECHNOLOGICAL LEVEL**

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The state the value system of grain quality in breeding, including biological (genetic potential and phenotypic realization on protein systems data) and technological level (grain is suitable for industry as a raw material).

The selection efficacy of high-quality form and their control in breeding process are complicated with evaluation complex on grain quality and necessity of the grate breeding material range.

Reasonable prospects of grain quality assessment development on two parallel progressing directions, mutually not exclusive: the creation and implementation of express analytical systems to greatly increase the rapidity of traditional labor-intensive, massive and long-term methods, search and adaptation of new methods of forecasting quality, including markers.

In principle the level selection grain quality data interpretation is determined by the goals and objectives of the breeding program and genetic research. In turn, they cause the list of methods and their optimal regulation of the use by stages grading breeding process. For each interpretation level characterized by its properties, methods of their determination and breeding parameters.

In the present works performed: 1) methodological developments 2) marking of genetic systems of grain quality and improving its evaluation providing the differentiation of breeding programs for the end-use (wheat – bakery, confectionery, pasta, barley – malting cereals, fodder, corn, sorghum – food, forage, technical, etc.) taking into account non-food and feed (biotechnological) use and MASbreeding. 3) Monitoring of the grain quality formation under stressful conditions actions drought, pests and diseases, and the optimization of its use 4) monitoring the quality of agricultural products in the soil-plant-product (grain) on biochemical, technological properties and parameters of environmental safety and nutritional value; 5 ) creation of a database for high-quality samples (donors and sources ) for the formation and registration of genetic resources collections for wheat, barley, oats, triticale, maize, sorghum, soybean, safflower, rice, etc. 6) Identification and optimization of crop production zones for different process types stable in yield and quality of model-based genotype environment interactions.

Through the use of the developed system to assess and interpret the quality of grain varieties created with / crops, sorted by type of technology on the basis of biochemical and technological properties of grain and genetic classification as a guarantor of its reproduction.

**INFLUENCE OF CLIMATE CHANGE ON YIELD AND BIOCHEMICAL COMPOSITION GRAIN OF WHEAT IN TAJIKISTAN**

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In recent years the attention of many researchers is aimed at the possible impact of global climate change on ecosystems. The reason is that under the influence of global and anthropogenic factors on the environment are substantial changes in climate that may negatively affect the life of the plant. Rising temperatures cause atmospheric drought and a long period of time can increase evapotranspiration, resulting in desiccation of the root layer of soil and increase the salt content. This has negative impact on growth and development of agricultural crops. In this regard, studies on the physiology of resistance of crops to climate change and finding ways to improve sustainability become urgent task of modern crop production. Study of the content of starch, protein and cellulose showed that soil drought and ozone help reduce starch content and high protein content in the grain of both varieties, extreme temperatures contribute to the reduction of the level of starch and protein content. High temperatures, drought, and increased concentration of carbon dioxide have negative influence on the content of starch and protein content in wheat. Analysis of the cellulose content in the seeds of wheat show that the highest of its contents was observed in the seeds of wheat, grown under conditions of drought, and it was more by 25%, than in the seeds of wheat, grown under optimum water supply. In variant of drought in the seeds of the cultivar Alex cellulose content increased by approximately 30% than that of the control group of wheat grown under optimal water supply. Increase cellulose content observed in conditions that are unfavorable for plant in stressful conditions. The spectra of the studied proteins gliadin wheat varieties contain up to 21 components, which differ in intensity and electrophoretic mobility in PAGE. Among them are the components with the highest, medium and low intensity. Comparative analysis has shown that in the protein component composition Zafar varieties grown in conditions of drought, there are intensive components that are completely absent in the same varieties grown under normal climatic conditions. Comparative analysis of the samples electrophoregrams gliadins both varieties showed that, despite the presence of a very similar structure, there are variations in the number and intensity of the protein components. Component of the protein composition of varieties Zafar varies considerably, depending on the growing conditions, not only in intensity, but also on the presence or absence of individual components. It should be noted that almost all classes, the maximum temperature of a large number of protein components is absent or present in trace amounts. The paper discusses the effect of elevated CO<sub>2</sub>, O<sub>3</sub>, heat, water deficit, air and soil drought on yield and biochemical composition of wheat differing in origin. Also influence of various climatic years on researched parameters is discussed.

**DISTRIBUTION OF ROOT BIOMASS IN DIFFERENT GROWTH STAGES OF BARLEY GROWN UNDER FIELD CONDITIONS****Hayati AKMAN<sup>1</sup> and Ali TOPAL<sup>2</sup>**<sup>1</sup>Selcuk University, Sarayonu Vocational School of Higher Education, Konya/Turkey<sup>2</sup>Selcuk University, Faculty of Agriculture, Department of Field Crops, Konya/Turkey

This study was conducted to determine distribution of barley root biomass in three different growth stages, stem elongation(GS 31) anthesis completed(GS 69) and full grain maturity(GS 92) under field conditions in 2012–2013 growing season. Two barley cultivars, Larende, adapted to irrigation land and Karatay-94 adapted to dry land were used. Experimental design was “in randomized complete block design” with three replications. For this purpose, 200 cm high and 12 cm diameter cylindrical PVC tubes were used. Plants were managed using the common farming practices. In growth stages, washed and cleaned root was cut into segments in length of 30 cm. Root dry weight was recorded after drying at 80 °C for 48 hour and collected data was transformed to percentage. The research results showed that there were statistically significant differences in root distribution in length, growth stages x root length interaction and also root biomass distribution in 0–30 cm, 60–90 cm, 0–60 cm and 0–90 cm in terms of different growth stages and no significant differences between cultivars. Root length of barley reached maximum elongation and above 240 cm at the GS 31. Root biomass decreased towards 0 to 270 cm of root length. Distribution of root biomass varied for different growth stages, which was 43.6% at GS 31, 51.1% at GS 69 and 62.8% at GS 92 in 0–30 cm of root length. It was 63.5% at GS 31, 71.6% at GS 69 and 82.6% at GS 92 in 0–60 cm of root length while distribution of root biomass was 80.4% at GS 31, 84.4% at GS 69 and 92% at GS 92. In conclusion, significant rate of barley root biomass developed in upper soil layer, varying in the different growth stages.

*Keywords:* Barley, Root Biomass, Distribution, Growth Stages

*Acknowledgement:* This study was taken from Ph.D. Thesis of Hayati AKMAN, Which was supported with project No. 10101037 by BAP Coordinator of Selcuk University being its admirable contributions

**DISTRIBUTION OF ROOT BIOMASS IN DIFFERENT GROWTH STAGES OF WHEAT GROWN UNDER FIELD CONDITIONS**

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This study was conducted to determine distribution of wheat root biomass in three different growth stages at stem elongation (GS 31), anthesis completed(GS 69) and full grain maturity (GS 92) under field conditions in 2012–1013 growing season. Two bread wheat (Konya 2002, Gerek 79) and two durum wheat (Çeşit 1252, Kunduru 1149) cultivars were used. Experimental design was “in randomized completed block design” with three replications. Each cultivar was sown in 200 cm high and 12 cm diameter cylindrical PVC tube. Routine agricultural practices were applied to plants. Plant roots were washed and cleaned in different growth stages and cut in to segments in length of 0–30 cm, 30–60 cm, 60–90 cm, 90–120 cm, 120–150 cm, 150–180 cm, 180–210 cm, 210–240 cm and 240–270 cm. Root dry weight was recorded after drying at 80 °C for 48 hour and data was transformed to percentage. According to research results, root length of wheat reached maximum elongation and above 240 cm at GS 31. For bread wheat, in 0–30 cm of root length the Konya 2002 cultivar had lowest root biomass, 37.8% at GS 31 and the highest root biomass, 71.4% at GS 69. For durum wheat, in 0–30 cm, Kunduru–1149 had lowest root length with 41.4% at GS 31 while Çeşit–1252 was maximum root length, 58.6% at GS 92. Root biomass distributed 43.9% at GS 31, 59.4% at GS 69 and 60.2% at GS 92 in 0–30 cm of root length. In 0–90 cm, root biomass was found 71.3% at GS 31, 83.5% at GS 69 and 85.2% at GS 92. In conclusion, significant rate of wheat root biomass accumulated in upper soil layer, increasing from GS 31 to GS 92 and differences in distribution of root biomass among cultivars were largely confined to upper soil layers.

*Keywords:* Wheat, Root Biomass, Distribution, Growth Stages

*Acknowledgement:* This study was taken from Ph.D. Thesis of Hayati AKMAN, which was supported with project No. 10101037 by BAP Coordinator of Selcuk University being its admirable contributions

**PRODUCTIVITY OF SPRING WHEAT, DEPENDING ON CHANGING WEATHER CONDITIONS AND GROWING CONDITIONS****K.A. Akshalov**

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Spring wheat acreage in the sowing area structure of North Kazakhstan occupies 87.5% (Statistics of the R. of Kazakhstan, 2013). Spring wheat, cultivated in arid conditions, potentially has a high protein content and is highly competitive in world markets (Kuzmin, 1978, Barayev, 1988). Spring wheat is the main and more stable cash crop in comparison with other crops. Depending on the weather conditions during the growing period the gluten content in spring wheat grain varies from 30-35 % to 19-20% and , depending on the technology of cultivation , the gluten content varies from 30-32 % to 19-20% (Suleimenov, Akshalov, 2011) . Intensive and soil -, energy saving technologies in growing weather conditions increase the yield of spring wheat to 3.5-4.0 t / ha, but not always increase the quantity and quality of gluten. On average, over many years, depending on growing conditions of spring wheat yields ranged from 0.5 t / ha to 2.4 t / ha. When spring wheat is sowing after summer fallow its yield increased to 4.0 t / ha, but the amount of gluten is reduced to 18-20% and below. In some years, the vegetation and ripening of spring wheat is delayed until October, and with a lack of solar radiation and high yields of spring wheat, grain is formed of low quality. Such scientific data were obtained in 2009, 2013 and earlier. In dry years, the gluten content of spring wheat is slightly higher after summer fallow field than wheat after stubble fields, however, the level of gluten content as high both on the summer fallow fields and after stubble fields. With the technology of direct seeding, there is a special development of spring wheat plants compared with traditional methods of cultivation. The development of spring wheat with direct seeding is slower in the first phase, especially in dry years. Gluten content in grain of spring wheat is comparatively lower in direct seeding compared with traditional methods of cultivation. Application of nitrogen fertilizer increases gluten content, but in wet years prolongs the vegetation and ripening period of wheat. In favorable growing weather condition years with high coefficient of tillering of spring wheat forms different layering of stems and ears and uneven ripening grain in the lower and upper ears of stems. Sustainable high quality grain of wheat is formed at a certain, but at not so high level of productivity. In more arid zone on chestnut soils sustainable and stable quality of grain of wheat is formed, but wheat production is unstable.

Long-term studies show that sustainable obtaining high quality wheat depends on the weather conditions and the level of productivity. Climatic limitations associated with abrupt changes in weather conditions and the possibility of climate change in general, intensify these problems. Due to changes in methods of cropping system, growing condition development of spring wheat plants is changing. Joint research of physiologists, climatologists, biotechnologists and soil and crop production researches are needed to develop more sustainable technologies and breeding varieties aimed more towards sustainable production of high quality grain.

## COUMARINS IN ROOTS AND RHIZOMES OF GARDEN *ANGELICA ARCHANGELICA L.*

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In literature results of the dried raw herbs studies are usually discussed. As certain changes of genuine biologically active substances often take place during their storage, the authors have studied the content of coumarin in freshly drawn roots and rhizomes of garden angelica. *Angelica archangelica* L. samples had been taken in the territory of the Bashkir State University experimental plot a few days before soil freezing. Fresh rhizomes and roots were ground at room temperature and poured with 96% ethanol. After two hours, the first portion of the extract containing glycosides was frozen in a refrigerator, and the remaining part was re-extracted by 96% ethanol for coumarin isolation intraday. The second portion representing 80% of the ethanol extract was evaporated to a "tar" state under vacuum at room temperature. Then it was dissolved in CHCl<sub>3</sub> and placed in the refrigerator. Every other day of keeping the chloroform extract at -10° C, its separation into two fractions was observed: a yellow-orange top and a poor-colored bottom.

After separation a gas chromatography-mass spectrometer Thermo Finnigan, 800-Finnigan chromatograph and mass spectrometer of high resolution MAT-95XP "Delta" with "Data System" processing were used.

In the colored fractions 0.41 % bergaptol, 0.41 % marmesin, 0.20 % oroselon, and 0.07 % neobyakangelikol have been found. High levels of ethylglucopyranoside amounting to 35 % were observed in this fraction as well. Furocoumarin glycosides are entirely possible to be hydrolysed during the extraction process.

The main part of coumarins (61,3 %) was concentrated on the bottom, namely: osthols, oroselone, oroselol, oxypeucedanin hydrate, methoxyprangenin, heraclenol 3'-meester, prangenin (imperatorin epoxide), isoimperatorin (4-prenyloxyxpsoralen), biakangelicin, imperatorin (8-prenyloxyspsoralen), isopimpinellin, angelicin, bergapten (5-methoxyspsoralen), methoxsalen (8-methoxyspsoralen).

Furanocoumarins compounds obtain antitumor and antiviral activity. In particular, prangenin suppresses the reproduction of respiratory syncytial virus (RS-virus), which causes inflammatory reactions in children. Imperatorin and isoimperatorin in the roots of garden angelica block L-voltage-sensitive calcium channels, reduce the concentration of Ca<sup>2+</sup> ions in cardiomyocytes, and provide for a vasodilatation effect. Imperatorin also inhibits the activity of matrix metalloproteinases by inhibiting neuronal apoptosis after transient cerebral ischemia.

Thus, fresh angelica roots and rhizomes grown in the Ural region are characterized by a high content of prenylation furanocoumarins comparable to the Asian *A.sinensis*, *A. keiskei* and *A. daurica* in composition. The obtained results allow us considering the underground angelica organs as a promising raw material for drugs aimed at preventing a cognitive dysfunction, neurobehavioral disorders and hypertension.

**Keynote****THE ROLE OF PROGRAMMED CELL DEATH IN THE INDUCTION AND LONG-TERM MAINTENANCE OF CEREALS' TOTIPOTENCY *IN VITRO*****N.K. Bishimbayeva**

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The key moment in the investigation of somatic embryogenesis process is study of its very early stages. It is crucial to clarify not only the signals and inductors of this process, but also the mechanisms that force differentiated cell *in vitro* to switch over to other developmental pathway (Butenko, 1999). Because the long-term cultivated friable embryogenic (FE) calli have a single cell origin of embryoids and appeared to be a very responsive to morphogenesis regulations by phytohormones and trophic factors, they have become a very useful model system for investigation of these issues.

Effect of phytohormones on the composition of cell populations of wheat and barley long-term FE calli, compared to friable and compact non-embyogenic tissues, have been investigated in this work by the methods of light and electron microscopy. As a result, we found the distinct features of embryogenic tissues in comparison with non-embyogenic calli: the presence of cells with signs of programmed cell death (PCD) or apoptosis, accumulation of dense net polysaccharides in the extracellular space, separation of spherical embryogenic competent cells covered by callose envelope. It has been shown, that the increase of the proportion of cells with signs of PCD in FE tissues under the effect of 2,4-D is accompanied by enhanced accumulation of extracellular polysaccharides (EPS) as well as by the stimulation of calli's growth and embryogenic potential. As it has been determined by cytochemical (electron microscopy) and histochemical methods EPS have the proteoglycan nature; cells with signs of PCD secrete EPS into the extracellular space during the course of death. Bioassays *in vitro* and *in vivo* revealed that acidic fractions of secreted EPS have antiauxin activity, i.e. they inhibit the cells' growth by elongation, stimulated by 2,4 D; increase the stress tolerance of plants; cause separation of callus cells by means of callose coat and their reprogramming into the embryoidogenic developemt pathway; stimulate the growth of callus tissues.

On the basis of fulfilled research we suggest hypothetical scheme, that demonstrates the cyclic character of the initiation and desintegration processes of somatic embryoids in the long-term totipotent embyogenic calli. According to this scheme, the sequence of events, caused by 2,4-D, as the following. High concentrations of 2,4-D (5,0-7,0 mg/l) effect on callus cells as strong stress factors, blocking differentiation processes of four-, eight- celled proembryos and globules, causing their desintegration. During this process embryoids are destructed onto the cells with signs of PCD and single competent cells, which under the effect of EPS enter the path of embryoidogenesis again. Initiated proembryos also a capable to dissociate through the PCD process with the formation of spherical competent cells. By this way embryogenic potential of calli is constantly maintained during multiple subcultivations. The decrease of 2,4-D concentration up to 1,0 mg/l diminishes stressful influence of phytohormone, and cell death does not occur. Somatic embryoids are able in this case to normal developement and differentiation with the formation of the whole plant.

On the whole, we have shown the important role of apoptosis and polysaccharides secreted during this process in the switching over of callus cells to the embryoidogenic developmental pathway, in the regulation of cells' shape and size, in the maintenance of embryogenic competent cells' pool, as well as in the regulation of embyoid's differentiation and callus tissues' growth.

This work was supported by grants of PFR MES RK (2003-2005r.), (2006-2008r.).

**THE FUNCTIONING OF ALTERNATIVE OXIDASE IN PEA SEEDLINGS ROOTS UNDER SIMULATED MICROGRAVITY****D.A. Bluma, O.S. Talalaiev, V.O. Brykov**

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Since plants adapt to real and simulated microgravity, it is very important to understand the cell mechanisms of energy sufficient supply of plants in these conditions. Mitochondrial respiration in plants provides energy for biosynthesis, and its balance with photosynthesis determines the rate of plant biomass accumulation. A specific feature of mitochondrial respiration in plants is the presence of the cyanide-resistant, alternative respiratory pathway. Activation of the alternative path under stressful conditions can significantly reduce the level of respiratory ATP production and therefore affect a process of growth and ion uptake by roots. The aim of our presented work was to study the mitochondrial ultrastructure, the respiration of seedling roots and the expression level of *AOX1* and *COX2* genes coding terminal oxidases of the mitochondrial electron-transport chain under influences of simulated microgravity. Pea seeds were germinated on filter paper in containers placed on horizontal clinostat (2 rpm/min). Pea seedlings grew up to 5 days in darkness at 24°C. The tissue oxygen uptake of 5 mm root apices was evaluated polarographically by using an oxygen electrode, whereas capacities of the cytochrome and alternative electron transport pathways were estimated with the use of their corresponding inhibitors. Gene expression level was evaluated by using quantitative RT-PCR.

Under clinorotation, mitochondria with the changed ultrastructure were mainly observed in cells of the root distal elongation zone. The intensity of mitochondrion ultrastructure changes was dependent on the duration of clinorotation. At the 5<sup>th</sup> day of clinorotation, structural changes of mitochondria are accompanied with increased respiration of root apices by 7%. It was established the redistribution of capacity of mitochondrial terminal oxidases during 5 days of pea seedling growth in the stationary control and under clinorotation: capacity of the respiration cytochrome pathway increased but capacity of the alternative pathway decreased considerably and it accounts for 10% of the total oxygen uptake of root apices. There was not a significant difference in capacity of alternative pathway in root apices under clinorotation. Also, the level of *AOX1* and *COX2* transcripts in root apices under clinorotation was similar to that in the control. Such changes in mitochondria are considered to be an adaptive character and provide energy homeostasis of cells under simulated microgravity. The adaptive response of mitochondria to microgravity conditions occur without the involvement of stress response of alternative oxidase at least in the early stages of seedlings growth.

## MODIFYING THE AMINO ACID COMPOSITION IN CONIFERS TOOBTAIN MIXTURES WITH ARGININE

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The green parts of conifers contain highly bioactive substances representing nearly all classes of organic compounds known in plants (Yagodin, 1981; Ushanova et al., 1998). A significant proportion of bioactive substances in the green parts of pine (up to 30%) is water soluble fractions, including free amino acids, which are used for treating many diseases. L-arginine belongs to the group of semi-essential amino acids, and plays an important role in the life of the organism, being a precursor of nitrogen oxide - NO, which performs a wide range of bioregulatory functions (Granik, 2003; Markov, 2005; Ul'yanov et al., 2010).

L-arginine in conifers is involved in various metabolic processes, including detoxification of excessive ammonium. Free L-arginine content in conifers can rise significantly (more than 100-fold) when excessive nitrogen doses are applied to the soil (Nasholm and Ericsson, 1990). When in addition to ammonium nitrate certain doses of boric acid are applied to Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* L.) crops, L-arginine content in the needles will rise significantly (tens of times) over one growing season already (Chernobrovkina et al., 2010, 2013). A high content of L-arginine and other amino acids in plant organs can be regarded as a biochemical indicator of misbalance in their mineral nutrition. When nitrogen supply to a coniferous plant is high compared to other mineral nutrients, the plant organs and tissues will not be able to utilize all of it for protein synthesis, and will store the remains as amino acids with high nitrogen content, first of all L-arginine. Additional supply of boron to the coniferous plant accelerates growth processes and at the same time aggravates the deficit of other nutrients, which results in intensified accumulation of L-arginine in needles.

In the future, the nutritional misbalance caused by excessive application of nitrogen can tell on various aspects of the plant metabolism. This fertilization design can be applied to the stands meant for logging with the possibility to use non-timber resources (pine shoot with needles rich in L-arginine), but not as a tending practice. A wise way to get tree greens rich in L-arginine is to use the residues from the logging of 10–15-year-old coniferous trees growing along power lines, in forest crops (Robonen et al., 2012). Procedures for application of fertilizers to the soils under Scots pine were elaborated with regard to the phenophase, and the methods and timing of harvesting the plant material over the annual cycle were determined.

We suggest using coniferous tree greens rich in L-arginine as the raw material for producing this amino acid, and as bioactive supplements in veterinary medicine (Chernobrovkina et al., 2010). A technology has been designed for processing the residues of Scots pine green parts rich in L-arginine into mixtures with arginine. Good results have been obtained from their trials as dietary supplements: to the rearing and laying flocks of Lomann Brown hens – promoted the growth rate in the young and the egg yield from hens, to American mink (*Mustela vison Schr*) pups – promoted the growth rate and survival. The timing and doses of the treatments were determined for poultry and fur animals.

**EFFECTS OF LOW DOSE CHRONIC RADIATION ON PLANT-PATHOGEN INTERACTIONS IN 30-km CHERNOBYL EXCLUSION ZONE****A.P. Dmitriev, N.I. Guscha, A.I. Dyachenko, D.M. Grodzinsky***Institute of Cell Biology and Genetic Engineering, Natl. Acad. Sci. Ukraine, Kiev, Ukraine  
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Changes in plant-pathogen interactions under low dose chronic irradiation may pose a threat to environment at least on two reasons. First, low dose radiation can induce mutations and speed up a pace of race formation. Second, the low doses may decrease innate plant disease resistance.

The aim of this study was to investigate the effects of combined biotic and radiation stress on plants in the 30-km Chernobyl Exclusion (ChE) zone and analyze some changes in plant pathogen population structure.

We provide clear evidence that low dose radiation could affect plant disease resistance. Wheat seeds ( $M_3$ ) of three cultivars (Mironivska 808, Poliska 70, Kiyanka) collected in the ChE zone were sowed in uncontaminated soil. It was established in pot experiments that infection with powdery moldew (*Erysiphe graminis* DC. f. sp. *tritici* Em. Marchal) and brown rust (*Puccinia triticana* Erikss. & Henn.) of three wheat (*Triticum aestivum* L.) cultivars (Mironovskaya 808, Polesskay 70, and Kiyanka) grown from seeds, collected in the ChE zone, was 1.5–2.0 times higher than of plants grown from control seeds

To elucidate alterations in plant disease resistance field trials were carried out in ChE zone. Wheat plants of three cultivars were artificially inoculated with brown rust spores. Incidence and extent of wheat rust was more severe on heavy contaminated plots.

We tried to analyze biochemical mechanisms underlying the decrease in plant disease resistance. The data obtained suggest that activity of proteinase inhibitors in grains of wheat and rye under low dose chronic irradiation was decreased to 35–60% as compared to control. Decrease of proteinase inhibitor activities could diminish plant disease resistance. This assumption was confirmed by experiments with high lysine *opaque-2* mutation of corn. The results indicate the increased sensitivity of maize plants containing the gene *opaque-2* to the action of low dose chronic radiation. This corn mutant can be regarded as a promising test system for assessing effects of low dose of biotic and abiotic stresses.

Phytopathogenic fungus *Puccinia graminis* Pers., the causal agent of the stem rust of wheat, rye and oat, is most damaging disease of these crops and regularly caused severe epidemics over most of Europe and Asia. It turned out that active form and race formation in the population of *P. graminis* was observed in the ChE zone. A “new” population of the fungus with high frequency of more virulent clones than in other Ukraine regions was distinguished.

Thus, the results obtained independently both in greenhouse and field trials performed in the 30-km ChE Chernobyl zone demonstrated radiation effects on the plant-pathogen interactions. These effects include a decreasing of cereals disease resistance under low dose chronic radiation, but also an active form- and race-producing processes occurred under chronic radiation in the ChE zone. As a result a population structure of *P. graminis* has been changed by appearance of a “new” population with high frequency of more virulent clones. The results indicate a necessity of monitoring over microevolutionary processes occurring both in plants and their pathogens under conditions of technogenic stresses. It should provide better understanding on how serious the threats to environment are.

**REGULATION OF HEAT SHOCK PROTEIN SYNTHESIS AND  
THERMOTOLERANCE OF *ARABIDOPSIS THALIANA* SEEDLINGS  
BY HSP90**

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Active synthesis of heat shock proteins (HSP) is one of the key components of the stress reaction and thermotolerance of various organisms. Their gene expression is induced by binding of an active trimeric form of heat shock transcription factors (HSF) with heat shock elements (HSE) located in promoter of *HSP* genes. There is genetic evidence for a negative regulation and feedback control of HSF activity. According to a hypothetical mechanism, maintaining of HSF in an inactive monomeric form may be realized by binding with cytosolic Hsp90s. This problem has been investigated on *Arabidopsis thaliana* seedlings using inhibitor analysis with geldanamycin (GDA) - a specific inhibitor of HSP90. It has been supposed that inhibition of HSP90 chaperone activity promotes release of HSF following formation of active trimers which can induce *HSP* expression. Accumulation of HSPs in turn has to result in increasing stress tolerance. So, influence of GDA on HSP70 and HSP90 synthesis and thermotolerance of seedlings was studied.

Seedlings were grown on sterile agar medium at  $24 \pm 1^\circ\text{C}$  with a 16-h light cycle. 1, 10 and 100  $\mu\text{M}$  GDA was used. Immunoblot analysis showed that GDA treatment of seedlings resulted in dose-dependent activation of HSP70 and HSP90 synthesis in the absence of stress. GDA-treatment of seeds also resulted in an increase in the amount of these proteins. When seedlings grown from the GDA-treated seeds were heat shocked, HSP70 and HSP90 synthesis was up-regulated, more significantly than without treatment. These results are approximated to other HSP families. It was also shown that GDA-treatment of seeds led to increasing thermotolerance of the seedlings. Obtained data confirm a role of HSP90 in negative autoregulation of heat response and thermotolerance of plants.

## MINERAL NUTRITION IN VITRO OF SOME SMALL FRUITS

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Plant growing in vitro at artificial nutritional media and using of modern methods of analysis (ionic chromatography, CHNS-analyzer and atomic emission spectrometry) is a good model to study mineral nutrition of horticultural crops. It makes possible to control the content of macro- and microelements in artificial nutritional media after at every stage of micropropagation.

The object of investigation was the plant regenerants of black currant (cvs. 'Tserera', 'Pamiat Vavilova') and Aroniamelanocarpa (cv. 'Venisa') cultivated at different in vitro stages, agar nutritional media. The methods are biotechnological (apical meristem culture, micropropagation), physical and chemical ionic chromatography, CHNS-analyzer and atomic emission spectrometry).

After 5 weeks of black currant growth at nutritional media the content of the ions dramatically decreases. The  $\text{NH}_4^+$  content loss is the highest (80,11 – 87,17 %), then  $\text{H}_2\text{PO}_4^-$  (58,48 – 62,28 %) and  $\text{NO}_3^-$  (56,75 % – 62,02 %), the level of  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Cl}^-$  и  $\text{SO}_4^{2-}$  decreased on  $\frac{1}{3}$ .

At the rooting stage black currant plants consume 88,5 % of initial content of  $\text{H}_2\text{PO}_4^-$  ions. Nitrogen is consumed successfully as nitrate (up to 64,37 %) and ammonium form (up to 76,88 %). More than half of initial  $\text{SO}_4^{2-}$  in a media is also absorbed by plants. During the rooting stage relative consumption of ammonium nitrogen, potassium and chlorine declines, magnesium, calcium, sulfur and phosphorus consumption increases in comparison with propagation stage.

At micropropagation stage the plants of aronia consume nitrate form of nitrogen mainly, then in descending order of mass  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ .

After a month of growth the content of main elements used by plants decreases dramatically, but the quantity of ions consumed at low rate becomes higher than initial content.

Of the raw of investigated microelements (Mn, Zn, Fe, B, Cu) black currant consumes manganese mostly, Aroniamelanocarpa – iron. Accumulation of microelements in plants is equal to their consumption from nutritional media.

**COMPARATIVE BIOCHEMICAL STUDY OF THE CHARACTERISTICS  
OF VARIETIES OF WHEAT AND ITS WILD RELATIVES**

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Strategy of modern breeding is directed on creation of varieties and hybrids of agricultural crops, combining high productivity and quality of the crop with increased adaptability to unfavorable environmental conditions. The success of breeding work largely depends on the availability of the source material for breeding, as well as effective methods of their estimation and knowledge of physiological-biochemical mechanisms that determine the quality of the harvest and resistance to stress factors of different nature.

The objects of study were the wild species of the genus Aegilops L. (*Ae. cylindrica*, *Ae. crassa*, *Ae. tauschii*, *Ae. triuncialis*) and four wheat cultivars (varieties Pandaki, Bobilo, Safedak and Marvi).

The content of starch and protein in wheat grains depends on genotypic and natural climatic factors. However, strict laws are not observed, although it is planned some tendency to increase of content of starch and protein under more optimum conditions.

The biochemical composition of species of Aegilops L. has not been adequately studied. Here is of great scientific interest in the study of some species of Aegilops L., collected in different ecological zones of Tajikistan.

The results showed that in all studied four samples Aegilops L., the content of starch in the grain varied in limits from 20.2 to 25.7 respectively.

On protein content in grain of wild species have higher limits of variability from 24.0 till 34.5%.

The relatively low value of this indicator set of sample *Ae. tauschii* and *Ae. cylindrica* growing in conditions of Faizabad district (24.0 - 25.2%), while the greatest of *Ae. triuncialis* grown in conditions Ecanbai district (34.5%).

It is interesting to note that the studied of species of Aegilops L., accumulation level of the main components of the grain, starch and protein) compared with the studied cultivars of wheat has the opposite tendency. The species of Aegilops L., in all cases, the protein content in grain was more than starch content.

Thus, the study of starch and their protein content in grain of different wheat varieties and species of Aegilops L. revealed ambiguous in the manifestation of these indicators depending on the species composition of plants and conditions. It is shown that environmental conditions of the habitats, along with the genetic characteristics of each species, the impact on the biosynthesis, and the level of accumulation of the main components of the grain. Some varieties of wheat and separate samples Aegilops L., on protein content in grain of very different and can be used in the selection process as donors on the indicator of high grain protein content have been investigated.

**PERSPECTIVE HYBRIDS OF SWEET SORGHUM  
FOR THE REPUBLIC OF KAZAKHSTAN**

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Experts from North America and Europe as well as from several other countries (China, India, Brazil) concluded that hybrid of sweet sorghum with significant potential biomass productivity of sweet juice content at sugarcane level gained worldwide interest as a plant with great economic opportunities. The problem of cultivation and industrial processing of sweet sorghum shall be made at a higher level, because the success of this culture, especially in countries with a continental and arid climate, which is the Republic of Kazakhstan, it becomes possible to quickly resolve issues related not only to agriculture, conservation of soil fertility, animal science, but also to the food industry, freight transport, restore ecological balance, etc.

For this purpose in the Republic of Moldova hybrids of sweet sorghum was obtained by conventional breeding methods, which by their morphological and economic traits: stem thickness 30 - 45 mm, its height 3.7 - 4.5 m and increased size of leaves, % fiber (35 - 38%) and sugar content in the juice of the stem up to 16-20%, are analogues of sugar cane. Of these hybrids Porumbeny 4 and 5 Porumbeny, SAŞM 1 and 2 SAŞM were zoned in Moldova and in neighboring countries.

This type of hybrid provides crop biomass up to 80 - 90 t / ha of rainfed and more than 130 - 140 t / ha under irrigation. In 2008 Porumbeny 4 hybrid was the largest in variety trials EU in the biomass - yield 184 t / ha. In comparison with sugar cane the growing season of these hybrids is 3-4 times shorter and the plants 7-8 times more economical use of soil moisture, soil salinity satisfactorily transferred, are not affected by diseases and pests, resistant to lodging stalks with carminative and overexposure to harvest standing, well-suited for Machine harvesting (G. Moraru, 2000; 2012).

Of 100 t of biomass processed at the production line of sweet sorghum can produced up to 50-55 m 14-16% sugar content of the wort and 25-30 tons of dry biomass, bagasse and silage-in option to 19-23 tons of feed units or more than 25 thousand m<sup>3</sup> of biogas. The recycling of pressed juice provides 8-10 t / ha of sugar syrup, similar in quality to bee honey or 4.5-5 t / ha of ethanol (in the embodiment of the entire mass of pyrolysis 1 hectare - up to 11 m or 18 m biosolyarki bioethanol). Of 30 tons of sorghum bagasse can get 16 - 18 thousand m<sup>3</sup> of biogas or amount sufficient to produce briquettes 15 - 17 thousand kW / h of electricity to produce the same side of thermal energy. During the growing season one hectare of sweet sorghum hybrid of Moldovan breeding absorbs from the atmosphere to 55 tons of CO<sub>2</sub> (deciduous forest temperate latitudes 16-18 t / ha / year), and in a controlled expansion well-developed root system (up to 14-16 m / ha dry weight) improves soil fertility positive balance of humus to 1.5-2 t / ha / year. Under irrigation hybrids can monoculture, and in the version without irrigation acceptable following crop rotation: sweet sorghum, peas (other beans) - winter wheat and sorghum again. Technology of cultivation of these hybrids is similar to corn silage technology.

**EFFECTS OF DIFFERENT NITROGEN DOSES ON THE GROWTH TREND AND SOME AGRICULTURAL PROPERTIES OF PEA**

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The purpose of this study was to determine the effects of different nitrogen doses (0-30-60-90 kg ha<sup>-1</sup>) on the weekly growth trend and some agronomic traits of pea. In this experiment, Furkan cultivar (*Pisum sativum ssp. arvense*) was used as the plant material and ammonium sulfate (21% N) fertilizer was applied as the nitrogen source. The study was established as a randomized complete block experimental design in 2013 and was carried out at irrigation conditions. According to the results of the study, plant height was found significantly important among the characters tested and the highest plants were observed from the 30 kg ha<sup>-1</sup> nitrogen (P ≤ 0.01) application; the first branch height, number of branches, the first pod height, number of pods, pod length, pod in the grain number, thousand grain weight, yield per hectare, were the other parameters evaluated based on the effects of the applied nitrogen doses none of which were found significant (P ≤ 0.05).

*Key words:* pea, nitrogen doses, growth trend, agricultural properties

**RESPONSE OF DRY BEAN (*PHASEOLUS VULGARIS L.*) GENOTYPES  
TO WATER SHORTAGE**

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This research was conducted to determine optimum timing and frequency of common bean irrigation in Konya. Field trial was conducted according to "Randomized Complete Blocks Design" with three replications in Selcuk University, Agricultural Faculty, Campus-Konya trial fields during the year of 2009. Sowings were made on 15<sup>th</sup> of May and harvest was made on September. After sowing, the plots were irrigated by sprinkler for only two hours to provide the emergence. A total of 41 common dry bean genotypes were grown in field conditions with only 2 drip irrigations during the flowering (50<sup>th</sup> day after sowing) and pod filling (58<sup>th</sup> day after sowing) periods for 6 hours (from 0am to 6am) per irrigation which was provided enough water to effective root depth. Some agronomical characteristics were determined on behalf of plant response to limited water. According to the results, number of main branch per plant was significant on the level of P<0,05 and, all the other investigated characteristics were significant on the level of P<0,01. Means of the investigated characteristics were ranged as following: number of main branch/plant 3,33-7,33; number of leave/plant 16-108; plant height 45cm-162cm; number of pod/plant 12-26; number of seed/pod 3,0-5,8; first pod height 3,56cm-6,67cm; biologic yield 212kg da<sup>-1</sup>-604kg da<sup>-1</sup>; seed yield 114kg da<sup>-1</sup>-355kg da<sup>-1</sup>; harvest index 46%-90% respectively.

The results implicated that all the investigated characteristics were in parallel with previous studies. It can be concluded that the timing and method of irrigation is more effective than making irrigation in a random period and excessive water.

*Keywords:* Arid land agriculture, bean, drought tolerance, sustainable agriculture, water management.

## PLANTS OF THE GENUS *ARTEMISIA* L. IS THE PERSPECTIVE SOURCES OF BIOLOGICALLY ACTIVE SUBSTANCES

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Plant of the genus *Artemisia* L. is the perspective sources of biologically active substances, some species, such as *Artemisia dracunculus* L., *Artemisia absinthium* L., *Artemisia vulgaris* L. is widely used in folk, traditional medicine and food industry. *Artemisia annua* L. successfully introduced into the culture in many countries in 2001 and has been recommended by WHO as the main source of artemisinin is a drug in the first-line treatment for malaria. *Artemisia annua* has a wild-growing species in Buryatia.

Along with the *Artemisia annua* widespread *Artemisia sieversiana* in Buryatia, which is also promising for medicine views. The herb contains flavonoids, coumarins and essential oil, which is of interest as a source chamazulene.

We studied objects of *Artemisia annua* and *Artemisia sieversiana* which collected in different areas of the Republic of Buryatia (Ivolginsky, Pribaikalsky, Selenginsky, Tunkinsky, Zakamensky and Kurumkansky districts), Irkutsk Region (island Olkhon ) and Mongolia (Selenginsky aimak) in the period from 2008 to 2013.

We investigated the chemical composition of these plants. Chemical composition represented of essential oils, flavonoids, fatty acids, macro- and microelements. Essential oil yield is varies from 0.1 to 1.9% in *Artemisia sieversiana*, in *Artemisia annua* - from 0.1 to 4.9 %. Essential oil is accumulation at the flowering stage higher (0.7 %) than in the budding stage (0.3 %). Component composition of essential oils and fatty acid composition was examined by gas chromatography-mass spectrometry on gas chromatography Agilent 6890 with detector is a quadrupole mass spectrometer (MSD 5973N). 1,8- cineol , terpineol -4 , germakren D, β-farnesene , selina -4 ,11- diene, 2- neryl methylbutanoate and chamazulen are constant components of the essential oil of *Artemisia sieversiana*. Artemisia ketone, caryophyllene, germakren D, β-selinene, caryophyllene oxide are main substances of the essential oil of *Artemisia annua*. The greatest number of chamazulene concentrated in *Artemisia sieversiana* in budding phase (62%) and flowering phase (34%). Palmitic, linoleic, linolenic, 10-oktadecanoic acids are main fatty acids in *Artemisia annua* and *Artemisia sieversiana*.

Extraction conditions were chosen to develop a methodology for the quantitative determination of artemisinin in the grass, in which the extraction of artemisinin reaches the maximum value. We analyzed the extract obtained by the methods - maceration, ultrasonic extraction and subcritical CO<sub>2</sub>-extraction. The greatest number of artemisinin (0.054 %) is contained in the extraction obtained at subcritical CO<sub>2</sub>-extraction.

Methods has been developed and validated for the quantification of artemisinin in *Artemisia annua* by HPLC-MS (relative error in determining ± 1.21%). The largest number of artemisinin accumulates *Artemisia annua* in at the flowering stage in the inflorescences (0.039%).

By HPLC-MS methods were found in these plants flavonoids – luteolin-7-glucoside, rutin, quercetin and chrizoeriol.

**DIVERSITY OF PLANT THIONINS AS MULTIFUNCTIONAL  
BIOLOGICALLY ACTIVE PEPTIDES**

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Thionins represent the first antimicrobial peptides (AMP) isolated from plants. At present they are combined in the individual AMPs' family, its some members have been discovered in various plant organs (seeds, stems, roots and leafs) of manifold botanical families. It has already known more than 110 partial and complete primary sequences of thionins from 20 cultivated and wild plant species, which are predominately localized in cell vacuoles. These peptides are basic or neutral with the length of 46 amino acid residues on an average, and linked by 3-4 disulfide bridges. Thionins are produced as precursor proteins with molecular mass near 18 kDa, that contain signal and mature peptides, and C-terminal prodomain too, that is being deleted by post translational modification procedure of the thionin precursor molecule. The function of this prodomain can be consisted in neutralization of toxic action of mature peptide before its transferring to intercellular space or vacuoles. The spatial structure of plant thionins is generated by two parallel alpha-helices and a short beta-fold, C-terminal sequence forms a hairpin.

Antimicrobial activity of these peptides was determined towards Gram-Positive and Gram-Negative bacteria, filamentous fungi, yeasts, and eukaryotic cell cultures. It was demonstrated that they can inhibit bacterial colony growth, and higher fungi and oomycetes also at concentrations caused one-half effect of 0,2-3,0  $\mu$ M. Antifungal activity of thionins *in vitro* is suppressed hardly by increasing of  $\text{Ca}^{2+}$  ion concentrations in the medium more than 5 mM, and by univalent cations at concentrations no less than 50 mM. Plant thionins can cause an effect on cell cultures of mammals and insects, and they are capable to permeabilize of plant protoplasts. Besides, the recent research investigations showed that some thionins are natural antimutagenes, reliably decreasing an expression level of oncogenes, and can selectively cause on tumor cells.

Thionins are compounds of passive and active plant immunity: they are actively generated as a response to bacterial inoculation and inserted into PR-13 class of plant defense proteins. Biological activity of thionins is principally realized through pore formation into cell membranes, reducing to their destruction, affecting of some main processes in the cell followed possible death.

## **BIOLOGICAL FEATURES OF SWEET SORGHUM VARIETIES IN THE CONDITIONS OF SOUTH-EAST OF KAZAKHSTAN**

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Global climate change, which is accompanied by an increase in temperature, decrease in water resources, reduction of atmospheric precipitation, expansion of the space of drought areas and desertification is one of the key environmental issues of the Earth. This is a serious concern to search and identify the most drought-resistant, heat-resistant and at the same time the highly productive crops to meet the needs of the food and feed industry and alternative renewable energy in new emerging environments. The sweet sorghum (*Sorghum saccharatum* (L) Pers.) meets these requirements which belongs to the genus *Sorghum*(L), Moench. – sorghum.

Sweet sorghum is a promising crop with high potential for growth in the southern arid, marginal and saline soils. Sweet sorghum includes many species, characterized by the fact that they as opposed to the grain sorghum and broom corn stem juice contains up to 20% or more of soluble sugars. It is a rare plant, which would have intensively synthesized carbohydrates. Plant differs in efficient use of soil moisture by a unique mechanism of regulation of the water regime. Despite this, the country is not concerned enough about this culture.

The paper presents the results of research about the biological peculiarities of sweet sorghum varieties of domestic and foreign breeding. It was revealed that the studied varieties differed significantly in a number of biological parameters such as the duration of the growing season, plant growth and development rate, shoot formation, biomass accumulation and its distribution in organs, as well as biological and grain productivity. Experimental data has been obtained that reflects the biological productivity, sugar content, juiciness, and the resistance of sorghum varieties to adverse environmental factors such as drought, salinity and contamination with heavy metals. It also has been shown that domestic varieties compare favourably on sugar content and juiciness of the stems, while foreign varieties (USA, India, Russia) differs in biological productivity due to intensive growth of aerial organs and enhanced tillering.

**CALLUS CULTURE PHOTOSYNTHESIS "LIGHT CURVE"  
AS A METHOD OF PLANT DROUGHT TOLERANCE TESTING**

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Photosynthetic activity (PA) of agricultural plants is closely related to their productivity. The influence of any stress factor results in photosynthetic yield. New technologies and innovative equipment for PA registration give an opportunity to fix all photosynthetic parameters without destruction of the sample. Also we are able to monitor dynamic of photosynthesis process of the one and the same sample for several times and different photosynthesis parameters such as maximum fluorescence, PSII quantum yield, relative apparent electron transport rate (ETR) by Light Curve mode.

The investigation of plant tissue physiological reactions on stress was conducted under callus culture stable controlled *in vitro* conditions. Calluses were induced on immature wheat embryos.

While calluses are proliferating under light they become pale green that is considered to be a mark of secondary differentiation and regeneration processes. This process hasn't been investigated well in aspect of callus sells photosynthetic system development

IMAGING-PAM M-Series MAXI Version fluorimeter and "saturation pulse" method in "light curve" writing mode (default programme) have been used for detection of PA of proliferating spring soft wheat callus culture. The ETR curve appeared to be the most representative and suitable for analysis when PA of different varieties was investigated under stress and optimal conditions. Variations in a form of this curve appeared under stress conditions induced by proliferation media containing chemical agents that induce osmotic stress (NaCl, polyethyleneglycol).

Reaction centers of PSII close under saturating light flashes when exact actinic light intensity is applied. This effect appears as a zero level of ETR on a light curve. Varieties that were investigated differed much in their ability to hold their reaction centers open while the actinic light intensity were rising and saturation pulses were being applied. This ability is supposed to depend on variety tolerance to lack of free water. This hypothesis was validated by ETR curves obtained on wheat calluses of varieties with certain level of stress tolerance. Hydrophilic wheat varieties Snubber and KS-1529 calluses decreased their ETR very quickly under osmotic stress over the investigated actinic light intensity range in contrast to middle drought tolerant variety Tulunskaya 12, that held its reaction center opened longer. Salt tolerant variety Milturum 2419 didn't decrease its ETR at all. The dynamic of the ETR curve shape changing has been investigated during callus proliferation. The results indicate that the clearest difference between reactions of callus photosynthetic systems on stress can be observed on 7<sup>th</sup> day of cultivation. ETR curves of varieties differ in drought tolerance diverge at ordinate axis significant at this moment.

Hereby, drought tolerance of wheat is suggested to be tested under callus conditions at the proliferation stage on stress media by detecting PA callus parameters, namely ETR, using modern fluorimeters.

**THE INTRODUCTION OF SAFFLOWER TINCTORIAL  
TO THE CENTRAL REGION OF RUSSIAN FEDERATION**

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N.I. Vavilov was the founder of plant introduction theory. He attached great importance to the issue of new crops, more efficient use of world's wild flora both within in our country and beyond. Following these ideas scientists of N.I. Vavilov Research Institute of Plat Industry attracted to collection previously unknown cultures in our agricultural science and practice.

As a result at the Center of reservation, maintenance and gene pool of the Selection and Technological Institute of Horticulture and Nursery Sciences Academy, previously named as Moscow branch of N.I. Vavilov Research Institute of Plat Industry (Mikhnevo, Stupino district, Moscow region) was created cultivar of safflower tinctorial named "Krasa Stupinskaya". This cultivar is used as the sidereal, phytomeliorative, stern, decorative and oilseed crop as in industrial purposes and also in individual household farms. Krasa Stupinskaya is included in the State register of breeding achievements sience 01.01.2013. The patent number - 6930. Authors: Temirbekova S.K., Kulikov I.M., Kurylo A.A., Norov M.S., Metlina G.V., Postnikov D.A., Ionova N.E.

Safflower (*Carthamus tinctorius L.*) belongs to the family of Asteraceae. Centre of origin is Egypt and India. It is an annual herbaceous plant with a well-developed, tap root system, deepening in soil to 10-20 cm (in the southern regions in 1.5-2 m). Vegetation period from germination to maturity in the years with different meteorological conditions is 105-130 days. Duration of flowering is about a month. Stem is erect, branching, naked, height is about 83-90 cm. Leaves are sessile, lanceolate, lantsetoovalnye or elliptic, the edges have small teeth, terminating with small spines.

Inflorescence - a basket with a diameter near 1.5-3.5 cm. One plant can from 5-7 to 20-50 and more baskets. The flowers are tubular with yellow, red or orange quinquepartite corolla. Fruit - achene, brilliant, similar to sunflower achenes. Seed's coat is hard, it is difficult to crack, reach 40-50 % from the mass of seeds. The seeds do not fall off after their maturation. The weight of 1000 seeds - 48-51 g. Productivety in our zone is 0.8-1.0 t/ha (in the southern regions - 1.0-1.2 t/ha). Safflower seeds contain 32-38 % of fat. Absolute fat content in the treated seeds reaches more than 60 %, and it is fit for food. Safflower oil is similar to sunflower oil, but contains more linoleic and oleic acids, may used for food and industrial purposes. It is very important that  $\alpha$ - $\gamma$  linolenic acid is an essential, synthesized only in the culture of safflower and breast milk. This cultivar does not affected by pests and diseases, except for enzyme-mycotic exhaustion of seeds (EMES). In wet years EMES causes seed's mass destruction by such diseases as Alternaria, Fusarium and others and as a result is a poor quality of seeds.

The variety Krasa Stupinskaya was awarded the Gold medal at the "Golden Autumn 2013"

**EFFECT OF SEED PRIMING WITH MOLYBDENUM ON THE ADAPTATION OF SPRING WHEAT PLANTS TO BIOTIC STRESS****O.N. Babenko<sup>1</sup>, Z.A. Alikulov<sup>2</sup>**

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It is known that the molybdenum containing enzymes - nitrate reductase (NR; EC 1.6.6.1), aldehyde oxidase (AO, EC 1.2.3.1) and xanthine dehydrogenase (XDH; EC 1.2.1.37) - play an important role in plant resistance to abiotic and biotic stress. According to the Institute of Soil Science of the National Academy of Sciences of Kazakhstan, soils of Kazakhstan contain the Mo amount, which was 3-5 times less than that necessary for normal growth and development of plants. Lack of Mo in the soil leads to a decrease in activity of molybdoenzymes or presupposes the existence of inactive forms of molybdoenzymes. However, pre-sown seed priming with molybdate is one of the cheapest and environmentally friendly ways to provide an adequate supply of Mo to plants. Wheat leaf rust caused by the fungus *Puccinia triticiana* Eriks. resulted to significant damage of grain production in Kazakhstan, where crop losses reached 10-20% or more during epiphytotic of fungus, reducing the quality of the grain. Mechanisms of response and defense reactions of plants against rust fungi are not enough studied. Therefore, we studied the effect of seed priming with molybdate or tungstate on the activity of these molybdoenzymes in the leaves and roots of spring wheat under leaf rust infection.

The objects of the study were seedlings of spring wheat (*Triticum aestivum L.*) varieties Akmola-2. Seeds sterilized by 15% sodium hypochlorite for 5 minutes, and then washed with distilled water. Seeds of wheat before sowing were primed at 6 hrs in 75 mM sodium molybdate or 75 mM sodium tungstate at room temperature. Seeds of control variants were primed in distilled water. Seedlings grown in manufactured soil («TERRA VITA», [www.torfo.ru](http://www.torfo.ru)) in plastic pots at 220C, 70-75% relative humidity and long-day conditions. The 1-week-old seedlings inoculated by urediniospores of fungus *Puccinia triticiana* Eriks. according to the procedure McIntosh et al. The explicit symptoms of leaf rust infection observed in seedlings on the 14th day of vegetation. In this period, leaves and roots' samples collected to determine the activity of molybdoenzymes - NR (spectrophotometric method), AO and XDH (method of native gel electrophoresis), and the hydrogen peroxide content in plant tissue (spectrophotometric method). All data processed statistically.

We have shown changes in the molybdoenzymes activity of spring wheat seedlings with molybdate or tungstate priming under leaf rust infection. NR, AO and XDH activities increased in the molybdate-primed plants by 1.5-2 fold compared with control. The increase in the activities of these enzymes associated with the active response of plants to biotic stress caused by leaf rust infection. NR, AO and XDH activities decreased in the tungstate-primed plants by 1.5 fold compared with control. The hydrogen peroxide content in molybdate primed plant tissues was lower than the control and tungstate primed plants, indicating that these plants better able to resist the effects of stress. Therefore, we can concluded that activation of these enzymes in wheat plants using pre-sown seed molybdo-priming improves resistance of wheat to a pathogen attack.

## **FRUCTOSE SYRUP IN SWEET SORGHUM**

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Sweet sorghum (*Sorghum saccaratum*), sugar beet, is a universal culture, raw materials which can be used not only in feed, but also in the food industry and for the production of biofuels. Sweet sorghum in their biological properties is characterized by great potential. This culture characterized by drought, salt-tolerant, ruggedness to different soil structure, high responsiveness to fertilizers and irrigation, the ability to effectively use the second half of summer rainfall and high yield of biomass. The biomass used in the green fodder to ensilage, and for sugar.

Sweet sorghum - a source of monosaccharides such as fructose and glucose. The sharp increase in interest in fructose due to the fact that it has several advantages compared with other types of sugars. Fructose - a natural monosaccharide, she is the sweetest sugar that allows to consume a smaller amount, and containing its products are suitable for both healthy people and diabetes. Over the past decade, an intensive growth of sugar substitutes. Replacing sucrose other substances related to its high energy and high digestibility. It is known that the excessive use of sucrose including a sugar products, especially at low physical activity, it may lead to serious disturbances of carbohydrate and fat metabolism. In this regard, the actual search is natural, organic sweeteners. These include sweet sorghum syrup, which is absorbed by the body more easily than regular sugar. As compared with conventional sweeteners such as fructose, it has several advantages. For example, crystalline fructose is not extracted from the fruit, and is synthesized by chemical means - by hydrolysis of sucrose, and polysaccharides (starch and cellulose), and the isomerization of glucose. This is not just refined and completely artificial, man-made product.

The objective of our research is to study syrups some varieties of sweet sorghum for breeding and selection of the most promising forms of high- monosaccharides (fructose and glucose ) as the most valuable carbohydrates used in the food industry .

Syrup grades Casket, Rostov, Early Ambe, Orange -160 produced by thermal evaporation, determined the content of total sugars and fructose. Total sugar content of the syrup (%) was measured with a refractometer , fructose Selivanova method . Revealed that the content of total sugars in the syrup with. Casket is 70%, p. Rostov 91 %, p. Amber Early 61%, p. Orange -160 73%. Number of shares of common fructose syrup with sugar. Casket 33% , p. Rostov 42% , p. Amber Early 18% , p. Orange -160 38% .

Thus, a greater amount of fructose and total sugars found in syrup three varieties of Rostov, Orange -160 , Chest and fewer in syrup Amber early .

**THE DISTRIBUTION PATTERN AND ACCUMULATION  
OF NICKEL AND ZINC IN *MIMULUS GUTTATUS* UNDER THE COMBINED  
ACTION OF NiSO<sub>4</sub> AND ZnSO<sub>4</sub> IN THE NUTRIENT MEDIUM**

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Increasing pollution due to heavy metals (HM) has become a serious environmental concern. Nickel and zinc concentrations in water and soil have risen as a result of human activities such as mining or production of wastewater. Nickel (Ni) and zinc (Zn) are the essential micronutrients. However, an excess of these metal ions is toxic to plant metabolism. Plants, like all organisms, achieve metal ion homeostasis in several ways. Although no less important than uptake and sequestration, the mechanisms controlling the correct distribution of metals into particular organs, tissues and cells of the plant have received less attention. Until now, the processes of HM ion partitioning on the whole plant level are not well characterized, especially, with regard to excess of two or some HM ions.

Because our research goal has been to define the pattern of metal ion partitioning, particularly Ni(II) and Zn(II), on the whole plant level under their combined action in the excess concentrations. The research has been carried out on the *M. guttatus* which is model system for the integration of ecological and genomic studies. After 4 wk of plant growth in Hoagland's solution containing NiSO<sub>4</sub> (20, 80 µM) and ZnSO<sub>4</sub> (50, 100, 200 µM), NiSO<sub>4</sub>+ZnSO<sub>4</sub> (20+100, 20+200, 80+50, 80+100 µM), where EDTA was not included, these plants were harvested and subsequently analyzed. Assay of the Ni and Zn contents were determined by means of atomic absorption spectroscopy. Assessment of HM ion movement was made by translocation coefficient which is proportionality between the HM content in mature leaves and the HM content in root.

At 80 µM the roots attained Ni concentration of 1564 µg g<sup>-1</sup>DW and the mature leaves did that of 176 µg g<sup>-1</sup>DW. At 200 µM the Zn concentration in the roots reached 12404 µg g<sup>-1</sup>DW, whereas that in the mature leaves did 924 µg g<sup>-1</sup>DW. The shoot concentrations of both Ni and Zn increased as the external Ni/Zn concentration increased, accordingly. Under the combined action of Ni and Zn ions a root concentration of Ni was observed to decrease reliably everywhere, whereas that of Zn only did where the molar ratio of Ni:Zn was 1.6:1. The root concentration decrease of Ni was coupled its concentration increase in the mature leaves and its translocation increase, accordingly. This effect was more pronounced at an increase of Zn concentration in the nutrient medium under the combined action. Ni did not influence a Zn translocation. At the Ni effects the Ni content was determined to be nearly equal in all aboveground parts (stems and leaves) but under the combined action that in the stems was not yielded and decreased 2-3-fold, as compared with the leaves. At all treatment variants tendency was detected to be the decrease of the Zn concentration from senescent to young leaves, whereas its stem concentration was authentically higher than this in the leaves. In contrast, in the control plants the Zn concentration was most pronounced in the young leaves, while its stem concentration was also higher than this in the leaves.

We conclude that under the combined action Ni and Zn compete for root uptake, as well as Zn effect a Ni translocation and there is change of the Ni distribution and accumulation on the whole plant level.

This research was funded by RFBR grant, project № 11-04-01305-a.

**SCREENING FOR SALT TOLERANCE IN RICE VARIETIES  
AND HYBRIDS AT AN EARLY SEEDLING STAGE**

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Plant resistance to salinity has a great practical importance for growing crops in saline soils. One of the problems of rice growing in Kazakhstan is the deterioration ameliorative status of soils under flooding. Most irrigated lands of Kyzyl-Orda region groundwater salinity ranges from 5-10 g/l. Thus predominates chemical composition of sulfate-chloride-sodium type of salinity, which is toxic to crops. Therefore researches of salt tolerance in rice varieties and the development of new morphological, physiological and biochemical methods of study and evaluate the selection of samples for resistance to salt stress are of great scientific and practical interest. The experimental material for the present investigation comprised of foreign and domestic varieties and F2 hybrids of rice.

Simple method of evaluation salt tolerance of plants is the using seedlings. Biomass accumulation at the chloride salinity type significantly was decreased compared to the control. It was shown that the investigated samples of rice differ by their resistance to salinity in the laboratory conditions.

The studies found that varieties Marzhan, Bakanassy, Serpantin and F<sub>2</sub> hybrids ♀ Hankaysky429 x ♂ Kurchanka, ♀ Kuban 3 x ♂ Col.sample 34-09, ♀ Darii 23 x ♂ Analog II,

♀ Bakanassy x ♂ Analog II exhibited high results (from 76 to 86%) of salt tolerance in chloride type of salinity.

Least by biomass accumulation as a percentage to the control at chloride salinity were characterized genotypes: Analog II, Madina, Darii, Regul, Col.sample .49-09, Liman, Col.sample 4-09, ♀ Darii23 x ♂ Col.sample 49-09, ♀Regul x ♂Kurchanka, ♀ Sonata x ♂ Liman.

Penetration of ions into cells and their accumulation in tissues of chloride salinity cause metabolic disturbances, and therefore changes the physiological state of the plant as a whole. This restructuring of metabolism leads to a corresponding growth rate reduction and biomass accumulation.

Thus, as a result of the screening of domestic and foreign rice varieties and their F<sub>2</sub> hybrids were screened for chloride salinity tolerance at seedling stage and revealed essential difference by salt tolerance.

**STUDY THE MECHANISMS OF ADAPTATION TO SALT STRESS  
ON THE LEVEL OF CELL CULTURE**

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Since the 70s of the last century it was established that the one of the promising approaches in the study of mechanisms of salt tolerance in plants is the use of cell and tissue culture methods (Stroganov et al, 1970). This approach is relevant now because cultured tissues have greater plasticity and adaptability to salt stress compared with origin intact plants. This may be associated with features of cytodifferentiation and intercellular communications, which include exchange by biologically active signal molecules. Due to insufficient knowledge of these issues at the level of cell and tissue culture, we have set the objectives to find out regularities of morphogenesis and cellular differentiation and to figure out histo- and cytochemical features of cultured tissues in the process of adaptation to salt stress.

As a result of screening more than 20 varieties and perspective wheat lines on the level of seedlings and seeds the varieties which contrast in salt resistance have been selected and used as objects for study of the salt resistance mechanisms at the level of cultured cells. The effect of salt stress (0.1%, 0.25%, 0.5%, 0.75%, 1.0%, 1.68% NaCl) on the processes of morphogenesis and cell differentiation *in vitro* of genotypes which contrast in NaCl resistance has been studied. In the resistant variety Kazakhstan-10 we found increased growth and embryogenic potential of tissues under the influence of concentration 0.5% NaCl, where in the salt sensitive varieties inhibition of growth and morphogenesis of calli were observed. It was found, that the distinctive features of salt tolerant calli of genotypes resistant to NaCl are the decrease of callus cells' length, the appearance of embryogenic cells of spherical shape, the initiation of embryos, the appearance of cells with signs of programmed cell death (PCD) or apoptosis. Extracellular polysaccharides and proteins released by cells with signs of PCD in the process of adaptation of resistant varieties' tissues to stress have been identified by histochemical and cytochemical methods.

In general, one of the possible cell mechanisms of adaptation to salt stress in the *in vitro* system has been identified: part of cells population degrades by PCD and releases extracellular substances of polysaccharide and protein nature during the death. These substances may have a protective and a growth-regulatory effects by stimulating the synthesis of protective callose coat in neighboring cells and by the formation of cells which competent to embryodogenesis. Also they inhibit the cells' growth by elongation and could switch their developmental programm on the path of mitotic divisions. All this may lead to the increased growth and embryogenic potential of resistant genotype' callus tissues under the salt stress.

This work performed under the projects of the Program of Fundamental Research MES RK (2003-2005), (2009-2011).

**IDENTIFICATION EXTRACELLULAR BIOLOGICALLY ACTIVE  
PEPTIDES IN WHEAT CELL CULTURE**

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The purpose of this research was to isolate fractions of extracellular peptides from wheat cell suspension cultures grown under the salt stress conditions (0,1%, 0,25%, 0,5%, 0,75%, 1,0%, 1,68% NaCl) and to study of their growth-regulating and protective physiological activities.

In the one-step assay it was revealed that extracellular peptides' fractions obtained under different NaCl concentrations were different in their qualitative composition of chromatographic profiles determined by reversed phase high performance liquid chromatography (RPh-HPLC) in variants with a maximum (1.68 %) and lower concentrations (0, 1-1,0%) of NaCl compared each other and control (no salt). Mass-spectrometric analysis of the fractions collected after RPh-HPLC allowed us to establish that they have molecular weights in the range of peptides (2,0-8,1 kDa).

Additionally, for the improvement of the quality of components separation we have been using a two-stage method of analysis based on the combination of liquid chromatography methods on molecular weight and hydrophobicity. Thus, exclusion chromatography of extracellular liquids' total extract in control and variants with 0.5 % and 0.75 NaCl allowed us to collect the prevailing fractions, which, according to mass-spectrometry, are components with masses ranging 5,0-7,5 kDa. These fractions were rechromatographed by RPh-HPLC method. When comparing the profiles of variants on the number of components and retention time, there were no differences between control and variant with 0,75% NaCl, whereas the spectrum of components in variant with 0,5% NaCl was different from control.

The study of biological activity of extracellular peptide compounds from variants with 0,5% NaCl, corresponding to weight in the range of 5,0-7,5 kDa and separated into fractions by RPh-HPLC on 9 peaks, has revealed their high physiological activity, which showed an increasing the survival of the test plants under the salt stress. Investigated fractions stimulated percent and energy of germination of mustard seeds, growth of roots and hypocotyls, increase in chlorophyll content and biomass accumulation of mustard cotyledons under the stress generated by sub-lethal dose of NaCl 0,75%, compared to control (0,75% NaCl, without adding peptide fractions).

It is important to point out that biological activity of fractions in conditions of salt stress was shown in the nano- and picomolar concentrations, and, in some cases, had saltatory character. Both of these features are characteristic of signaling molecules.

Thus, we have identified the extracellular fractions of biologically active peptides released by cultured plant cells in response to salt stress, which can act as signaling molecules that stimulate growth and protective processes under stress at the cellular level and whole plants.

This work performed under the project 11H in the frame of the Programm of Fundamental Research (F.0479) MES RK (2009-2011).

## STUDY THE CHEMICAL COMPOSITION OF EXTRACELLULAR POLYSACCHARIDES FROM WHEAT CELL CULTURE

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Monosaccharide composition of extracellular polysaccharides from wheat cell suspension culture was investigated by HPLC and GC-MS methods as a function of the hormonal composition of nutrient medium. It was revealed that the monosaccharide composition of polysaccharides (PS) isolated from the extracellular liquid of medium containing ABA consists of 87% of glucose and has the following ratio: Ara: Gal: Xyl: Glc: Man: GlcA: GalUA - 10: 4: 10: 160: 0,4: 0,02: 0,02. As the monosaccharide composition of the PS from the medium with ABA mainly consists of glucose, we can suggest, that ABA stimulates releasing of  $\beta$ - glucans into the extracellular medium.

Analysis of monosaccharide composition of the PS from extracellular liquid of medium containing 2,4-D showed an increase the amount of arabinose - 6-fold, galactose - 8-fold, xylose - 5-fold and glucuronic acid - 6-fold compared with the extracellular PS from the medium with ABA. Extracellular PS from the medium with 2,4-D have the following proportion of monosaccharides : Ara: Gal: Xyl: Glc: Man: GlcA: GalUA - 10: 6 : 10: 14: 1 : 6: 0. Data of HPLC analysis confirmed the results previously obtained by GC (Sartbayeva, Gunter, Bishimbayeva, 2010), about the composition of extracellular PS isolated from medium with 2,4-D of arabinoxylans, arabinogalactans and xyloglucans.

Acidic and basic fractions of the extracellular PS obtained using ion exchange chromatography have been analysed by HPLC. It was revealed that the acidic fraction has the cumulative effect of monosaccharides such as arabinose, galactose, xylose and glucuronic acid. Significant increase in the content of arabinose – 21-fold (from 2,2 to 46.4  $\mu$ g/ml), galactose - 26-fold (from 1,3 to 34,2  $\mu$ g/ml), xylose - 9-fold (from 3,0 to 27,0  $\mu$ g/ml) and glucuronic acid - 12-fold (from 0,4 to 4,3  $\mu$ g/ml) and significant decrease of glucose content - from 59,7 to 0,6  $\mu$ g/ml, were revealed in the acidic fraction in comparison with total fraction. On the contrary, decrease of the content of arabinose, galactose, xylose and increasing of glucose ratio were observed in the basic fraction, glucuronic acid was not determined.

Thus, we have identified the arabinogalactan enriched acidic fractions with the impurities of xylans, basic and neutral fractions enriched with glucose and total fractions comprising a mixture of arabinoxylans, arabinogalactans and xyloglucans have been identified. Mass spectrometry (GC-MS) analysis confirmed the monosaccharide composition of PS obtained by GC and HPLC methods, as well it was proved that the PS fractions are free from the impurities of 2,4-D and ABA phytohormones which were added into the nutrient medium of suspension culture.

This work was supported by innovative grant of NATD MIT RK (2012-2014.), International scholarship «Bolashak» for the scientific training abroad (2012 ).

**DIURNAL DYNAMICS OF PIP2-AQUAPORIN GENES EXPRESSION  
IN *SIUM LATIFOLIUM L.* UNDER DIFFERENT WATER SUPPLY**

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Water transport through plant cell membranes is provided generally by aquaporins - membrane proteins, that form pores in plasma membrane. Most numerous group of aquaporin family are plasma membrane aquaporins (PIP). This group is devided to PIP1 ta PIP2 subgroup. The PIP2 play important role in water transport across plasma membrane of the cells. The regulation of aquaporin genes expression level may be one of the mechanisms of regulation of the intracellular water balance during plant adaptation to varying water supply. The suitable objects for studying the water deficit effect on the expression of aquaporin genes are aerial-aquatic plants that capable to grow at terrestrial arias, close to ponds. Thus, terrestrial forms of these plants are affected by some water deficit events in comparison to aerial-aquatic plants during development. The aim of this paper was to investigate diurnal dynamics of PIP2 genes expression of aerial-aquatic and terrestrial plants of *Sium latifolium L.* using RT-PCR method.

The dynamics of PIP2 transcripts accumulation in *S. latifolium* leaves during twenty-four hours was demonstrated. The highest level of PIP2 expression observed during 6am to 12am in both aerial-aquatic and terrestrial plants. After 12am amount of transcripts significantly decreased. In the period of 15pm to 3am the PIP2 expression remained at low level. At 6am the significant increase of PIP2 expression was observed again. We expect that there is a specific mechanism of diurnal regulation of aquaporin genes expression and the increase of aquaporin genes expression at the first part of day is due to increased requirement of plants in water at this time, since the intensity of photosynthesis is increased in the morning. Another suggestion that the aquaporin genes expression is regulated directly by irradiation.

**EFFICIENCY OF DNA REPAIR SYSTEMS IN THE OPTIMIZATION  
OF SEED PRIMING PROCESS IN SUGAR AND RED BEET (*Beta vulgaris*)**

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Osmopriming is widely used in the world to improve seed material quality of agricultural and horticultural species. The aim of this research was to characterise nucleic acid metabolic events associated with priming, with the hope of identifying biochemical markers which could be developed into tests to determine the nearest point to germination to which a given seed lot can be brought safely by priming. This project can therefore be portrayed as a search for "safety markers" - readily and routinely measurable parameters that can reliably indicate the optimal stage of priming, i.e. where there is the maximum gain in germination performance with minimum loss of seed quality during storage. Whereas the differences between lots of commercial-quality seed of a particular variety may be relatively small, those between varieties and species can be considerable. For this reason, the quest for "safety marker" technology must be directed towards physiological responses of seed lots and varieties, as well as applicability to crop species of interest.

Experiments have been carried out on the seed of different hybrids of sugar beet and red beet, that was obtained commercially. We have confirmed first that seeds, whether primed or not, do not appear to lose their desiccation ("stress") tolerance until the initiation of cell division has occurred in the embryo. Loss of desiccation tolerance takes place first in the root cells of the embryo immediately above the quiescent centre. During priming of red beet and sugar beet, using what are currently regarded as "optimal" priming procedures, this vulnerable stage of the cell cycle is not reached in most cases. However, progressive degrees of over-priming facilitate the entry of a larger numbers of cells into a pre-cell division condition, which increases the vulnerability of these most advanced cells of the root tip to stress damage when the seed is dried.

Effect of the same priming conditions is not identical for various sugar beet hybrids and number of cells accumulated in G<sub>2</sub> phase at the end of treatment are differs. This also leads to the different viability of treated hybrid seeds after storage. It was shown that under optimal level of priming number of cell in G<sub>2</sub> with 4C DNA content should not exceed 15%. But the percentage of cells in the G-2 phase, although correlated with the level of priming - hardly suitable as molecular marker because its "best value" differ significantly for different plant species.

That is why we have analysed an integrity of DNA after different regimes of priming for sugar and red beet. It turned out that all treatments lead to an increased level of high molecular weight DNA in cells because of DNA repair function. However, during the drying of primed seed we also see accumulation of degraded (low molecular weight) DNA, concentration of which is proportional to the priming intensity. Using ratio content values of high to low molecular weight DNA in the embryos of treated seeds, it is possible to estimate priming quality and predict (to the certain extend) risk of overpriming. It is also shown that reparative DNA synthesis in the first hours of germination reflects DNA repair intensity for the damage accumulated during priming. Efficiency of repair in primed beet seed can be tested by introduction additional DNA damage into embryo cells via gamma-irradiation. Potential capability of repair systems to recover from such additional DNA damage together with measurements of DNA-ligase I induction can be used as a reliable molecular marker for priming optimisation of sugar and red beet.

**IN VITRO ARABIDOPSIS THALIANA ROOT CAP STRUCTURE  
UNDER CLINOROTATION****I.V. Bulavin**

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One of the most important environmental stimuli that control plant growth and development is Earth's gravity. In plant organs there are sites of its perception. It is known that a root cap is the site for gravity perception due to its formation and functioning actively investigated on Earth and in space flight to understand the influence of real and simulated microgravity on a graviperceptive organ. But the majority of such research were performed on embryonal roots *in vivo*. Therefore, we used the model "Rhizogenesis *in vitro*" for studying the root cap cell differentiation (especially graviperceptive cells – statocytes) under clinorotation.

*Arabidopsis thaliana* plants of wild type and *scr* mutant (№ 3999 by NASC database) were used. For rhizogenesis induction, rosette leaves with petioles were cut and transferred in Petri dishes on MS medium, contained 1/10 of MS mineral salt, without vitamins and hormones. One half of Petri dishes were placed vertically (control), the other - on a slow horizontal clinostat (2 rpm). For anatomical and ultrastructural analysis, roots formed *de novo* *in vitro* on leaf explants petioles were fixed in 2,5 % glutaraldehyde on 0,1 M sodium-cacodylate buffer at pH 7,2, and processed by the standard procedure. Semithin (0,5-1 µm) and ultrathin (55-65nm) sections were made on an ultramicrotome MT-XL (RMR Instruments, USA). For anatomy studying, sections were stained with 0,12% toluidine blue and examined with a light microscope Axioscope (Carl Zeiss, Germany). For electron microscopy, sections were stained with uranyl acetate and lead citrate and investigated with a JEM 1230 (Jeol, Japan) transmission electron microscope.

We showed that a root cap formed *in vitro* in *A. thaliana* wild type and *scr* mutant consists of columella and peripheral cells in the control and under clinorotation. In the cap columella there are meristematic cells, statocytes (graviperceptive cells), and secretory cells. Root cap length and width were similar in the control and under clinorotation. The ultrasructure of cap meristematic was typical for cells of this type. In statocytes, a nucleus was localized in the proximal part of a cell. ER clusters were detected in cell corners. ER separated cisternae were observed in the cell periphery along tangential cell walls. Mitochondrium size and shape varied. Amyloplasts–statoliths were localized in the distal pole of statocytes in the control. Under clinorotation, amyloplasts were in the cell center or distributed in the whole cytoplasm volume. Such amyloplast position indicates that statocytes do not execute their role as gravipeceptive apparatus. Structural rearrangements occurred similarly in statocytes under their transformation in secretory cells in the control and under clinorotation. A nucleus displaced in the cell center, and it was surrounded by amyloplasts. Dilated dictyosome cisternae produced mucilage. So, we can conclude that under clinorotation: 1) a root cap of the typical structure is formed *in vitro*; 2) columella cells pass all stages of differentiation; 3) statocytes are formed but did not function. On the basis of obtained data, a model "Rhizogenesis *in vitro*" is proposed for using in spaceflight experiments.

**CHANGES ANTIOXIDANT ENZYMES UNDER THE INFLUENCE  
GLYPHOSATE SUSPENDED CELLS ON POTATO**

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One early nonspecific responses plant organisms abiotic stressors, including herbicides, is an amplification process free - radical oxidation , leading to the accumulation of reactive oxygen species (ROS) which can lead to serious functional disturbances because the various components are damaged cells. The main defense against ROS is their inactivation of antioxidant enzymes such as superoxide dismutase (SOD) , ascorbate peroxidase (PO ) and catalase (CAT).

Glyphosate refers to nonspecific herbicide acting after plant emergence and widely used to control weeds . It has been shown that glyphosate causes oxidative stress in plants, pea , wheat and corn. At the same time an increase in the level of pro-oxidants and the activation of antioxidant enzymes.

In this regard we have examined changes in the activity of antioxidant enzymes in cells of the potato slurry effects of different concentrations of glyphosate (  $10^{-7}$ ,  $10^{-5}$ ,  $2 \times 10^{-5}$  %) after 6, 24 and 48 h after treatment.

It has been shown that the enzyme activity varied in the extracellular and cytoplasmic fractions depending on the concentration and duration of treatment with herbicide . It has been established that the greatest influence exerted on glyphosate SOD and CAT , wherein an increase in activity of 2-3 times at an earlier stage (after 6 h) at all concentrations tested as compared with the control. At high concentrations of SOD was observed for the second (after 48 h) upregulation . APO activated after 24 hours in both fractions at all concentrations 3-5 times exceeding the level of control.

The study showed that the antioxidant enzymes involved in detoxification of ROS to maintain redox balance, which contributes to the formation of protective responses of suspension cells of potato to herbicide .

**FEATURES OF FORMATION OF LEAF AREA PLANT HALOPHYTES  
IN THE CONDITIONS OF THE NATURE RESERVE «TIGROVAYA  
BALKА»**

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In the conditions of reserve « Tigrovaya Balka» (Tajikistan) to study the dynamics of formation of the leaf area halophyte plants during vegetation. The objects of study were 4 plant species of halophytes: camel's-thorn (*Alhage Canescens*), French tamarisk (*Tamarix ramosissima*), Ferghana wormwood (*Artemisia Ferganensis Krasce et poljak*), *Belangeriana* (*Halostachys Belangeriana*), which grow throughout the reserve, and are characterized by high biological productivity, are promising forage and therefore the local population for many years, their use as a highly digestible food.

During vegetation, measured the area of a single leaf (took the middle leaf) and the area of all leaves of the same plant.

The area of a single leaf between the studied halophytes there is little difference, analysis of the seasonal changes of rise (formation) of the leaf area of the four studied us halophytes it was found that the maximum size of the leaves of the plant was Camel's-thorn-521 2 in 2010. and 571 2 in 2011, a little less in the French tamarisk 396cm.2 in 2010 and 477.2.cm.2 in 2011, and Fergana wormwood and bélanger area was in 2.5-3 times less than Camel's-thorn and French tamarisk. If bélanger area was minimal in the beginning of the growing season (April-may), when the leaves have been reduced in small triangular scales, Fergana wormwood reduction of the area of leaves we have seen in the hottest period of the season (July), and by the end of the growing season, when the reduction of the surface of the leaves was due to drying. and dying leaves.

Thus, our studies have shown that plants are halophytes in conditions of arid zone, have managed to adapt to the formation of a small leaf surface vegetation period, probably as a result of various anatomic-morphological and physiological adaptations involving their species adaptability.

**WATER REGIME HALOPHYTES GROWING IN RESERVE  
“TIGROVAYA BALKA” IN TAJIKISTAN**

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State reserve «Tigrovaya Balka» is organized in 1938 year and located in the south-west of the Republic of Tajikistan in the floodplains of the rivers Vakhsh and Pyanj.

In recent years, renewed research reserve, especially us, conducted the study of morphological and biochemical parameters in salt- and drought tolerant plants to determine their adaptability to soil and atmospheric drought. Drought-resistant plants halophytes', not demanding to water, salt tolerance, but is very light.

Objects of study were 4 species of plants - halophytes: camel thorn (*Alhagi canescens Resel shop.ex Keller et Shop*), French tamarisk (*Tamarix ramosissima*), Fergana wormwood (*Artemisia ferganensis Krasch ex poljak*), Belangeriana (*Halostachys Belangeriana Mog.Botsch*), which grow throughout the reserve

Determined water retention capacity and the intensity of transpiration of leaves of plants, halophytes and daily dynamics and during vegetation.

Study of water-holding capacity of leaves showed that the leaves of camel thorn and tamarisk were characterized by relatively high water-holding capacity, the Fergana wormwood and Belangeriana under the same conditions saline desert much weaker hold water in the leaves.

It is shown that the highest intensity of transpiration in leaves daily dynamics observed in the middle of daylight 11h and 14 h, then by the end of the day in 17h with decreasing temperature, observed a decrease in water flow leaves. Among the studied plants - halophytes during vegetation maximum transpiration plant camel thorn and French tamarisk. Somewhat less water loss we observed in the leaves of Fergana wormwood and Belangeriana (*Halostachys Belangeriana Mog.Botsch*).

Transpiration intensity in the seasonal dynamics in all studied plants increased to a maximum in mid-summer in the maximum period of drought, then decreased water loss and held in different ways depending on the plant species , the timing of their vegetation and, more importantly, on the ability to show resistance to extreme environmental factors.

**PHENOLIC COMPOUNDS IN THE MECHANISM OF SALT  
TOLERANCE OF PLANTS**

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The phenolic complex of plants is highly susceptible to the salinity of the environment reflecting the degree of development of the salt stress. The results obtained allowed to identify one of the biochemical mechanisms of adaptation to the environment salinity resulting from the disruption of the phenol status of the plant. It was found that the phenolic complex (PC) of the studied plants of different species and varieties, and salt tolerance degree, have mainly similar type of variability expressed in disruption of quantitative content and qualitative composition of phenolic compounds (PS), redistribution in the bodies of plants and in the cell, unambiguous disruption of fractional composition mainly due to increase in the less polar free forms, enhanced generation of polymeric forms – lignin, the induction of oxidoreductases participating in phenolic exchange, in the formation of toxic compound – quinones in salt intoxication. The above indicates a single direction of the adaptation process, both in salt tolerant and non-tolerant plants in conditions of salinization. However, the response rate of the PS, including individual fractions and components is differentiated depending on the species and the variety, degree of salt tolerance, concentration, quality of salinization ( $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ ), and the qualitative composition of the PC. In less salt-tolerant plants, the quantitative and qualitative disruptions in the PC occur at lower concentrations of salts and in the narrow range. It was shown that characteristics of changes in individual components of the PC can be used in the evaluation of differences between varieties in terms of salt tolerance, degree of inhibition of plant growth, and quality of salinization. It was found that the environment salinity stimulates formation of lignine and changes the polymer composition of cell membrane, promotes the process of lignification, and as a result, the “ageing” of the plant cells. Along with glycophytes, the PC of halophytes (more than 30 species) in the dried bed of the Aral Sea have been studied. It was found that salt-accumulating species (euhalophytes) of the *Chenopodiaceae* family mainly synthesize flavonols and flavones, i.e. more oxidized forms, the accumulation of hydrolysable tannins along with flavonoids is typical for the crinothalophytes (*Tamaricaceae*), and accumulation of condensed tannins – for glycohalophytes (*Polygonaceae*). The specifics of qualitative composition of the PC of halophytes contributed to the formation of environmentally sustainable natural population. Thus, the revealed regularities in changes of the PC of plants under conditions of salinization indicate multifaceted nature of participating of the PS in adaptation and reveal possible ways and their role in the mechanism of salt tolerance and salt intoxication of the plants.

**ADVANCED TECHNOLOGY IN THE AREA OF THE PEDUNCULATE OAK (*QUERCUS ROBUR L.*) CONTAINERIZED SEEDLINGS GROWING****P. M. Evlakov, L.A. Ryazantseva, O. M. Korchagin**

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Pedunculate oak (*Quercus Robur L.*) is the main economically valuable species, dominating in the forest-steppe zone of Central Black Earth Region and taking a leading position in the field-protective forestation, it is also a plant-edificator. Voronezh Region is located in the South-West of the European part of Russia, between 49°34'N and 52°06'N and between 38°09'E and 42°54'E; it is a typical forest-steppe and steppe, according to natural zoning. Voronezh Region has temperate continental climate. The temperature swings, which are possible during the autumn, winter and spring months (especially during the early spring period), can cause serious damage to the overwintering seedlings.

One of the present worrying problem is the progressive oak forests deterioration within its areal such as dying-off, poor regeneration, lack of quality planting material etc. There is an advanced method proposed for the pedunculate oak containerized seedlings growing with the use of an “air root pruning”; according to this method the high quality seedlings will be produced and it will take only one year to get standard planting stock.

The correct choice of the type and size of the plant boxes forms the basis of containerized oak seedlings growing technology in Voronezh region.

Field and laboratory studies were conducted on the pedunculate oak seedlings, which were grown in the plant boxes of “Quick Pot” trademark, where the height of cells is 16, 18 and 20 cm and the volume of turf substrate is 330, 300 and 400 cm<sup>3</sup>. The plant boxes of BCC - Hiko V-150 Side Slit trademarks were used as a control; the height of cells and the volume of turf substrate were 10 cm and 150 cm<sup>3</sup>. Milled neutralized bog peat with a low degree of mineralization of “AgroBalt-N” trademark was used as a substrate. All the plant boxes were placed on special trestles. There was an air gap about 15-20 cm between the soil and the boxes, which provided a soft “air root pruning” and stimulated the formation of active root tips, which, in turn, if transplanting were ready for growth. Operations with solid containers made of high-quality plastics can easily be mechanized and automated, their service life period is more than 10 years.

These studies have shown that the plant boxes of “Quick Pot” trademark with a 16-centimetre cells height and 330-cubic centimeter volume of turf substrate are superior in growth characteristics. By the end of the 2012 and 2013 growing season up to 56% of high-quality seedlings (against 12-27% check experiment) can be formed while their preservation during the overwintering can reach 90%. Experimental data, confirming the normal process of physiological and chemical development of stem and root and their gradation from deep dormancy to induced dormancy and forth to the spring growth, turn up to be essential characteristics, showing as successful the overwintering was and as viable the seedlings are after it. These data include: characteristics of nucleic acids (DNA and RNA, their relations in the roots are twice as much as in the stalk: 1:14.4-9,5 against 1:5), decrease in amount of amyloid and normal anatomical structure of the stem and the root of the oak seedlings during the 2012 and 2013 growing season.

## EFFECT OF SHORT- AND LONG-TERM LOW TEMPERATURE TREATMENTS ON THE PHOTOSYNTHETIC RATE AND STOMATAL CONDUCTANCE OF *CUCUMIS SATIVUS* L. LEAVES AT DIFFERENT GROWTH PHASES

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Short-term exposures of plants to low temperatures differ from the long-term actions of suboptimal temperatures frequently encountered throughout the growing season by cold-sensitive crops planted at the low temperature margins of their geographic range (Allen, Ort, 2001). Furthermore, periodic short-term temperature drop is widely used present-day horticultural technique for plants grown in greenhouses and closed systems (Moe, Heins, 2000). Leaf age can influence the ability of a plant to acclimate to changed environmental conditions, particularly temperature. It is widely discussed that full cold acclimation can occur only in plant tissues developed at low temperature, and tissues shifted to cold cannot acclimate to the same extent (Atkin et al., 2006; Campbell 2007). The aim of this study was to establish whether the leaves at different (lag and exponential) growth phases differ in their ability of photosynthesis acclimation to long-term low temperature and short-term daily temperature drop.

Cucumber plants (*Cucumis sativus* L.) were grown at 23°C, 12 h photoperiod, a photon flux density (PPFD) of 120  $\mu\text{mol m}^{-2} \text{s}^{-1}$  and relative air humidity of 60-70% during two weeks. When the first leaf was about 75% of fully expanded leaf and the second leaf was at the lag-phase of growth some plants were continuously grown at 23°C (control), a part of plants was shifted to a 12/12°C day/night temperature regime (CLT-constant low temperature) and a part of plants was subjected daily to temperature decrease from 23 to 12°C for 2 h at the end of the night (DROP treatment). After the 6-day treatments, all plants were returned back at 23°C; here the second leaves were allowed to fully mature in warm. The net photosynthetic rate ( $A$ ) and stomatal conductance ( $g_s$ ) of the first and second leaves were measured with a portable gas exchange system at every 5°C from 8 to 33°C at PPFD of 200 and 800  $\mu\text{mol m}^{-2} \text{s}^{-1}$ .

CLT-treatment resulted to a decrease of  $A$  of both first and second leaves at all measuring temperatures at 200  $\mu\text{mol m}^{-2} \text{s}^{-1}$  PPFD and at high temperature at 800  $\mu\text{mol m}^{-2} \text{s}^{-1}$  PPFD. The DROP-treatment increased  $A$  for the first leaves at high temperature and for the second leaves at low and high temperatures leading to an increase of acclimation capacity of photosynthesis of DROP-treated plants. The temperature response of net photosynthesis of DROP-treated leaves was similar regardless leaf age during the treatment, but younger leaves had more ability to maintain higher photosynthesis at low and high temperature during the more prolonger time than older leaves. So, short-term periodic temperature drop resulted to acclimation of net photosynthesis for leaves of *C. sativus* leading to an increase in the photosynthetic rate at the wide temperature range. Stomatal conductance of leaves of all treatments was similar at optimal and suboptimal measuring temperatures. At high temperature (33°C)  $g_s$  values of the first and second leaves of DROP-treated plants were higher than those of control and CLT-treated plants. Such unusual response of stomata at high temperatures is possibly explained by abscisic acid redistribution in the plant (Kudoyarova et al., 2011).

The reported study was partially supported by RFBR, research project N 14-04-00840a.

**ROLES OF HISTONE ACETYLATION AND DEACETYLATION  
IN OXIDATIVE STRESS OF PLANTS****S.I. Jadko***Institute of Botany NAS of Ukraine, Kyiv, Ukraine*

The reactive oxygen species (ROS), including  $H_2O_2$ , in plant cells have double function: signaling and oxidative destruction. By signaling way the ROS can act as second messengers in induction of cell stress respond. First of all, the ROS can induce of antioxidant respond. ROS can induce early changes in acetylation and deacetylation of nuclear histones by changes in activities of histone acetyltransferases (HAT) and histone deacetylases (HAD). The HAT and HDA can participate in antioxidant respond too.

This study was aimed to investigate the role of ROS and  $H_2O_2$  in induction of antioxidant respond and changes in histone acetylation and deacetylation in tissue culture under osmotic stress.

12-14 days old tissue culture of *Arabidopsis thaliana* has been studied. Osmotic stress was produced by 20% solution of polyethylene glycol-6000 (PEG). After 240 min content of ROS (chemiluminescence intensity) and  $H_2O_2$  and activities of HAT and HAD were determined. 10 mM solution of ascorbate (A) was used to research of ROS-depending increasing of the enzymes activities. Protein content was determined according to Bradford. All experiments were repeated by 3-5 times. Experimental data were statistically treated.

Early increasing of ROS and  $H_2O_2$  contents, with follow-up increasing of HAT and HAD activities took place under PEG. But under A+PEG the amplitude of the stress increasing of ROS and  $H_2O_2$  were lower in 1,6-2,2 times with subsequent decreasing in activities of the investigated enzymes.

Thus, in reaction of tissue culture of *A. thaliana* to osmotic stress early increasing of ROS and  $H_2O_2$  take place. Than, the ROS/ $H_2O_2$  as second messengers induce of the antioxidant cell stress respond. The role of HAT and HAD in mechanism of the antioxidant stress respond is under discussion.

## HUMATES RAISE PHYTOREMEDIATIONAL POTENTIAL OF THE PLANTS

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Study of resistance and adaptation of the plants towards heavy metals is the most important aim of plant physiology. In spite of the big number of works, the mechanisms of plants' resistance to heavy metals is still unexplored. There are very few researches of the humates' influence towards phytotoxicity of the heavy metals (Semenov, 2009, Budaeva and others 2005). At the same time the protective function of the humic substances, which bound heavy metals and radionuclides, thus forming insoluble inactive complexes is well studied (Christeva, 1977 and others). In this connection the research of the nature and mechanisms of the humates' influence towards phytotoxicity of the heavy metals is of great interest.

The influence of the humic product from peat (Kalinnikov, Vashurina, Kyrdey, 2007) towards the adaptation of the plants of wheat (*Triticum aestivum L.*) of Pryokskaya variety to the high concentration of lead nitrate in conditions of the greenhouse experiment in hydroculture was studied. In prototype versions to the Hoagland's solution (Hoagland, Arnon, 1950) there was added the lead nitrate in concentration 1 to 2 mm/l and the humic product in concentration 0,005% according to the scheme of the experiment. The degree of plants' resistance was identified in the relation of dry weight of plants' aboveground organs by experiment and control (Udovenko, 1977). Protective action coefficient of the humate was calculated as a relation of weight of the organs of plants, grown using humic product and without humate. Regulation of the process of toxic ion build-up was estimated according to the ion content in roots (lower leaves) and above-ground organs.

As a result of the research there was found that humic product from peat fastens the growth of wheat plants – statistically proved growth of weight (at 56-84%) was observed before panicle stage. Plant resistance towards lead nitrate lowers with the growth of salt concentration – at 2 mm/l the level of metal resistance is half as much lower than at 1 mm/l during the stage of tillering and lower at 1,4 during panicle stage. The degree of metal resistance grows with the plants vegetation, which shows that the plants adapt to the stress factor. Coefficient of humic protective action is lower than 1 under lead nitrate concentration 2 mm/l during the whole vegetation of the plants, while it is under 1 mm/l lower during the stage of tillering and the stem elongation. This shows the growth of phytotoxicity of lead in the presence of humate. Obviously with the high concentration of toxic ions there's no protective effect of the humic products in the environment, which is characteristic of the low concentrations (Kyrdei, 2013). At the same time at the all variants of the experiment there were obtained viable seeds, while the whole amount of grains from plants, grown using humate was higher than that without the humate (3 times as much with 2mm/l lead nitrate).

There was shown the growth of lead content in the aboveground organs of plants at, 4,6-10 times with humates in root environment (up to 1200 and 4300 mg/kg of the dry weight with 1 and 2 mm/l of the lead nitrate accordingly). Therefore with the high concentration of lead nitrate – 1 and 2 mm/l – humate strengthens lead accumulation in the aboveground organs of wheat plants, thus growing phytoremediational potential of plants.

**DYNAMICS OF ACCUMULATION AND DISTRIBUTION OF SOLUBLE SUGARS IN THE STEMS OF SWEET SORGHUM**

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In areas with a hot and dry climate it is difficult to solve the sugar problem by sugar beet, and sometimes it is impossible. Sweet sorghum is an essential sugar plant as a drought-resistant, heat-tolerant and high-yielding crop in these conditions. Sweet sorghum plant is a tall-grown bush (200-350 cm) with sappy stems (up to 60% of total weight). Sweet sorghum stems yield is 50-55 t/ha. Biological features of this culture allow to get a good yield of green mass even on very poor soils and saline soils under loss of about 200 mm of precipitation per year.

The ability of sugar sorghum plants to accumulate a large amount of soluble sugars makes it a potential source of raw materials for the food industry. Sweet sorghum stalk juice is not inferior to juice of sugar cane in sugar content, but differs significantly in composition. If the juice of sugar cane contains only sugar (crystallizing sugar), then the juice of sweet sorghum except sucrose has a lot of fructose, glucose and soluble starch. High biological productivity and the accumulation of sugars in sorghum are associated with a particular, C<sub>4</sub> type of photosynthesis, allowing effectively assimilate the carbon dioxide of atmosphere.

This paper presents the research results on the dynamics of accumulation and distribution patterns of soluble sugars in the organs and the internodes of some sweet sorghum varieties grown in the conditions of south-east of Kazakhstan. Refractometric determination of the amount of soluble sugars in all studied varieties showed that it increases gradually with the growth and development of plants, peaking at the end of the vegetation, the phase milky wax and full ripeness of grain. It was observed that the content of soluble sugars is higher in lateral shoots than in the main. It was also revealed that the content of soluble sugars increased from the lower to the upper internodes, peaking at 7 and 8 internodes. Further, sugar content decreases again at 9 and 10 internodes. Domestic varieties compare favourably with sweetness and juiciness of stems, while foreign (USA, India, Russia) varieties with biological productivity due to intensive growth of aerial organs and enhanced tillering.

## EFFECT OF BACILLUS SUBTILIS ON CADMIUM UPTAKE IN TRITICUM AESTIVUM

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The effect of seed inoculation of endophytic bacterial strains *Bacillus subtilis* on the accumulation of cadmium ions in *Triticum aestivum* shoots, grown on the soil contaminated by cadmium, was investigated. It has been shown that inoculation of plant cells *B. subtilis* reduced the toxic effects of cadmium, which was manifested in terms of better growth at high concentrations of the metal.

Experiments were conducted in the laboratory. Seeds of *Triticum aestivum* L. (cv. Omsk 35) were sterilized in 96 % ethanol, washed with distilled water, and dried. The experiments used the bacterium *B. subtilis* strain 26D and strain 11VM. Seed treatment with bacteria was carried out in laminar box . In experiments using 20-hour culture of bacteria growing on meat-peptone agar at 37 °C. Bacterial cells were washed with a solution of 0.001 M KCl. The cell suspension was adjusted to the desired concentration by absorbance. 1 g of seed was treated with 20 ml of the bacterial suspension concentration of  $10^6$  cells/ml. Treated seeds were allowed to stand for one hour, then used in the experiments. Control seeds were treated with distilled water.

The inoculated and control seeds were grown in pots. The inoculated and control seeds grown in pots. Salts of Cd(NO<sub>3</sub>)<sub>2</sub>•4H<sub>2</sub>O were added to the soil in the form of a solution once after planting the seeds, at concentrations of cadmium ions 10 and 200 mg/kg of soil. Control plants were watered with distilled water. Plants were grown at 18-20° C under uniform illumination. The sampling was conducted on the 30th day from the start of the experiment.

The dry shoots were ashed in a mixture of nitric and perchloric acid (5:1 by volume). Cadmium in shoots was determined by atomic absorption spectrophotometry on the device Spectra AA 200 (Australia). All experiments were performed in three biological replicates.

The experiments revealed that the treatment with bacteria *B. subtilis* seeds has a positive impact on plant growth.

Plants inoculated with cells of *B. subtilis*, had higher biomass of shoots than untreated, and with increasing age of the plants, these differences become more pronounced. The heavy metal content in the soil at concentrations of 10 and 200 mg / kg has little stimulatory effect. Treated with the bacteria plants grew in the presence of cadmium better than untreated. Thus, at a concentration of 200 mg/kg weight of shoots treated bacteria *B. subtilis* strain 26D and strain 11VM was greater by 14 - 18%, and at a concentration of 500 mg/kg 10 - 14%, respectively.

There was a reduction of cadmium content in the shoots of plants treated with bacteria, in contrast to untreated. Thus, at a concentration of 10 mg/kg of cadmium in shoots treated with *B. subtilis* strain 26D and strain 11VM plants was lower by 21.5 % and 14 %, respectively, than the untreated, and at 200 mg/kg was lower by 14.4 % and 3.4%, respectively.

## ANTIMICROBIAL ACTIVITY OF CRUDE EXTRACTS FROM WILD PLANTS GROWING IN KAZAKHSTAN

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Biologically active substances of plants are represented by various types of organic compounds with a broad spectrum of pharmacological action , which is a subject of particular interest. On the territory of the Republic of Kazakhstan there are more than 6,000 plant species. With proper research they could become material source for creation and production of new original domestic herbal medicines. Given this testing biologically active compounds from Kazakhstan plants is a timely and challenging task.

Subject of the study was wild plants of Kazakhstan flora collected during expedition trips in Almaty region. Collected plants belong to different families: *Epilobium hirsutum* (Onagraceae), *Rumex confertus* (Polygonaceae), *Vexibia alopecuroides* (L.) Jakovl. (Fabaceae), *Sanguisorba officinalis* L. (Rosaceae Juss). The prospects of practical use may be associated with tanning and other biologically active substances.

Antimicrobial activity of crude extracts from above mentioned plants was evaluated using modified version of broth micro-dilution assays. The following strains of microorganisms were used as test objects: *Staphylococcus aureus* ATCC 29213, *Methicillin-resistant S. aureus* ATCC 43300, *Pseudomonas aeruginosa* ATCC 27853, *Candida albicans* ATTC 90028, *Candida krusei* ATCC 6258, *Candida glabrata* ATTC 90030.

The results of the present research clearly indicate that the antibacterial and antifungal activities vary with the plant species. Crude extract of *Epilobium hirsutum*, obtained from the aerial parts using dichloromethane solvent, demonstrated good activity against *Candida glabrata* (50 % inhibitory concentration ( $IC_{50}$ ) was 2  $\mu$ g /ml ), crude extract of *Rhodiola quadrifida*, obtained from the whole plant using dichloromethane solvent, demonstrated good activity against *C. glabrata* ( $IC_{50}$  2,9  $\mu$ g / ml), and *C. krusei* ( $IC_{50}$  9,2  $\mu$ g / ml ), the dichloromethane extract of *Rumex confertus* (roots) demonstrated good activity against *C. glabrata* ( $IC_{50}$  2,9  $\mu$ g / ml ). Ethanol extract obtained from the roots of *Sanguisorba officinalis* L., demonstrated activity against *C. glabrata* ( $IC_{50}$  2,47  $\mu$ g / ml ), *C. krusei* ( $IC_{50}$  8,7  $\mu$ g / ml ), and weak activity against *C. albicans* ( $IC_{50}$  19,2  $\mu$ g / ml). Only two dichloromethane extracts isolated from the roots of *Rumex confertus* and *Vexibia alopecuroides* demonstrated antibacterial activity. *Rumex confertus* demonstrated good activity against *Staphylococcus aureus* ( $IC_{50}$  10,8  $\mu$ g / ml) and *Methicillin-resistant S. aureus* ( $IC_{50}$  16,2  $\mu$ g / ml). Crude extract of *Vexibia alopecuroides* demonstrated the strongest antibacterial activity against *Staphylococcus aureus* ( $IC_{50}$  3,05  $\mu$ g/mL) and *Methicillin-resistant S. aureus* ( $IC_{50}$  2,9  $\mu$ g / ml).

Based on the research results plants were selected to produce drugs from their extracts.

## INVESTIGATION OF NUCLEIC ACIDS CONTENT IN THE TISSUES OF AGRONOMIC PLANTS AT EXTREMAL TEMPERATURE CONDITIONS

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Cold stress is a major environmental factor that limits the agricultural productivity of plants. Plants differ in their tolerance to chilling ( $0-15^{\circ}$  C) and freezing ( $< 0^{\circ}$  C) temperatures. Cold acclimation is associated with biochemical and physiological changes. Determining the nature of the genes and mechanisms responsible for freezing tolerance and the sensing and regularity mechanisms that activate the cold-acclimation response provides the potential for new strategies to improve the freezing tolerance of agronomic plants. Despite large achievements in the field of researches of physiology-biochemical bases of stability of plants to low temperature, the universal theory of adaptation to low temperatures and measures of prevention of disastrous action of not only negative temperatures, but also low positive temperatures, remain extremely inefficient. Therefore disclosure of causes of plant's death from low temperatures for the purpose of development of effective methods for increase the stability, represents one of the most important problems of plant physiology. These problems are very important for numerous Russian agricultural regions.

Influence of low positive temperature on the ratio RNA/DNA for series varieties of barley (*Hordeum vulgare L.*) and peas (*Pisum sativum L.*) was studied in our investigation. The plants for our study were grown during 5-6 days at  $+20^{\circ}$  (control) and  $+6^{\circ}$  C during 24 hours before the experiment at dark or light conditions.

It was shown that present varieties of barley differed in their response to low temperature. Steady to cold stress varieties were of low growth and low content of RNA (RNA/DNA=6,67). Unsteady to low temperature varieties were of intensive growth and more high RNA content (RNA/DNA=8,25). Inversely correlation between cold tolerance and RNA/DNA ratio was established ( $r=0,91$ ;  $P<0,05$ ). Plant's respond to cold stress correlated with their age: the more elder were shoots the more they were tolerant to low temperature. These conformities to natural laws were just for plants grown at light.

We suppose that it is possible to use RNA/DNA ratio for determination of freeze tolerance of agronomic plants in selection work. On the basis of the obtained data it is possible to draw a conclusion that the indicator of RNA/DNA can be used in practice of selection work for the purpose of receiving plants with a sign of freeze-and cold resistance. It is known that this indicator characterizes relative biosynthetic activity of cells, is one of kinetic parameters of a cellular differentiation. As data research has showed, the index of transcriptional activity increased under stress conditions in the tissues of plants of low resistant varieties in a bigger measure, than of resistant varieties (by 14-17% in relation to control). The similar picture was observed in comparing response to stress temperature conditions at summer and winter-annual barley (Toptikov et al., 2010).

**DROUGHT RESISTANCE INDICES OF CEREALS AND LEGUMES****T. Lee<sup>1</sup>, U. Orazbaeva<sup>1</sup>, Z. Spankulova<sup>1</sup>, S. Didorenko<sup>2</sup>, A. Omarova<sup>2</sup>**

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Under the condition of abiotic stress physiological and biochemical responses of the plants may be tested on many parameters: the activity of antioxidant enzymes - peroxidase (*POD*) and superoxide dismutase (*SOD*), accumulation of proline, the definition of relative water content (*RWC*). Study the functioning of antioxidant enzymes complexes that protect plants at the cellular level can reveal potential adaptation mechanisms of drought tolerance for plants.

Objects: 1) drought-tolerant medium-maturing wheat *Triticum aestivum* cvs. Severyanka, Alem and Miras, and as drought-sensitive Kaz-10;

2) drought-tolerant early-maturing maize *Zea mays* cvs. IKV-6 - Ukraine , Russia ; IK65 -I - Ukraine ; standard 05438 - Kazakhstan with vegetation period of 100-110 days. 3) ultra-early maturing cultivated soybean *Glycine max L.* cvs. from world collection: Ustya (Ukraine ), K589109 (Russia), K583583 (USA) with vegetation period of 85-95 days. As standard was used variety of domestic breeding - Almaty.

In condition of drought RWC in wheat leaves went down, however, dehydration occurred less dramatic for varieties Alem and Kaz 10. It was found that maize variety IK65 -I less exposed water shortage, compared with varieties 05438 and IKV-6, which were less drought tolerant in our experiments. Varieties K589109 and Ustya were less subjected to drought and more exposed – Almaty and K583583 .

Substantial changes in antioxidant enzymes activity were detected for wheat at the booting-heading stage of ontogenesis – SOD activity under drought stress was increased in all lines except Kaz10 standard, while POD activity was decreased; for maize at the 3-5 leaf and 20 days before throwing panicle vegetation stages *POD* activity under drought was increased in both vegetation stages, and *SOD* activity for cvs. IKV-6 and IK 65-I was increased on 25-45% respectively.

*POD* activity under drought for soybean cvs. was decreased at the flowering and grain filling stages, but *SOD* activity at the grain filling stage was increased for cvs. Ustya - 200%, K583583 -60%, K589109 – 20%.

Soybean plants exhibited an enhanced adaptation mechanisms and tolerance to drought compared with wheat and maize.

The correlative links were revealed between physiological and biochemical parameters of drought resistance and the main elements of yield structure which allow us to develop *adequate drought tolerance indices* for screening major crops – wheat, maize and soybean at the early stages of ontogeny.

Have been identified genotypes of wheat, corn and soybeans resistant to drought stress.

**IDENTIFICATION OF PROMISING SPECIES OF *ARTEMISIA L.*  
AS A PROSPECTIVE SOURCES OF FLAVONOIDS**

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At present a lot of attention paid to the search of plants containing biologically active substances (BAS). Among BAS, synthesized and accumulated by plants, are known classes of natural compounds such as alkaloids, phenolics and glycosides, terpenoids, polysaccharides, fatty oils, organic acids, vitamins, microelements. Search for new sources of flavonoids by the comparative study of *Artemisia L.* species ( fam. *Asteraceae*), growing in the deserts of the Almaty region, is an urgent problem of domestic pharmacology.

As a result of geobotanical studies of deserts flora of the Almaty region has been collected about 500 herbarium samples of promising species of *Artemisia L.* Morphological description of 8 promising species of *Artemisia* - *A. absinthium*, *A. dracunculus*, *A. sieversiana*, *A. vulgaris*, *A. terrae-albae*, *A. nitrosa*, *A. scoparia*, *A. juncea* was conducted.

Flavonoids extraction from the plants material was carried out in two ways: using a Soxhlet for 8 hours (cold extraction) and hot extraction for 3 hours. The results showed that the hot extraction is more efficient than using a Soxhlet extraction. Methanol, ethanol and acetonitrile were tested as extractants.

It has been developed a preliminary purification methanolic and ethanolic extracts of plants from the matrix. Column chromatography was proposed as the purification method. There were tested two adsorbents – florisil and silicagel. The extracts were passed through chromatography column for purification, followed by the elution with organic solvents having different polarity: hexane, chloroform, isopropanol and acetonitrile. Eluates from the column were analyzed using the technique based on the optimized HPLC. Optimized methods for extraction and purification were tested on plants samples selected during expeditions.

Identification of flavonoids was performed by HPLC with diode-matrix detection at the optimized parameters previously defined using a calibration curve. Chromatograms absorption spectra analysis showed that the samples containing compounds with double absorption peaks can be assumed that the samples contain the desired flavonoids.

It have been optimized parameters for extraction, separation and identification of flavonoids from the aerial parts of the plant - the extractant, temperature, pressure, and time of extraction - HPLC and gas chromatography with diode-matrix and mass-spectrometric detection.

**THE SUGARS REPRESSION OF GIBBERELLIN-INDUCED WHEAT  
GRAIN  $\alpha$ -AMYLASE**

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Wheat - one of the three major food grain crops in Kazakhstan. The quality of wheat is dependent not only on the quantity and quality of gluten proteins, but also on the carbohydrate- $\alpha$ -amylase complex of grain, which is largely determined by the activity and heterogeneity of  $\alpha$ -amylase.

The effect of various sugars on the GA-induced enzyme synthesis in isolated germ and aleurone layer of grains of soft wheat (*Triticum aestivum L.*) variety of Kazakhstan 10 had been studied. Freshly isolated embryos after 24 hours caryopses soaking were incubated in 5mM CaCl<sub>2</sub> and 1 mM GA<sup>3</sup> during 32 hours in the presence of sugars at the concentrations of 10 mM, 40 mM and without (control). Results of the study showed a mixed effect of different sugars to the hormone-induced formation of the  $\alpha$ -amylase isoenzymes. The greatest inhibition of  $\alpha$ -amylase in the noted embodiments to mannose, galactose and raffinose (70-60% at a concentration of 10 mM). Glucose, fructose, sucrose and maltose inhibit the enzyme to a lesser degree (50-40% at 10 mM concentration). Other sugars, lactose and mannitol did not provide explicit repressor action. The low sugar concentrations (10, 40 mM) used in the experiment allow to exclude osmotic pressure factor. Synthesis of  $\alpha$ -amylases in germ markedly more sensitive to the presence of sugars and the inhibitory effect was observed at low (10-20 mM) concentrations, while inhibition of the aleurone enzyme occur only at relatively high (more than 40 mM) of the sugar content in the medium. These results indicate a specific (repressor) nature of different sugars on embryo  $\alpha$ -amylase activity regulation and more less effect of them on the aleurone cells enzyme activity. It was also established that the phosphorylated forms of sugars are more effective  $\alpha$ -amylase repressors in comparison with non-phosphorylated sugars.

## FREE PROLINE AND TOLERANCE OF WHEAT AND BARLEY TO HEAVY METALS

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For grain advance to the world markets considerable interest submits the analysis of xenobiotics various influence, including the heavy metals (HM), on activity of grain crops. Metal stability research, search of physiology-biochemical indicators for an assessment of ecological safety of grain production belong to works, priority around the world.

The breeding wheat materials including winter, spring forms and facultative wheat in different ecological conditions on experimental sites of Kazakh Scientific Research Institute of Agriculture and Plant Growing. Laboratory researches on ions influence of  $Zn^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$  of metals (20 mg/l in a nutrient medium) on physiological & biometric parameters growing changes of 7 day sprouts of wheat were carried out in 2010-2013.

Many high level of a free proline was observed at ions action of  $Cd^{2+}$ . It is proved that  $Cd^{2+}$  ions are the strongest toxicants in comparison with  $Zn^{2+}$  that involves activation of cellular stress stability mechanisms. Faculty wheat differed with a high proline content in control that is caused by resilience to their extreme factors of the environment, so the increased adaptive potential. Under the HM influence there was a considerable accumulation of a free proline in cultivars as Kazakhstanskaja 10, Intensivnaja and Pamjat' 47 in winter option and Gedera 1225 summer option, especially under the influence of  $Cu^{2+}$  and  $Cd^{2+}$ .

It was found that cereals resistance to the action of  $Zn^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$  metal depends on the content them in grain, the growth conditions, a varietal and genotypic specificity. A number of stability of winter facultative wheat cultivars to studied metals is constructed: Cu: Pamjat' 47> Intensivnaja> Gedera 1225> Gedera 495> Gedera 152> Kazahstanskaja 10> Ruta; Zn: Intensivnaja> Gedera 495 > Pamjat' 47> Gedera 152> Gedera 1225> Kazahstanskaja 10> Ruta; Cd: Intensivnaja> Pamjat' 47> Gedera 1225> Gedera 152> Gedera 495> Kazahstanskaja 10> Ruta. Resistance of summer option facultative wheat cultivars to HM: Cu: Araj> Guadalup> Gedera 1225>Intensivnaja> Ruta> Pamjat' 47> Bonpen; Zn: Araj> Gedera 1225> Pamjat' 47> Kazahstanskaja 10> Intensivnaja> Guadalup> Ruta> Bonpen; Cd: Araj> Gedera 1225> Guadalup> Kazahstanskaja 10> Ruta> Intensivnaja> Pamjat' 47>Bonpen. Resistance of barley cultivars to HM: Cu: Chernigovskij 5>Doneckij 8>Bereke>Arna; Cd: Arna>Chernigovskij 5>Doneckij 8. It is demonstrated, that for the plants – exception, particularly for wheat and barley, are characterized by displaying of the "barrier", "accumulative" and "filtering" function of the root.

Agro-biological tolerance of the most important cereals in Kazakhstan – wheat and barley to the influence of HM is an extremely important issue. Questions with the most considerable interest are varietal specificity on the crops in relation to HM and the role of individual plant organs in their accumulation. It is shown that HM are among the most dangerous environmental pollutants, and the accumulation of various plants and individual organs of plants is subject to considerable variability. Knowledge of the physiological and biochemical mechanisms of metal tolerance in providing of general adaptability of crops is essential for establishing the leading role of this indicator in the index system of environmental safety of agricultural products.

**BIOCHEMICAL SYSTEMS OF PROTECTION IN FORMATION AND  
REALIZATION OF RESISTANCE MECHANISMS OF CEREALS TO  
BIOTIC AND ABIOTIC UNFAVOURABLE FACTORS**

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One of the priority tasks of modern biology is to reveal ways of forming plant resistance to unfavourable environmental biotic and abiotic factors, and the role in these processes of protection of biochemical systems. It is known that trypsin inhibitors, lectins, phenylalanineammonia-lyase, dehydrins, sucrose phosphate synthetase take part in the plant protection mechanisms to stresses of different nature. One of inducers of plant protective reactions is jasmonic acid which carries out the functions of a signal mediator and a plant hormone.

Conformities of changes of activity and component composition of the trypsin inhibitor, activity of lectins of cellular walls and phenylalanineammonia-lyase in plant varieties of wheat and barley which varying in resistance to *Fusarium spp.* upon infection of agents of fusariose and under the action of jasmonic acid has been studied in the Plant Biochemical Laboratory. The optimum terms of the action of jasmonic acid in which its maximum effect on the protective plant proteins have been established. The correlation of wheat varieties resistance with *Fusarium graminearum* whith the level of gene expression of plant lectins has been revealed.

It is shown that the influence of abiotic stressors (water deficiency, hyperthermia-hypothermia) causes the heterospecific and specific changes in the character of accumulation and redistribution of lectins of the cellular walls and dehydrin spectrums of wheat plants, according to the level of drought, heat and frost tolerance. It is presumed that the synthesis of these proteins is under the control of abscisic acid, an increase of which was observed in the wheat plants. The features of changes in the contents of sucrose and sucrose phosphate synthetase activity in the wheat, barley and corn seedlings in the conditions of water deficiency and hyperthermia in relation to the level of drought resistance of cereals lines and varieties have been establied. The results obtained and further researches will allow to perfect the existing methods of evaluation of plant - breeding material on resistance to unfavourable biotic and abiotic factors, they will become a basis for creating effective inducers of stimulation and management of the protective systems of cereal plants.

**FATTY ACIDS AND LIPIDS CONTENT IN *PISUM SATIVUM* SEEDLINGS PLASMALEMMA UNDER CLINOROTATION**

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The cytoplasmic membranes are participated in sensing and transfer of gravitational signal. However, the role of lipid components of plant cell plasmalemma at altered gravity are still unclear. The comparative study of content of phospholipids, glycolipids, sterols and fatty acids of plasmalemma that was isolated from *Pisum sativum* L. seedlings epicotyl and root in the stationary control and in conditions of imitated microgravity (horizontal clinorotation, 2 rev/min) was carried out. Roots are characterized with positive gravitropic reaction, and epicotyls - with negative ones, accordingly. The fraction of plasmalemma was obtained by the method of two-phase water-polymer system. The composition of fatty acids and lipid content in the plasmalemma fraction was analyzed with liquid thin chromatography (Agilent 1100). The differences in physical-chemical properties of the plasmalemma fraction obtained from roots and epicotyls in the stationary conditions and under clinorotation were established. The content of some fatty acids and content of phospholipids in epicotyl and root plasmalemma is changed under clinorotation. Particularly, the content of linolenic and myristic fatty acids is increased in epicotyls' plasmalemma under clinorotation. Whereas, the content of palmitic and oleic fatty acids is increased and stearic - is decreased in root's plasmalemma under clinorotation. It is established that clinorotation is provoked the increase of sterols in two and 3.3 times in epicotyls and roots plasmalemma, accordingly. The plasmalemma from roots was shown to be more sensitive to action of clinorotation in comparison with that from epicotyls.

**INFLUENCE OF SODIUM CHLORIDE SALINITY ON GROWTH  
OF SWEET SORGHUM VARIETIES**

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Salt tolerance of plants is an actual problem plant growing, attracting the attention of many researchers and practitioners in agriculture.

In agricultural practice, the most valuable is the annual cultural sorghum, divided into grain, sugar, broomcorn and herbaceous (Sudan grass).

For soils sorghum is undemanding. It is cultivated even on saline soils, which are often found in arid zones. Sorghum can grow in different soils, the most severe and even prone to water logging to poor lung depleted long-term use.

As shown by the results of studies Mamedbekova KK (1980) in Dagestan conditions, sorghum is a good culture ameliorating saline soils. Sorgo culture not only give high yields of grain and the green mass, but they are carried out of the soil of 31 to 75 t / ha of salts , including chlorides and sulphates. Rudenko, DM (1980) notes that the salt-tolerant sorghum culture so that when watering them with salt water from the Caspian Sea (salt content of 4.05 - 8.18 g / 1, salinity type - sulphate-chloride-magnesium-sodium), yield green mass while maintaining a threshold of soil moisture at 90 % of the HB was 527 kg / ha, whereas without irrigation - only 40 kg / ha.

There are various methods for determining the salt tolerance of plants. The most common ones are: 1) accounting for germination salination, 2) long-term study of plants on saline soils, and 3) the use of crossing pollen of plants grown in saline soils.

The objective of our research was to identify the high salt tolerance of sorghum samples, using the above methods of breeding for salt tolerance, in order to on saline lands and alkaline soils, commonly found in the south and southeast of the country, hardier crops of grain and green mass.

The aim of the study was to study the influence of sodium chloride (NaCl) on growth and some physiological characteristics sweet sorghum varieties (*Sorghum saccharatum Pers.*). The object of research was sweet sorghum: Kazakhstan-20, Rostov, Oranzhevoe 160, Kulzha. Sweet sorghum plants were grown in tap water in plastic bottles for 14 days. Plants were placed in solutions containing NaCl (0,3%; 0,6%; 0,9%) and without NaCl (control). Increasing salinity in medium was inhibited the germination of sorghum seeds. Rostov and Kazakhstan 20 plant varieties showed high stability, varieties Oranzhevoe 160 and Larez showed greater sensitivity to salinity. Salinization was inhibited seed germination, seedling formation, biomass accumulation processes and changed their distribution in organs, reduced content of photosynthetic pigments in the leaves, and led to the accumulation of proline in individual organs of sweet sorghum varieties.

## PHYTOREMEDIATION SOIL POLLUTED WITH ORGANOCHLORIDE PESTICIDES

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In Kazakhstan, a deepening ecological crisis has been caused by contamination of the environment with obsolete and expired pesticides. Large-scale physical and chemical technologies for managing pesticide contaminated soils are expensive and unacceptable for Kazakhstan because of limited financial resources. Phytoremediation is a promising innovative technology for managing pesticide-contaminated soils. Pesticide contamination is common on land surrounding destroyed warehouses that were part of the official plant protection service of the former Soviet Union.

The strategy for this project was to development remediation of pesticide contaminated soil with pesticide-tolerant wild plant.

In this study, pesticide analysis was limited to the organochlorine pesticides DDT (p,p'-dichlorodiphenyltrichloroethane) and HCH (hexachlorocyclohexane), along with their associated metabolites and isomers: 2,4 DDD (p,p'-dichlorodiphenyl dichloroethane); 4,4 DDD; 4,4 DDT; 4,4 DDE (p,p'-dichlorodiphenyl dichloroethylene;  $\alpha$ -HCH;  $\beta$ -HCH; and  $\gamma$ -HCH). While these pesticides represent only a subset of all obsolete pesticides, they are important due to their status as persistent organic pollutants and as compounds that represent a much larger problem.

Phytoremediation technology developed contaminated organochlorine pesticides , which consists of the following steps: estimation of concentration of pesticides in soil; epy development of an optimal sowing seeds schemes (the selection species composition of plants, schema definition planting, choice needed land treatment growing plants (the preparation of seed, land preparation, application of mineral fertilizers or regulators of growth ); harvesting of biomass plants; monitoring of sites ( accumulation and detoxification pesticides by plants); utilization of the harvested biomass through composting.

To identify pesticide-tolerant plant species, plant community structure was investigated at five former storehouse sites (Karasai and Talgar districts Almaty region). Observations of plant diversity at these sites show that each site had a different plant community structure. Plant species diversity in the zone of influence of pesticide-contaminated sites included more than 113 species of flowering plants (not including seasonal ephemeral species). Twenty five pesticide-tolerant species were identified/

In green and field experiments was identified as pesticide-accumulating plants *Amaranthus retroflexus*, *Artemisia annua*, *Ambrosia artemisiifolia* and *Xanthium strumarium*. They possessed tolerant in respect to pesticides, ability to accumulate pesticides in vegetative organs, concentration of pesticides in plant tissue exceeds MAC up to 293 times, to translocate pesticides in the system "soil - root - stem - leaves – fruit, some species reduced concentration of pesticides in the original soil to 28% of control, at the expense of phytoextraction and other species increased concentration of pesticides in the rhizosphere to 18%, at the expense of phytostabilization.

**AERENCHYMA FORMATION IN AIR-AQUATIC *ALISMA PLANTAGO-AQUATICA* L. AND *SIUM LATIFOLIUM* L. ADVENTITIOUS ROOTS**

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Plants in the natural habitats are adapted by various environmental factors. Aerenchyma formed in many species, both monocot and dicot, that occupy wetland habitats and it plays an important role for aerial-aquatic plants in providing an internal pathway for oxygen transport between roots and the aerial environment formed. Plants form aerenchyma using two different processes, either schizogeny or lysigeny, or by their combination. Schizogenous aerenchyma involves cell wall reorganization and cell separation, whereas lysigenous aerenchyma is formed as a consequence of programmed cell death (PCD) and cell wall autolysis.

The aim of this study was to carry out the comparative investigation of the structure and arrangement of cortical cells in adventitious roots of *Alisma plantago-aquatica* L. and *Sium latifolium* L. in order to understand better how aerenchyma is formed. *Alisma plantago-aquatica* L. (*Alismataceae*) and *Sium latifolium* L. (*Apiaceae*) which are aerial-aquatic plants and are distributed widely in Ukraine over a range of habitats - continuous flooded, transient flooded and free-drained soils. The light microscopic and scanning electron microscopic studies were carried out according to the traditional methods. Cross sections were stained with 0,025% toluidine blue and viewed with light microscope-AXIOSCOPE (Zeiss). In these species, as in other aerial-aquatic plants, adventitious roots are characterized with the presence of aerenchyma. It begins to form in the root proximal meristem on a schizo-lysigenous type and fully developed in the root mature part. In monocotyledonous *A. plantago-aquatica*, aerenchyma is surrounded with epidermis and one cortex layer on the root periphery and one cortex layer, which cells closely adjoined, and endoderm on the inner side. In dicotyledonous *S. latifolium*, a number of cortex layers, which surround aerenchyma on root periphery and on the side of a central cylinder, significantly increased, a secondary growth is typical for roots. In terrestrial plants: adventive roots are characterized with very small intercellular air spaces. It needs to note that presence or absence of aerenchyma is not constant and can vary in dependence on changes in water supply. In cases of increasing soil humidity due to long-term rainy weather or the regulation water level in river, the formation of new adventive roots with well developed aerenchyma begins in *A. plantago aquatica* and *S. latifolium* terrestrial plants.

The obtained data show a key role of the water regime in development of adaptive reactions for the formation and functioning of root systems in aerial-aquatic plants. Aerenchyma formation is accelerated in response to aquatic environments that typically contain small concentrations of oxygen. These species have developed the structural adaptation of its root system to the wetland habitats.

**WATER STRESS CHANGES THE CALLOSE CONTENT IN *SIUM LATIFOLIUM* L. LEAF EPIDERMIS AND MESOPHIL CELL WALLS**

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In connection with the anthropogenic influence and global change of climate there is an actual problem of plant adaptation to the environment, in particular, to flooding and drought. Water stress as a result of water deficiency in land, drought or flooding, causes a wide range of metabolic disorders. One of the mechanisms of structural and functional changes in leaf of above species may be the changes of callose content. Callose is a structural polysaccharide which is involved in water transport. We study the influence of natural changes of water regime on the content of callose in leaf blades of *Sium latifolium* L.

We investigated two ecological forms - air-aquatic and terrestrial plants growing in different conditions of water supply at the phases of budding and flowering-fruiting. In cell walls of epidermis and mesophyll of sheet plates, the relative content of callose was determined by cytofluorimetric analysis and fluorescence intensity of callose was determined by laser scanning confocal microscopy.

Cytochemical studies have shown that callose is typical polysaccharide of cell wall for all tissues of sheet plates of *S. latifolium* L. in the phases of budding and flowering-fruiting regardless of the water regime. Content of callose in cell walls is changed in dependence of tissue type, phase of ontogenesis and terms of growth of *S. latifolium* L. The cell walls of mesophyll and vessels contain the highest amount of callose. It testifies participation of this polysaccharide in the apoplast transport of water via mesophyll and vessels.

It is assumed that the callose acts as a molecular sieve through its small fibrillar structure and high water absorption, moisture reserves and it adequately regulates the entry and exit of various metabolites.

## GROWTH REGULATIVE AND PROTECTIVE ACTIVITY OF EXTRACELLULAR POLYSACCHARIDES FROM WHEAT CELL CULTURE

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Growth regulative and protective activity of extracellular polysaccharides (PS) isolated from wheat cell culture were investigated by the use of ten agricultural crops (wheat, barley, corn, rape, tomato, cucumber, watermelon, melon, soybean, cotton). For the investigation of growth-regulative activity seeds of agricultural crops were preliminary soaked into polysaccharide solutions in different concentrations (0,1, 0,01, 0,001 and 0,0001 mkg/ml). Then seeds were removed from polysaccharide solution and grew up in water during 5 days at 26 C° and 16-hours photoperiod. During the growth process we studied the energy and percentage of seeds germination, measured the length of shoots and roots. To identify the protective activity of PS, we determined for each crop sublethal doses of stress factors – salt and osmotic, initiated by different concentrations of NaCl and saccharose, accordingly. Seeds, preliminary soaked in PS solutions, were grown in solutions with sublethal concentrations of NaCl and saccharose.

Considerable differences in growth-regulative and protective activity of PS on various types of crops have been shown in the result of investigation. Very low (nanomolar) concentrations of PS – 0,001 and 0,0001 mkg/ml, showed stimulating effect on the seedlings growth of all investigated crops. As well as medium concentrations of PS – 0,01 mkg/ml, stimulated the growth of seedlings in tomato, barley and cucumber. High concentration of PS – 0,1 mkg/ml, stimulated the growth of seedlings in cotton and rape. In general, under the PS influence, the growth of shoots increased by 2-4 times, the growth of roots – from 0,5 to 5,5 times in comparison to control ( $H_2O$  without preliminary soaking in PS), depending on the crop. All tested concentrations of PS have shown to accelerate germination of seeds, particularly, very low (nanomolar) concentrations – 0,0001 mkg/ml. For example, percentage of germination for tomato, watermelon and wheat elevated from 50 to 100%, for rape – from 20 to 75%.

Under the salt and osmotic stress all PS concentrations have been found to be a physiologically active, in particular, in medium (0,01mkg/ml) and very low (nanomolar 0,001; 0,0001 mkg/ml) concentrations. During osmotic stress PS demonstrated protective activity as the growth of shoots increased 2-3 times, the growth of roots – 3-4 times, compared to control (saccharose without preliminary soaking in PS solutions). We have shown capability of extracellular PS to increase germination of seeds under the salt and osmotic stresses as well. Under the salt stress protective activity of PS was found in medium - 0,01 mkg/ml, and very low – 0,001 and 0,0001 mkg/ml concentrations. Seeds germination increased from 10-40% to 50-100%. Protective activity of PS during osmotic stress is being expressed in very low (nanomolar) concentrations – 0,001 and 0,0001 mkg/ml. Seeds germination, overall, increased from 12-35% to 60-75%, compared to control, depending upon the crop.

Obtained results allow to suggest the preparations of extracellular polysaccharides for implementation in biotechnology and agriculture as a biostimulators of plant growth and immunity with nanomolar activity.

This work was supported by the innovative grant of NATD MIT RK (2012-2013).

## EFFECTS OF NATURAL FACTORS ON CO<sub>2</sub>/H<sub>2</sub>O EXCHANGE OF WOODY PLANTS IN THE TAIGA ZONE OF NORTH-WEST RUSSIA

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The information about ecophysiological investigations of responses of woody plants (*Pinus sylvestris* L., *Picea abies* L., *Betula pendula* Roth.) to different natural and antropogenic factors in conditions of the north-western Russia is presented in this report. The principal aim of the research was quantification of the natural variation in the ecophysiological parameters (CO<sub>2</sub> gas exchange, water exchange, mineral nutrition) of Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) Karst.) and silver birch (*Betula pendula* L.) which reflect their capacity to adapt to the modern climate. By studying the patterns in the basic physiological processes against the background of variable hydrometeorological parameters we found the ranges of environmental factors (temperature, relative air humidity, and solar radiation rate) within which the metabolism in pine, spruce, and birch is most intensive. It was shown that the high rate of these processes was observed in a large range of the hydrometeorological factors, suggesting that species investigated was adapted to the wide range of growth conditions. The observed differences of investigated parameters of coniferous and deciduous plants under variation of external conditions are caused by specific features of the ecology, biology, and behavioral strategy of these species.

Photosynthesis and stomatal conductivity were parametrized for the Mixfor-SVAT model using the results of measurements for pine, spruce and birch growing under different conditions. The parameters of photosynthesis, respiration and stomatal conductivity in pine, spruce, and birch needles (leaf) were measured using the photosynthesis system LI-6400 (LI-COR Inc., USA) in sample plots of the Forest Research Institute, Karelian Research Centre of RAS. The field measurement setup included building of CO<sub>2</sub> and light curves for photosynthesis in leaves at different air temperatures, and determination of temperature-related patterns of dark respiration. The technique by Sharkey et al. (2007) based on CO<sub>2</sub> curves was used to calculate max carboxylation rate ( $Vc_{max}$ ), the rate of electron transport for acceptor regeneration at light saturation ( $J_{max}$ ), and the rate of triosophosphate utilization ( $TPU$ ), which reflects the availability of internal inorganic phosphates ( $Pi$ ) to the Calvin cycle. Temperature relations for  $Vc_{max}$ ,  $J_{max}$  and  $TPU$  were obtained by statistical analysis of the set of  $Vc_{max}$  and  $J_{max}$  values at different leaf temperatures using the equations proposed by a group of researchers (Medlin et al., 2002). Preliminary estimates of  $Vc_{max}$ ,  $J_{max}$  and  $TPU$  were derived from the temperature relations for the selected reference temperature of 25°C. The results of provided leaf photosynthesis, respiration, stomatal conductance and transpiration measurements were used in the process-based Mixfor-SVAT model (Olchev et al., 2002, 2008) to derive the possible response of CO<sub>2</sub>/H<sub>2</sub>O budgets of Karelian forest ecosystems to future climatic changes.

The study was supported by grant (13-04-00827-a) of the Russian Foundation of Basic Research (RFBR).

**ON THE PROBLEM OF RECYCLING PHYTOREMEDIANTS**

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Much effort is now being invested in the development of the methods for phytoremediation of soils contaminated with heavy metals (HM), based on the capacity of some plants to accumulate substantial amounts of HM in their organs. Studies have shown that maximal removal of certain HM from the soil by plants can be induced by regulating the doses of boric acid applied to the soil (Chernobrovkina et al., 2012). Apparently, one of the mechanisms through which boric acid application promotes HM uptake from the soil by plants is the involvement of boron in the formation of complex compounds with polysaccharide derivatives – pectin rhamnogalacturonan II, as the network is formed in the cell wall matrix (Kobayashi et al., 1996; O'Neill et al., 1996). Hyperaccumulator plants mainly accumulate metals in aboveground organs and in high concentrations. Application of this method would inevitably raise the problem of recycling the contaminated (including HM contaminated) biofilter plants. Agricultural utilization of such wastes is prone with the risk of including the contaminants in the food chain. Processing of such wastes into substrates and organic fertilizers for forestry, primarily for forest nurseries, is preferable (Zaitseva, 2004). Using such raw material for producing peat substrates one should make allowances for the ranges of tree seedlings' tolerance of chemical elements.

The study was based on the biotesting technique for germinating seeds in the inert medium and peat. Experimental data were treated to plot the regression curves of specific response functions for boron, nitrogen, zinc, and copper under constant incubation settings. The concentration levels corresponding to zone limits were calculated using the resultant regression equations for each of the elements. The upper and lower limits of the tolerance range were determined as the crossing points of the regression lines based on the pessimum zone data and the abscissa. The upper and lower limits of the optimum range were determined from the regression equations based on all data sets for the given treatment where the germination success was more than 70% of the maximum. The optimum ranges proved to be much wider in peat compared with the inert medium, and the tolerance ranges did not differ. The optimum range was the narrowest for boron. The elements in question – boron, nitrogen, zinc and copper, produce the greatest stimulating effect when the respective concentrations of the solutions are 25, 13, 200 and 20 mg l<sup>-1</sup> in the inert substrate and 31, 159, 40 and 50 mg l<sup>-1</sup> in peat.

**BIOCHEMICAL ANALYSIS OF SEED ORIGINAL PARENT FORMS  
AND HYBRID RICE**

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Creating their own highly productive glutinous rice adapted to local conditions of cultivation with useful economically valuable traits is necessary for the strategic development of agriculture and food safety of the Republic Kazakhstan. The first step is to deploy widely selection works on creation of new exclusive glutinous rice varieties that were previously not been done in Kazakhstan. It should be noted that the demand for glutinous rice on the world market is constantly increasing. Glutinous varieties are needed to create children and dietary foods that have high nutritional properties and biological values of organoleptic, physico-chemical and rheological parameters. The domestic rice markets in Kazakhstan completely absent glutinous rice cereals, therefore, the creation of domestic food products based on glutinous rice is timely and important issue.

In order to create the initial material for breeding of glutinous rice russia cultivars (Violetta and Viola) have been crossed with domestic varieties (Bakanassky, Marjane, Akdala) that are donors signs of resistance to abiotic stresses in rice growing regions in Kazakhstan.

Electrophoretic analysis have been conducted for establishing similarities and (or) differences of seed storage proteins in hybrids ( $F_2 \text{ ♀ Viola} \times \text{ ♂ Bakanassky}$ ;  $F_2 \text{ ♀ Violetta} \times \text{ ♂ Akdala}$ ;  $F_2 \text{ ♀ Viola} \times \text{ ♂ Marjane}$ ) with the parental forms. It is known that cereal storage proteins are inherited in a codominant and in the spectrum appear heterozygous genotypes depending on the dose of genes in triploid endosperm: two gene dosage from maternal and one gene dosage from paternal genome. The spectrum of the hybrid seed storage proteins noted the appearance of intense protein bands paternal form (Waxy protein) for example, a component with a molecular mass about 60 kDa, which is a confirmation hybrid origin of these lines.

In order to identify the perspective glutinous forms the hybrids were screened on amylose content. According to preliminary data, amylose content of fissionable lines are stabilized in combinations  $F_3 \text{ ♀ Violetta} \times \text{ ♂ Akdala}$  and  $F_4 \text{ ♀ Viola} \times \text{ ♂ Bakanassky}$  compared with previous generations.

Thus, in a result of comprehensive evaluation of biochemical parameters have been isolated and characterized glutinous perspective hybrids from different generations of combination. Currently part of glutinous grains sown for accelerated receipt of the seed progeny in the greenhouse conditions of IBBR.

**THE ROLE OF METHYLJASMONATE IN REGULATION  
OF PLANT GROWTH AND RESISTANCE**

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Scientists all over the world paid the special attentions to the problems of plant resistance to the extreme stress factors and different pathogens. Changes in the environment and invasions of pathogenic agents are recognized through signals from places direct factor impacts or wounding of plants. Plants possess greater chemical protection mainly secondary metabolites that are toxic to pathogens or herbivores too (Roshina and Roshina 2012). There are networks of signaling pathways by help of which the plants survive if develop adaptation strategies to the effect of the stressor. It is shown that jasmonic acid (JA) and methyl jasmonate (MeJA) of the lipoxygenase signaling system are regulatory substances that trigger systemic resistance of plants.

In order to understand how plants protect themselves from the harmful effects of stress, in particularly salt and rust we undertook a study of the influence of pretreatment of wheat seedlings and sunflower plants with methyl jasmonate in concentrations  $10^{-4}$ mM and  $10^{-5}$ mM before treating them with NaCl in concentrations 50,100 and 200 mM and inoculation with rust urediospores. Also we have studied the effect of methyl jasmonate on biomass accumulation of marine unicellular algae. We studied the rate of coleoptiles elongation, root and first leaf growth of wheat, rust infections of sunflower plants and growth of algae biomass in laboratory bioreactor. The results show activating and protective properties of methyl jasmonate on seedling growth of wheat on the accumulation of unicellular algae biomass and on sunflower plants infection.

Jasmonic acid and methyl jasmonate is natural substances, what are derived from oxygenated polyunsaturated fatty acids involving lipoxygenase (Vick and Zimmerman, 1984). JA and MeJA participate in the processes of growth and development (Greelman and Mullet, 1997), the signaling functions (Tarchevsky 1991; Grechkin, 1992, Wasternack, 2007) in response to salinity stress (Fedina, 1999), and act as biochemical insecticides.

There is a need to produce new products among them the plant secondary metabolites – natural insecticides, herbicides and fungicides for the future biotechnology development. The role of oxilipins in biotech elaborations for the development of new substances, and compositions as regulators of growth and resistance to stresses are discussed.

**INFLUENCE OF LIOFILIZATOM *AMARANTHUS RETROFLEXUS* L.  
ON PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF  
WHEAT SEEDLINGS ACUTE  $\gamma$ -IRRADIATED SEEDS**

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Radiomodifying study the action of various biologically active substances (BAS), derived from plants is one of the priorities of the radiobiological studies. To control radiosensitivity use different radiomodifying agents. Using extracts from vegetative parts of *Amaranthus. retroflexus* L., BAS containing antioxidant action may be modified by the action of the radiation reaction of acute  $\gamma$ - irradiation on animal and plant organisms .

The aim of this work was to study the effect of freeze-dried product *A. retroflexus* L. physiological and biochemical characteristics of wheat seedlings varieties "Yakutyanka-224" and "Prilenskaya-19" grown from  $\gamma$ - irradiated grains.

Wheat seeds were irradiated by gamma rays from  $^{60}\text{Co}$  dose rate 7 rad/s on the "Isledovatel" with a dose of 10, 200 and 600 Gy. Extract from vegetative parts of *A. retroflexus* L. was prepared by sequential extraction of 40 and 70 % water-alcohol solution with a further of its lyophilization. Treatment of seeds subjected to  $\gamma$ -irradiation PRESOWING carried out in aqueous solution freeze-dried product. Physiological parameters were evaluated by germination and seedling dry weight. The biochemical parameters of tissue seedlings activity of peroxidase, superoxide dismutase, the amount of low molecular weight antioxidants and malondialdehyde content. Radiomodifying effect was evaluated by "Factor changing the dose" (FCD), which was calculated as the ratio of equally effective doses in the presence and absence of radiomodifying agent.

Postradiation impact on lyophilisate wheat seeds had studied as radioprotective and radiosensibilization effect in terms of weight and total antioxidant protection of germ cells. There was a 20-30 % increase in dry weight of the seedlings by the action of 1.0 and 2.0 % aqueous solution and a 20-30 % increase in antioxidant activity in tissues from the seedlings are 30-40% decrease lipid peroxidation .

Factor changing the dose ranged from 1.0 to 2.5, therefore, the lyophilisate of *A. retroflexus* L., containing antioxidants, which we used in concentrations has radioprotective action that effectively removes postradiational defeat as on physiological, and biochemical levels.

## THE IMPACT OF HEAVY METALS ON GROWTH PROCESSES IN STEMS OF *BETULA PENDULA*

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Mechanisms of heavy metals entry, accumulation and distribution in tissues and organs of woody plants as well as changes in structure and functioning of tissues and individual cells attract attention of many researchers, especially in connection with problems of technogenic transformation of landscapes. The objective of this work was to study the influence of technogenic pollutants on morphometric characteristics of tissues in birch stems (*Betula pendula* Roth.). Birch stands in Krasnoyarsk forest-steppe, growing in the line of prevalent wind pollution by emissions of aluminium works and thermoelectric power stations may be considered as many years' reservoirs of technogenic waste. The quantitative parameters of heavy metal accumulation in birch leaves were determined and the influence of pollutant concentration in leaves on morphometric characteristics of stem tissues (xylem increment width, xylem rays and vessels frequency, vessel diameters) was established.

The study were carried out in 2006-2011 on monitored sample plots in birch stands in the line of prevalent wind pollution by industrial emissions of metallurgical works, thermoelectric power stations, cement works, lime-pits. For the comparison birch stands were chosen at the distance of 40 and 100 km from the town in a background conditions and out of the predominant wind direction.

In this study we used standard methods of ecology, chemistry and plant anatomy. Dust accumulation by birch stand components was estimated according to J.Detrie (1973). At the every sample plot a portion of birch leaves was collected from 5 model trees. Analyses of heavy metal concentrations on and inside leaves were carried out with programming analytical complex on the basis of roentgen fluorescent spectrometer "SPECTROSCAN-MAKS G". Morphological parameters of stem wood were measured under light microscope on cross sections of core samples from stems of 5 model trees on every plot (Yatsenko-Khmelevsky, 1954).

For revealing an influence of individual element from heavy metal complex on xylem growth processes the sample plots were combined into 4 groups by the method of cluster analysis on the basis of similarity of individual heavy metal concentration in birch leaves. Group K (control) involved plots with low and middle concentrations of all four elements. Group N (Nickel) formed from plots with maximal nickel concentrations and middle values of strontium, zinc and chrome. Group ZC (zinc and chrome) was characterized by high levels of zinc and chrome and low ones of strontium and nickel. Elevated accumulation of zinc in birch leaves at sample plots of this group were accompanied by high concentration of chrome, correlation coefficient between amounts of these elements was found to be significant ( $R=0,56$ ,  $p < 0,1$ ). Group S (Strontium) consisted of plots with high quantity of strontium and low and middle ones of other elements in leaves.

The differences in combinations of heavy metal concentrations were found to cause some changes in amount and structure of wood increment in birch stems. Increasing accumulation both strontium and zinc in leaves involved decrease of annual ring width and vessel diameters, but increase of ray and vessel frequencies. High content of nickel was shown to associate with decreasing of average vessel diameter and increasing of ray frequency.

**WATER REGIME PARAMETERS OF FLAG LEAF  
AT CULTIVARS, SPECIES AND INTERSPECIFIC HYBRIDS  
OF WHEAT**

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Water regime plays a critical role in the adaptation of plants to drought. In South- East of Kazakhstan greatest effect of soil and atmospheric drought on crops observed in the period from earing to grain filling. Since the flag leaf is the main producer of assimilates involved in grain filling, high interest rate of hydration of flag leaf during drought.

Water-holding capacity of flag leaf at this largely reflects an adaptive metabolism and determines the resistance of plants, allowing them to withstand dehydration, the differences in this indicator between contrasting forms of stability are preserved in all conditions of water availability.

Experiments were conducted to determine the total water content and water-holding capacity studied varieties, species and hybrids of wheat in the field.

Revealed that the overall water content of all forms studied was high enough , the greatest - the species *T. turgidum* L. (75.3 %), grade Leningradka (73.8 %) and hybrids *T. turgidum* x Saratovskaya 29 - F2 (1 type morphologically cleavage) (73,2%), *T. turgidum* x Leningradka F4 BC1 (type 1) (74.2 %) and *T. compactum* L. x Leningradka F4 BC2 (type 1) (77.94 %).

However, with the loss of water wilting flag leaves the samples studied was different. Maximum water holding capacity of leaves in this experiment were characterized hybrids *T. turgidum* x Saratovskaya 29 - F2 (Type 1) - 77,8%, *T. compactum* L. x Leningradka F4 BC2 (Type 1) - 70.05 % and *T. compactum* L. x Leningradka F4 BC2 (type 2) - 62.86 %. Since the sample having a greater water-holding capacity in drought conditions at the same or higher total water content of the leaves is considered more drought-resistant, isolated in the experiment hybrid forms should be classified as the most drought-resistant in the second half of ontogenesis.

## INFLUENCE OF DIFFERENT CONCENTRATIONS OF SODIUM AZIDE (NAN3) ON SOME PHYSIOLOGICAL AND BIOCHEMICAL INDICATORS OF GLUTINOUS RICE VARIETIES

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Necessary element of rice breeding in Kazakhstan is the enrichment of biodiversity in the collection of source material using chemical mutagens. Studies in recent years have shown the efficiency of sodium azide in rice breeding. Therefore, to increase genetic diversity and studies of the effect of sodium azide on physiological and biochemical and economically useful indicators the grain of glutinous rice varieties "Viola" and "Violet" was treated with mutagen - sodium azide ( $\text{NaN}_3$ ) at three concentrations: 1 mM, 3 mM, 5 mM. The seeds were kept in the mutagenic solution for 8 h at room temperature  $28\pm2^\circ\text{C}$ . After the treatment time is over, the seeds were thoroughly washed in running tap water for two hours to remove the chemical present in them and were germinated in thermostat ( $27^\circ\text{C}$ ). Rice seedlings were moved into pots and were grown in the greenhouse until full maturity of seeds. Seed germination percentage was reduced in all samples by increasing the concentration of mutagens. Concentration 3 mM caused decrease in germination varieties to 38/23% (cultivar Viola and Violetta, respectively), it is at a concentration of 5 mM was 13/14%. The measuring of the seedling height at stages 4-5 leaves showed that the concentration of sodium azide (1 mM, 3 mM, 5 mM) are not significantly affect to the plant height. But at 5 mM concentration at tillering stage rice varieties Viola and Violetta occurred 2 days later compared to control. Accounting for an average flag leaf area ( $\text{cm}^2$ ) showed that the mutagenic treatment at three concentrations was not significantly affected and was at the control level. Chlorophyll content were determined at the tillering and booting stages. At the 1 mM concentration in the cultivar Viola chlorophyll content increased 1.5-2 times at the tillering and booting stages compared to the control, while in the cultivar Violetta chlorophyll content were increased 3 times only at the tillering stage at the same concentration. By increasing the concentration of 3 mM and 5 mM chlorophyll content were reduced of both varieties. At the full ripeness stage plants were selected for the determination of amylose content and analysis of the structural elements of the crop (tillering, plant height, panicle length, number of spikelets per panicle, number of grains per panicle, length of roots, weight of 1000 grains). By increasing doses of mutagen the amylose content in the cultivar Violetta was increased in all treatment samples compared to the control, but this regularity was not observed in the Viola cultivar. It was shown the differences between control and treatment plants by the number of sterile spikelets and grain weight of the main panicle, 1000 grain weight and shape of the grains. Further study and selection of promising mutant forms will be held in  $M_2$  generation under greenhouse and field conditions.

The results of studies were revealed the perspective forms for inclusion in a further breeding process to create domestic glutinous rice varieties.

## ELITE SEED MATERIAL OF THE HIGHLY PRODUCTIVE FORMS OF KOK SAGHYZ

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The problem of natural rubber deficit on the world market has brought up the spotlight to the natural rubber producing plants, which could serve as an alternative to the rubber tree (*Hevea Brasiliensis*). Among the wide range of natural rubber producing plants, rubber extracted from kok saghyz (*Taraxacum kok saghyz*) is the closest in terms of quality to the benchmark rubber tree produce. Kok saghyz is an everlasting grassy plant from the aster family. This endemic Kazakhstani plant, grows in the Eastern Tian Shan, is included into the Endangered-species list of Kazakhstan.

Currently, the US, Canada, European Union, China and Russia conduct intensive research on developing industrial size crops of kok saghyz in order to provide rubber producing industry. In it advised to use the genetic resources of kok saghyz from its natural center of origin for industrial use. In accordance with the abovementioned factors, the goals of the research were: collection of the seed material in natural populations from the botanically authentic samples, introduction, selection of highly productive forms, and obtaining of elite seed material of kok saghyz. The results of the research could be used for genetic selection research, creation of seed bank, international exchange of germplasm and commercial use.

The research was conducted using samples of natural populations of kok saghyz in Almaty Region, Kazakhstan. Naturalization of plants on the experimental area of the Biology and Biotechnology of Plants Institute (Almaty) was conducted exclusively with seeds from natural populations. Rubber from the roots of kok saghyz was extracted through alkaline extraction.

*Kok saghyz* dandelion possesses high level of environmental plasticity and in natural conditions grows in various conditions, from mountainous chestnut brown alkaline and saline soils to moist, alkaline, shore crushed stony soils. Condition of the natural populations is stable.

We conducted research on naturalization of kok saghyz for seed propagation. Seeds were planted in the end of April. First seed crop was gathered in June, second in July and third in August of 2013.

Naturalized plants have 72-80 seeds from one flower, compared to natural plant's 45-48 seeds. Moreover the mass of the naturalized plant's seeds increased 2.5 times, compared to natural plants.

Wide polymorphism of rubber content in kok saghyz roots was determined from 2 to 16 %. Elite seed material from kok saghyz forms with high rubber content.

Therefore, as a result of our research, we obtained elite seed material of highly productive forms of kok saghyz, which could be used for research and preservation of biodiversity, genetic selection research, creation of seed bank, international exchange of germplasm and commercial use. Elite kok saghyz seed material could be used on the industrial scale.

This publication is produced as a part of "Obtaining High Productivity Forms of *Taraxacum kok-saghyz* Rodin. - Domestic Producer of Rubber" project, funded by Technology Commercialization Project, supported by the World Bank and the Government of the Republic of Kazakhstan. Statements contained herein do not necessarily reflect the official views of the World Bank and the Government of the Republic of Kazakhstan.

**ANATOMICAL FEATURES OF LATERAL ROOT FORMATION  
IN *BUTOMUS UMBELLATUS* AND *SAGITTARIA SAGITTIFOLIA*****I.V. Zhupanov, V.O. Brykov***M.G. Kholodny Institute of Botany of NASU, Ukraine*  
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It is well known that lateral roots (LR) in angiosperm plants are initiated from pericycle cells in the parent root mature zone. However, there are some terrestrial plants e.g. *Cucurbitaceae* and *Polygonaceae* species, and aerial-aquatic ones, in which LRs originate in the root apical meristem. We studied the LR formation in adventitious roots of *Butomus umbellatus* and *Sagittaria sagittifolia* aerial-aquatic plants, growing in the river Psel in Poltava region, Ukraine, by using the methods of light and electron microscopy. Root apices were fixed in 2,5 % glutaraldehyde on 0,1 M sodium-cacodylate buffer, pH 7,2, and processed by the standard procedure. Semithin (0.5–1 µm) and ultrathin (55–65 nm) sections were made with an ultratome MT-XL (RMR Instruments, USA). For anatomy studying, sections were stained with 0.12% toluidine blue. For electron microscopy, sections were stained with uranyl acetate and lead citrate. Samples were investigated with a light microscope Axioscope (Carl Zeiss, Germany) and JEM 1230 (Jeol, Japan) transmission electron microscope.

We showed that lateral root primordia (LRP) are initiated in the apical meristem of adventitious roots only from pericycle cells at the distance of 350 µm from the root apex. The first morphological event related to the LRP initiation is the radial enlargement of initial pericycle cells. Periclinal divisions of pericycle cells were founded at the distance of 400 µm from the root apex in *B. umbellatus* and 500 µm in *S. sagittifolia*. LPR growth rate considerably increased at the distance of 1–2 mm from the root apex. The ultrastructure of LPR cells was similar to that of meristematic cells. At the distance of 4 mm from the root apex, LRP consisted of 7–8 cells layers and were differentiated on three histological zones: 1) protoderm that consisted of small, closely located, isodiametric cells, 2) periblem (future cortex) formed by relatively large, round or oval cells, and 3) plerome (future central cylinder) that consisted of closely situated oval or elongated cells.

It was also shown that LRP growth occurs in two phases. At the first phase, cells actively divide, and LRP differentiate on three histogenic zones. At the second phase, LRP growth become considerably slower. LRP reach the parental root surface in the mature zone at the distance of 6–8 cm from the root apex. The possible connection of such patterns in LR development in aerial-aquatic plants with their ecology is discussed.

# **Session 4.**

# **Plant Cell and Genetic Engineering**

**THE INTERACTIONS OF PLANT ORGANELLES ON GENE LEVEL:  
RETROGRADE REGULATION AND REDOX SIGNALING**

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During ontogenesis in plant cells the mechanism of effective coordination of nuclear, plastid and mitochondrial genomes expression operates under continuously changing environment. This regulatory mechanism, from one hand, involves nuclear control of expression of chloroplast and mitochondrial genes (so-called “anterograde regulation”). From another hand, there is so-called “retrograde regulation” directed from chloroplasts and mitochondria to nucleus to provide feedback between the cytoplasm and nucleus and to supply the information about the functional state of organelles. The results of studies of retrograde regulation of *Arabidopsis thaliana* *gdh2* gene expression will be presented. Expression of *Arabidopsis thaliana* nuclear gene *GDH2* encoding glutamate dehydrogenase subunit depends on a redox state of electron transport chain (ETC). Treatment of *Arabidopsis* cells with respiratory inhibitors for complex III or IV led to rapid increase of transcript content. Complex I inhibition had no influence on the transcript level. We suggest that *gdh2* expression responds to changes of redox state of the respiratory chain segment located between complex I and complex III. It seems that the revealed effect is not due to elevated generation of ROS occurring upon the electron transport chain blockage, because cell treatment with hydrogen peroxide and paraquat did not lead to *gdh2* induction. Sugar starvation or ATP depletion cannot be the main factors in regulation of *gdh2* because oxidative phosphorylation uncoupling by FCCP did not mimic the effects of antimycin A or prolonged dark treatment. Some chloroplast-to-nucleus regulatory signals can be initiated by redox state of plastoquinone pool and mediated by thylakoid membrane-bound protein kinases. We assume that a similar mechanism would exist in mitochondria-to-nucleus signaling, so that *gdh2* expression would depend on redox state of ubiquinone pool. The involvement of serine/threonine protein kinases in the antimycin-related *gdh2* induction was demonstrated as an ultimate step in transduction of the regulatory signal to nucleus. We investigated also the influence of alternative oxidase (AOX) protein level on transcription of chloroplast genes using transgenic *Arabidopsis* plants with a reduced and elevated AOX1a content (Zubo et al., 2014). The results obtained showed that the treatment of these plants with inhibitors of the main and alternative electron transfer pathways causes opposite changes in the transcription intensity. As a whole, the involvement of AOX, which is located in mitochondria, in the regulation of transcription of chloroplast genome, indicates that AOX plays a key role in the mitochondria-chloroplasts interactions.

The work was supported by RFBR (12-04-01148-a) and SB RAS (Integration project 59).

## **A NOVEL STRATEGY FOR CONTROL OF PLANT VIRUS DISEASE**

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Viruses cause major losses of crop productivity worldwide. These losses directly impact incomes of farmers and their quality of life. The problem is more acute in marginal farming where use of agrochemicals is limited or nonexistent.

We at the University of Nebraska in the U.S. have developed a simple, unique, and effective one-step approach to control all plant viruses in any given crop. This strategy has the potential to minimize pandemics of plant virus diseases and virus losses, and will have an immediate and sustained impact on farmers.

As part of a study on expressing multiple open reading frames in a single cistron, we serendipitously discovered a unique transgene silencing phenomenon that we called direct repeat-induced gene silencing (DRIGS). During the DRIGS experiments we observed that in our transgenic lines a non-targeted marker gene routinely became totally silenced if it was adjacent to a gene that we targeted for silencing. We initially called this ‘Silencing–Relay’ which was later termed transitive silencing. Recent studies indicate that transitive silencing is caused by production and amplification of secondary siRNAs from sequences (genes) adjacent to the target sequence and is responsible for the observed silencing of a non-targeted gene.

This unique approach can be extended to eliminate virus disease losses from all relevant crop plants including maize, rice, beans, chickpeas, groundnuts, cassava, sorghum, millets, and yams. Successful deployment of our approach has far-reaching implications for farmers everywhere as resistance against virus diseases will be significant, broad-spectrum, and durable.

**GENETIC MODELS OF RNA SILENCING AND ITS SUPPRESSION BY PLANT VIRUSES**

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RNA interference (RNAi) in animals; initially introduced as post-transcriptional gene silencing (PTGS) in plants, commonly represents an evolutionary conserved pathway that operates as a regulatory developmental mechanism to down-regulate gene expression. RNAi in higher plants presumably also evolved as a natural host-defense response for selective recognition and subsequent degradation of invading viruses. The initial and triggering event in RNAi is the generation/synthesis of double-stranded (ds) RNA. The next functional step of RNAi involves the action of Dicer like enzymes (DCL)-(members of the RNase III family) that catalyze the generation of short (21-30 nucleotide (nt)) interfering RNAs (siRNAs) with signature 2-nt overhangs at the 3' ends containing 5' monophosphate and 3'-OH groups.

Recent studies in plants indicate that methylation of siRNAs also seems to play an important functional role by protecting these molecules from oligouridylation and subsequent degradation. The methylation of siRNAs occurs on the 2'-OH at their 3'-terminus, and this enzymatic modification is catalyzed by HUA ENHANCER1 (HEN1) methyltransferase.

In a subsequent step of RNAi, siRNA duplexes contribute one of the strands to the multicomponent effector unit referred to as the RNA-induced silencing complex (RISC). While incorporated into RISC, the siRNAs function as guiding "search-primers" to direct nucleotide sequence-specific recognition of the targeted transcripts and their subsequent enzymatic hydrolysis or translational repression. The base paring between siRNA and target RNA ensures effective and sequence-specific recognition of the target. Evidence suggests that siRNAs and Argonaute family (AGO) proteins represent the universal components of RISC. Conserved signature motifs of AGO proteins are referred to as PAZ and PIWI, and structural studies of the PAZ domain revealed that AGO directly interacts with the small RNA in RISC. To enable this, the PAZ interacts with the 3' ends of siRNAs, and this occurs for AGO, as well as for DCL that also contains this domain. The PIWI domain of AGOs represents the key catalytic entity of RNAi because it has the capacity to cleave the targeted RNA.

In response to host-defensive RNAi, viruses developed specific strategies to combat this protective surveillance system. It is now known that as a most effective countermeasure against RNAi many viruses encode proteins (viral suppressors of RNA silencing (VSRs)) that interfere with the host-enforced defense system in order to block (or to a certain degree compromise) silencing-mediated degradation of cognate RNA. The expression of VSRs by viruses to combat this sophisticated host-surveillance system in plants is used to argue that RNAi may have originally evolved as a molecular immune mechanism against viral pathogens.

Many viral proteins currently known as VSRs were initially identified as pathogenicity or virulence factors, since their expression modulates symptom severity in viral infections. For the most part they are not mandatory for replication but required for successful virus accumulation and spread during infection. Although a wide array of viral proteins exhibit VSR activity, the precise modes of their biochemical activities have only recently begun to unravel. For instance, latest molecular, biochemical and structural studies of diverse VSRs provided valuable insight into detailed mechanisms of silencing suppression. It turns out that these proteins interfere with various steps of the RNAi pathway and represent examples of a complex and intense "evolutionary battle" between viruses and plants. The co-evolution between virus-encoded VSRs and the host RNAi machinery also illustrates the intricate nature of pathogen adaptation to the host-defense system.

**MOLECULAR MECHANISMS REGULATING PRIMING OF PLANT  
INMUNITY BY BENEFICIAL SOIL MICROORGANISMS**

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Beneficial soil microorganisms (BSM) are frequent in nature and confer major benefits to plant fitness and ecosystems dynamics. They are able to promote plant growth and increase the plants' ability to cope with biotic and abiotic stresses. In particular, some microorganisms are able to enhance plant resistance to potential deleterious organisms including microbial pathogens, phytophagous insects and parasitic plants. During the interaction of the plant with BSM a mild but effective activation of the plant immune system may occur. This activation can lead to a primed state of the plant that allows a more efficient activation of defence mechanisms in response to attack by potential enemies that results in Induced Systemic Resistance (ISR). Analysis of the molecular mechanisms underlying this ISR reveal the key role of the signaling pathway coordinated by the plant hormone Jasmonic acid. The characterization of effective BSM and of key regulatory elements in the signaling pathway regulating ISR open multiple opportunities for the development of biotechnological strategies to improve plant resistance to stresses.

**ADVANTAGES OF USING HAPLOID TECHNOLOGY IN THE PROGRAMMES OF CLASSICAL WHEAT SELECTION**

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Implementation of haploid technology in combination with the methods of classical selection allows us to select varieties and hybrid individuals with valuable economic traits.

Currently in China over 20 varieties of wheat varieties Jinhya № 1, 2 are registered which are characterized by high productivity.

In Europe the DH- lines are used for rye and forage grasses, selection of which is suffering from inbreeding depression.

In Russia haploid technology in combination with conventional breeding is successfully applied in the Southeast for Agriculture and WALS. Saratov scientists showed that varieties developed using DH- lines have a high resistance to drought conditions in the Volga region.

In Kazakhstan under creative collaboration of S.Seifullin Kazakh Agro Technical University with the Institute of Plant Biology and Biotechnology, SPC GF named after Barayev A.I. and Karabalyk breeding centers purposive hard work to integrate dihaploid lines in the selection process is being conducted.

Seed generation of regenerated plants was tested under field conditions in different ecological zones.

To expedite the selection process hybridization with lines and forms that are characteristic of drought resistance donors was carried out. Lines significantly exceeded the standard for productivity on 2.9-3.6 t / ha in terms of Akmola region. Lines exceeded the standard were transferred to the reproduction test in LLP "Karabalyksky AES." In terms of Kustanai region AR45 line on productivity yielded standard varieties Karabalyksky 90 and length of growing season ripened for 3-4 days later and it was to be expected since there was the other ecological zone. Weather conditions of Kostanai region differ greatly on weather conditions of Akmola region and complex polygenic traits depend on ecological and geographical area. According to V.A. Dragavtsev multilocus epistasis effects vary from year to year in the same geographic location and change limiting environmental factor changing the number and variety of genes that determine the mean and variance of genetic dispersion characteristic. Lines in anther culture were selected for drought tolerance and Kostanai area is more moisture region than Akmola district.

Thus, on the basis of conducted research a technological chart which skillfully combines traditional and biotechnological methods that can be applied to other crops to improve their genetic basis was developed.

**THE EFFECT OF MUTATION IN THE *AtTOR* GENE ON ACTIVITY OF ENZYMES INVOLVED IN ABSCISIC ACID BIOSYNTHESIS IN *ARABIDOPSIS THALIANA* UNDER SALT STRESS**

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TOR (*target of rapamycin*) kinase is present in most species of higher eukaryotes and plays a key role in the regulation of growth and development of organisms and the formation of the metabolic response of the cell to the action of various stress factors. In mammalian cells, mTOR acts as the catalytic subunit of two functionally distinct complexes, called as mTOR Complex 1 (mTORC1) and mTOR Complex 2 (mTORC2).

In plants, there are some members of the TOR complexes (raptor and mLST8 / GBL), substrates TOR and TOR signaling up regulators. *Arabidopsis* encodes two LST8/G $\beta$ 1 homologues (*At3g18140*, *At2g22040*). The TORC1-specific protein Raptor/KOG1 is encoded in two copies in *Arabidopsis* - AtRaptor1A (*At5g01770*) and AtRaptor1B (*At3g08850*). The TORC2-specific proteins Rictor/AVO3 and hSin1/AVO1 are not found in any available plant sequence. In *Arabidopsis*, the kinase activity of S6K1 was found to be inhibited by osmotic stress, suggesting that the TOR signal pathway can be enabled in the regulation of metabolism of plant cells in response to stress factors. It was found that hypo- and overexpression of AtTOR genes in *Arabidopsis* affects the size of the cells and organs of plants, number of seeds and resistance to osmotic stress. Plant growth is positively correlated with the expression level of TOR genes in *Arabidopsis thaliana*. Suppression of AtTOR expression by RNA interference leads to stop the growth and development of plants. AtRaptor1B-/- embryos are hypersensitive to various stress conditions. Under salt stress disturbed water and ionic homeostasis at the cellular level as well as at the whole plant. Despite the large number of experimental studies of TOR regulation of cellular processes in plants, some issues of participation the signaling system in the physiological processes of plant organisms remain poorly understood. For example, have not been investigated relationships between TOR and abscisic acid (ABA) on adaptation of plants to stressful environmental conditions.

In this study was examined the role of TOR kinase in the physiological mechanisms of adaptation of *Arabidopsis thaliana* to salt stress by using a different mutant lines in AtTOR gene: *GK-548G07.01*, *GK-548G07.07*, *GK-548G07.12*, *Agrik line* - 35-7, *SALK\_7846C*, *SALK\_147817*, *SALK\_7654*, *SALK\_146186CL*. The expression level of TOR in mutants was determined by RT-PCR. The area of rosette leaves increased gradually as the expression of AtTOR was augmented, and a comparable increase in epidermal cell size was observed. In case of TOR – hypoexpressing lines was detected small size of leaves. It was found increased activity of aldehyde oxidase and xanthine dehydrogenase in mutant lines under salt stress. Based on activity of these enzymes participating in ABA biosynthesis we suggest that TOR kinase can act as a negative factor of ABA biosynthesis regulation under certain conditions.

**FRUIT TREES TRANSFORMATION METHODOLOGY  
AND APPLICATION**

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Fruit crops are an especially suitable target for improvement through direct gene manipulations because of the genetic limitations associated with high heterozygosity and polyploidy which hamper the conventional breeding programs. Fruit crops are an especially suitable target for improvement through direct gene manipulations because of the genetic limitations associated with high heterozygosity and polyploidy which hamper the conventional breeding programs. Recent developments in biotechnology have provided an alternate approach to horticultural crop improvement through the introduction of genes encoding desirable traits. Most research to date has focused on genes conferring resistance to viruses, bacteria, insects and fungi. Recently attention has also been given to genes that regulate such characters as freezing tolerance and fruit taste.

The development of reliable regeneration systems from somatic tissues is a prerequisite for the application of gene transfer techniques to improvement of woody species. High regeneration frequencies of commercial apple, pear, plum and sour cherry cultivars as well as pear and apple dwarf clonal rootstock have been achieved in our laboratory. Efficient transformation methods for these cultivars were also developed by usage different transformation protocols and selective agents. Positive selection based on phosphomannoseisomerase genes (pNOV35S-GFP, Syngenta) was used for production of marker free transgenic plum trees, that very important for improve its attractively for consumers. Herbicide resistant fruit rootstock is a new way conferring selectivity and enhancing fruit crop safety and production. The *bar* gene cloned in have been used in our research for obtaining phosphinotricine-resistant apple and pear clonal rootstocks. For fruit taste improvement of important temperate horticultural crops apple and pear, the gene of supersweet protein thaumatin II from *Th. danielli* has been transferred to apple and pear cultivars by usage agrobacterial strain CBE21 and vector pBI121thau based on the coding sequence cloned in Unilever. Fruit taste modification was observed in three transgenic pear lines contained *thaII* genes. Degree of sweetness correlated with expression of the gene. For improving resistance for one of the most serious disease of stone fruits - sharka or plum pox, two technologies were used. One based on co-suppression and another on RNA-silencing. Seven independent transgenic lines of Startovaya with *ppv-cp* gene and six transgenic lines of cultivar Startovaya with a two inverted repeats of *ppv-cp* gene fragment were produced. After grafting by PPV infected buds in all control and *ppv-cp* transformed Startovaya plants were detected by Western blot analysis lines corresponding PPV coat protein, whereas no any spots corresponding PPV coat protein were observed in samples from plants transformed "hairpin" construct. These preliminary results confirmed efficiency of RNAi strategy for protection plants from virus attack in general, and for stone fruits from PPV particular. Since 2000 year most of resulted transgenic plants are testing in field conditions.

*Key words:* fruit trees transformation, herbicide resistance, taste improvement, virus resistance.

**Keynote**

**CISGENIC WHEAT TO ADDRESS PUBLIC CONCERNS OVER GMO**

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Genetically modified (GM) or transgenic plants, first grown in 1996, covered an area of 1.7 million hectares in the USA alone. In 2013, the cultivated area of GM crops in 27 countries has already exceeded 175 million hectares, which is more than 10% of the world's arable land.

Opinion polls conducted in Europe and the USA have shown that one of the main problems for potential consumers of GM products is the presence of alien genes in them, originating from different organisms that do not interbreed naturally. Recent studies in the EU countries showed that up to 70% of Europeans support cisgenic technologies that produce improved crops expressing only their own genes and/or the genes from the crossable plant species.

Cisgenesis has the advantage over conventional breeding in that it is able to produce new varieties of crops where only selected beneficial genes are transferred with no other genes nearby on the chromosome that may be detrimental to performance. In conventional breeding, multiple backcrosses must be performed, each taking at least several months to create a new cultivar. Cisgenesis can achieve the same results in a fraction of the time but more importantly, it can produce expression variants of native genes that cannot be achieved by conventional breeding.

The ACPFG is focused on the use of cisgenic technologies to produce herbicide resistant wheat plants expressing the wheat genes regulating abiotic and biotic stress responses.

**CELL, TISSUE AND ORGAN CULTURE OF *HEDYSARUM THEINUM*  
KRASNOB. AS A SOURCE OF BIOLOGICAL ACTIVE SUBSTANCES**

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*Hedysarum theinum* (red root) possesses a unique phytochemical composition that determines a wide range of its medicinal activities: anti-inflammatory, antibacterial, spasmolytic, immunoprotective, antioxidant, etc. As a result of mass harvesting, *H. theinum* is an endangered species, its extremely slow growth makes this species especially vulnerable. Valuable curative properties of *H. theinum*, limited distribution and biological peculiarities are preconditions for development of biotechnological methods of its cultivation.

The starting material for *in vitro* culture were seeds of *H. theinum*. Callus culture was obtained from seedlings, they were divided into 2 types of explants – shoot and root and grown in two ways – the correct position of the explant and inverted. For callus culture media were tested: MS + NAA 20 µM + BAP 1 µM, MS + 2,4-D 5 µM + BAP 1 µM, B5 + NAA 20 µM + BAP 1 µM, B5 + 2,4-D 5 µM + BAP 1 µM, B5 + 2,4-D 10 µM; BDS + NAA 20 µM; BDS + 20 µM BAP. Callus were cultured in flasks in the dark at 24 ± 2 °C with an interval of 28 days.

Culture «hairy roots» *H. theinum* prepared using the soil bacterium *Agrobacterium rhizogenes* strain 15834 Swiss. After 24 hours of incubation explants with *Agrobacterium*, the plant material was washed with culture medium and transferred on MS medium, containing 500 mg/l cefotaxime for elimination of *Agrobacterium*. When the culture «hairy roots» were clean, explants were transferred to a liquid medium S and grown on a shaker in darkness at 24 ± 2°C.

Found, that the response of explants was dependent on all considered factors (composition of the nutrient medium, the type of explant, and its position on the medium). Steadily growing callus culture could be obtained from the root and stem explants of origin in an inverted position on a nutrient medium BDS + 20 µM NAA and B5 + 2,4-D 10 µM. In the exponential growth phase of the cells entered the 9th day of cultivation, stationary - on the 24th day.

Thus, we selected growth media types and explant culture methods make it possible to obtain from the primary explants steadily growing callus cultures, which can later be used in the work on the selection of high yielding strains of suspension cultures *H. theinum* *in vitro*, the study of their properties and productivity. Introduction *in vitro* culture of genetically transformed roots *H. theinum*, which are grown under controlled conditions, while maintaining a high growth rate, can be considered as a potential source of biotechnological environmentally pure raw materials.

**THE EXPRESSION OF M2E PEPTIDE OF AVIAN INFLUENZA VIRUS H5N1 IN TRANSLATIONAL FUSION WITH SUBUNIT B OF RICIN IN THE TRANSGENIC TOBACCO AND DUCKWEED PLANTS**

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The aim of this study was to express M2e peptide from avian influenza virus A/chicken/Kurgan/5/2005 in duckweed for following development of edible veterinary vaccine. The 30 amino acids N-terminal fragment of M2 protein including M2e peptide and 6 residue of the transmembrane domain was selected for the expression (hereinafter M130). The non-toxic B subunit of ricin (RTB) was used as an adjuvant. The M130 nucleotide sequence optimized for expression in duckweed plants was cloned in translational fusion with the 3'- end of RTB. The sequence of the signal peptide of tobacco PR1 protein (Sp) defining the fusion protein transport to the apoplast was added to the 5'-end of the RTB-M130. The fragment encoding chitin-binding domain (CBD) of chitinase A was added to the 3'-end of Sp-RTB-M130 for further optimization of the quantity of antigen in the plant extracts using chitin affinity matrix. Obtained construct Sp-RTB-M130-CBD was cloned into the plant vector pBI121 instead of  $\beta$ -glucuronidase gene. The resulting plasmid has been successfully used for transformation of duckweed; 14 lines of the transgenic plants have been obtained. Western blot analysis showed the target protein expression in 12 transgenic lines. The target fusion protein was detected as a single band around the 80 kDa that corresponded to protein expressed as a dimer (the expected weight of Sp-RTB-M130-CBD is 38 kDa to take no account of RTB glycosylation). Western blot using anti- RTB, -CBD and -M2e antibodies confirmed the presence of all these fragments in fusion protein. The quantitative asialofetuin-binding ELISA of the crude protein extracts from transgenic duckweed lines confirmed expression of functional RTB-containing fusion protein, its accumulation in different lines ranged from 0,008 to 0,043 ng per  $\mu$ g of total soluble protein. These values are equivalent to yield 1,0-2,2  $\mu$ g of Sp-RTB-M130-CBD protein per 1 g FW of duckweed plants. Further we are going to assess the immunogenicity of the obtained fusion protein on the animals

**Keynote**

**MOLECULAR MECHANISMS OF PROTEIN BIOSYNTHESIS  
REGULATION IN PLANTS**

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Earlier we have shown that in plants the molecular mechanism of activity regulation of the key translation initiation factor 2 (peIF2) differs from that in mammalian cells. We established for the first time that affinity of peIF2 to GDP ( $K_{dGDP} = 150$  nM) only 10 times higher than to GTP ( $K_{dGTP} = 1500$  nM) whereas for the similar factor of mammals (meIF2) such a difference is of two orders of magnitude ( $K_{dGDP} = 30$  nM,  $K_{dGTP} = 2500$  nM). As a consequence, for cyclic functioning of plant factor peIF2 no factor eIF2B is required, which is strongly necessary in mammals, and also the role of peIF2 $\alpha$  phosphorylation is decreased in regulation of translation initiation [Shaikhin e.a., 1992, *Biohimie*, 74:447]. Indeed, the biochemical activity and genes of eIF2B-like factor are not found in plants till now. Besides, out of four protein kinases (PKR, HCR, PERK, GCN2), which phosphorylate regulatory alpha-subunit of eIF2-factor in mammalian cells, the activity and the gene for only GCN2-kinase were found in plants and mutants with defective gene *gcn2* are quite viable [Zhang e.a., 2008, *J.Exp.Bot.* 59:3131; Lageix e.a., 2008, *BMC Plant Biol.* 8:134; Immanuel e.a., 2012, *Func. Plant Biol.* 39:717].

Also for the first time we demonstrated that in plant cells there is no protein kinase activity that specifically phosphorylate translation elongation factor 2 (peEF2). We have shown that activity of peEF2 may potentially be regulated by phosphorylation, because this plant factor can artificially be phosphorylated by meEF2-kinase of mammalian cells, what is accompanied by inhibition of peEF2 functional activity. However, even using detection methods with high sensitivity, we failed to find in plant cells of endogenous kinase, capable to phosphorylate factor peEF2 [Smailov e.a., 1993, *FEBS Lett.*, 321:219]. Later our results and conclusions were confirmed by other research groups.

These and other data suggest that unlike mammals, plants do not have mechanisms, which control protein biosynthesis with a principle «all, or nothing» that works by means of reversible phosphorylation of translation factors.

Further, for the first time in plant objects we established cap-independent mechanism of mRNA interaction with 40S ribosomal subunits in the course of translation initiation, which is based on the complementary interaction of mRNA 5'-untranslated region (5'UTR) with the central domain of 18S rRNA. We mapped important segment in the central domain of 18S rRNA and have experimentally shown that artificial rising of complementarity in mRNA 5'UTR to this segment of 18S rRNA results in significant increase of mRNA translation efficiency [Akbergenov e.a., 2004, *Nucl. Acids Res.*, 32:239].

Besides, ribosomes themselves can control translation of mRNA groups. Thus it is known that phosphorylation of ribosomal protein S6 (RPS6) leads to translation augmentation of mRNAs with 5'-terminal oligopyrimidine tract (5'TOP<sup>+</sup>mRNAs). Inasmuch the 5'TOP<sup>+</sup>mRNAs encode proteins of translational apparatus (of ribosomes, factors), and also transcriptional factors and regulators of cell cycle, the increased translation of 5'TOP<sup>+</sup>mRNAs leads to growth and division of cells. By artificial increase of RPS6 phosphorylation, it is possible to improve productivity of plants.

**USE OF BIOTECHNOLOGICAL METHODS FOR PRODUCTION  
OF POTATO FORMS RESISTANT TO LATE BLIGHT**

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Introduction of resistant varieties is the main task for protection of potato against the late blight. Utilization of resistant varieties allows to more effectively deal with a problem of environmental pollution by chemical fungicides. It also improves profitability potato growing. Currently new disease-resistant potato varieties are extensively developed by combination of traditional breeding and biotechnological methods. Limited land and water resources, rapid population growth and increasing population pressure on the environment encourage use of biotechnology for the advancement of agriculture.

Purpose of this research was to create potato forms resistant to late blight. We used of microbiological, biotechnological and molecular genetic methods in combination with traditional breeding.

At the initial stage of this work we isolated and identified pathogenic and toxic strains of the fungus *Phytophthora infestans*, causes potato late blight. Methods of single round and multiple round selection for resistance to late blight we used to obtain potato cell lines and regenerated plants.

We planted 1027 explants and 927 calluses on selective medium supplemented with the cultural filtrate of fungus *Ph.infestans*. 645 callus lines were planted for plant regeneration, from which 229 calluses gave the regenerated plants (35.5%). Regenerated plants Nos. #9-10-04, #21-10-06, #26-10-07, #18-10-02, #6-10-03, #2-10-03, #23-10-02 were micropropagated and expanded to give 1166 test-tube plants.

Next, 658 test-tube plants were transferred to a greenhouse. The resulting lines of regenerated potato significantly differed from the initial lines by morphometric indices. The structural analysis of regenerated plants was done by fractions of tubers, tuber color and shape, weight of tubers per plant. The average number of tubers per plant was 10.5, depended on the genotype and ranged from 5.8 to 17 tubers.

Hybrids and lines of regenerated potato were evaluated for resistance to late blight using mycelium and zoospore suspension of the fungus *Ph.infestans*. Latona variety, line #9-10-04 (30-50% CF), and #21-10-06 hybrid were moderately susceptible to late blight.

Line #21-10-06MC had intermediate resistance. Six hybrids (#9-10-04, #26-10-07, #18-10-02, #6-10-03, #23-10-02, #2-10-03) and 10 lines of regenerated potato (#9-10-04 MC, #9-10-04 (5% CF), #26-10-07 MC, #26-10-07 (5% CF), #18-10-02 (20% CF), #18-10-02 (5-10% CF), #21-10-06 (5% CF), #6-10-03 MC, #23-10-02 (5% CF), #2-10-03 (10% CF)) demonstrated high resistance to late blight.

We plan to utilize selected lines of the regenerated potato for genetic identification with RAPD and transfer lines into the selection process.

**GROWING ENDEMICAL SPECIES OF TULIPS IN KAZAKHSTAN  
IN *IN VITRO* CONDITIONS**

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Tulipa (*T. greigii*), which belongs to the elite category of flowers, had been included in the Red Data Book of Kazakhstan, due to the fact that it's recorder very rarely. To date, the method of selection of this plant is difficult because of its complexity of vegetative propagation. In order to preserve and increase the genetic material, the method of clone micropropagation allows to obtain callus cultures from *T. greigii* at *in vitro* conditions and to propagate it in large quantities in a short amount of time.

The purpose of the research is to obtain cell cultures of *T. greigii* – (*Liliaceae*) of endemic species and to optimize the culturing conditions.

The flowering bulbs of *T. greigii* during its blossoming phase have been taken as research object.

Sterilization of the bulbs was conducted according to the following method: bulbs were put into 10% sodium hypochlorite solution for 20 minutes, then changed by 70% ethanol for 5 minutes, and then shaked with bi-distilled water 3 times.

In order to obtain callus cultures from the *T. greigii*, after sterilization stage, the top part of the bulb was cut into strips, and put into Murashige and Skoog medium with addition of growth regulators: kinetin, 3-Indoleacetic acid with the content of sucrose and casein. After 16 weeks of the experiment, the formation of first callus from tulip bulbs was observed. Calli were grown at a temperature of +26 ° C, in an incubator, in the dark conditions.

A method of *T. greigii* callus culture was introduced and optimized using – bulbs. Thus, this method provides a stable reproduction of callus cultures of wild species tulips in *in vitro* conditions.

**CLONING OF GRAPEVINE VIRUS A GENOME INTO BINARY VECTOR AND INVESTIGATION ITS INFECTIOUS ACTIVITY**

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Plants as biofactories have several advantages over other organisms for production of desired products. Currently, molecular biology offers various approaches to deliver a heterologous gene into the plant. For expression of target proteins commonly used transgenic plants or transient expression with a use of virus vectors. Creation of virus-based vectors enables efficient production of the desired product with a minimum cost. Cloning of the complete genome of the grapevine virus A into the binary vector with retaining its infectivity will allow creation of the viral vector on the basis of this genome by using gene engineering methods for insertion of target gene and expression of heterologous products for medicine, agriculture, biotechnological industries and scientific purposes.

For creation of construct we used the binary vector pCambia2300, this vector has LacZ multiple cloning site that allowed to select clones carrying the complete genome of the grapevine virus A on the principle of white and blue colonies ( $\beta$ -galactosidase enzymatic cleaves X-gal).

Previously, we created construct that contains the complete genome of the grapevine virus A with flanking regulatory sequences (35S promoter and 35S terminator), this genome with regulatory sequences was subcloned into the binary vector by using Ecl136II restriction site.

The resulting clone was checked for the presence of grapevine virus A genome by PCR amplification of the genome region from ORF3 to ORF5 and restriction analysis by using the Hind III restriction endonuclease, the viral genome has two site for Hind III at position 1978 bp, 3425 bp and another site in the binary vector. Several selected clones containing grapevine virus A genome were used to transform *Agrobacterium tumefaciens* (EHA105 strain). Agroinfiltration of *Nicotiana benthamiana* were done by bacterial suspension with the different optical density (0.4, 0.6, 1 OD) for identifying the optimum density for the *N. benthamiana*. First signs of infection were seen in the apical leaves of plants (yellowing of the veins, deformation of leaves) at 7-10 days after agroinfiltration, which confirms that made construct is infectious. Symptoms on all plants appeared simultaneously, despite the different optical densities of bacteria. The signs of infection appeared on most of the leaves at 11-20 days post infiltration.

This construct is the first step in creating viral vector using modification of grapevine virus A genome by insertion of heterologous genes for production of target proteins in plants. Agroinfiltration method to infect plants by using construct on the basis of virus genome more efficient compared to mechanical inoculation. All plants (100%), which were subjected to agroinfiltration, showed signs of grapevine virus A infection.

**PHENOTYPIC PLASTICITY AND EPIGENETIC**

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The idea, that system stability is determined with the lability of its components, is one of the paradigms of advanced science. In biology, it is a phenomenon of phenotypic plasticity, i.e. the genotype ability to change its expression and realize in different phenotypes in a response to various environment signals owing to this organisms can adapt to temporal and spatial variations of the environment. Phenotypic appearance of changes in gene expression is detected at the level of transcription efficiency, RNA processing, and translation and includes a lot of ecologically important patterns – physiological and biochemical, anatomical, morphological, features of developmental biology, time of transition from vegetative to generative phase, reproduction systems, and progeny development. It is of special interest an idea that phenotypic changes are already identified at the transcription level. The epigenetic system is known to be a part of signal perception by a cell and its transfer to changes in gene expression, as well as it has a potential to keep the permanent memory through many cell generations. Therefore, the epigenetic system has to be a key to understand the mechanisms of plasticity of plant responses to environment signals. In the paper, components of epigenetic systems for gene expression control – DNA methylation, histone modifications and small RNAs are considered. Such approach is especially important for plants due to high plasticity of their development and significant dependence on the environment. On the basis of current ideas, the questions on the possible participation of epigenetic systems for gene expression control in plant phenotypic plasticity are discussed. It is taken into account the wide distribution of vegetative reproduction in plant world, growth modularity and unboundedness, the presence of both numerous cycles in ontogenesis of perennial plants and apomixis – adventive embryony and apospory, as well as individual changeability at the population level. These patterns of plant development are considered as the basis of their adaptation to constant fluctuations and unfavorable changes in the environment. The prospects of future research on such the questions are also discussed.

**TRANSGENIC WHEAT: METHODS AND APPLICATION**

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The availability of transformation technology provides an opportunity to manipulate cereals to enhance its agronomic performance, resistance to abiotic and biotic stresses and yield. Although wheat (*Triticum aestivum* L.) can now be routinely transformed using biolistic or agrobacterium methods, the complete process for production of commercial genotypes from the efficient DNA delivery to fast generation of the homozygous transgenic progenies still remains an art. Our research is being directed toward the speeding up the process of identification of transgenic tissue and the reducing the time and the amount of work involved in the production of transgenic plants of Russian cultivars and their transgenic progenies. A dual selection system based on the combination of *gfp* as vital reporter gene and *bar* gene for transgene recovery allowed the establishment of efficient escape-free protocols for Russian wheat cultivars. The biolistic approach was used to produce transgenic plants using explants from immature zygotic embryos as well as from tissues from mature seeds. The system of dual selection was successfully applied for early scoring of transgenic/non transgenic progenies and homozygous transgenic plants and to generate herbicide resistant wheat lines. Different homozygous transgenic populations were successfully undergone the field trials and showed the stability and inheritability of the new traits in wheat. To improve the plant growth and yield of wheat in saline soils, we have generated transgenic wheat plants overexpressing genes encoding vacuole-type Na<sup>+</sup>/H<sup>+</sup> antiporters isolated from barley and salt-brush. Several transgenic wheat plants with higher levels of antiporter transcripts exhibited better biomass production at the vegetative growth stage in saline condition. Besides the modification for better agronomic characters, the assessment of transgenic wheat safety was also investigated in field trials. Our research for crop-to-crop genes flow during several years found the clear variation in the rate of the hybridization between transgenic and conventional wheat. Analyses of phenotypic and molecular data showed that gene flow was greatly affected by the direction of the dominant wind, the distance between the targets and amount of transgenic plants cultivated as the donors of the pollen.

**THE ROLE OF VIRAL P19 PROTEIN IN INFECTION OF SOLANACEAE FAMILY MEMBERS**

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*Tomato bushy stunt virus* (TBSV) derived P19 protein is an important pathogenicity factor, required for symptom development and elicitation of a hypersensitive response (HR) in a host-dependent manner. For example, it was shown to be dispensable for infection of *Nicotiana benthamiana*, yet it was required for systemic invasion of other hosts, such as pepper (*Capsicum annuum*) and spinach (*Spinacia oleracea*).

The involvement of P19 in suppression of gene silencing was first demonstrated on green fluorescent protein (GFP) transgenic plants infected with a *Potato virus X* (PVX) vector expressing P19. Further investigations revealed a crucial role of TBSV P19 in protecting viral RNA during systemic infection on *N. benthamiana*. Moreover, the biological activities of the protein were dosage dependent, *i.e.* successful infection, symptom severity, and viral RNA stability require abundant levels of P19 accumulation.

A major function of P19 appears to be sequestering siRNAs to prevent incorporation to RISC complex, but during infection this can also lead to interference with another regulatory pathways.

Our preliminary results show that p19 protein is expressed in different forms in tomato (*Solanum lycopersicum* cult. Money maker). For instance, we could detect the protein in monomeric form in the leaves and oppositely it gave intensive signal as dimer in root material. However, the infection symptoms were not detected in plants. From this, we propose that beyond siRNA binding, p19 can be binded to or modified by another plant defense components and it can lead to plant tolerance.

**OPTIMIZATION OF *AGROBACTERIUM* – MEDIATED GENETIC TRANSFORMATION FOR DOMESTIC COTTON VARIETIES**

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Cotton is one of the most important fiber crops in the world. Genetic improvement of cotton through genetic engineering has become a reality due to the social and economic benefits this crop may offer. Weeds are one of the major problems encountered in crop management. Weeds compete with crops for water and nutrients and, as result, decrease farming yields and productivity. For this purpose we optimized *Agrobacterium*-mediated genetic transformation for domestic cotton varieties by using cotyledon pieces, hypocotyl and root segments as explants to transfer the PAT gene that results resistance to herbicide. The binary vector harboring pBG7 harboring the GUS gene under the control of the maize Ubiquitin promoter and PAT gene driven by the CaMV 35S promoter was used. Transformation parameters were optimized including *Agrobacterium tumefaciens* stains (LBA4404, EHA105, AGLO), optical density of *Agrobacterium* culture (O.D. = 0,3; 0,6 and 1,0 measured at 600nm), infection, co-cultivation period (48 and 72 hours) and acetosyringone (As) concentration (100, 150, 200 µM). The efficiency of LBA4404 was higher for transformation than EHA105 and AGLO in the cotton cultivars Turkistan and 4007. Strains EHA105 and AGLO were found to overgrow on the explants during selection. Factorial analysis of the interactions of co-cultivation duration, bacterial suspension densities and acetosyringone concentration on survival of explants revealed that there was significant interaction. Highest survival of explants (55,6) resulted from the effect of interaction between 48 hours co-cultivation duration and 0,3 O.D. of bacterial suspension. However high levels of transient GUS expression was detected in the transformed explants by histochemical assay, when the explants co-cultivated with 0,6 O.D. bacterial suspension for 48 hours. Lowest survival of explants (5,3) was observed when co-cultivated for 72 hours with 1,0 O.D. of bacterial suspension containing 200 µM acetosyringone, and resulted in excess growth of bacteria which interfered with callus induction on selection medium. The problem of bacteria overgrowth was solved by including meropenem (25mg/ml) in addition to cefotaxime (250 mg/ml) in the selection medium.

In short, the interaction effect among various factors indicated that the transformation with 0,6 O.D. *Agrobacterium* suspension for 30 min co-cultivated with acetosyringone at 100 µM for 48 hours is optimal for domestic cotton cultivars Turkistan and 4007.

**Keynote**

**ISOLATION OF LATICIFER TISSUE-SPECIFIC PROMOTER  
AND DANDELION TRANSFORMATION**

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Rubber tree (*Hevea brasiliensis*) is an important industrial crop for natural rubber production at commercial scale. However due to disease risk to existing supplies of raw material from *Hevea Brasiliensis* and predicted shortages of supply of natural rubber, it is important to identify alternative sources of natural rubber and to increase plant rubber content using molecular approaches. *Taraxacum kok-saghyz*, a Russian dandelion, produces natural rubber that is of high quality. In this study, the SMALL RUBBER PARTICLE PROTEIN (SRPP) promoter from *H. brasiliensis* was characterized to determine its suitability for the expression of latex-specific genes in *Taraxacum brevicorniculatum* which is another Russian dandelion species of *T. kok-saghyz* from the similar geographical areas. Studies using transgenic *Taraxacum* plants carrying the SRPP promoter:  $\beta$ -glucuronidase (GUS) sequence indicate that the SRPP promoter does induce gene expression primarily in laticiferous tissues. We propose that the SRPP promoter is suitable for the latex-specific expression of a target gene(s) such as key rubber biosynthetic genes. Additionally, the promoter was regulated by various external conditions including light, tapping, and cold. These findings suggest that the SRPP promoter will be a useful molecular tool for the manipulation of gene expression to enhance natural rubber production in the laticiferous tissues of *Taraxacum* plant species.

**OBTAINING AND ANALYSIS OF TRANSGENIC TOBACCO PLANTS  
CONTAINING 5'-END SEQUENCE OF M2e PEPTIDE OF AVIAN  
INFLUENZA VIRUS H5N1 IN TRANSLATIONAL FUSION WITH THE  
GENE SUBUNIT B OF RICIN CASTOR (*RICINUS COMMUNIS*)**

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A promising direction in the development of modern biotechnology is the use of plant systems as bioreactor for the production of pharmaceutically relevant proteins. Plant expression systems have a significant advantage over other biological systems as it allows, first, to synthesize almost any protein, and second, to significantly reduce the cost of the final product. Influenza is one of the most common viral illnesses in which the best protection is vaccination. Traditional vaccines are based on the immunity against the highly variable viral protein hemagglutinin and neuraminidase, quickly lose their relevance and should be updated regularly. In this regard, intensive studies establishing vaccine broad spectrum based on the conservative viral antigen such as M2e peptide.

The purpose of this study was the cloning and expression analysis in tobacco plants M2e peptide M2 protein of avian influenza virus A/chicken/Kurgan/5/2005 (H5N1) for the subsequent development of edible vaccines for veterinary use. The sequence of the 5'-end fragment of the gene M2, which includes M2e peptide, was synthesized by ligation of synthetic oligonucleotides with preliminary optimization of codons for expression in plants. The next step was the cloning of the gene M2e in translational fusion with the nucleotide sequence of adjuvant. As such, we chose the sequence of ricin B subunit (RTB) - lectin from the castor bean (*Ricinus communis*), which can be used as an adjuvant in the production of "edible" vaccines of plant origin. The genes of ricin B subunit and M130 were cloned in translational fusion based on a binary expression vector pBI121 under the control of the 35S promoter of cauliflower mosaic virus CaMV. The plasmid, pBIspRM130, was used for transformation of plants *Nicotiana tabacum*. The result showed the presence of the fusion protein RTB-M130 in the three lines of transgenic tobacco plants. Analysis of transgenic plants protein extracts using the asialofetuin has confirmed the correctly processing ricin B subunit selected lines that will subsequently use these lines for immunization experiments in laboratory animals.

*The work was supported by a grant of the Ministry of Education of the Russian Federation №14.B25.310027*

**CREATION OF MARKER-FREE TOMATO PLANTS WITH  
THE SUPERSWEET PROTEIN GENE UNDER THE CONTROL  
OF CIS-REGULATORY ELEMENTS**

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The presence of marker genes in GM plants is of concern in society due to fears associated with risks for the environment and human health. Creation of transgenic plants that do not contain the foreign genetic material, especially bacterial and viral origin largely alleviates the tension and probably will be necessary term for commercialization of GM crops in the future.

In our investigation we used the pMF vector system (Plant Research International, Wageningen) containing of the R recombinase from yeast *Zygosaccharomyces rouxii* and a CodA-nptII bifunctional selectable gene for produce marker-free transgenic tomato carrying the super sweet thaumatin II gene from tropical plant *Thaumatococcus daniellii* under the control of tomato fruit-specific ELIP or E8 gene promoter and RBCS terminator. We have obtained a total of 170 transgenic tomato lines after agrobacterium-mediated transformation that have been thoroughly analyzed by PCR for the presence of whole T-DNA and RS site sequences using seven pairs of primers. About half of them contained a partial sequence of the T-DNA, mainly RS site missing near left border, but the majority of the checked by Southern blot had two or more inserts. This result corresponds to the data that most T-DNA integrations in tomato require sequence homology between the LB and plant target DNA (Thomas and Jones, 2007). The thaumatin II gene expression has been confirmed by RT-PCR and organoleptic analyzes.

We then used the delayed strategy for the selection of marker-free plants with 35 transgenic tomato lines. After induction of recombinase activity in cotyledon leaf explants about half of them did not produce any regenerants on negative selection medium with 5-FC. One hundred twenty one resistant sublines was obtained from 18 original lines, most of them lost their resistance to kanamycin, but the sequence of the *nptII* gene was detected by PCR in 120 plants. So, only one fully marker-free transgenic tomato line was obtained. We suppose that an incomplete excision and chromosomal rearrangements due to the presence of multiple and aberrant or partial T-DNA insertions occur in other cases.

These results imply that the system based on pMF vector system is an acceptable for production marker-free transgenic tomato, but work could be of some difficulties for easy-transform cultures and *Solanum* species.

**THE EVALUATION OF THE EFFECTIVENESS OF VARIOUS  
CONSTRUCTIONS WITH CHRYSANTHEMUM VIRUS B (CVB)  
ENVELOPE PROTEIN GENE TO OBTAINING OF VIRUS RESISTANT  
CHRYSANTHEMUM PLANTS**

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Currently there are several molecular-biological approaches to improvement of the plant resistance to the viruses, including methods based on the plant transformation with virus coat protein gene in sense or antisense orientation. Furthermore, the techniques based on RNA interference are actively developed now. The objective of this study was to comparing the effectiveness of the different approaches to the obtaining of virus resistant varieties of chrysanthemums.

The chrysanthemum plants *c.v. White Snowdon* were transformed with chrysanthemum B virus coat protein gene (CP-CVB) in the sense orientation (pBSS), in the antisense orientation (pBAS), double-sense sequence of CP-CVB gene (pBDS) and RNA interference construct based on CP-CVB (pRNAiVB). These sequences were under the control of double 35S promoter of cauliflower mosaic virus and the terminator of gene *nos* *A. tumefaciens*.

Virus infection assay of transgenic chrysanthemum lines and non-transgenic uninfected plants which were used as a control was carried out by grafting. To do this, the 2 cuttings from infected chrysanthemum plants were cleft grafted to the stems of the tested plants, the average survival rate of the grafts was more than 90%. Detection of the virus in the infection assay was carried out by enzyme-linked immunosorbent assay (ELISA). ELISA was performed using antibodies to CVB envelope protein («Loewe», Germany).

As a result, it has been shown that grafting of the infected cuttings onto the control non-transgenic plants lead to the infection of all plants. Only 1 line pBAS of 5 studied and 1 line pBSS of 3 studied were fully resistant to the virus infection. All studied lines pRNAiVB (4 lines) showed only partial resistance to the infection. In case of lines pBDS, three lines of 6 were fully resistant to the infection, three other lines showed increased, but partial resistance to infection of CVB.

The dates of ELISA were further confirmed by Western blot analysis using the above antibodies. In the virus-resistant lines the band corresponding to the viral envelope protein was not detected. In case of infected control plants and transgenic plants of partially resistant lines, antibody specifically recognized the virus envelope protein of molecular weight approximately 37 kDa.

The obtained results will be used in further studies.

**EMBRYOGENIC CELL LINES OF CONIFEROUS SPECIES  
IN VITRO AND THEIR PRODUCTIVITY**

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Immature isolated embryos and megagametophytes of *Larix sibirica*, *Larix sukaczewii*, *Larix gmelinii*, *Pinus sibirica*, *Pinus pumila* were experimentally cultured on  $\frac{1}{2}$  LV modified medium and AI (patent №2456344) medium added by L-glutamine, casein hydrolysate, ascorbic acid, and 2,4-D and BA. The obtained cell lines is consisted from embryonal suspensornal mass which active proliferation on these media under a reduced concentration of cytokinins. The somatic embryos matured on the basal media with ABA (60-120 mM) and PEG. The germination of somatic embryos occurred on hormon-free  $\frac{1}{2}$  AI and LV medium. In spite of species specificity the embryogenesis of morphogenic structures had the same scheme: elongation of somatic cells, formation of initial cells and embryonal tubes, development of globular, «torpedo» and bipolar somatic embryos, embryos maturation and germination.

Long-term proliferating cell lines were obtained in *Larix sibirica*, *L. sukaczewii* (10 lines), *Pinus pumila* (2 lines). Those embryogenic cell lines produced of 2040-4090 embryos per 1 g of callus capable of at 4 years self maintained. Cell lines are differed by embryogenic activity, embryo maturation and germination. Nuclear simple sequence repeat (SSR) microsatellite markers were analyzed in calli obtained from *L. sibirica* megagametophytes to reveal the calli to be unstable. Somatic embryogenesis was strongly genetically controlled. Embryogenic cell lines and somatic embryos were produced only from the donor tree genotypes having high reproductive potential. Clonal seedlings of *Larix sibirica* are growing in Greenhouse.

This work was supported by p\_siberia research grant, project no.13-04- 98045

**Keynote****CREATION OF SOURCES RESISTANCE TO POTATO VIRUS Y (PVY)  
USING SOMATIC HYBRIDISATION AND TRANSGENIC PLANTS**

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Viruses are very widespread in potato and cause severe yield losses. *Potato virus Y* (PVY) is one of the most damaging ones of potato: yield losses can reach 80-90 %. Development of biotechnology methods provides potato breeding with non-traditional sources of resistance to PVY (SR-Y) by utilization somatic hybridization and transgenic plants. Crucial moment in somatic hybridization is the problem of fertility of obtained somatic hybrids and their capacity to generate the viable progeny in crosses with cultivated potato. We regard as SR-Y those products of biotechnology which are resistant to PVY and able to set berries with viable seeds on free pollination and (or) crosses with cultivated potato.

The cultivated potato *Solanum tuberosum* L. (tbr) has one of the largest gene pools, including more than 200 wild relatives which reveal high resistance to diseases and pests but most of them have sexual incompatibility with tbr, 4x. Somatic hybridization via protoplast fusion permits to get the interspecific hybrids when initial species are not crossed.

In our experiments the interspecific somatic hybrids of potato were obtained by chemical fusion of mesophyll leaf protoplasts. Somatic hybrid plants were identified by isoenzyme peroxidase and (or) soluble protein patterns, PCR markers on nuclei and cytoplasm genomes, analysis of morphological characters. The sources of resistance to PVY were revealed among somatic hybrids and their sexual progeny for 4 combinations of somatic hybridization: 2D – 86-6 (*S. tuberosum* × *S. chacoense*) + E55-1 *S. etuberosum* (nontuberous), 4D – 86-6 + L49-2 (*S. etuberosum* × *S. brevidens*) (nontuberous), SB – 78563-76 (tbr, 4x) + S.b. *S. bulbocastanum*, F – 78563-76 + L39-2 *S. polyadenium*. The somatic hybrids SB, F, 2D, 4D differed by combination plastid and mitochondrial genomes according PCR markers on chloroplast (NTCP09, ALC\_1/ALC\_3) and mitochondrial (ALM\_1/ALM\_3, ALM\_4/ALM\_5) genomes.

Resistance to PVY was estimated in the test with grafting of analyzed genotype on the tomato plants cv. "Nevsky" infected with the stains  $Y^{NTN}$ ,  $Y^O$ ,  $Y^N$  in separation. Symptoms of diseases on the wilding and alive grafts were described in 28-35 days after grafting. At the same time the plants of graft and wilding were tested by ELISA.

Spontaneous berries were gathered from plants of analyzed genotype grown in greenhouse and (or) in the field. Backcrosses of analyzed genotype with the tbr, 4x as the male parents were performed in the greenhouse on grown "a brick" mother parents. The viability of seeds isolated from berries determined on germination *in vitro* and (or) *in vivo*. As a result of evaluation of interspecific somatic hybrids and their sexual progenies in test with grafting and on ability to set fruits with viable seeds is creation over 25 sources resistance to PVY.

Transgenic sources resistance to PVY were selected between potato lines of Belarusian cultivar Belorusky 3 (B3) with coat protein (CP) gene of PVY strain N which were obtained from Moscow Bioengineering Centre. They have stable revealing target sign after inoculation by PVY ( $Y^N+Y^O$ ) two years running and following vegetative propagation about 15 years. PVY-resistant lines were revealed among sexual progeny of transgenic SR-Y and used for selection of candidates of transgenic potato variety with PVY resistance. Transgenic SR-Y and candidates of transgenic potato cultivar contain gene CP PVY according SCAR-marker PVYco2.

**INITIETE OF ISOLATED MICROSPORES CULTURE  
OF WHEAT AND BARLEY**

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Cultivar of wheat Severyanka, and F2 hybrid generation of barley have been used as plant material. The material was planted in a controlled environment. The temperature was set at 20 °C during the day and 14 °C at night, photoperiod was 16 hours a day and 8 hours a night.

The collection of spikes was carried out in the early morning in mononuclear microspore stage, in hours of intense division of pollen. Spikes pretreatment was carried out in the silver nitrate solution at a concentration of 40 mg / l, at a temperature of +4 °C for 3 weeks. Before isolating of microspore culture the spikes were sterilized in 5.6% solution of sodium hypochlorite for 7 min and in 70% of alcohol for 30 seconds followed by 3-5 - fold washing with sterile distilled water, and portions 10 - 15 spikes were placed on sterile paper for removal of water.

Wheat microspore isolation was performed by the protocol Csaba Lantos ( 2006) with our modifications. For effective isolation used commercial blender Waring 31BL92. Spikes placed in a coolblender (10°C) using 50 ml of a 0.3 M mannitol solution (10-12°C) , and homogenized 7-9 sec. A suspension of microspore from the blender was passed through a filter pore size of 80µm, and was poured into a sterile 15ml tube Falkon. Blender washed with additional mannitol solution in a volume of 4 ml, and the resulting suspension was filtered too, merging into a test tube. The filtrate was centrifuged at 80g for 5 minutes, the supernatant was decanted, the residue was poured into a solution of 5ml of 0.3M mannitol and 21 % maltose and centrifuged again for 5 min at 80g. Microspore washing was repeated once more by solution of 0.3 M mannitol. After the final wash, the microspores were placed in a medium CHB3. Density of microspores was 20000-25000 microspores/ml. Microspore suspension was dispensed in 5 ml of 60 mm diameter petri dishes. Then microspores were placed in an incubator with temperature 32°C for 48 hours. After heat shock was added 1 ml of fresh medium in each petri dish and placed in an incubator with temperature 28°C.

Barley microspore isolation was performed by the protocol of Li and Devaux (2003) with our modifications. Unlike wheat, after pretreatment with a solution of silver within 3 weeks, spikes were homogenized in a solution of WS (0,3mannitol, 10mM CaCl<sub>2</sub>) 7-9 sec. A suspension of microspore from the blender was passed through a filter pore size of 80µm, and poured into a sterile 15ml tube Falkon. After a week in the pretreatment medium microspore suspension were added to 21% maltose solution and centrifuged at 1000rpm for 10 minutes. The supernatant was decanted, the residue was poured into a fresh solution of 21% maltose, centrifuged again at 1000rpm to remove dead microspores. For the final washing of microspore was used WS solution, centrifuged at 600rpm for 3 minutes. To the residue was added 10 ml of medium IMI. The petri dishes with microspores were placed in an incubator with temperature 26°C.

The experiments obtained embryogenesis in wheat and barley in the amount of 1.2% and 0.8%, respectively, of the number of cultured microspores.

**TBSV ENCODED p19 PROTEIN AND PLANT DEFENSE SYSTEM  
COMPONENTS**

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*Tomato bushy stunt virus* (TBSV) encoded p19 is crucial for protection of viral RNA during systemic infection in *N.Benthamiana* plants. Whereas, only local lesions appear in response to p19 expression in another host *Nicotiana tabacum*. It is well known that localization of infection directly linked with SA accumulation. Consequently, it is likely that viral suppressor may influence on SA levels and as a result may regulate HR response. Hence, the elucidation of possible connection between basal plant hormone defense system and RNAi is a subject of great scientific importance.

In our experiments with *Solanum lycopersicum* (cult. Money Maker) plants did not demonstrate any noticeable disease symptoms upon TBSV infection, only local yellow areas have been detected on inoculated leaves. However, immunoblotting assay shows presence of the p19 protein in local, noninoculated upper leaves and root tissues of tomato at 14, 16 dpi. From this we propose that p19 protein somehow can be inhibited in function or modified in structure. Our aim is to elucidate plant components, which can interact directly or indirectly with p19 and as a result can be explanation of tomato tolerance to TBSV.

## **REGULATORY PROCESSES FOR GMOs CREATION, USE AND TURN IN KAZAKHSTAN**

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On the basis of synthesis of the international experience of regulatory processes for creation, use and a turn of GMOs the corresponding recommendations were developed for Kazakhstan. Adoption of the law "About State Regulation of Genetic Engineering Activity" has to be accompanied by development of a number of the necessary regulations providing appropriate implementation of this law. In this regard it is offered to develop provisions, rules, the procedures devoted to an assessment of risks, to delivery of permission to use and ensuring biosafety of GMO. These measures have to be harmonized with the international regulating documents: The Convention on Biological Diversity, the Cartagena Protocol, the Code Alimentarius, the Convention on Human Rights and Biomedicine, the Agreement on protection of the rights for intellectual property. It is necessary to consider thus also leading principles on GMOs regulation in Europe, the USA, Russia (Directives and rules of the European Union, Agriculture Department – USDA/AFIS, Food and Drug Administration – FDA, Environment Protection Agency – EPA, some resolutions of the Government of the Russian Federation, and also regulations of specially authorized bodies of the Russian Federation: Ministry of Health, Ministry of Agriculture, Ministry of Industry).

For the right ensuring implementation of the Law of the Republic of Kazakhstan "About State Regulation of Genetic Engineering Activity" acceptance of a number of bylaws is desirable by the Government of RK: "About an order of the state registration of GMO"; "About the state registration of new foodstuff from GMO"; "About examination of GMO and GM-products". It is recommended to create advisory councils at specially authorized organizations (the Ministry of Education and Science, the Ministry of Health, the Ministry of Agriculture, the Ministry of Environment and Water Resources) and to organize the Coordination center at the government authorized body on regulation of genetically engineered activity.

It is recommended to develop special Regulations and Rules on providing biosafety in creation, testing, transportation and imports of GMOs which are considered by the Coordination center and are approved by the government authorized body.

It is necessary to develop Instructions and Methodical instructions for supervision of GMO and the foodstuff containing GMO, after passing of the state registration for implementation of monitoring of their turn.

It is necessary to create the Republican database of the genes used for genetic transformation and its integration into the International System of Registration of Genes for expeditious definition of alien genes and gene constructions which were introduced earlier in a genome of crops.

At an assessment of food safety of GMO it is recommended to compare data on allergenicity and toxicity of transgene products with the international databases: ALLPEPTIDES, ALLERGENS.

It is expedient to carry out periodic post-registration monitoring for establishment the fact of lack of negative effects of GMO on environment, agricultural practice and human health. Methods for obtaining of transplastomic plants for prevention of the alien gene flow giving stability to herbicides, viruses and insects and cis-gene technologies are recommended to use more widely.

**METHODS OF HAPLOID BIOTECHNOLOGY AND MOLECULAR MARKERS IN RAPID SELECTION *TRITICUM AESTIVUM* L.**

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At present the problem of enhancing of resistance in cultural plants to unfavorable environment factors along with growth of Earth population is global problem. Important challenge stand before scientists for accelerate production of new cultivars in main food cultivars resistant to unfavorable environment factors.

In first stage of project accomplishment the monitoring of wheat genotypes was conducted in conditions of South Kazakhstan for resistance to rust diseases in natural and artificial nurseries. As infecting agent the races of *Puccinia graminis*, *Puccinia striiformis*, *Puccinia recondite* were used. High resistance to rust diseases was shown by following genotypes: *Triticum kihara*, *Triticum dicoccum*, *Triticum timofeevi*, Almaly, Naz, Taza and others. In study it were used the sources of Lr genes created on base of isogenic line "Thatcher".

Resistant genotypes selected were used for crossing and production the perspective intercultivar and interspecies wide hybrids. It was created more than 120 hybrid combinations. The hybrids obtained were genetically stabilized by methods of haploid biotechnology on base of isolated anther and microspore culture in vitro.

A use the haploid biotechnology on base of isolated anther and microspore culture in vitro permits to product constant homozygouse doubled haploid (DH) lines from hybrid populations of plants during 1-2 years while it is need 8-10 years for obtaining the stable lines by traditional breeding.

It were modified the composition of nutrient media on base of Blaydes and N6 media by adding activated charcoal and amylodextrine. In next series of experiments the resistant and receptive to rust diseases parental genotypes, hybrids created and new DH-lines were analyzed on DNA level by use the molecular markers. In result of the SSR-analysis it was detected that resistant to rust diseases genotypes and lines posses Lr 24 gene. In final stage the new promising DH-lines were tested for resistance to rust diseases in natural and artificial backgrounds in two regions of South Kazakhstan (Almaty and Zhambyl region). Among DH-lines studied a number of DH-lines: DH-lines 1057, 1050, 1045, 1027 were selected that shown resistance to rust diseases and are characterized by high productivity and grain quality. On base of DH-line 1050 the new high productive and resistance to rust diseases wheat cultivar "Nureke" which has been zoned in Almaty and Zhambyl region of South Kazakhstan is created.

**DNA CONTENT AND PROLIFERATION RATE IN LATERAL ROOT PRIMORDIA OF *SAGITTARIA SAGITTIFOLIA* AND *SPARGANIUM SIMPLEX* AERIAL-AQUATIC PLANTS**

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As it was shown recently, lateral roots in a *Sagittaria sagittifolia* and *Sparganium simplex* aerial-aquatic plant originate from pericycle cells of the adventive root apical meristem, unlike the majority of angiosperm plants, in which lateral roots originate from differentiated pericycle in the root mature zone. Lateral root primordia (LRP) are characterized with two-phase growth. First, LRP cells divide quickly resulting in the formation of a primordium differentiated in three histogenic zones. Later, primordium growth become slower, and lateral roots reach the surface of a parent root in its mature zone. Therefore, it was of interest to determine the DNA content in cells of LRPs at the first stage of their growth and in adjacent cells of the parent root apical meristem by using the cytophotometry method. A number of meristematic cells, which were at the different phases of a cell cycle, has been determined at the squash preparations of root apices stained by the Feulgen reaction with a cytophotometer (length of wave 510 nm). A standard method of specimens preparation was modified by using an enzyme pectinase for tissue maceration. We showed that majority of LRP cells contained the DNA amount in units exceeding 2C and reaching 4C, i. e. cells are in the S- and G2 – phases of a cell cycle. Apical meristem cells adjacent to LRP were in the main at the G1 phase, more rarely – at the S and G2 that is the typical proliferation level for these cells. The obtained data are discussed in connection with the features of LRP initiation and development in adventive roots and ecological patterns of aerial-aquatic plants. The further research will be directed to the study of cell cycle gene expression in the apical meristem cells and LRP cells in *S. sagittifolia* and *S. simplex* adventive roots.

**ISSR AND SSR ANALYSIS TO CONFIRM GENETIC STABILITY  
OF MICROPROPAGATED PLANTS OBTAINED FROM DIFFERENT  
EXPLANTS OF SEVERAL GRAPEVINE CULTIVARS: ISOLATED  
MERISTEMS, DORMANT BUDS, APICAL TIPS**

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The development of commercial viticulture in Kazakhstan began in the late 50s of the last century and grapevine cultivated mainly in four provinces: Yuzhnny Kazakhstan, Almatinskaya, Zhambylskaya, and Kyzyl-Ordinskaya. The grapevine industry percentage in the total volume of food processing industry was 10-13.5%. From 1980-ies grapevine industry in Republic has been steadily declining due to economic and socio-political changes. Programs and Regulations of Kazakhstan Government are aimed to recover the vineyards area and obtain a productivity up to 220 000 tons. Determinant step of viticulture recovery in Kazakhstan depends on evaluation of available cultivars assortment, in those number of Kazakhstan selection perspective cultivars, some of which declared as cold resistant and resistant to the most destructive fungal grapevine pathogens.

Micropropagation of perspective cultivars of Kazakhstan and foreign breeding ones is aimed to development of sanitized nurseries. True-to-type clonal fidelity is one of the most important prerequisites in micropropagation of crop species. In presented work ISSR and SSR markers have been used to genotype for their genetic stability of in vitro raised grapevine plants derived from different explants bearing meristem: isolated meristems, dormant and axillary buds, and shoot tips. ISSRs have high reproducibility due to the use of longer primers as compared for example to RAPD primers. SSR markers have gained considerable importance owing to hypervariability, multiallelic nature, codominant inheritance, reproducibility, relative abundance, extensive genome coverage. From 6 Kazakhstan cultivars meristems were isolated from dormant buds aseptically excised; the apical dome of the shoot was eliminated and the basal cluster maintained for 30 days in culture medium (IM) supplemented with 4,4 µM BA (initiation of meristem, Mezzetti et al., 2002); arisen microshoots of the meristem cluster were subcultivated in IM with 8,8 µM BA; portions of cluster were transferred in medium with 13,2 µMBA. Excised shoots were transferred in IM medium, then rooted in ½ MS (Murashige, Skoog, 1962) medium with 5,7 µM IAA. Three cultivars were used for elucidation of the influence of different cytokinin/auxin concentrations (4/0; 4/0.05; 4/0.1; 8/0; 8/0.05; 8/0.1 µM BA/NAA) on the effectiveness of micropropagation through dormant buds as explants. Microclones obtained with 4–0.05 and 8–0.05 hormone concentrations were used for genotyping. Microclones obtained from apical tips of several cultivars were genotyped as well. In each case for genotyping five representatives of microclones and of corresponding cultivars were used. Fidelity was assessed by 25 ISSR and 6 SSR markers. 9 ISSRs out of 25 assessed ones produced clear, distinct and scorable bands. These nine ISSR primers generated unique sets of amplification products ranging in size from 350 to 1850 bp. They produced from 46 to 65 band classes with an average of bands per marker from 5,1 to 7,2 depending on the cultivar. Allele sizes for 6 SSR loci were: for VVS2 from 131 to 159, for VVMD5 from 228 to 242, for VVMD7 from 239 to 257, for VVMD27 from 181 to 195, for VrZAG62 from 189 to 207, and for VrZAG79 from 243 to 259 bp.

It has been demonstrated that ISSR and SSR markers can detect sufficient polymorphism to differentiate among different grapevine genotypes. On the other hand, with used markers microclones derived from any of explant type containing the meristem did not show any genetic variation compared to their corresponding initial field-grown mother cultivar plants, corroborating the high level of clonal fidelity of the *in vitro* regenerated grapevines.

**EFFECTS OF LICORICE EXTRACTS ON PROLIFERATION,  
CELL CYCLE AND DIFFERENTIATION OF ACUTE MIEYLOID  
LEUKEMIA CELLS**

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Failure to cure acute myeloid leukemia (AML) by conventional chemotherapy still represents a challenge for hematological oncology. Small molecule plant-derived agents and their derivatives (e.g., vinblastine, paclitaxel, etoposide, topotecan) have been successfully employed for the treatment of several types of malignancies but are ineffective in patients with AML. Thus, it is still unclear whether natural compounds can be used for the management of this type of leukemia. In this study we investigated the effects of Ural licorice (*Glycyrrhiza uralensis* L.) and pharmaceutical licorice (*Glycyrrhiza glabra* L.) root extracts, alone or in combination with the active form of vitamin D (1,25-dihydroxyvitamin D<sub>3</sub>; 1,25D<sub>3</sub>), on the growth and differentiation of HL60 human AML cells.

To determine whether licorice preparations affect cell proliferation and viability, HL60 cells were treated for 24-96 h with root extracts prepared in 50%, 80%, 100% ethanol or 50% acetone. It was found that Ural licorice and pharmaceutical licorice were most effective following extraction in 100% ethanol and 50% ethanol, respectively. In both cases incubation with 100 µg/ml extracts resulted in a similar marked reduction in viable cell numbers already after 24 h and almost total cell death was observed after 48 h. Determination of dose dependence for the above antiproliferative effects revealed that the Ural licorice extract was about 5-fold more potent than the pharmaceutical licorice extract (IC<sub>50</sub> = 15 µg/ml and 75 µg/ml, respectively).

The cell cycle analysis demonstrated that incubation with 25 µg/ml Ural licorice extract for 24 h results in G0/G1 arrest manifested by the accumulation of cells in G1 phase and a concomitant reduction in the S phase population. Furthermore, the appearance of a small population of apoptotic cells (sub-G1 phase) was observed. A higher dose of 50 µg/ml caused G2/M cell cycle arrest and a profound apoptosis. Following 48 h, even a lower dose of the extract (25 µg/ml) induced a total disruption of the cell cycle and apoptotic death of the entire cell population. Interestingly, despite its marked antiproliferative effect, the pharmaceutical licorice extract (50-100 µg/ml) only slightly affected cell cycle distribution without induction of apoptosis.

The myeloid HL60 cell line can be differentiated into the monocyte or granulocyte lineage, depending on the applied inducing agent, and 1,25D<sub>3</sub> is known to induce monocytic differentiation of these cells. However, 1,25D<sub>3</sub> concentrations required for the induction of terminal differentiation of AML cells are extremely toxic for humans, leading to severe hypercalcemia. Certain plant polyphenolic antioxidants, e.g., carnosic acid from the rosemary plant, have been shown to considerably potentiate the antileukemic activity of near physiological doses of 1,25D<sub>3</sub> without increasing its toxicity. Here we show that both Ural licorice and pharmaceutical licorice extracts at 10 µg/ml and 50 µg/ml, respectively, tended to enhance the differentiation-inducing ability of very low concentrations of 1,25D<sub>3</sub>.

Collectively, the above results suggest that Ural licorice root preparations may have potential as adjuvants in the treatment and/or prevention of AML and, possibly, other malignant diseases.

**PLANT DIHAPLOID OBTAINING METHOD IN CULTURE ISOLATED  
MICROSPORES**

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Microspore culture in vitro is a process liquid culture medium generative cells released from the anther somatic tissues. Microspores extracted from the anthers at the late stage of development of a single core. The basic scheme of the experiment on the isolation and cultivation of microspores follows: anthers are extracted from fragments of heads, broken blender a few seconds in a solution of 0,3 M mannitol. The resulting suspension is filtered through a filter and centrifuged YuOtsm few minutes. After the end of centrifugation, the precipitate of microspores stirred solution 0,3 M mannitol. Then centrifugation repeated the need for effective washing the cells, microspores. The further is carried out culturing microspores in liquid culture media, the composition of which differs depending on genotype or experimental objectives and generally contains maltose and sometimes growth stimulants.

Designed protocol, results of joint work with ATSFGR, to establish procedures for the cultivation of culture microspores isolated microspores of wheat and barley is important for Kazakhstan, as only the mass yield of haploids can provide use in breeding programs at the level of the doubled haploid lines carriers valuable agricultural traits. Since the division of microspores and especially subsequent regeneration of plants are genetically dependent stages (Touraev et al., 1997, Ferrie and Caswell, 2011), our task was to select the most responsive genotypes of spring wheat and use it as a model to accelerate mining protocol.

According to the results of experiments on spring wheat cultivar Kazakhstanskaya 19 was the most responsive to the culture of isolated microspores. Thus, Kazakhstanskaya 19 can be used as a model grade in further experiments. Were produced in the culture of microspores and seeds obtained 21 lines dihaploid regenerants wheat varieties Astana 2, Kazakhstanskaya 19 Kazakhstanskayarannespelya, Saratovskaya 29, corresponding to the four new varieties of the quality of grain, drought, and productivity. Obtained from seeds of wheat regenerants dihaploid: Kazakhstanskaya 19 –from 146 to 288 units, Astana 2 - 278 pcs, Kazakhstanskaya rannespelya—from 15 to 272 pcs, Saratovskaya 29 - 46 pcs. As a result of the research protocol designed to obtain homozygous plants regenerated from isolated microspore culture, which is applicable to various genotypes of wheat. On the basis of this protocol, we prepared and published textbook. Improved protocol mikrospornoy haploid biotechnology can be used and adapted for other important crops, as shown by our recent experiments with varieties of barley (Bashabaeva B.M. et al, 2013). In order to practical usage the developed protocols in breeding the further optimization of allocation of microspores, their culture and regeneration of fertile plants is important.

**CHANGE OF PROPERTIES MERISTEMATIC TO LINE OF POTATO  
AT THE PROTRACTED CULTIVATION OF IN VITRO**

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Currently, research institutions and other organizations involved in the production of primary source material for seed collection HEALTHCARE potato varieties are supported in vitro.

Technology of reproduction and maintenance of the collection of planting material is constantly being improved , and it has several versions - retardants , at baseline and modified nutrient media under optimal and low temperatures. However, there is no general consensus as possible of cultivation HEALTHCARE accessions in vitro. Several authors argue that the long-term deposition of plant culture in vitro, when grown in the field , some varieties may not correspond to the original genotype sortootlichitelnym featured . Along with phenotypic variability , increased susceptibility and decreased productivity in recent years, there are data in the literature about the possibility of mutations .

In the Kazakh Research Institute of Potato and Vegetable Crops carried out to study the influence of the duration of in vitro culture on phytopathological and productive signs of potato varieties , in order to identify the possible impact of cultivation in vitro stability of genomic DNA analyzed by PCR meristematic lines of different potato varieties cultivated in vitro from 2 up to 10 years . To study the polymorphism used molecular marker RAPD. Polymorphism is the soluble protein effective direction in the study of genetic variation , therefore , studied the protein markers by electrophoresis as they better describe the genetic stability of the starting material.

The results obtained in this direction showed that long-term in vitro culture can have a significant impact on indicators such plants as its height, number of internodes on the stem cuttings yield from one plant on an artificial medium.

Supported by successive regenerated plants from cuttings at 4 years were amazed complex viral infections. It was found that plants cultured in vitro for more than 6 years , the survival rate decreases under conditions in vivo. Meristematic tubers derived from regenerated plants cultured in vitro 6-7 years differed low coefficient of breeding conditions in vivo.

As a result of molecular genetic analyzes revealed no differences between the original forms and lines of potato meristem collection lines in vitro.

However, the study of genotypes of potato varieties and lines by protein assay showed that the lines cultured for a long time clearly differ in loci. At grade 8 Ulan summer cultivation in vitro noted appearance sufficiently intense protein band with a molecular mass of 32 kDa .

Therefore , research on the use of molecular genetic and protein markers for identification of genotypes confirms the necessity of complex use of DNA markers and protein levels. Thus, the findings suggest the feasibility of cultivation of potato plants regenerated in vitro no more than 4-5 years.

**SYNTHESIS IN PLANT SYSTEMS *IN VITRO* AND *IN VIVO*  
OF SHEEP POX VIRAL COAT PROTEIN L1R**

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Sheep pox – disease of small ruminants that can cause epizootics and, as a consequence, big economic losses. Transgenic plants producing immunogenic viral coat proteins are good alternative to existing vaccines based on attenuated strains of viruses.

Sheep pox viral *SPPV-NISKHI-56* gene (738 bp) encodes ortholog of immunodominant protein L1R of vaccinia virus. The sequence from 1 to 564 nucleotides that encode hydrophilic part of the protein (L1RΔ) and contain 5 single nucleotide substitutions (to eliminate two *NdeI* sites and three plant splicing signals) was artificially synthesized and cloned in pET-19b vector for expression in bacteria. Substitution of nucleotides did not change the amino acid sequence of recombinant protein.

Purification of L1RΔ protein synthesized in *E. coli* was performed using Ni-NTA agarose by virtue of 10 histidines (His-Tag) at N-terminus. His-Tag sequence was also used for immunodetection of L1RΔ by specific antibodies (PentaHis-HRP Conjugate).

For *in vitro* transcription of mRNAs several DNA-constructs were designed based on pBluescript II KS(+). These constructs contained bacteriophage T7 promoter, different 5' untranslatable regions (UTRs) serving as translational enhancers, His-Tag, and recombinant *SPPV-NISKHI-56* gene. L1RΔ protein was efficiently synthesized in wheat germ cell-free system. 5'UTRs of genomic RNAs (gRNAs) of potato virus Y (PVY), alfalfa mosaic virus (AMV), tobacco etch virus (TEV) and artificial 5'UTR «ARC1x5» sequence, which were used as translational enhancers, were able to significantly increase the levels of mRNA translation compared to «pl» sequence that does not possess translational enhancer activity.

For transformation of tobacco plants (*Nicotiana tabacum* L. cv. Samsun-NN) recombinant DNA-construct was designed based on pcAMBIA 2300 vector. This construct contained 35S promoter of cauliflower mosaic virus (CaMV), 5'UTR of AMV gRNA, nucleotide sequence of signal peptide from small subunit of RuBisCO for specific targeting of recombinant protein into chloroplast, His-Tag, gene of L1RΔ protein, and transcription terminator of nopaline synthase (NOS-ter). Transformed and regenerated plants, which formed roots in the medium with kanamycin, were analyzed using PCR for transgenic insertion and using RT-PCR for the presence of respective mRNA. Recombinant protein was detected in several transgenic plants by antibodies specific for L1RΔ protein.

**OVERCOMING THE GENOTYPE-DEPENDENCE OF PLANT  
REGENERATION OF CEREALS ON THE BASE OF  
STUDY THE METAMORPHOSIS IN VITRO**

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The genotype dependence of regeneration capability in vitro and the loss of regeneration capability during long-term subcultivation are the main obstacles that limit the development of biotechnology methods for improvement of cereals. This is due to high morphological heterogeneity and instability of callus tissue's morphology types in cereal culture. Despite the development of somatic embryogenesis and plant regeneration activation pathways in various research works, there are no sufficient common methodological approaches of morphogenesis in vitro has been developed in cereals. Consequently, there was the need to select regeneration conditions empirically for each variety and even for an every cultivar.

We have conducted research on morphological heterogeneity and metamorphosis during multiple subcultivations of wheat and barley callus tissues. We classified callus tissues on morphotypes with the investigation of their histological structure, methamorphosis and capability to regeneration during long-term subcultivation on media with various composition.

In the result, we identified callus type universal for various genotypes and stable during subcultivation, which contain morphogenetically plastic or polypotent cells; changes in media composition could lead to the induction of different types of morphogenesis from these cells, including somatic embryogenesis and plant regeneration. Considering recent understandings, this allows to assume analogy between the cells of universal stable meristematically active callus type and stem cells.

On this basis we developed an approach to solve an important problem in the area of plant biotechnology – overcoming genotype dependence of long-term regeneration process in vitro. This approach means the selection of meristematically active calli universal for different genotypes, that under the effect of 2,4-D and stress can display the same morphogenetic reaction for all genotypes – undergoing the methamorphosis with generation of embryogenic tissues capable to maintain long-term regeneration capacity. At the same time, differences in morphogenetic reactions in vitro between the genotypes are eliminated. Processes of cells differentiation during methamorphosis have been found out in this work: stress causes inhibition of cell division, disruption of intercellular connections, death of cells by means of programmed cell death, increased secretion of extracellular substances, isolation and reprogramming of competent cells on the pathway of embryoidogenesis. After the stress elimination we observed activation of cell divisions, active proliferation of embryogenic cell complexes, initiation and differentiation of embryoids from reprogrammed competent cells up to the regeneration of whole plants.

As a result of this fundamental research, genotype-independent long-term regeneration technology in cereal tissue culture have been developed and is used as biotechnology instruments for the improvement of commercially valuable varieties of Kazakhstan.

This work performed under the project of PFR MES RK (2003-2005).

**SCREENING OF GENETIC AND PHENOTYPIC MARKERS  
OF POTATO VARIETIES**

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Detection of DNA polymorphism of potatoes that can be used as genetic marker of heat and drought-tolerant germplasm is major interest in plant-breeding.

The purpose of this research is identification of genetic markers for heat and drought resistant by molecular methods and based on the selection of perspective potato varieties in *in vitro*.

As objects of research has been taken genotypes of the Kazakhstan's selection created by Kazakh's Research Institute of Potatoes and Vegetables, in particular 11 varieties and 5 hybrid lines of potatoes. DNA was taken from test plant-regenerates by a method described by Moller et.al (1992). PCR amplification was carried out in a programmable thermocycler of MC2 (JSC DNA-Technology, Moscow), by method described by Osipova and others (2001).

PCR products were then run on a 2.0% (w/v) agarose gel in 0.5x TBE buffer at 90 V. After electrophoresis, PCR bands were examined and documented under UV. To determine length of fragments used 1kb DNA Ladder (Fermentas).

Results of PCR amplification with single M13 primer showed that DNA-RAPD-profiles of varieties of Aksor, Tohtar, Udvovitskyi, Maksim and Dzholbarys and line of 25-07-01 were commonly same but just Maksim had different by minor zone that is about 700 bp in length.

It should be noted that the Maxim is obtained by a method of interspecies hybridization (Kardy x 128-6Sh) with the subsequently repeated selection of clone. Among studied varieties and lines of potato, the Maksim, 2-07-02 and 24-07-02 lines were more heat and drought-tolerant than others. A variety of Nikitka and its offspring have also a resistance to heat and drought.

Genetic analysis of these potato varieties and lines based on SCAR-PCR showed that line of 18 have not gene of resistance to late blight disease. The SCAR6300 specific primer for the gene of a resistance to late blight disease was not able to amplify PCR product of the 18 line which is originated from variety of Red Pontiac that is characterized as a susceptible to the disease. Moreover the SCAR6300 primers were not able to amplify DNA of Nartau, Zhualy, Tamasha, Maxim and Valentina varieties that is suggesting about their susceptibility or weak resistance to this phytophthora.

Along with the susceptibility of Nartau, Zhualy, Tamasha, Maxim and Valentina and potato line 18 to late blight disease our studying showed that these varieties have high heat- and drought-tolerant. It is suggesting that some varieties of potato with a resistance to late blight disease could not be high heat- and drought-tolerant because of plants of potato with a resistance to biotic stresses had not a resistance to negative abiotic factors of environment as previously reported by Perfilieff A.I. et. al (2012).

**IMPROVING THE EFFICIENCY OF DOUBLED HAPLOID  
PRODUCTION IN ISOLATED ANTERS CULTURE OF RICE  
*ORYZA SATIVA* L.**

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Creation of new varieties of self-pollinating plant consists of three main elements: the creation of variability by crossing, selfing or backcrossing stabilization for several generations and selection of desired recombinants. For acceleration the selection process used method of haploid biotechnology, the main advantage is to quickly obtain constant lines from segregation hybrids. An efficient method for mass production of haploid rice is the method anther culture and isolated microspore.

For obtain haploids of rice were used 20 hybrids, 6 lines, 10 varieties of domestic and foreign selection. Donor plants were grown in IPBB greenhouse. Panicles were collected in booting phase. Cold treatment of anthers performed at +4 C for 3-5 days. After cold treatment, the anthers were passaged to induction N6 medium supplemented with 2 mg/l 2, 4-D, 90 g/l maltose for callus induction. Anther derived calli were transferred to modified Murashige - Skoog(MS - R) medium supplemented with 5 mg/l BAP, 0.5 mg/l IAA 500 mg/l casein hydrolyzate, 500mg / l glutamine, and 30 g/l sucrose for regeneration. Due to fact that part of the regenerants not survive after polyploidy by using colchicine treatment and transfer to the soil, clonal propagation of regenerants was used to produce more plants. Plants with strong tillering *in vitro* divided to individual shoots and cultured separately on MS-R medium. Regenerants plants with well-developed root system was washed from the culture medium and placed in containers filled with water for 2 days. After adaptation of soil-peat mixture, through week, the plants were grown in greenhouse to produce grains. Among regenerants along with fertile sterile plants were observed.

In practice, in addition to colchicine treatment, used the method of stem nodes culture of sterile haploid regenerants for produce of fertile plants. In stem nodes are meristematic cells that can regenerate the whole plant. As a result of actively growing meristems *in vitro* chromosome doubling occurs spontaneously at a high frequency. Stem nodes from sterile regenerants isolates were sterilized in a solution of the drug "Belizna" and bidistilled water in a ratio of 1:3 for 20 minutes. Sterile nodes were cultured on MS medium supplemented with 2 mg/l 2, 4-D. In the next week of cultivation observed the beginning regeneration of plants from stem nodes. As a result of this work were obtained fertile regenerants from stem nodes sterile haploid plant glutinous varieties "Violetta", hybrids F<sub>3</sub>- BR- 3, F<sub>3</sub>- BR- 8 and F<sub>3</sub>KS -6- 8. Dihaploid plants obtained from these rice genotypes were differed in amylose content, tillering, 1000 grain weight and other agronomic traits.

Thus, the use of clonal propagation and doubling the chromosomes by culturing stem nodes, significantly increase the frequency of receiving the seed generation in rice anther culture.

**GENETIC ENGINEERING OF THE KEY METABOLIC  
PATHWAYS FOR CROP IMPROVEMENT**

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The next generation of biotech crops promises to include a broad range of products that will provide benefits to both farmers and consumers, and continue to meet the global agricultural challenges. These products will most likely involve regulation of key endogenous plant pathways resulting in improved quantitative traits such as yield, photosynthesis, and stress tolerance. Genetic engineering of key metabolic pathways is a powerful tool for crop improvement in new step Biotech in Post-Genomics era. To date, successes in genetic improvement of environmental stress resistance have included manipulation of a single or a few genes involved in signaling/regulatory pathways. The emergence of novel ‘omics’ technologies: genomics, proteomics and metabolomics, is now allowing researchers to identify the genetic behind plant stress responses.

Soybean diseases world-wide is one of the serious problems that reduce yield up to 11%-30% of the total production. In many countries, including Kazakhstan, disease-control in soybean is limited only by agricultural technologies. The main idea of our research is to improve soybean innate resistance to biotic and abiotic stresses via genetic engineering of the phenylpropanoid pathway, namely – introduction into soybean key genes involved in lignin biosynthesis, - the compound that is assigned to a broad range of physiological processes participating in plant growth, providing the rigidity to the cell walls, the natural mechanical barrier and defense against pathogen penetration. The general phenylpropanoid metabolism generates an enormous array of secondary metabolites based on the few intermediates of the shikimate pathway as the core unit. In recent years, various excellent reviews summarized the current knowledge on structural genes involved in phenylpropanoid, specifically lignin and flavonoid formation, regulatory transcription factors, hormonal control of the whole pathways by jasmonate or auxin and evolution of pathway genes from primary metabolism.

The aim of our research is to improve soybean innate resistance to biotic and abiotic stresses via genetic engineering of the phenylpropanoid pathway, namely – introduction into soybean key genes involved in lignin biosynthesis, - the compound that is assigned to a broad range of physiological processes participating in plant growth, providing the rigidity to the cell walls, the natural mechanical barrier and defense against pathogen penetration.

Obtained results: 1. Gene constructs of transcription factor *Cs/MYB4* sensitive, key genes involved in lignin biosynthesis: – *PAL5*, *C4H*, *COMT*, *CAD*, cloned in plasmid *PBI121*, transformed into *Agrobacterium* tumefaciens, strain *EHA 105* and *Agrobacterium* rhizogenes, strain *K599* – so prepared for introduction into soybean. 2. Optimized germ-line genetic transformation technique for soybean transformation via *A. tumefaciens* pipetting into flowers with using natural soybean pollen tubes for recombinant DNA delivery into zygote as well as elaborating of “hairy roots” model system for soybean *in planta* transformation with *A. rhizogenes* for confirmation of genes construction working and experiments with pathogens penetration. 3. Molecular confirmed soybean transgenes of T<sup>1</sup>-T<sup>2</sup> generations with valuable genes. 4. Biochemical confirmation of increased lignin biosynthesis, metabolic profiling. So, transition is achieved from Genome to Phenome in post – Genomics era.

**GENETIC ANALYSIS OF TRANSGENIC APPLE PLANTS  
CONTAINING A COMPLIMENTARY HAIRPIN STRUCTURE  
TO THE SECOND EXON OF THE APPLE GENE ACO**

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Carrying out genetic research on apple (*Malus domestica* L.) is laborious and long process which is primarily due to the long cycle of reproduction. However, soon after the first successful attempt to transform apple it became quite popular object for research of regulation of the ethylene biosynthesis level, primarily because of its economic importance and well-studied physiological aspects of ripening process. One of the directions of genetic transformation is modification of apple fruit ripening process in order to increase the retention period.

The aim of this study is to determine the level of ethylene synthesis in apple plants containing the hairpin structure complementary to the second exon of the apple gene ACO (self-complementary gene fragments ACC oxidase of apple plants in different orientations of the antisense-sense and sense-antisense).

In our laboratory we were obtained using six lines of vector constructs containing self-complementary fragments of ACC oxidase genes, three of them contained the target gene under the control of CaMV35S promoter - pARTMdACOsa, pARTMdACOas, pCamMdACOsa; other three vectors contained the tomato fruit specificity polygalacturonase promoter - pART PGMdACOas, pARTPGMdACOsa , pARTPGLeACOas. Apple variety "Melba" was used in the experiments of the genetic transformation.

In the first step of our work PCR analysis of the lines was performed. As a result, inserts of selective nptII and hpt genes were confirmed in all samples (a total of 62 samples). The stable integration of the gene cassettes into the genome of plants was confirmed for 3 of 3 apple lines obtained with the vector pARTMdACOsa, for 9 of 16 lines transformed by the vector pCamMdACOsa, for 8 of 9 lines obtained by the construct pARTMdACOas and for 18 of 20 lines obtained by pARTPGLeACOas, for 6 of 10 lines - pARTPGMdACOas and for 4 of 4 lines developed using the vector pARTPGMdACOsa. In plants transformed by the vectors pCam the integration of the target gene was not confirmed in all the lines obtained. It may be due to the fact that the target gene in the vector follows the selective gene. And probably there is a rupture of T-DNA by inserting into the plant genome. In the next step of our research assessment of the level of expression of the gene isoforms ACO, measurement of ethylene synthesis level in different parts of the plant and assessment of its influence on the growth and development of transgenic plants are planned.

## **CLONING OF THE ORF7 OF POTATO VIRUS M GENOMIC RNA**

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Now the RNA-interference (RNAi) is recognized to be the important cellular mechanisms of RNA metabolism and the basic cellular mechanism of protection against viruses as well. It is well established that many viral proteins are capable to suppress cellular process of RNAi (RSS-proteins - from RNA-silencing suppressor proteins) and thereby to provide advantage for viruses to reproduce in plant cells. The potato virus M (PVM) belongs to the genus *Carlavirus* of *Betaflexiviridae* family. PVM is economically important since the harvest losses, caused by infection of potato plants by this virus, are estimated of about 20 % that in combination with other viruses can be significantly higher (up to 80 %). The suppressor proteins of PVM and mechanisms of their action remain insufficiently studied.

The fifth open reading frame (ORF34K) of PVM genomic (g)RNA encodes coat protein of 304 amino acids and molecular mass of 34 kDa (34K-protein). This ORF34K begins with AUG-codon at nucleotide 7227 and ends by stop codon at nucleotide 8141. Earlier we have shown that coat protein of PVM possesses ability to suppress the RNAi process in cells of tobacco *Nicotiana benthamiana* of line 16C.

Later we found that inside the ORF34K the additional ORF7 is contained (nucleotides 7264-7464), which encodes the putative protein with molecular mass of 7 kDa (7K-protein). Similar ORFs that potentially encode of small proteins have been detected inside coat protein genes of several other *Carlaviruses* and *Potexviruses* as well. The functional importance of these small ORFs is not clear.

In the present work the cDNAs of ORF34K and ORF7K (that is located inside OPC34K) of PVM gRNA were amplified by means of reverse transcription (RT) and polymerase chain reaction (PCR). Cloning of amplified fragments was made firstly in bacterial (pBluescript SK II), and then in the modified plant vectors based on pCambia 2300. Presence and correctness of target inserts after each stage have been checked by restriction and PCR analyses, and also by sequencing method with use of specific oligonucleotide primers. Electrophoretic analysis of DNA fragments was carried out.

This stage of work is devoted to amplification of PVM gRNA cDNA fragments and to their cloning for transformation of agrobacteria and subsequent co-infiltration of tobacco *N. benthamiana* of line 16C, in order to ascertain which ORF (of 34K-coat protein or of 7K-protein) is responsible for RNAi suppression.

**Keywords:** potato virus M (PVM), RNA-interference (RNAi), PVM gRNA ORFs cloning, PVM proteins - suppressors of RNAi.

**INDUCTION OF SOMATIC EMBRYOGENESIS  
IN *PINUS SIBIRICA* DU TOUR**

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To initiate embryogenic callus three basal media were used: DCR (Gupta and Durzan, 1985), LV (Litvay et all, 1985), MS (Murahsige et al., 1962). All tested media were capable to support proliferation cells lines *P.sibirica*. Among another components of medium, plant growth regulator concentration (proportion of auxins and cytokinins) has more significant effects on initiation somatic embryogenesis. The highest numbers of embryogenic lines were obtained on half-strength Litvay medium contained 2 mg/l diclorophenoxyacetic acid (2,4-D) and 1 mg/l benziladenine (BA).

Our results showed that success of established embryogenic culture *P.sibirica* is affected by morphophysiology status of explants, plant growth regulator level, physics factors (light, temperature) . Megagametophytes containing immature embryos at the pre-cotyledonary stage, have been the most responsive explants for induction somatic embryogenesis. Initiation rate gradually diminishes as zygotic embryo mature. The initiation frequency ranged from 0 to 3,4%, somatic embryogenesis is affected by genotype.

Cold treatment (+3 C for 72 h) has statistically significant positive effect on initiation success.

**TRANSIENT PRODUCTION OF HETEROLOGOUS PROTEINS  
IN PLANTS****S.A. Manabayeva, A.O. Rakhimzhanova**

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Plant virus vectors for expression of heterologous proteins in plants represent an attractive biotechnological tool to complement the conventional production of recombinant proteins in bacterial, fungal, or mammalian cells. Transient gene expression is a fast, flexible and reproducible approach to high level expression of useful proteins. Expression of a range of proteins have been enhanced by co-expression of a viral encoded suppressor of gene silencing, the p19 protein of tomato bushy stunt virus (TBSV), that prevents the onset of post-transcriptional gene silencing in the infiltrated tissues and allows high level of transient expression heterologous proteins in plants. For this purpose we developed vector based on the genome of TBSV in which the internal CP gene was replaced by the green fluorescent protein (GFP) gene carrying polyhistidine tags and that can be delivered as DNA into plant cells. TBSV encodes proteins necessary for its replication and infectivity efficiency, including gene silencing protein p19, which is a significant advantage of the TBSV vector system. Recombinant strains of *A. tumefaciens* used for transient expression of TBSV-GFP that have been inserted into the T-DNA region of the bacteria Ti plasmid. For comparative purpose, the three strains (EHA105, AGLO and LBA4404) of *A. tumefaciens* carrying the binary vector with TBSV-GFP under the control of theCaMV 35S promoter. Recombinant strains of *A. tumefaciens* were grown overnight to logarithmic phase ( $OD_{600} = 0.6$ ) at  $28^{\circ}\text{C}$  in 50 ml Falcon tubes containing 5 ml of LB medium supplemented with 100 mg/l kanamycin. Bacteria were centrifuged and resuspended in agroinfiltration buffer MMA containing 10mM MES, 10 mM MgCl<sub>2</sub> and 100  $\mu\text{M}$  acetosyringone, and then infiltrated into the abaxial side of *Nicotiana* plants (*N.benthamiana* and *N.tabacum*) by using a needle-less syringe. The GFP fluorescence was monitored with UV light on 3-5 days of post inoculation. For GFP extraction, infiltrated leaf sections with GFP expression were removed with a razor blade and homogenized in TE buffer with chilled mortars and pestles. Extracted proteins were analyzed by SDS-PAGE and GFP expression was confirmed by Western blot analysis using monoclonal antibodies to GFP. The highest level of GFP fluorescence was reached with strain LBA4404. The results also demonstrated that the *N.benthamiana* is the best host for transient production of heterologous proteins to compare the *N. tabacum*. Polyhistidine tagged GFP purification from the plant protein extract was achieved by Ni<sup>2+</sup>-NTA affinity chromatography. The analyses of eluted protein by Western blot is demonstrated the detection of GFP (27 kDa).

**SHOOT INDUCTION OF THE ENDANGERED *IRIS* SPECIES -  
*I.TIGRIDIA* BUNGE, *I.HUMILIS* GEORGI, *I.GLAUCESCENS* BUNGE  
IN CALLUS CULTURE**

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Genus *Iris* L. is widely spread in the Northern hemisphere and comprises 200 species. 40 wild species of this genus grow on the territory of Russia and 22 species and 2 subspecies - in Siberia (Conspect of Siberian Flora, 2005). *I. glaucescens*, *I. humilis* belong to Asiatic areological group, *I. tigridia* is sub endemic Central Asian species. These endangered species are rated to subgenus *Iris* and included in all levels state and Siberian regional cadastres (Red Book of Russian Federation, 2008; Endangered..., 1980). Due to prolonged seeds germination and poor vegetative propagation of 3 threatened iris species tissue culture technique was engaged for their preservation. The aim of this work was to study the influence of phytohormones on the plant regeneration in callus culture of the endangered Siberian iris species *I. humilis*, *I. glaucescens*, *I. tigridia*. Plants were sampled from their native cenopopulations from Altai Republic and Novosibirsk district at the stage of seeds ripening, when endosperms were at the wax-ripeness stage. Surface sterilization of irises capsules was conducted as follows: 70%  $C_2H_5OH$  – 1 min.; 4% lysoformin – 15 min; sterile  $H_2O$  – three times for 5 min. Isolated embryos were the explants for the callus induction. Embryos and calli were maintained on the nutrient medium MS, supplemented by casein hydrolysate – 500 mg  $l^{-1}$ , 3% sucrose, agar – 6 g  $l^{-1}$ . Plant growth regulators – 2,4-dichlorophenoxyacetic acid (2,4-D); 1-naphthaleneacetic acid (NAA); 6-benzylaminopurine (BAP); N-phenyl-N'-1,2,3-thidiazol-5-ylurea (TDZ) were tested at different combinations. Immature embryos and calli were incubated under dark conditions at 22-24° C and regenerants were maintained under a daily 16-hr light (3000 lx) at the same temperature. The ability to form morphogenic callus was different due to genotypes of 3 iris species: morphogenic callus formation was observed at 59,8 % isolated embryos of *I. glaucescens*, 40 % *I. tigridia*, 31,9 % *I. humilis*. The primary callus was formed on the apical parts of isolated embryos of 3 iris species at the wax-ripeness stage of endosperm. In order to obtain regenerants on the (1-4) stages of the in vitro culture the following concentrations of plant growth regulators were tested: stage (1) – induction of morphogenic callus: 1-2 mg  $l^{-1}$  2,4-D + 0,2-0,5 mg  $l^{-1}$  BAP + 0,2 mg  $l^{-1}$  TDZ; stage (2) – callus subculture: 1-2 mg  $l^{-1}$  2,4-D + 0,2-0,5 mg  $l^{-1}$  BAP; stage (3) – adventitious shoots induction: 0,5-1 mg  $l^{-1}$  BAP + 0,3-0,5 mg  $l^{-1}$  NAA + 0,2 mg  $l^{-1}$  TDZ; stage (4) – rooting of regenerants:  $\frac{1}{2}$  MS + 0,3 mg  $l^{-1}$  IBA (indole-3-butric acid). The results indicated that active morphogenetic processes were performed at low concentrations of plant growth regulators, whereas increased ones caused vitrification of regenerant's tissues and rooting failure. During the process of adventitious shoots appearing, clusters of plants consisting of 7-8 rosellate shoots (maximal - 17) were formed. Regenerants with adventitious roots were isolated from shoot clusters for planting ex vitro. The plantlets without roots were placed on the  $\frac{1}{2}$  MS with addition of 0,3 mg  $l^{-1}$  IBA. Thus, for the first time it was shown that cytokinin TDZ when added to the induction medium - promoted the initiation of morphogenic callus; and added to the differentiation medium – mass formation of adventitious shoots. The application of plant growth regulators in low concentrations on all embryo culture stages allows to obtain plants of 3 endangered species of subgenus *Iris* via indirect organogenesis.

## **OBTAINING OF TRANSGENIC PLANTS THAT EXPRESS GENE OF TRANSCRIPTION FACTOR AtCBF3**

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Expression of gene *AtCBF3* that encode of transcription factor was usually detected in response to low temperature. The product of gene expression activates many genes of stress inducible proteins.

Recombinant gene *AtCBF3* was amplified and cloned under control of different regulatory elements. Gained DNA-constructs contained the following expression cassettes:

- 1) {35S-promoter-[5'HTII PVY-(*AtCBF3*)-3'TMV]-nos-terminator};
- 2) {35S-promoter-[ «ARC x 3»-(*AtCBF3*)-3'TMV]-nos-terminator};

were 35S-promoter is the promoter of 35S RNA transcription of Cauliflower Mosaic Virus;

5'UTR PVY - 5' untranslated region of Potato Virus Y genomic RNA;  
«ARC x 3» - 3 copies of artificial enhancer of translation placed into 5'UTR;  
(*AtCBF3*) - protein-coding sequence of *AtCBF3* gene from *Arabidopsis thaliana*;  
3'TMV - 3' untranslated region of Tobacco Mosaic Virus genomic RNA;  
nos-terminator - transcription terminator of nopaline synthase gene of *A. tumefaciens*.

These expression cassettes were transferred into binary agrobacterial vector pCAMBIA 2300.

Plant transformations were carried out for tobacco *Nicotiana tabacum* var. Samsun NN and canola *Brassica napus* of two cultivars "Cris" and "Gedemin". As a result of stable transformation and subsequent selection the transgenic plants were obtained.

To study influence of low temperatures all transgenic tobacco and canola plants were put in the following temperature regime: 3 h at temperature +5 °C, 3 h at temperature -3 °C, 18 h at temperature +5 °C.

Using RT-PCR we analyzed the presence of *AtCBF3*-transcripts in the total RNA samples isolated from plants before and after cold stress treatment and divided transgenic tobacco and canola plants into three groups: (1) plants that lack *AtCBF3*-transcripts both before and after cold stress, (2) plants with the constant amount of transcripts in both cases, (3) plants with higher amount of *AtCBF3*-transcripts after cold stress.

In the course of further testing some transgenic tobacco plants demonstrated even higher resistance to low temperatures (+4 °C during 16-18 h and -10 °C over a period of 3 h) and all the cold-resistant plants fall into second and third groups according to the presence of *AtCBF3*-transcripts.

**POTATO PLANTS THAT EXPRESS TRANSGENE *HvNHX2*,  
DEMONSTRATE INCREASED SALT-TOLERANCE  
AT CULTIVATION IN SOIL**

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The cDNA sequence of gene *HvNhX2* coding barley vacuolar  $\text{Na}^+/\text{H}^+$ -antiporter was amplified via reverse transcription and following PCR. Obtained sequence was cloned in agrobacterial plasmid pCambia 2300 under the control of cauliflower mosaic viral transcription promoter and terminator. Via co-cultivation of potato shoots (var. "Tamasha") with agrobacteria, genetically modified with this plasmid, we obtained five transgenic potato lines. We could not detect *HvNHX2* protein in total soluble protein fraction of these plants using specific polyclonal antibodies. Then using standard method for isolation of microsomal fraction (sucrose gradient 45%-25%-15%) we prepared fraction enriched with tonoplast fragments. In this fraction *HvNHX2* protein was detected however quantities were quite different – the maximum *HvNHX2* quantity was found in lines H202 and H203.

Mini-tubers from control non-transgenic plants and transgenic lines were planted in soil containing 100 mM NaCl. Sprouts were cultivated in greenhouse at 22°C, 70% relative humidity and 16-hours photoperiodicity. The death level of control plants reached 51% by the 160-th day of experiment meanwhile for transgenic lines it was between 50% and 90% except for line H202 with 31% of death level. By the time of complete death of control plants (day 220 of experiment) and almost all transgenic plants of other lines, death level for line H202 plants was of 69%.

Only plants of line H202 formed tubers (mean weight was about 13 g per tuber) during cultivation in soil containing 100 mM NaCl. These tubers and tubers of non-transgenic plants were planted into the soil containing 150 mM NaCl. Sprouts were cultivated in conditions mentioned before. After seven months of cultivation all control plants went under, transgenic plants of line H202 died after one more month of cultivation. And again only plants of line H202 formed tubers during cultivation in soil containing 150 mM NaCl. Mean weight of obtained tubers was about 6 g per tuber.

Thus, we conclude that transgenic potato line H202 expressing transgene *HvNhX2* demonstrate higher salt-resistance during cultivation in saline soil in comparison to control plants.

**PRODUCTION OF TRANSGENIC TOMATO PLANTS  
EXPRESSING THE GENES OF PETUNIA TRANSCRIPTION FACTORS  
EOBI&EOBII**

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Fruit flavor is a mixture of molecules of various volatile substances that are synthesized during maturation, and is an essential feature of quality and ripeness of the fruit. Volatile organic compounds, forming a tomato flavor composition, are products of various plant metabolic pathways, and their synthesis is determined by a huge pool of different enzymes, whereby the aroma becomes complicated for the study and modification. Modern methods of genetic engineering can create such vectors, which will initiate a cascade transcription of the whole pool of gene in a certain ontogeny stage.

The aim of our research was to obtain tomato plants with more attractive fruit aroma and improved consumer appeal.

Recently a group of scientists led by Prof. A. Vainstein discovered genes of transcription factors EOBI EOBII (Emission Of Benzenoids) recently found in petunia, they show that EOBII directly affects the level of transcription of several genes encoding enzymes of phenylpropanoid biosynthetic pathway of volatile organic compounds and genes of shikimate pathway. (Spitzer-Rimon et al, 2010). So we have decided to use these gens for genetic transformation of tomato.

We created two vectors that are equipped with the gene EOBI/EOBII under control of the fruit-specific promoter E8, which provides a high level of expression and tissue specificity. Also we chose 5 different varieties of tomatoes, including cherry, yellow and pink tomatoes, also tomatoes with increased lykopene.

Currently we have more than 10 lines each variety with each of the vectors, insertion of the target gene was confirmed by PCR analysis, also gene expression were proved by RT-PCR. Changes in the content of several phenylpropanoid volatiles in the tomato fruit were identified by gas chromatography and mass spectrometry.

Thus, the results demonstrate the effectiveness of the chosen approach to the modification of tomato fruit flavor that allows us to offer to use such a strategy in the future.

Spitzer-Rimon B., Marhevka E., Barkai O., Marton I., Edelbaum O., Masci, T., Prathapani N., Shklarman E., Ovadis M. and Vainstein A. EOBII, a gene encoding a flower-specific regulator of phenylpropanoid volatiles' biosynthesis in petunia // Plant Cell. – 2010. – V. 22. – P. 1961-1976.

**EXPRESSION OF TRANSCRIPTION FACTOR *AtDREB2A* GENE  
IN VITRO И IN PLANTA**

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Transcription factor DREB2A controls expression of many inducible genes under drought conditions and requires posttranslational modification for activation.

We amplified two DNA-fragments: one containing full coding sequence of AtDREB2A from *Arabidopsis thaliana* (natAtDREB2A), and another one for constitutively active form ΔAtDREB2A with deletion of 30 amino acid residues in the central region (positions 135-164). Both DNA-fragments were fused with sequence coding six histidine residues on 3'-termini and were cloned in pET11d vector. Induction of protein expression was performed in *E. coli* BL21(DE3)pLysS under three temperatures 30, 37 and 42°C in the presence of IPTG (1-7 mM). Expression of both proteins did not depend on the IPTG concentration. Protein products differed by mobility in SDS-PAGE (about 50 and 40 kDa respectively). While synthesis of natAtDREB2A protein was independent of temperature, the maximum yield of protein ΔAtDREB2A was observed at stress temperature 42°C. Both proteins were purified using Ni-agarose affinity chromatography.

Then both DNA-fragments were re-cloned under control of the following regulatory elements: constitutive 35S CaMV- or inducible rd29A-promoter; 5'-UTR of PVY or artificial enhancer of translation “3xARC1”; 3'-UTR of TMV and transcription terminator of nopalinsyntase gene. Created recombinant cassettes were transferred into vector pCAMBIA2300. Plant transformation was carried out and transgenic potato plants were obtained.

Some of transgenic plants gained obvious resistance to artificial drought stress (medium with 300 mM mannitol). Using qRT-PCR we analyzed level of expression *AtDREB2A* or *natAtDREB2A* in transgenic lines and determined quantity of transgene copies.

**INDUCTION OF MORPHOGENESIS AND AGROBACTERIUM-MEDIATED TRANSFORMATION OF *WOLFFIA ARRHIZA***

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Vaccines creation based on transgenic plants may be considered as a groundbreaking technology in modern vaccinology with the advantages as compared to bacterial and yeast systems, such as the lack of common human and animal pathogens, and high level expression of heterologous proteins.

Currently plants of the *Lemnaceae* family, particularly *Lemna minor* and *Spirodela oligorrhiza*, are used as the producers of recombinant proteins ( $\alpha$ -interferon, plasminum, microplasmogene, monoclonal antibodies) by their culturing within the framework of the superficial fermentation systems under factorostatic terms.

Yet more promising target for biopharming is Wolffia rootless (*Wolffia arrhiza*), belonging to the *Lemnaceae* family. The main feature of this plant is the absence of rootage, which implies the possibility of its submerged cultivation in a fermenter. Despite the increased interest in plants of the *Lemnaceae* family as an expression platform for biopharming and active work in this direction actually there is not a single report about stable transformation of plants belonging to the *Wolffia* genus.

One of the main methods for producing transgenic plants is Agrobacterium-mediated transformation. However, regardless of the transformation method, first of all it is necessary to have a reliable and efficient system for regeneration of whole plants *in vitro*. We have developed a two-step procedure of callus induction in *Wolffia* using the Schenk-Hildebrandt's medium (SH), containing glucose, mannitol and sorbitol in varying concentrations. At the first stage cluster structures are induced in the presence of 2,4-D and BA during 16 weeks. At the second stage BA in the medium for callus induction is replaced by PCL over a period of 4 weeks. The resulting callus can be maintained *in vitro* for a long time at a relatively low concentration of the PCL or it is possible to regenerate the whole plants of *Wolffia* by transferring the obtained callus on to the hormone-free SH medium.

Three Agrobacterium strains were involved in the experiments on transformation (AGL0, CBE21 and EHA105). *pCamGFP* and *pVec035* containing the selective gene *hptII*, and *pBINmGFP5ER* containing the selective gene *nptII* were employed as the vector constructs. The constructs comprised the *gfp* and *gus* genes as reporters.

The most efficient transgenesis and selection of the transgenic lines occurs in the presence of hygromycin B at the concentration of 5 mg / l. The successful transformation requires the presence both of 2,4-D and BA in the cultivation medium within 15 days. 4 transgenic lines of *Wolffia* has been obtained as a result of investigations. All the lines were analyzed for expression of the reporter proteins. According to the results of histochemical GUS assay all of lines with the integration of *pVec035* construct expressed enzyme  $\beta$ -Glucuronidase.

**WIDENING THE SPECTRUM OF WHEAT GENETIC VARIABILITY ON  
THE BASE OF LONG-TERM PLANT REGENERATION TECHNOLOGY  
*IN VITRO***

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For the reason of the significance of wheat as important domestic export product as well as because of the awareness of society against the genetically modified objects, implementation of genetic engineering methods for wheat improvement in Kazakhstan is limited. In this regard, the one of the additional biotechnological instruments that allows increasing genetic diversity of domestic wheat is appeared to be the variability, gained by cells in the process of cultivation in vitro and inherited to regenerated plants (Larkin, Scowcroft, 1981; Сидоров, 1990).

We have developed genotype-independent cell technology of plant regeneration during long-term subcultivation that allows overcoming the differences in plant regeneration capacity in vitro between the wheat varieties and lines. This allows obtaining of regenerated plants from any commercially important cultivars and perspective lines according to the breeders order. Earlier the methods of cell and genetic engineering have been fulfilled with the use of genotypes with high regeneration capacities but not always commercially valuable.

Currently, long-term in vitro plant regeneration technology is being used in our research targeted to the study of genetic variability in vitro. In the result, we have revealed the widening of spectrum and degree of genetic variability in somaclonal lines on their quantitative (height of plants, length of main ear, quantity of grains and grain mass per ears) and qualitative traits (grain colour, glumes' colour and shape, awniness). Detection of red coloured grained forms, forms with anthocyanin coloured ears, awned and precocious forms indicates the widening of the spectrum of genetic variability of somaclonal lines compared to initial genotypes. Widening the range of quantitative signs is demonstrated on the somaclonal lines of cv. Otan. Thus, the mean value of plant height at R3 lines of cv. Otan changed from 50,2 to 85,1 cm, whereas in control cv. Otan it equals to 85,2 cm. The range variation of "height of plants" in lines of cv. Otan has been significantly expanded to 42,0 cm compared to the initial cultivar (9,4 cm) predominantly due to the lowerest level of this value which leads to arising of short-stem and dwarf forms. It is important to point out, that the changes of traits in studied somaclonal lines are significantly depend from the initial genotype and significantly differs in different varieties and hybrids that are in accordance to the data suggested in literature.

On the whole, the general tendency in all varieties has become the appearance of somaclonal lines with large and high yield grained ear, with the changes in shape and colour of grains and glumes. The long-term regeneration technology has the perspective to be implemented in haploid technology for obtainment of gametoclonal lines with improved valuable traits.

This work performed under the projects of RSTP program of MES RK (2001-2005).

**REMOTE HYBRIDIZATION AND EXPERIMENTAL HAPLOIDY  
IN WINTER TRITICALE BREEDING**

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The improvement of cytological and ecological stability of triticale (*X Triticosecale* Wittmack) synthetic culture is a crucial task for practical breeding. Biotechnological methods play the important role in the solution of this task. New dihaploid varieties of cereal crops, primarily barley and rice, widely spread in Europe and in the United States are characterized by high competitiveness in the food market and comply with the biosafety requirements. Triticale varieties possessing high productivity potential and good nutritional value, often do not meet the requirements of uniformity, distinguishability, and stability showed by modern varieties.

For stabilizing the genome of winter hexaploid triticale ( $2n=42$ , AABBRR) and obtaining a wide range of constant dihaploid recombinants, we used remote hybridization and haploidy. Using the scheme of double tester top cross, reciprocal crosses between promising triticale samples and wheat species *T. spelta* L. ( $2n=42$ , AABBDD) and *T. turgidum* L. ( $2n=28$ , AABB) which are the gene sources determining the high quality of grain and resistance to abiotic factors and diseases were conducted. *In vitro* embryoculture was used to overcome postgamous incompatibility and increase the safety of hybrid embryos. For obtaining fertile progeny, polyploidy was used. The evaluation of the effectiveness of the parent components by set showed that wheat is preferable to use as the female parent. However, the analysis of the developed triticale-wheat F<sub>1-6</sub> hybrids by the elements of productivity and grain quality showed that in terms of competition in the breeding process, the progeny of *Triticale* × *T. turgidum* combinations proved to be the most successful.

We also used *Hordeum bulbosum* L., maize, broomcorn, Sudan grass, and sorghum-Sudan grass hybrids as haploproducers with the aim of genome homozygotisation of intraspecific winter triticale hybrids. For increasing set and the degree of embryo differentiation, the inflorescences of the haploidising form were treated before and after flowering by the solutions of cytokinin and auxin biologically active compounds in which such essential and limiting amino acids as lysine, arginine, and threonine were added. *Hordeum bulbosum*, sorghum, and Sudan grass might be referred to the effective haploproducers for winter triticale. The dihaploids obtained after seed multiplication were included into the breeding process, in which the obtained material was tested in terms of economic value. The isolated accession of Zhemchug developed by us on the genetic basis of winter triticale using broomcorn Venskor, in 2012 was transferred to the State Inspection for Testing and Protection of Plant Varieties of the Republic of Belarus.

**BIOTECH AND MOLECULAR GENETIC TECHNIQUES IN WHEAT  
(*TRITICUM AESTIVUM L.*) BREEDING**

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We carry out a PCR analysis of HMW glutenin [M.Ahmad, 2000] for optimization PCR techniques - genotyping KRIACP varieties (Jenis, Erythrospermum, Almaken). PCR is of molecular biology method, allowing a substantial rise (amplification) of low concentrations of specific DNA fragments of biological material (sample). PCR analysis was carried out at 94°C for 5 minutes to the next mode for 45 cycles: 1) denaturation: 94°C - 1 minute, 2 ) primer annealing 63°C-1 minute, 3) elongation: 72°C - 1 minute. The resulting PCR - product was cooled to 4°C. Stored in a freezer at - 20°C . Quality of the DNA was determined in a 2% agarose gel with addition 2mkl ethidium bromide for 1 hour [Maniatis, 1984]. For DNA isolation from plants used CTAB-method.

Hexaploid wheat baking quality is a complex trait. The amount and composition of protein can influence the rheological properties of dough. The high molecular weight glutenin loci encoding the Glu-1 group 1 on the long arm of homeologous chromosome A, B and D genomes. In our work we used the STS DNA markers as a tool to detect differences wheat for baking quality. These markers are very important in the breeding of wheat for bread-making quality. The range of lengths of the DNA fragments obtained using four primers ranged from 250 to 2500 bp. Number of detected DNA fragments depends on the genotype. For our breeding materials in the amplification primers HMWP1 + HMWR2 and HMWR3 + HWMR4 showed the maximum number of bands. This may indicate the relative diversity of genetic data of all genotypes of breeding materials. For wheat genotypes used markers enable to identify the baking quality of spring wheat.

Molecular genetic analysis makes it possible to identify specific genomic markers that can be used for the breeding. Use of specific primers allow researchers to reduce the labor and resources needed to analyze the samples. In the future, the breeding based on molecular markers, can significantly increase the efficiency of crops breeding. All our studied varieties are 1Dx5-1Dx10 types.

**OBTAINING OF TRANSGENIC RAPESEED PLANTS EXPRESSING  
THE GENE TRANSCRIPTION FACTOR HvNHX2**

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The aim of this study was to obtain transgenic rapeseed expressing cDNA gene HvNHX2 vacuolar Na<sup>+</sup> / H<sup>+</sup>-antiporter barley for use in the selection process for resistance to salinity.

For Agrobacterium-mediated transformation of plants rape was used the following construction: {35S-promoter - 5'NTP PVY - (HvNHX2) - 35S-terminator} where 35S-35S promoter of RNA transcription promoter of cauliflower mosaic virus; 5'NTP PVY 5'-untranslated sequence of the genomic RNA of potato virus Y; HvNHX2 protein-coding sequence of the gene from barley HvNHX2; 35S-35S RNA transcription terminator of cauliflower mosaic virus. This construct was cloned into the binary vector Agrobacterium pSS, based on the commercial vector pCambia2000. pSS plasmid differs from pCambia2000 presence is the transcription terminator from the cauliflower mosaic virus (CaMV), instead of the terminator of the nopaline synthase (nos).

As explants for transformation were used diploid and haploid cotyledons and hypocotyls of rapeseed. In this case it is determined that after the transformation of haploid explants obtained few viable regenerated. Also as a result of our experiments revealed that the highest number of viable regenerates after transformation can be obtained from diploid cotyledons.

Rapeseed transgenic plants in vitro were obtained by transformation and subsequent selection, which were tested for the presence of the transgene insert and its expression by Western blot analysis.

Three transgenic rapeseed plants (lines) were cloned in vitro and tested for resistance to salt. Cloned lines of each plant were placed on MS medium with half-dial salts, 500 mg / 1 cefotaxime and 100 mM NaCl. The experiment was performed in triplicate on 10 plants in each.

In the first 7 days of survival of the third line of the test plants was 75% and 67% of control, after 14 days 68% and 36.7%, through 67 days after the death of the control plants remained 33% of the test plants. Clones of the first and second lines behaved like control plants and died after 58 and 62 days respectively.

**OPTIMIZATION OF *IN PLANTA* GENETIC TRANSFORMATION FOR  
THE LOCAL COTTON VARIETY**

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Advantages of *in planta* genetic transformation are the overcoming the problem of genotype dependence in plant regeneration process and avoiding the time-consuming steps of tissue selection in sterile conditions during the genetic transformation *in vitro*. The purpose of this study was to optimize the conditions for *in planta* transformation of local cotton variety using agrobacterium strain carrying a plasmid with the reporter glucuronidase gene (*GUS*-) and the marker gene neomycin phosphotransferase (*nptII*-). Pollen of flowering plants and shoot apexes have been used as a recipient systems for transformation. Local commercial variety Maktaaral-4005 have been used as an object of investigation.

In the course of the optimization of *in planta* transformation of flowering plants pollen was transformed by co-cultivation with agrobacterium cell suspension; then flowers were pollinated with the transformed pollen. As a result, 19 bolls and 600 set seeds of putative transformants of T0 generation were obtained from 250 pollinated flowers. For 25 of them we obtained histochemical proof of *GUS*- gene expression in T1 generation, which is 4.2 % of the total amount of putative transformants. For 13 of the *GUS*- positive plants we obtained molecular biological confirmation for introduction of *nptII* and *GUS*- genes by PCR method, which is 2.2 % of the set seeds.

In the course of *in planta* apex transformation apical buds of 14-day old seedlings have been cocultivated with agrobacterium cell suspension with the exposure to vacuum infiltration. As a result of optimization, 6 transgenic plants were obtained from 101 apexes, in which the amplification products of *nptII*- and *GUS*- genes have been detected, representing 5.6 % of the transformed apexes.

In general, we have optimized conditions for the production of transgenic plants from local cotton varieties using reporter and marker genes, which will allow to introduce "useful" genes responsible for economically valuable traits into their genome. Transgenic plants of local commercial cotton variety expressing reporter *GUS*- gene have been generated.

The authors thank to professor A.Mitra (Nebraska University, Lincoln, USA) for the kind providing of plasmid constructs and agrobacterium strains containing *nptII*- and *GUS*- genes.

This work performed under the projects of STP MES RK 01.01.08.03.R1 (2006-2008), 02.2.03.P4 (2009-2011).

**PRODUCING HYBRIDS OF RAPSEED WITH MUSTARD  
AND COLESEED**

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In the field, carried interbreeding rapeseed (*Brassica napus* L., 2n = 38) with mustard (*Brassica juncea* L., 2n = 36) and coleseed (*Brassica campestris*, 2n = 20).

Hybridization was performed in the early morning in the field. Before castration plants removed all axillary buds and lateral shoots in the central racemes removed the opened upper and immature buds. Buds opened with forceps and carefully removed the anthers in the bud leaving only one pistil. After that, the plants wore insulator. After 3 days of pollination performed by depositing pollen on the pistil and again woreplant under the insulator.

After 14 days, the immature embryos of rapeseed interspecific hybrids size of 2-3 mm were extracted from the pre-sterilized pods and planted to MS medium with hormones: Kinetin 1 mg / l, IAA 0.1 mg / L, GA 1 mg / L, casein hydrolyzate 10 mg / l, 6 embryos per tube. Embryos were cultured on this medium before pipping. Hatched embryos were transplanted onto MS medium with the hormones BAP 0,5 mg / l, Kinetin 1 mg / l, IAA 0.5 mg / l, 2,4-D 0.1 mg / l for further cultivation. Germinated embryos were transplanted to MS medium before the formation of leaves and then on MS medium without hormones and full composition of salts for rooting. After cloning, 1/3 was left for a further regenerants cloning and 2/3 were transplanted into the soil, the temperature, humidity, illuminance was maintained.

When flowering plants of the first generation hybrids obtained by crossing spring rape with mustard and coleseed, it is determined that more than 80% of them are sterile.

Irregularities in the meiotic division of hybrid plants were studied. Bud recovered from 2-3 anthers and placed on a clean glass slide in a big blob acetocarmine. Heated 3-4 times over the flame of a spirit lamp and covered with a cover glass. Viewing performed under the microscope at 100 fold magnification. It was found that in the second meiotic division at anaphase II observed improper chromosome segregation, abnormal mitotic spindle, as well as three groups of telophase chromosomes in the first division. In consequence pentads were formed from tripolar spindles in the second meiotic division. These irregularities led to the formation of sterile pollen grains.

**OPTIMIZATION OF MEDIUM COMPOSITION IN THE CULTURE  
OF ISOLATED ANTER OF RICE *ORYZA SATIVA* L.**

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Currently, haploid technology has tremendous use for accelerating breeding process that allows obtaining a stable plant in one generation. Homozygous lines can be used by breeders to study of gene interactions and determining linkage group for creating genetic maps. The most effective method of getting haploids of rice is the culture of isolated anthers. Haploid plants from anther culture of rice usually obtained through direct callus formation or regeneration of somatic embryos, in which are formed embrionic structure with the subsequent development of them embryos.

In the course of research, there was made a comparison influence of hormones 2.4-D and phenyl acetic acid (PAA) on the induction androgenetic structures of 39 rice genotypes. Two variants of the induction medium-N<sub>6</sub> + 2 mg/l 2.4-D, and N<sub>6</sub> + 2 mg/l PAA were used. In 20 days of cultivation was observed occurrence of the first androgenic structures. The greatest number of callus was obtained from F<sub>3</sub> KS-6-8 lines and glutinous varieties Violetta. The literature notes that glutinous rice genotypes exhibit maximum responsiveness in anther culture, followed by: japonica, *japonica/indica* hybrids, *indica/indica* hybrids and subspecies *indica*. On induction medium containing PAA, was observed direct plant regeneration in hybrids F<sub>3</sub>GS-176, 208 and F<sub>3</sub>GS-F<sub>3</sub>BR-8. In general, the medium from 2.4 - M was more effective at inducing callus compared to medium containing PAA. Nutrient medium was optimized for induction of roots regenerants. The most effective medium for root formation was nutrient medium containing 1/2 set of micro and macroelements Murashige-Skoog supplemented with sterilized by membrane filtration 1 mg/l IAA 500 mg/l casein hydrolyzate, and 0.2 mg / l CuSO<sub>4</sub>. It was shown the dependence of regeneration processes of donor plants genotype. The most responsive genotypes of the tested varieties were Violetta, Bakanassky, F<sub>3</sub> hybrids BR-8, F<sub>3</sub>KS6-8-194i F<sub>3</sub>GS and F<sub>3</sub>SSP5-6.

In the course of the study found that the optimal medium for induction of callus formation is N6 supplemented with 2 mg/l 2.4-D, for rhizogenesis Murashige-Skugas medium with half the composition of micro and macroelements, supplemented with sterilized by membrane filtration 1 mg / l IAA, 500 mg / l casein hydrolyzate, and 0.2 mg/l CuSO<sub>4</sub>. PAA in induction medium causes direct plant regeneration in rice anther culture.

**INVESTIGATION OF TRANSLATION INITIATION AT NON-AUG CODON  
IN 5'-UNTRANSLATED REGION OF POTATO VIRUS Y GENOMIC RNA****A.V. Zhigailov, R.I. Borankul, N.S. Polimbetova, B.K. Iskakov***Ajtkhozhin Institute of Molecular Biology and Biochemistry, Almaty, Kazakhstan*  
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Eukaryotic protein synthesis begins almost exclusively with methionine that is coded by AUG-start-codon. Nevertheless some viral and cellular mRNAs can efficiently initiate translation at non-AUG-codons. Initiation at non-AUG-codons may provide synthesis of different polypeptides from the same mRNA.

We noted that *in vitro*-translation in wheat germ cell free system of different recombinant mRNAs, containing 5'-untranslated region (5'UTR) of Potato Virus Y (PVY) genomic (g)RNA, produces additional polypeptide ( $P_+$ ) that is approximately 15 amino acids larger than the main translation product ( $P_0$ ).

Inasmuch as 5'UTR of PVY gRNA does not contain upstream AUG-codons, to identify the start non-AUG-codon of  $P_+$  open reading frame (ORF) we constructed recombinant mRNAs that contain native ("5'Y-[AUG- $P_0$ -6His]") or mutated ("5'Y-UAA-[AUG- $P_0$ -6His]") variants of PVY 5'UTR before  $P_0$ -ORF.  $P_0$ -ORF encodes 14 kDa polypeptide containing six histidines (6His) at C-terminus that allow detection of  $P_0$  and  $P_+$  using antibodies (Penta-His-HRP Conjugate). ORFs of both mRNAs do not contain AUG-codons except the start-codon. In "5'Y-UAA-[AUG- $P_0$ -6His]" mRNA the UAA stop-codon was inserted before the start AUG-codon in the same reading frame.

Then recombinant mRNAs were translated in wheat germ cell free system. It was shown that both mRNAs provided synthesis of  $P_0$  polypeptide (14 kDa). "5'Y-[AUG- $P_0$ -6His]" mRNA besides  $P_0$  produced additional  $P_+$  polypeptide (15.5 kDa). Additional  $P_+$  polypeptide is not synthesized in the course of mRNA "5'Y-UAA-[AUG- $P_0$ -6His]" translation. This indicates that  $P_+$  ORF begins from non-AUG codon located in PVY gRNA 5'UTR in the same phase as the start-AUG codon.

On the basis of "5'Y-[AUG- $P_0$ -6His]" and "5'Y-UAA-[AUG- $P_0$ -6His]" mRNAs we constructed the respective mRNAs "5'Y-[GCG- $P_0$ -6His]" and "5'Y-UAA-[GCG- $P_0$ -6His]", in which start AUG-codon was replaced by GCG-codon. As expected these mRNAs lost the ability to produce polypeptide  $P_0$  (14 kDa). At the same time  $P_+$  polypeptide (15.5 kDa) continued to be synthesized from "5'Y-[GCG- $P_0$ -6His]" mRNA (apparently from upstream non-AUG codon).

All described above recombinant mRNAs were translated *in vitro* in the presence of L-[<sup>35</sup>S] methionine. Translation products after fractionation in SDS-PAGE were examined by autoradiography.  $P_0$  polypeptide (14 kDa) was detected among translation products of mRNAs "5'Y-[AUG- $P_0$ -6His]" and "5'Y-UAA-[AUG- $P_0$ -6His]", but was absent among products of translation of mRNAs "5'Y-[GCG- $P_0$ -6His]" and "5'Y-UAA-[GCG- $P_0$ -6His]". At the same time  $P_+$  polypeptide (15.5 kDa) being the product of non-AUG translation was detected only among products of translation of mRNA "5'Y-[AUG- $P_0$ -6His]", but not "5'Y-UAA-[AUG- $P_0$ -6His]" mRNA. These results suggest that translation initiation at non-AUG-codon of PVY gRNA 5'UTR happens without the participation of Met-tRNA<sub>i</sub>.

Translation enhancers that can mediate non-AUG initiation could be useful in biotechnology for elevated synthesis of recombinant proteins containing amino acid residues other than methionine at their N-termini.

## **Секция 1.**

# **Генетические ресурсы растений**



**ОРГАНИЗАЦИЯ БАНКА СЕМЯН ДИКИХ СОРОДИЧЕЙ  
КУЛЬТУРНЫХ РАСТЕНИЙ КАЗАХСТАНА**

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По данным международных оценок экспертов в мире сложилась настораживающая ситуация. В течение XX столетия было утрачено около 75% мирового генетического разнообразия сельскохозяйственных культур, ориентировано треть из существующих на планете высших цветковых растений, может исчезнуть уже к середине 21 века. Примерно сто тысяч глобальных сортов растений находятся под угрозой исчезновения сегодня по следующим причинам: глобальное потепление климата, чрезмерная эксплуатация экосистем, нерациональная хозяйственная деятельность. Всё это способствует ускоренному исчезновению и сокращению генетических ресурсов и является невосполнимой потерей ценного для человечества материала, что также определяет настоятельную и неотложную необходимость создания коллекций и генбанков растительных ресурсов. Сохранение генофонда диких сородичей культурных растений в частности является исключительно важной целью для разрешения тех экологических проблем, которые стоят перед человечеством сегодня или возникнут в будущем. Наиболее приоритетным способом сохранения генетического разнообразия растений сегодня является их сохранение в составе естественных природных сообществ – *in situ*. А также используют метод *ex situ* – сохранение компонентов биологического разнообразия вне их естественных мест обитания, то есть создают банки семян растений. Создание банка семян растений имеет большое значение для сохранения разнообразия видов и передачи их будущим поколениям. В настоящее время в Китае находится крупнейший генетический банк растений, в котором хранятся гены 300 000 видов растений. В США расположен второй по величине генный банк, заботящийся о сохранности 280 000 видов растений. В ведении правительства Норвегии (Глобальный траст-фонд по разнообразию сельскохозяйственных культур), а также Центра генетических ресурсов Северных стран находится хранилище Svalbard Global Seed Vault. На 5 марта 2013 года число образцов, поступивших в это хранилище из 27 генбанков разных государств мира, превысило 770 000 образцов. Следует отметить, что доля семян именно диких сородичей культурных растений в генетических банках мала. В этой связи нами изучен международный опыт по созданию и сохранению генофонда полевых культур и их диких сородичей. Надо отметить что, в большинстве случаев акцент делается на сохранение культурных растений.

Впервые в Институте ботаники и фитоинтродукции начата работа по созданию семенного банка диких сородичей культурных растений в рамках государственной научно-технической программы «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации Продовольственной программы» на 2013-2015 гг. Подготовлено специализированное помещение для размещения активной и базовой коллекции, оборудована сушильная комната, холодильная комната, комната предварительной заморозки. Закуплено необходимое оборудование для вакуумной упаковки семян, оборудование для определения их морфологии и качества.

В 2013 году сотрудниками института и его соисполнителями было собрано и заложено на сохранение 538 образцов семян дикорастущих растений 200 видов 33 семейств из 17 флористических районов Казахстана. Также проводится работа по налаживанию контактов с семенными банками разных государств мира для дублирования уже сформированных коллекций диких сородичей культурных растений.

**СОХРАНЕНИЕ РЕДКОГО ЭНДЕМИЧНОГО ВИДА *ASTRAGALUS SERICEOCANUS (FABACEAE)* С ПОМОЩЬЮ МЕТОДОВ *IN VITRO*****Е.В. Амброс, Т.И. Новикова**

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Сохранение редких и исчезающих видов является важнейшей составляющей поддержания генетического разнообразия растений. Астрагал шелковисто-седой (*Astragalus sericeocanus* Gontsch., сем. *Fabaceae* Lindl.) – узколокальный эндемик флоры Сибири, нуждающийся в государственной охране, статус 3 (R). По оценке общего содержания флавоноидов (выше 2%) вид относят к перспективным источникам биологически активных веществ. Антропогенная нагрузка и экология мест обитания препятствует естественному воспроизведению вида. Анализ электрофоретических спектров запасных белков семян показал, что величина генетической изменчивости в популяции *A. sericeocanus* невысока, что свидетельствует о процессах деградации, происходящих в данной популяции. Согласно данным Г.П. Семеновой (2007) по критериям приспособленности вид относится к группе среднеперспективных растений. Эксперименты по интродукции и размножению вида *in vivo* показали низкий процент прорастания семян и выживаемости высаженных растений. Метод культивирования *in vitro* в интеграции с традиционными подходами сохранения растений *in situ* и *ex situ*, позволяет решить проблемы, возникающие в условиях реинтродукции и интродукции.

Цель данной работы заключалась в оптимизации режима проращивания семян *A. sericeocanus*, размножении и сохранении вида в коллекции *in vitro*. При введении в культуру *in vitro* использовали зрелые семена *A. sericeocanus* 2010 – 2012 г.г. сбора из трех ценопопуляций, расположенных в окрестностях оз. Байкал. Семена предоставлены лабораторией редких и исчезающих растений ЦСБС СО РАН. Для стерилизации использовали 70%-ый раствор этилового спирта (2 мин), затем 20%-ый раствор «Domestos» (15 мин). После стерилизации количество эксплантов, свободных от контаминации, составило 96,7%. Для снятия экзогенного физического покоя была проведена скарификация 50%-ной серной кислотой (продолжительность обработки до 60 мин). Семена проращивали на безгормональной питательной среде Мурасиге и Скуга (МС) с половинным содержанием микро- и макроэлементов, сахарозой в концентрации 2% и агаром – 0,7% при температуре 24<sup>0</sup>С. Контролем служили интактные семена. Показано, что обработка серной кислотой увеличивала прорастание семян по сравнению с контролем. Всхожесть семян у *A. sericeocanus* после скарификации составила 37%, в контрольном варианте – 13%. Экспланты (проростки, семядоли, гипокотиль, пазушные меристемы побегов) помещали на среды по прописи Гамборга и МС, дополненные зеатином (0,1-2,0 мг/л), 6-бензиламинопурином (0,5-0,75 мг/л), тиодиазуроном (0,05 и 0,1 мг/л). Оптимальной средой, стимулирующей развитие пазушных меристем из проростков, была среда Гамборга, содержащая зеатин в концентрации 0,25 и 0,75 мг/л. Индукция адвентивного побегообразования отмечена на среде МС с тиодиазуроном при использовании в качестве эксплантов пазушных почек.

Таким образом, разработаны эффективные технологии микроразмножения редкого вида *A. sericeocanus* из различных типов эксплантов путем активации пазушных меристем и индукции адвентивного побегообразования.

Работа выполнена при поддержке гранта Президиума РАН «Живая природа: состояние и развитие» № 30.3.

## **ИСХОДНЫЙ МАТЕРИАЛ ДЛЯ СЕЛЕКЦИИ РИСА**

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Гибридизация сортов разных подвидов *indica/japonica* – в настоящее время основной метод создания сортов в мировой селекции риса. Главная цель межподвидовой гибридизации – создание сортов с еще более высоким потенциалом урожайности и качеством зерна. Достижение ее предполагается рекомбинацией лучших признаков и свойств основных культивируемых подвидов риса.

Использование межподвидовой гибридизации в Казахстанских селекционных программах по рису наталкивается на значительные трудности, связанные с экологической спецификой и агротехническими особенностями возделывания риса. Поэтому была поставлена задача создания собственных широкосовместимых линий риса подвида индика для умеренной зоны, ранее не существовавших в этом геоклиматическом поясе. Они будут использованы и как формы посредники, и для прямых скрещиваний с лучшими сортами японика.

Отобраны первые 70 элит индика форм умеренного пояса и изучены их селекционно-генетические признаки в коллекционном питомнике. Изучение исходного материала – это первое и очень важное звено селекционной работы, которое во многом определяет успех работы по созданию новых сортов любых сельскохозяйственных культур. Основное требование, предъявляемое к новым сортам риса – сочетание высокого качества и урожайности.

Полевые и лабораторные эксперименты выполнялись в КазНИИ рисоводства в соответствии с Методическими указаниями ВИР. Стандартом являлся районированный сорт Маржан. Собственные популяции индика (СПИ) изучались по признакам: высота растений, длина метелки, число колосков на метелке, а также по физическим параметрам и консистенции эндосперма: форма зерновки (длина, ширина, толщина и отношение длины к ширине), пленчатость, стекловидность, трещиноватость эндосперма и масса 1000 семян.

Все образцы отличались низкорослостью (62-73 см), достаточно высоким числом колосков (130-158 шт.), высокой и средней массой 1000 семян (29,0-32,5 г.). Форма зерновки и консистенция эндосперма являются важнейшими показателями качества. Так, изученный набор образцов характеризовался длиннозерностью (отношение длины зерновки к ширине 2,4-3,04). Известно, что на мировом рынке преобладает торговля длиннозерным рисом подвида индика, с продолговатой формой зерновки. Дальнейшее исследование и использование их актуально для создания длиннозерных форм риса, которая является основой деления товарного риса на коммерческие типы.

Консистенция эндосперма определяет не только товарный вид риса, но и кулинарные и вкусовые свойства. Диапазон стекловидности и трещиноватости не отличался от стандарта Маржан, но следует отметить, что при такой длиннозерности присутствие низкого количества трещиноватости указывает о высокой устойчивости и стабильности этих форм. Все изученные образцы представляют особый интерес.

Следовательно, собственные популяции индика являются не только важным фактором расширения генетического базиса и преодоления генетической унификации будущих сортовых ресурсов РК, но и эффективными источниками повышения качества зерна и крупы.

**ГЕНЕТИЧЕСКИЕ РЕСУРСЫ И РЕЗУЛЬТАТЫ СЕЛЕКЦИИ  
ПОДСОЛНЕЧНИКА В ВОСТОЧНОМ РЕГИОНЕ КАЗАХСТАНА**

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История создания коллекции генофонда подсолнечника (*Helianthus annuus* L.) в «Опытном хозяйстве масличных культур» начинается с 1965 года – это год создания Казахской опытной станции масличных культур, в задачи которой входило изучение различных сортобразцов подсолнечника для популяционной селекции. С 1973 года начались научно-исследовательские работы по гетерозисной селекции, с использованием генетических систем ЦМС –Rf.

Методом инцюхтирования создан генофонд самоопыленных линий насчитывающий 1720 образцов, из них: 180 ЦМС – аналогов созданных на цитоплазме *H. petiolaris*; 12 линий на цитоплазме *H. rigidus*. Создано 516 отцовских линий, содержащих гены Rf- восстановления фертильности пыльцы для ЦМС –PET, ведется работа по созданию восстановителей фертильности пыльцы для ЦМС –RIG. Однолетние дикорастущие формы подсолнечника, которых в коллекции содержится незначительно, используются при создании исходного материала. В коллекцию подсолнечника за 2009-2012 гг. привлечено 157 образцов отечественной и зарубежной селекции путем селекционных работ и обмена коллекционными образцами между научными учреждениями.

Сохранение, формирование генофонда подсолнечника, изучение биологических свойств коллекционных образцов подсолнечника для дальнейших селекционных исследований на сегодняшний день является важной задачей. Паспортизация генофонда подсолнечника проведена согласно международным дескрипторам, за основу документирования принята форма с 15 полями с информацией об образце: дате регистрации, месте и статусе хранения, стране происхождения и доноре, биологическом статусе, типу развития, наличия гербарного материала и др..

Для более эффективного использования в селекционных программах генофонда подсолнечника созданы признаковые коллекции: по раннеспелости, крупноплодности, масличности, лужистости, по высоте растений, диаметру корзинки, устойчивости к ложной мучнистой росе, заразихе, а также по маркерным признакам.

На основе генетически разнообразной коллекции самоопыленных линий подсолнечника выведены и занесены в Государственный реестр селекционных достижений Республики Казахстан 10 раннеспелых, высокопродуктивных гибридов и 3 сорта подсолнечника, а также 4 перспективных гибрида находятся на Государственном сортоиспытании сельскохозяйственных культур РК.

**Ключевой доклад**

**СОХРАНЕНИЕ БИОРАЗНООБРАЗИЯ ГЕНЕТИЧЕСКИХ РЕСУРСОВ  
СЕЛЬСКОХОЗЯЙСТВЕННЫХ РАСТЕНИЙ, ВОЗМОЖНОСТИ  
ИСПОЛЬЗОВАНИЯ В СЕЛЕКЦИИ**

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Ежегодно в мире районируются тысячи сортов, вместе с тем постоянно растет спрос на новые сорта, обладающие комплексом ценных признаков, способные давать урожай в разнообразных условиях среды и позволяющие использовать энергосберегающие и природоохранные технологии. Ведущее место при этом отводится рациональному использованию генофонда. Согласно отчетным данным проекта «Формирование генофонда сельскохозяйственных культур для устойчивого и конкурентоспособного развития агропромышленного комплекса Республики Казахстан» на 01.01.2014г. НИУ МСХ РК поддерживают и хранят более 50,0 тыс. (59422), образцов с./х. культур. Более 50% коллекций составляют зерновые и зернофуражные, ≈ 20,0% - кормовые, ≈ 1,0 % – масличные и зернобобовые, ≈ 1,0 % – технические, ≈ 25,0% – овощные и картофель, ≈ 5,0% – плодовые и ягодные. Собранный генофонд уникален структурой – коммерческие сорта национальной и мировой селекции; дикие и дикорастущие сородичи сельскохозяйственных растений; местные и стародавние сорта; лучшие селекционные линии национальной селекции; генетические коллекции, мутанты, новообразования, синтезируемые в процессе различных селекционно-генетических экспериментов. Неполный охват намеченного таксона, неполный географический охват, потеря известных местных и стародавних сортов, потеря исторических сортов – основные пробелы, обнаруженные в хранящихся коллекциях. Объемные коллекции сохраняются с различной степенью риска. В связи с доминированием в течение длительного времени (более 10 лет) краткосрочного вида хранения отмечено понижение (в среднем до 20 -30 %) жизнеспособности, в отдельных случаях потеря материала (отчеты КазНИИЗиР, 2009-2011гг). Регенерация является одним из приоритетных направлений программ по ГРРПСХ Казахстана. Необходимость восстановления установлена для всех культур. С 2010 года в КазНИИЗиР, сосредоточившего ≈1/3 национального генофонда, внедрены стандарты среднесрочного (-5;-10<sup>0</sup>С) хранения с регулярным мониторингом жизнеспособности и регенерацией семенных коллекций с уровнем всхожести ≥ 50%. В 2013 году проведен мониторинг жизнеспособности и регенерация 2230 образцов семенных коллекций с критическим уровнем всхожести. В ТОО «КазНИИПиВ» организовано хранение *in vitro* (+4<sup>0</sup>С) 422 сортов, и диких форм гермоплазмы плодовых, ягодных культур и винограда. Хранение генофонда кормовых, плодовых, овощных культур проведено частично путем закладки полевых генбанков.

Изучение большинства образцов проведено в недостаточной мере. Необходимы предселекционные исследования для расширения адаптации с.х. культур к меняющимся условиям среды. Согласно опубликованным данным недостаточно источников ценных полигенных признаков засухоустойчивости, холодостойкости, морозо-зимостойкости, солеустойчивости, с различным периодом вегетации, определенными параметрами качества. Установлена необходимость тщательной проработки линий в процессе практической селекции - много ценного генетического материала, получаемого в селекционных программах, не сохраняется и не идентифицируется.

**ТЕХНОЛОГИЯ КЛОНАЛЬНОГО МИКРОРАЗМНОЖЕНИЯ  
*RHODODENDRON DAURICUM* И *RHODODENDRON SCHLIPPENBACHII***

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Виды рода *Rhododendron*, произрастающие на территории РФ, являются не только ценным генетическим ресурсом для селекции форм и сортов, перспективных для ландшафтного дизайна, но и источником биологически активных веществ. *Rhododendron dauricum* L. и *Rhododendron schlippenbachii* Maxim. – морозоустойчивые виды, успешно адаптирующиеся на юге Западной Сибири, однако, массовое размножение этих видов в культуре традиционными методами затруднено. Кроме того, *R. schlippenbachii* является редким исчезающим видом, занесенным в красную книгу РФ, и нуждается в охране. Цель исследования – выявить морфогенные реакции проростков *R. dauricum* и *R. schlippenbachii* на различные регуляторы роста в культуре *in vitro* и разработать эффективные технологии клonalного микроразмножения этих видов.

Асептические семена проращивали на поверхности водного раствора агара (0,6%) на свету для получения стерильной культуры. Экспланты – проростки с удаленными корешками – инокулировали на агаризированные среды Андерсена (AM), дополненные различными концентрациями и комбинациями регуляторов роста (1,0 – 10,0 мкМ зеатина; 5,0 мкМ зеатина с 5,0 мкМ индолил-3-уксусной кислотой; 1,0 мкМ тиодиазурана). Через 8 недель после инокуляции определяли частоту морфогенного ответа, коэффициент размножения и побегов. Число побегов на эксплант, полученных под действием тиодиазурана (TDZ), считали через 8 недель элонгации на безгормональной среде (AM0).

Для стимуляции ризогенеза использовали 4-х часовую импульсную обработку в растворе 148,0 мкМ индолил-3-масляной кислоты (IBA) или непосредственное культивирование в течение 6 недель на AM, дополненной IBA (10,0 мкМ; 25,0 мкМ). После импульсной обработки регенеранты помещали для укоренения либо на AM0 в условиях *in vitro*, либо высаживали *ex vitro* в смесь торфа и песка (1:1). Адаптацию укорененных растений проводили в смеси торфа и песка в течение 6 недель. Адаптированные растения высаживали в горшки с грунтом и переносили в теплицу.

Установлено, что семена *R. dauricum* и *R. schlippenbachii* перспективны в качестве материала для получения *in vitro* стерильных эксплантов, поскольку они имеют высокую всхожесть (74 и 96%, соответственно) и неглубокий физиологический тип эндогенного покоя (тип B<sub>1</sub>). Низкие концентрации TDZ и Zea стимулируют как активацию пазушных меристем, так и закладку адвентивных почек, которые образуются на гипокотиле проростков. Содержание 1,0 – 2,5 мкМ Zea в среде для микроразмножения исследуемых видов является оптимальным. TDZ значительно повышает коэффициент размножения эксплантов, однако, требует последующей элонгации побегов.

Предобработка IBA (148,0 мкМ) с последующим укоренением *ex vitro* и адаптацией в смеси торфа и песка значительно увеличивает выход качественного посадочного материала *R. dauricum* до 89%, *R. schlippenbachii* – 60%.

## ОСОБЕННОСТИ ИНИЦИАЦИИ И ПРОЛИФЕРАЦИИ СОМАТИЧЕСКИХ ЗАРОДЫШЕЙ *PICEA PUNGENS*

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Ель колючая (*Picea pungens*) считается одним из наиболее декоративных видов хвойных, а также данный вид устойчив к условиям города – пыли и дыму. В работе исследовали процесс инициации и пролиферации соматического эмбриогенеза (СЭ) *Picea pungens* в контролируемых условиях культуры *in vitro*. Экспланты служили изолированные зиготические зародыши, отобранные на этапе раннего, позднего эмбриогенеза и на стадии зрелого зародыша. Материал собирали со свободноопыленных деревьев, произрастающих в искусственных насаждениях г. Новосибирска. Инициацию СЭ проводили на базовых средах  $\frac{1}{2}$  DCR и  $\frac{1}{2}$  LV с добавлением аскорбиновой кислоты (0-300 мг/л) и/или глютатиона (0-300 мг/л). В качестве регуляторов роста использовали 2,4-дихлорфеноксусную кислоту (2,4-Д) и 6-бензоаминопурин (6-БАП). Переход к пролиферации регулировали снижением количества сахарозы и 6-БАП. Культуры инкубировали в темноте, при  $24\pm2^{\circ}\text{C}$ . Цитологический контроль проводили методом давленных препаратов.

При введении в культуру зиготических зародышей, находящихся на стадии раннего эмбриогенеза морфогенетических реакций не наблюдалось. При инокуляции зародышей на питательные среды на этапе позднего эмбриогенеза (стадия инициации семядолей) морфогенный ответ наблюдался только у эксплантов на среде  $\frac{1}{2}$  LV и составлял 30-40 % в зависимости от генотипа растения-донора. Добавление аскорбиновой кислоты к среде увеличило способность эксплантов к каллусообразованию до 50 %. Однако по данным цитологического анализа эмбриогенных структур в полученном каллусе не обнаружили.

При введении в культуру зародышей со сформировавшимися семядолями морфогенный ответ увеличился и варьировал от 60 до 100 %, а частота формирования эмбриогенного каллуса достигала 8,4 % на среде  $\frac{1}{2}$  DCR и 28 % на среде  $\frac{1}{2}$  LV. Цитоэмбриологический анализ первичного каллуса показал, что во всех исследуемых генотипах присутствовали соматические зародыши, находящиеся на ранней и/или поздней глобулярной стадии, однако к пролиферации был способен только один генотип. Морфологические, онтогенетические и количественные характеристики пролиферирующих соматических зародышей различались в зависимости от состава среды, используемой для инициации СЭ и пролиферации эмбрионально-сусpenзорной массы (ЭСМ). Добавление глютатиона в среду увеличивало частоту образования ЭСМ, на этапе инициации, но тормозило развитие соматических зародышей и даже приводило к их деградации на стадии пролиферации. Внесение аскорбиновой кислоты стимулировало формирование ЭСМ при инициации СЭ и способствовало онтогенетическому развитию глобулярных зародышей на этапе пролиферации. При введении в культуру зрелых зиготических зародышей морфогенный ответ составлял от 70 до 100 %, а частота образования эмбриогенного каллуса колебалась от 2 до 8 %. Цитологический анализ первичного каллуса показал в нем наличие двух типов клеток, способных к дальнейшей пролиферации: удлиненных эмбриональных трубок и изодиаметрических эмбриональных инициалей. Отмечено развитие соматических зародышей до поздней глобулярной стадии. Таким образом, выявлено, что на индукцию соматического эмбриогенеза оказывала влияние стадия развития экспланта, состав питательной среды, а также генотип растения донора.

## КОМПОНЕНТЫ ЭФИРНЫХ МАСЕЛ РАСТЕНИЙ РОДА *ARTEMISIA* L. БУРЯТИИ И МОНГОЛИИ

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Территория Бурятия представляет собой сложный фитогеографический узел на пересечении экосистем Северной и Центральной Азии и представляет собой классический вариант экотонной территории. По характеру распределения полыней выделяют 6 главных центров их происхождения (Крашенинников, 1958). Очень важным центром видеообразования полыней является Ангарский, включающий в себя район наших исследований - Прибайкалье и Северную Монголию. Родовой комплекс полыни представлен в Бурятии 46 видами (Намзалов, 2001), многие из них имеют обширный ареал и формируют значительную фитомассу, что определяет перспективы их практического использования. Установлено, что они обладают антимикробной, противовоспалительной и анфунгальной активностью. Физиологическая активность полыней обусловлена разнообразием содержащихся в них биологически активных соединений, в том числе эфирных масел. Эфирные масла широко используются в парфюмерной, пищевой и фармацевтической промышленности. Эфирное масло получали методом гидродистилляции из воздушно-сухого сырья. Эфирное масло исследовали методом хромато-масс-спектрометрии на газовом хроматографе Agilent Packard HP 6890 N с квадрупольным масс-спектрометром (HP MSD 5973) в качестве детектора. Качественный анализ основан на сравнении времен, индексов удерживания, масс-спектров и библиотеки хромато-масс-спектрометрических данных летучих веществ растительного происхождения (Ткачев, 2008). Все исследованные нами образцы эфирных масел по содержанию 27 константных соединений можно разделить на три группы. К первой группе относятся виды полыней, доминирующим компонентом которых является хамазулен. Ко второй группе виды, с преобладанием в составе ацетиленовых углеводородов (бензилдиацетилена, капиллена и капиллина). К третьей группе можно отнести виды полыни, эфирные масла которых в своем составе содержат большое количество терпеновых соединений (1,8-цинеола, камфоры, гермакрена D, карифиллена, спатчулена и др.). В Монголии из хамазуленсодержащих видов наиболее распространена полынь крупноголовчатая *Artemisia macrocephala* Jacq ex Bess., а в Бурятии полынь Сиверса *Artemisia sieversiana* Willd. и *Artemisia jacutica* Drob. Содержание хамазулена в эфирных маслах полыни якутской до 54%, п. крупноголовчатой до 12 %, п. Сиверса до 36 %. Ко второй группе полыней, с преобладанием в эфирном масле ацетиленовых углеводородов относятся *A. glauca*, *A. commutata*, *A. dolosa*. Типичным представителем этой группы является полынь серая *A. glauca* Pall. ex Willd. Выход эфирного масла из воздушно-сухой массы достаточно высок (0,44-0,90%). К третьей группе можно отнести виды полыни *A. gmelinii*, *A. anethifolia*, *A. mongolica*, *A. dolosa*, *A. tanacetifolia*, *A. scoparia*, *A. subviscosa*, *A. dracunculus*, эфирные масла которых в своем составе содержат большое количество терпеновых соединений (1,8-цинеол, камфора, гермакрен D, карифиллен, спатчуленол и др.). Одним из наиболее распространенных видов растений является полынь холодная *Artemisia frigida* Willd. Образцы полыни холодной в разных точках ареала похожи друг на друга, но демонстрируют и заметные различия. Выходы эфирного масла также варьируют в довольно широких пределах – от 0,024 (северный Хангай) до 0,550 % (остров Ольхон). Анализ образцов эфирного масла *A. frigida* показывает, что основу эфирных масел изученных образцов составляют монотерпеновые соединения. Образцы из разных популяций похожи по набору доминирующих компонентов: 1,8-цинеол (6,6-23,4%), камфора (3,6-35,9%), борнеол (6,1-17,0%), терpineол-4 (4,2-14,1%), борнилацетат (1,1-6,0%), гермакрен D (1,4-5,0%). Наилучшие совпадения наших данных по составу эфирного масла обнаружены с данными, полученными в Китае и Монголии.

## МАҢҒЫСТАУ ОБЛЫСЫНЫҢ ФЛОРАСЫНДАҒЫ МӘДЕНИ ӨСІМДІКТЕРДІҢ ЖАБАЙЫ ТҮҚЫМДАСТАРЫНЫҢ ТАРАЛУЫ

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Сыртқы ортаның қолайсыз жағдайларына, кеселдер мен зиянкестерге бейімделген, жоғары сапалы мал азығы мен азық-түлік өнімдерін өндіру үшін пайдаланылатын жана жоғары сапалы өсімдік сұрыптарын шығарып алу бастапқы материалдардың маңызды құрамы болып табылатын мәдени өсімдіктердің жабайы түрлерін молырақ таңдауды талап етеді (МӘЖТ). Соңғы жылдары Қазақстан үшін МӘЖТ тізімін әзірлеудің табанды түрде қажеттілігі пайда болды, өйткені республикадағы шаруашылықта құнды түрлерін түгендеуге бағытталған арнайы зерттеусіз оларды қорғау мен тәжірибеде қолдану барысындағы шараларды жоспарлау мүмкін емес еди.

Зерттеудің мақсаты болып Маңғыстау флорасындағы МӘЖТ толық тізімін жасап шыгару болды.

Маңғыстау облысының МӘЖТ тізімін құрастыру үшін республикалық және өлкелік флора материалдары, әдебиет деректері, нұсқаулық тізімдері басты материал ретінде пайдаланылды.

Далалық зерттеулер мен әдебиеттерді шолу нәтижесінде Маңғыстау облысы флорасында 65 туысты, 21 түқымдасты құрайтын МӘЖТ 118 түрі анықталды. МӘЖТ-нің түрлік алуантүрлілігінің бірталайы Маңғышлақтың флористикалық аудандарының аумағында – 103 түрі, саны екі есе аз түрлер Солтүстік Үстіртте көбірек – 51, Оңтүстік Үстірт пен Бозаңыда соған сәйкес барынша аз мөлшерде – 30 бел 32 түрі кездесті.

Түрлердің бұлайша таралуы топырақты климаттық жағдайларға байланысты. Сонымен, Маңғышлақ түбегінде өсу жағдайы барынша қолайлы, сондықтан түрлік құрам көп мөлшерде байқалды.

МӘЖТ түрлері әртүрлі түқымдаста біртегіс таралмайды, түрлердің барынша кең таралған өкілдері *Chenopodiaceae*, *Fabaceae*, *Poaceae* түқымдастарына жатады. Қалған түқымдастар өкілдері Маңғышлақтың флористикалық аудандарының аумағында көбірек кездеседі. Өсімдіктердің шаруашылықты-құнды топтарына саралтама жасадық. Сонымен, МӘЖТ арасында сан мөлшері жағынан мал азығы өсімдіктер болатын көп – 91 түр, екінші орында тағамдық өсімдіктер – 34 түрі, ал үшінші орында дәрілік өсімдіктер – 23 түрі болатыны анықталды. Бал беретін өсімдіктердің 20 түрі, техникалық дақылдардың – 14 түрі, дәруменді өсімдіктердің 14 түрі, сәндік өсімдіктердің 15 түрі бар.

Осылай, Маңғыстау облысының аумағында 65 туыс пен 21 түқымдаска жататын МӘЖТ 118 түрі кездеседі. Алуантүрліліктің көптеген түрі 13б. Маңғышлақтың флористикалық ауданында таралған.

Барынша көп таралған түрлерге Алабұта, Бұршаққап, Астықтүқымдастар түқымдастарының өкілдері жатады. Шаруашылықты-құнды топтары бойынша мал азығы, тағамдық және дәрілік қасиеттері бар МӘЖТ басымырақ.

Зерттеу нәтижелері Маңғыстау флорасындағы МӘЖТ биологиялық алуантүрлілігінің молдылығын және оларды кең көлемде пайдалану әрі мәдениетке ендіру маңызды екенін көрсетеді.

Зерттеу «Батыс Қазақстанның мәдени өсімдіктерінің жабайы түрлерінің ботаникалық алуантүрлілігі – азық-түлік бағдарламасын жүзеге асыруда агробиоалуантүрлілік тектік қорын сактап қалу мен байытудың көзі» тақырыбы аясында орындалды.

## РАСПРОСТРАНЕНИЕ ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ ВО ФЛОРЕ МАНГИСТАУСКОЙ ОБЛАСТИ

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Создание новых высокопродуктивных сортов растений, используемых для производства высококачественных пищевых продуктов и кормов, адаптированных к неблагоприятным условиям внешней среды, болезням и вредителям, требует широко выбора исходного материала, важной составляющей которого являются дикие сородичи культурных растений (ДСКР). В последние годы возникла настоятельная необходимость подготовки списка ДСКР для Казахстана, поскольку без специальных исследований, направленных на тщательную инвентаризацию хозяйствственно-ценных видов республики, невозможно планировать мероприятия по их охране и практическому использованию.

Целью настоящего исследования являлось выявление полного перечня ДСКР во флоре Мангистау.

Материалом для составления списка ДСКР Мангистауской области служили республиканские и региональные флоры, литературные данные, рекомендательный список, разработанный сотрудниками Института ботаники и фитоинтродукции.

В результате литературного обзора и полевых исследований во флоре Мангистауской области было выделено 118 видов ДСКР, относящихся к 65 родам и 21 семейству. Наибольшее видовое разнообразие ДСКР выявлено на территории флористического района Мангышлак – 103 вид, вдвое меньшее число видов произрастает на Северном Устюрте – 51, наименьшее число отмечено на Южном Устюрте и Бузачи – 30 и 32 вида соответственно. Данное распределение видов обусловлено почвенно-климатическими условиями. Так, на полуострове Мангышлак условия более благоприятные, поэтому наблюдается максимальный видовой состав.

Виды ДСКР из разных семейств распределяются неравномерно, наиболее широко распространенными являются представители сем. *Chenopodiaceae*, *Fabaceae*, *Nitrariaceae* и *Poaceae*. Остальные семейства растут преимущественно на территории флористического района Мангышлак.

Нами проведен анализ хозяйствственно-ценных групп растений. Так, было определено, что среди ДСКР наибольшее число относится к кормовым растениям – 91 вид, вторую позицию занимают пищевые растения – 34 вида, на третьем месте лекарственные растения – 23 вида. Медоносные растения представлены 20 видами, технические – 14 видами, витаминные – 14 видами, декоративные – 15 видами.

Таким образом, на территории Мангистауской области произрастает 118 видов ДСКР из 65 родов и 21 семейства. Наибольшее видовое разнообразие приурочено к флористическому району 13б. Мангышлак.

Наиболее широко распространенными являются представители сем. Маревых, Бобовых, Селитрянковых и Злаковых. По хозяйствственно-ценным группам преобладают ДСКР, обладающие кормовыми, пищевыми и лекарственными свойствами.

Результаты исследований показывают широкое биологическое разнообразие ДСКР флоры Мангистау и перспективы их широкого использования и введения в культуру.

Исследования выполнены в рамках темы «Ботаническое разнообразие диких сородичей культурных растений Западного Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации продовольственной программы».

## РАЗМНОЖЕНИЕ РЕДКИХ ВИДОВ РОДА *FRITILLARIA* МЕТОДАМИ БИОТЕХНОЛОГИИ

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Одной из самых важных задач современной биологической науки является предотвращение сокращения видов на планете, вызванное как естественными причинами, так и возросшей антропогенной нагрузкой. Для растений рода *Fritillaria* характерна низкая скорость как вегетативного, так и семенного размножения, при этом многие представители этого рода используются в традиционной китайской медицине, что зачастую приводит к бесконтрольным заготовкам. Немало среди представителей этого рода и редких видов, внесенных в Красные книги различных уровней. Исходя из этого, встает проблема интенсификации размножения данных растений, в целях сохранения биоразнообразия, успешным решением которой является использование методов биотехнологии.

*Fritillaria sonnikovae*, *F. meleagroides* и *F. dagana* – редкие многолетние виды, принадлежащие к сем. *Liliaceae*, имеющие огромный потенциал как декоративные растения, используемые в озеленении и для срезки.

Цель работы – оптимизация технологии клonalного микроразмножения представителей рода *Fritillaria* (*F. sonnikovae* Schaulo et A. Erst, *F. dagana* Turcz. ex Trautv., *F. meleagroides* Patrin ex Schult. et Schult.).

Исходным материалом для введения в культуру *in vitro* послужили части луковичных чешуй 5\*5 мм *Fritillaria sonnikovae*, *F. meleagroides* и *F. dagana*, которые стерилизовали 70% этанолом (30 сек), затем 0,1% HgCl<sub>2</sub> с добавлением 1% Tween 80 (30 мин). Далее растительный материал трехкратно промывали в стерильной дистиллированной воде. Основными питательными средами явились среда по прописи Данстена и Шорта (BDS), а также среда по прописи Гамборга (B5), дополненные регуляторами роста: 6-бензиламинопурин (БАП), тиодизурон (ТДЗ), α-нафтилуксусная кислота (НУК), индолил-3-уксусная кислота (ИУК) в различных концентрациях. Морфогистологический анализ развития растений проводили с помощью стереомикроскопа Carl Zeiss Stereo Discovery V 12, светового микроскопа Axioskop-40 (Carl Zeiss, Germany).

В ходе работы было оценено влияние минерального состава питательных сред BDS и B5, которые применяются для клonalного микроразмножения луковичных. Было использовано 12 комбинаций регуляторов роста, вносимых в питательные среды, в концентрациях 2,0-10,0 мкМ. Контрольной являлась среда BDS без регуляторов роста. Установлено, что наиболее предпочтительно для *Fritillaria sonnikovae* и *F. meleagroides* использование сред, содержащих цитокинины совместно с ауксинами, позволяющие получить 3-4 луковички на экспланте. При оценке влияния типа цитокининов на регенерационную способность выявлено, что ТДЗ в концентрации 10,0 мкМ индуцирует более интенсивное побегообразование у *F. sonnikovae* и *F. dagana*, в сравнении с аналогичной концентрацией БАП. Высокий коэффициент размножения на безгормональной питательной среде BDS для *F. sonnikovae* свидетельствует о том, что микрорастения содержат достаточное количество эндогенных регуляторов роста для индукции побегообразования. Гистологический анализ показал, что для растений *Fritillaria dagana* и *F. sonnikovae* в культуре *in vitro* характерно адвентивное побегообразование.

Работа выполнена при финансовой поддержке гранта компании ОПТЭК.

## СОХРАНЕНИЕ *EX SITU* РЕДКОГО И ИСЧЕЗАЮЩЕГО КАЗАХСТАНСКОГО ВИДА *LONICERA ILIENSIS*

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На территории Казахстана произрастает 21 вид рода *Lonicera*. Среди этого разнообразия *L. iliensis* Pojark. является редким, почти эндемичным видом, занесенным в Красную книгу Казахстана. При обследовании трех природных популяций жимолости илийской в Алматинской области было выявлено, что жизненное состояние популяции в пойме реки Иле хуже и естественное возобновление идет медленнее, чем в популяциях по рекам Чилик и Чарын (Мухитдинов и др., 2013).

В настоящей работе проведена оптимизация протоколов сохранения *ex situ* гермоплазмы *L. iliensis* несколькими способами: семенами, в культуре *in vitro* и методом криосохранения апикальных меристем. Семена были собраны в мае-июне 2012 года, подсушены на воздухе в течение месяца до 11,3% влажности. Лабораторная всхожесть семян из трех популяций не различалась при  $P < 0,05$ : 76,3% (р. Или), 71,5% (р. Чилик) и 81,7% (р. Чарын). Подсущенные семена были криосохранены в жидким азоте, при этом не выявлены достоверные различия в прорастании после воздействия жидкого азота в течение 1 ч. и 3 мес. Коллекция семян *L. iliensis* сохраняется при +4°C, -20°C и -196°C для дальнейшего изучения. Проростки *L. iliensis* из семян трех популяций были введены в культуру *in vitro* и размножены на среде МС с добавлением 1 мг/л 6-бензиламинопурина (БАП). Была проведена оптимизация протокола криоконсервации апикальных меристем, проводили сравнение длительности закаливания асептических растений (1-3 нед при температуре +4°C, фотопериоде 8 ч день / 16 ч ночь, освещенности 10  $\mu\text{mol} / \text{m}^2 / \text{сек}$ ), состава среды для предварительного культивирования меристем (0,3 М сахароза или 5% ДМСО), длительности обработки криопротектором PVS2 (20, 40, 80 мин). Наиболее высокий процент регенерации меристем после жидкого азота (76,2%) был достигнут при 3 неделях закаливания асептических растений, 2 сут культивирования меристем на среде МС с 0,3М сахарозой, 80 мин обработки меристем криопротектором PVS2.

Таким образом, разработаны способы сохранения *ex situ* *Lonicera iliensis*, позволяющие надежно депонировать гермоплазму этого редкого вида Юго-Востока Казахстана в виде коллекции асептических растений *in vitro*, а также криогенной коллекции семян и апикальных меристем.

**ОПЫТ ПРИМЕНЕНИЯ ОПТИМИЗИРОВАННОЙ ТЕХНОЛОГИИ  
ВОССТАНОВЛЕНИЯ ЛЕСНЫХ ЭКОСИСТЕМ НА НАРУШЕННЫХ  
ЗЕМЛЯХ КРАЙНЕСЕВЕРНОЙ ТАЙГИ РЕСПУБЛИКИ КОМИ**

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Нарастание площади нарушенных земель на Севере таежной зоны требует разработки результативных технологий их восстановления. Цель работы: выявить эффективность оптимизированной технологии восстановления лесных экосистем, включающей одновременное проведение посадки древесных пород с внесением удобрений, посевом трав и дальнейший уход за формирующейся экосистемой (патент № 2343692). Опыты по применению технологии заложены на песчаном карьере крайнесеверной тайги. В опыте 1 испытывали 2-летние сеянцы *Pinus sylvestris* с открытой корневой системой, в опыте 2 – дички *Pinus sylvestris*, *Larix sibirica*, *Betula pubescens* 43-74 см высотой с комом земли. Одновременно с посадкой древесных растений проводили посев многолетних злаков при норме высева семян 20 кг/га, внесение минеральных (N60P60K60), органических (до 5 т/га) удобрений и уход за формирующейся экосистемой (внесение минеральных подкормок в течение 5 лет). Для сравнения был заложен опыт 3 по традиционной технологии лесной рекультивации (посадка сеянцев без улучшения субстрата).

В опыте 1 отмечена низкая сохранность и темпы роста высаженных сеянцев. Несмотря на дополнение посадки к концу первого десятилетия опыта сохранность *Pinus sylvestris* составила всего 20%, высота – около 30 см. В опыте 2 сохранность дичков – 83-100 %, высота – 1.5-2 м. Устойчивости дичков в посадках способствовало их местное происхождение, лучшая сохранность корневой системы, привнесение с комом земли микоризообразующих грибов.

В вариантах опытов 1 и 2 к пятому году формируется сомкнутый травостой (фитомасса до 300 г/м<sup>2</sup>), после прекращения подкормок наблюдается его угнетение (к концу десятилетия опыта фитомасса – 10-25 г/м<sup>2</sup>). В ходе своего существования травянистый ярус обусловил накопление выше 400 г/м<sup>2</sup> ветоши и формирование одернованного слоя (подземная фитомасса в слое 0-10 см – 1000 г/м<sup>2</sup>), закрепившего субстрат. С распадом травостоя при развитии мохового покрова формируется мохово-травянистая подстилка. В верхнем двухсанитметровом слое повышается содержание органического углерода (0.4 %) и элементов-биогенов (N<sub>гидр.</sub> – 1.5 мг/100г в.с.п., K<sub>2</sub>O – 11.7 мг/100г в.с.п.) по сравнению с исходными показателями (0.2, 0.3, 2.2 соответственно). К этому слою приурочена максимальная численность бактерий (20-30 млн.кл./г), спор (1.1-1.4 млн./г) и большая длина мицелия грибов (60-130 м/г).

В опыте 3 (без посева трав и внесения удобрений) сохранность сеянцев 20%, высота – 30 см. Напочвенный покров не формируется и изменение субстрата не отмечено. Микробиота характеризуется низкой численностью. Максимальное количество бактерий приурочено к глубине 2-5 см – до 8 млн.кл./г, ниже они не обнаружены. Споры грибов зафиксированы до глубины 15 см, максимальная численность около 1 млн./г. Мицелий грибов не зафиксирован.

Итак, оптимизированная технология более эффективна в целях ускорения формирования лесной экосистемы, чем традиционная.

Работа выполнена при поддержке программ РФФИ (проект № 3-04-98818 «Ускоренное восстановление лесных экосистем на посттехногенных территориях таежной зоны РК») и УрО РАН (инициативный проект № 12-У-4-1005 «Закономерности ландшафтно-зонального распределения почвенных микромицетов в природных экосистемах Северо-Востока Европейской части России»).

**Ключевой доклад**

**ИСПОЛЬЗОВАНИЕ МЕТОДОВ БИОТЕХНОЛОГИИ В СОХРАНЕНИИ  
ГЕНОФОНДА РАСТЕНИЙ**

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Наряду с традиционными методами сохранения растений *ex situ* применение культуры изолированных тканей и органов становится все более и более актуальным.

Цель наших исследований – совершенствование технологии клonalного микроразмножения, изучение морфогенетических процессов и создание банка *in vitro* редких и ценных видов растений.

Разработка эффективных методов устойчивого воспроизведения растений является основой работ по сохранению генофонда.

На основе массового скрининга разработаны высоко эффективные технологии клonalного микроразмножения растений различных таксономических групп для более 1200 генотипов, 144 видов, 57 семейств, включающих 64 вида занесенных в Красную книгу РФ. На основе этих исследований создана крупнейшая в России коллекция *in vitro* ценных видов и сортов растений. Редкие, ценные гибриды лекарственных, декоративных, мало распространенных культурных и декоративных видов растений представлены болееreprезентативно и комплексно.

Особое внимание уделяется применению биотехнологических методов для сохранения редких и исчезающих видов растений. Наиболее представительными в банке меристем редких видов являются семейства: *Orchidaceae*, *Iridaceae*, *Liliaceae*, *Paeoniaceae*, *Rosaceae*, *Amaryllidaceae*, *Araliaceae*.

Способность к органогенезу *in vitro* существенно отличается между семействами, видами и сортами растений. Для устойчивого воспроизведения растений определены компетентные экспланты (апикальная меристема с листовыми примордиями).

Подобраны оптимальные условия для длительного хранения меристем в генетическом банке культур *in vitro* ( $t=3-7^{\circ}\text{C}$ ). Установлены важнейшие факторы, влияющие на длительность сохранения в условиях *in vitro*. Особую роль в сохранении растений *in vitro* принадлежит осмотикам, ретардантам и физическим факторам культивирования – температуре и освещенности.

Первостепенное значение при создании генетического банка *in vitro* уделяетсярепрезентативности и сохранению генетической чистоты.

На модельных объектах, для оценки стабильности образцов хранящихся в банке *in vitro*, проведен RAPD-анализ. Предложен метод проверки *in vitro* коллекций, основанный на анализе относительных генетических расстояний между проверяемыми микроклонами и известными таксонами.

Хранение *in vitro* ценных форм растений является высокоэффективным способом для содержания коллекций растений и сохранения биологического разнообразия.

**КОРНЕОБРАЗУЮЩАЯ АКТИВНОСТЬ ЭКСТРАКТОВ  
*BERGENIA CRASSIFOLIA* И *SANGUISORBA OFFICINALIS***

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В настоящее время актуальным становится разработка экологически безопасных регуляторов роста нового поколения на основе природного сырья, важной особенностью которых является эффективность при низких концентрациях, малотоксичность, низкие нормы расхода. Богатая и разнообразная дикорастущая флора Казахстана - источник доступного и дешевого сырья для производства отечественных биопрепаратов широкого спектра действия, но «по степени изученности флору Казахстана можно рассматривать как недостаточно изученную в фитохимическом аспекте и в отношении биологических активностей» (1). Особый интерес для изучения биологических активностей представляют дубильные вещества растений, которые широко используются в народной медицине, в фармацевтике, в кожевенной промышленности и во многих других отраслях (2).

Целью работы явилось изучение рострегулирующей активности суммарных экстрактов и фракций дубильных веществ, выделенных из бадана толстолистного *Bergenia crassifolia* (L.) Fritsch. и кровохлебки лекарственной *Sanguisorba officinalis* L., произрастающих на территории республики.

Из собранного на территории Восточно-Казахстанской области растительного сырья были получены суммарные экстракты способом последовательного настаивания в дихлорметане, этиловом спирте, дистиллированной воде с последующей перегонкой на роторном испарителе.

Фитохимический анализ показал, что в растительном сырье бадана толстолистного преобладают дубильные вещества гидролизуемого и конденсированного типа (20,87 %), в незначительном количестве присутствуют флавоноиды, фенолкислоты, аминокислоты и углеводсодержащие соединения. В сборах кровохлебки лекарственной обнаружены дубильные вещества преимущественно гидролизуемого типа (21,08 %), фенолкислоты, аминосодержащие соединения, флавоноиды и стероиды. В результате разделения суммарных экстрактов с помощью колоночной хроматографии получены очищенные фракции конденсированных и гидролизуемых танинов, галловой и эллаговой кислот, галлотанинов, эллаготанинов. По УФ-спектрам в отдельных фракциях идентифицированы галловая кислота, пирогаллол, пирокатехин, производные галло- и эллаготанинов.

Полученные экстракты и отдельные фракции дубильных веществ оценивали в системе биотестов и методом зеленого черенкования на трудноукореняемых сортах роз и различных сортах туи западной. На различных тест-системах *in vivo* и *in vitro* экспериментально доказано, что экстракты и отдельные фракции дубильных веществ бадана толстолистного и кровохлебки лекарственной обладают ростстимулирующей активностью и оказывают синергический эффект на развитие корневой системы при их сочетании с ИМК или препаратами на его основе.

**Список литературы**

1 Введение в фитохимические исследования и выявление биологической активности веществ растений. Под редакцией Мамонова Л.К., Музычкиной Р.А. – Алматы: Школа XXI века, 2008. – 216 с.

2 Cseke L.Y., Kirakosyan A., Kanfman P.B. Natural Products from Plants// Boca Raton. London. New York, 2006. – 611 p.

**Ключевой доклад**

**ГЕНЕТИЧЕСКИЕ РЕСУРСЫ ТАДЖИКИСТАНА**

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С учетом демографических прогнозов для обеспечения растущей человеческой популяции мы должны увеличивать продовольственный потенциал ежегодно в среднем на 2%. Испокон века, для обеспечения развития сельского хозяйства генетические ресурсы растений являются важным источником для удовлетворения потребностей в продовольствии. Поэтому, первоочередная задача заключается в охране мировых генетических ресурсов, при этом сохраняя их для рационального использования.

В современных условиях изменения климата, когда резерв пахотных земель почти исчерпан, предел урожайности по важнейшим сельскохозяйственным культурам почти достигнут в результате интенсивной селекции, проводившейся в последние 100 лет, оставшиеся резервы весьма незначительны и ни в коей мере не обеспечивают темпы роста народонаселения. Значит, нужны новые подходы к решению продовольственной проблемы, которые могут появиться только на основе анализа достижений современной фундаментальной науки. Естественно, чтобы удвоить в будущем объем производимого продовольствия, необходимо создать принципиально новые формы – с реконструированными геномами и более продуктивные, качественные и устойчивые к абиотическому и биотическому стрессу. Для этих целей, дикие и культурные сородичи интенсивно используются для поиска и переноса в современные коммерческие сорта новых генов устойчивости к стрессу. Работы, начатые Н.И. Вавиловым и его коллегами, показали исключительно высокую эффективность целенаправленной селекции по созданию высокоурожайных сортов сельскохозяйственных растений.

В этом контексте изучение диких сородичей культурных растений Таджикистана на примере диких плодовых и зерновых культур, описание мест их произрастания с учетом эколого-географических и климатических условий представляется чрезвычайно важным. В рамках проекта МНТЦ №Т-1105 «Геномный анализ диких сородичей злаков Таджикистана» проведены работы по биохимическому и молекулярно-генетическому исследованию диких сородичей *Aegilops* с использованием молекулярных маркеров. Широкое применение ДНК-маркеров в оценке полиморфизма геномов различных видов рода *Triticum* сделает возможным построение их генетической классификации, которая будет раскрывать историю происхождения, распространения и адаптации пшеницы. Поэтому это направление исследований должно получить дальнейшее развитие в оценке генетического разнообразия различных видов этой культуры. В целом, оценка генетического разнообразия селекционных сортов пшеницы и ее диких сородичей с применением генеалогического анализа может быть полезной для уточнения стратегии и программ селекции, выбора приоритетных направлений в изучении коллекции, а также для отбора образцов при формировании различных выборок для анализа.

**Специальный доклад**

**БИОТЕХНОЛОГИЯ РАСТЕНИЙ В КАЗАХСТАНЕ: СОСТОЯНИЕ  
И ПЕРСПЕКТИВЫ**

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В Казахстане исследования в области биотехнологии растений были начаты в 1970 году. Разработаны биотехнологические протоколы клонального микроразмножения в культуре тканей и изолированных органов редких и исчезающих видов, а также лекарственных, кормовых, технических и декоративных растений. Оптимизированы концентрации регуляторов роста в составе питательных сред с учетом содержания эндогенных фитогормонов в тканях интактных растений. Предложенный методологический подход способствовал повышению эффективности биотехнологических методов клонирования растений.

Проведены обширные исследования по культуре тканей, клеток и протопластов зерновых культур. Выяснены закономерности пролиферации, дифференцировки, морфогенеза и регенерации в культуре половых и соматических клеток. На основе установленных теоретических представлений разработаны регламенты регенерации гомозиготных дигаплоидных растений в культуре пыльников и изолированных микроспор и получения гетерозиготных диплоидных сомаклональных вариантов в культуре соматических тканей. Разработаны протоколы регенерации растений в культуре изолированных протопластов. Выявлены пути регуляции цитодифференцировки и морфогенеза в длительно культивируемых эмбриогенных тканях. Создана технология регенерации растений из многократно субкультивируемых каллусных тканей пшеницы и ячменя.

Изучены цитофизиологические закономерности влияния сверхнизких температур на растительные клетки и разработаны биотехнологические регламенты криосохранения гермоплазмы плодовых и ягодных культур. Разработаны методы эмбриокультуры для повышения жизнеспособности гибридных зародышей пшеницы с дикими сородичами.

Исследовано влияние факторов космического полета на рост и морфогенез в каллусных тканях ячменя, а также на развитие генеративных органов пшеницы. Установлено, что происходит значительное снижение скорости роста каллусов и секреторной деятельности клеток. Показано, что в условиях невесомости в культуре изолированных колосьев пшеницы может происходить формирование гамет и развитие зародыша.

Приоритетным направлением развития биотехнологии в Казахстане является генетическая инженерия. Налажены методы стабильной генетической трансформации и регенерации трансгенных растений. Получены трансгенные растения картофеля с генетически закрепленной резистентностью к Y-вирусу. В геном картофеля внедрен фрагмент вирусного генома в антисмысловой ориентации. Осуществлена генетическая трансформация кукурузы путем переноса в протопласты генов, кодирующих синтез антифризных белков, обеспечивающих устойчивость к низким температурам. Оптимизирована технология получения трансгенных растений рапса.

## ИСПОЛЬЗОВАНИЕ МОНОСОМНЫХ ЛИНИЙ ДЛЯ СОЗДАНИЯ ЗАМЕЩЕННЫХ ФОРМ У ХЛОПЧАТНИКА *GOSSYPIUM HIRSUTUM* L.

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В Узбекистане в течение долгого времени выполнялись исследования по созданию моносомных линий хлопчатника путем использования радиации как источника моносомиков. Между 1987 и 2010 годами, мы получили 94 первичных моносомика хлопчатника *G. hirsutum* в общем генетическом фоне высоко инбрейдной линии Л-458 после облучения семян тепловыми нейтронами или гамма-облучения пыльцы. Большинство из них (75 из 94) возникли от двух типов радиации непосредственно в  $M_1$ ,  $M_2$  и  $M_3$  поколениях. Оставшиеся 19 моносомных растений были получены в потомствах с аберрациями.

В дополнение к моносомикам хлопчатника, полученных традиционным путем с помощью радиации, мы использовали десинаптический эффект, который ранее был найден полезным источником анеуплоидии у других культур. В результате, 17 первичных моносомиков было получено из потомств 7 десинаптических растений и одного растения с неустановленным кариотипом, выделенного из потомства растения с десинапсисом.

Анализ мейотической метафазы I, проведенный у 94 первичных моносомиков хлопчатника, обнаружил модальную конъюгацию хромосом с 25 бивалентами и одним унивалентом у 38 растений. 50 моносомных растений характеризовались присутствием дополнительных унивалентов. У семи моносомиков, наряду с унивалентом и бивалентами, формировались редкие триваленты в метафазе I мейоза. Анализы размеров моносом выявили средний размер унивалента у 44 моносомиков; наряду с этим, обнаружилось 22 моносомика с большим размером унивалента. Число моносомиков, имеющих маленькие униваленты, было немного выше (27); кроме того, среди них были обнаружены 6 моносомиков с очень маленьким размером унивалента. Поэтому, в соответствии с предварительной припиской моносом к субгеномам на основе их размеров, 22 больших моносомы могут быть приписаны к  $A_t$  - геному и 27 моносом с малым размером к  $D_t$  - геному. Поскольку известно, что только три пары хромосом *G. hirsutum* имеют длинные плечи, которые в два или три раза длиннее коротких плеч, моносомы средних размеров требуют специальных анализов с участием транслокаций для субгеномной приписки.

Мы уже начали использовать гибридные  $F_1$  моносомики от скрещиваний моносомных линий с линией 3-79 (США) *G. barbadense* L., полученной на основе удвоения гаплоида, в качестве родителя донора для хромосомной приписки хромосом-специфичных SSR маркеров. В настоящее время, моносомные гибриды  $F_1$  были получены и изучены в 27 гибридных семьях. В 5 семьях, по 3 растения с нехватками хромосом было обнаружено в каждой семье, в 8 семьях по 2 гибридных моносомика было изолировано, и в 14 семьях по одному моносомику на потомство было идентифицировано. Эти результаты указали на возможность обнаружения моносомиков в различных гибридных фонах и различий в темпах воспроизведения моносом.

## ОБОГАЩЕНИЕ УНИВЕРСИТЕТСКОЙ КОЛЛЕКЦИИ ФАСОЛИ И ИЗУЧЕНИЕ ЕЕ МОРФОЛОГИЧЕСКИХ ПАРАМЕТРОВ

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Приведены результаты изучения основных морфогенетических особенностей 37 сортов фасоли из разных почвенно-климатических зон (Казахстан, американские, китайские, польские, российские, турецкие и чешские коллекции). Коллекция выращивалась в горных и степных зонах Алматинской области в условиях севооборота 2011-2012 гг. Основная цель данных исследований – размножение отечественных сортов фасоли; создание коллекции и вовлечение студентов в ее обработку под руководством своих научных руководителей; развитие полевых и научно-исследовательских работ на новой Агробиостанции КазНУ им. ал-Фараби "Жана Талап".

Определены основные морфогенетические свойства, отвечающие за сельскохозяйственно-ценные признаки фасоли. Часть фондовых сортов после предварительного размножения и внедрения были зарегистрированы в качестве Государственного Авторского Свидетельства «Распространение и обмен образцов фасоли»(№ 612 от 14 мая 2012 г.).

В результате размножения чешской коллекции в горной зоне установлено, что сортообразец "Луна" чешской коллекции является наиболее раннеспелым (80 дней), по сравнению с другими образцами, которые созревали позднее на 10-12 дней. Проведенный кластерный анализ по морфогенетическим признакам позволил установить различия по всхожести между казахстанскими и чешскими линиями. Показано, что местная линия "Назым" ближе к чешской линии "Зузка" и другой местной линии "Талгат". На основе данных кластерного анализа и изучения других полезных сельскохозяйственных признаков линия «Назым» может быть рекомендована как более перспективная для выращивания в коммерческих целях в юго-восточных регионах Казахстана.

С использованием местного сорта "Актатти", было исследовано влияние нового отечественного биорганического удобрения на ряд морфогенетических признаков и показано увеличение урожая на 25%.

Наряду с чешской коллекцией и местными сортами, были размножены шесть французских образцов кустовой и вьющейся фасоли ("Argus", "Coco nain blanc precoce", "Triomphe de Farcy", "Merveille de Venise", "Mistica", and "Phenomene", предоставленных компаниями Трюффо и Вилморин. Пять образцов, за исключением "Coco nain blanc precoce", показали высокую или умеренную продуктивность.

Продолжаются исследования образцов и линий местной коллекции для изучения биохимических, цитогенетических и других особенностей с целью дальнейшего их использования в селекционной работе.

## СОХРАНЕНИЕ И ИСПОЛЬЗОВАНИЕ ГЕНЕТИЧЕСКИХ РЕСУРСОВ ОВОЩНЫХ КУЛЬТУР В КАЗАХСТАНЕ

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Генетические ресурсы растений обеспечивают биологическую базу продовольственной безопасности любой страны. Генетические вариации являются стратегическим ресурсом селекционных программ в создании новых сортов и гибридов растений, в том числе и овощных и бахчевых культур.

В Казахском НИИ картофелеводства и овощеводства работы по хранению и изучению генофонда овощных культур были начаты в 1995 году. К концу 2013 года было собрано 10750 образцов 156 культур 182 ботанических видов, входящих в 22 ботанических семейства. Образцы, собранные в генофонде института, происходят из 97 стран мира, по происхождению на Казахстан и Россию приходится 72,8% образцов, на СНГ и Грузию – 4,6%, на европейские страны - 10,7%, на страны зарубежной Азии – 4,6%, на американский континент и Австралию – 4,9%, на Африку – 2,4% образцов.

Наибольшее число образцов собрано по тыквенным растениям – 3472 образца по 13 культурам из 12 ботанических видов. Значительную долю из них составляют образцы дыни (2186) и арбуза (562).

Пасленовые овощи также формируют большую группу генофонда института – 3231 образец по 7 культурам, больше всего образцов среди них приходится на томат (2266) и перец (728).

Генофонд корнеплодных овощей включает 826 образцов, представляющих 3 ботанических семейства, объединяющих 12 ботанических видов, среди них наибольшее количество собрано по моркови – 255 образцов. Луковые растения в генофонде представлены 797 образцами 36 ботанических видов, больше всего образцов чеснока (285) и репчатого лука (205).

Зеленные овощи представлены 10 ботаническими семействами из 29 видов, больше всего в генофонде хранятся образцы укропа (410). По бобовым овощам собрано 628 образцов, представляющих 9 ботанических видов, среди них больше всего образцов обыкновенной фасоли (370).

В генофонде группа пряных овощей представлена 494 образцами, принадлежащим к 42 ботаническим видам, где лидируют по числу образцов календула (62) и тагетас (60).

В группе капустных овощей сосредоточено 421 образец, здесь лидером является белокочанная капуста (197 образцов). В прочих овощах числятся всего 90 образцов, из них на сахарную кукурузу приходится 35 образцов.

В структуре генофонда по статусу образцов наибольшее количество их составляет селекционный ресурс, на который приходится 41,2% всего генофонда. Больше всего селекционных образцов имеются в группе тыквенных (арбуз, дыня), пасленовых (томат, перец) и луковых (репчатый лук, чеснок) растений. На долю селекционных сортов приходится 36,8% всех образцов генофонда, и больше всего их в группах пасленовых растений и корнеплодов. На долю популяций и местных сортов приходится 15% генофонда, больше всего их среди пасленовых, зеленных и пряно-вкусовых растений. Гибриды F<sub>1</sub>, составляет 6,3% генофонда, и они в основном имеются в группах пасленовых, тыквенных и капустных растений. На долю дикорастущих растений, используемых в качестве овощей, приходится всего 0,7%, в основном это пасленовые, зеленые и луковые растения.

**БИОЛОГИЯ ЦВЕТЕНИЯ И СЕМЕННОГО РАЗМНОЖЕНИЯ  
*STEVIA REBAUDIANA* BERTONI ПРИ ИНТРОДУКЦИИ В УСЛОВИЯХ  
 СУРХАНДАРЬИНСКОЙ ОБЛАСТИ РЕСПУБЛИКИ УЗБЕКИСТАН**

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Одной из важнейших задач на современном этапе является интродукция растений с ценными признаками и введение их в культуру в новые регионы. Тропическое растение короткого дня *Stevia rebaudiana* Bertoni (*Asteraceae*), родина – Парагвай, обладает уникальными вкусовыми и целебными свойствами. Полученный из листьев 6-7%-ный стевиозид на протяжении последних десятилетий находит широкое применение в пищевой промышленности, при лечении сахарного диабета, кожных заболеваний, органов пищеварения и других болезней.

Исследования проводились в Сурхандарьинской области: в экспериментально-фермерском хозяйстве «Оллохёр-охун», расположенном в Шурчинском районе на высоте 448 м над уровнем моря, почва – типичный серозем с pH=7 (1999-2010 гг.); в Термезе на опытном участке кафедры ботаники Термезского государственного университета, на высоте 302 м над уровнем моря, почва – такырно-лугового типа (2009-2010 гг.).

Для семейства *Asteraceae* характерен ксеногамный тип опыления путем энтомофилии, у *S. rebaudiana* не отрицается и автогамия. В условиях Шурчи и Термеза цветки *S. rebaudiana* не утратили свойства протерандричности и во время цветения активно посещались насекомыми, что свидетельствует о ксеногамном типе и энтомофильном способе опыления. Однако, прорастание собственной пыльцы на рыльце подтверждает возможность и автогамного типа опыления. Изучение сезонной динамики показало, что при многолетней культуре (2000-2011) цветение начиналось с первой декады сентября и продолжалось до заморозков. Раскрытие цветков проходит в светлое время суток с 8 до 18 часов в диапазоне температур +8-+24°C и ОВВ – 55-90% и представляет собой одновершинную кривую с пиком в конце октября. В ходе суточной динамики цветения массовое раскрытие цветков отмечено с 12 до 14 часов при +22-+24°C и ОВВ 55-70%. Цветение прекращалось в 18 часов при +11-+15°C и ОВВ 75-82%. Основное количество цветков раскрывалось с 10 до 16 часов, когда температура воздуха поднималась выше +15°C, ОВВ при этом была от 50 до 80%.

Наиболее стабильный показатель семенной продуктивности – это количество цветков в соцветии. Реальная семенная продуктивность увеличивается с возрастом растений за счет увеличения количества генеративных побегов и соцветий и достигает максимума на 3-й год вегетации. В то же время коэффициент продуктивности у разновозрастных растений был близким по значению: у 1-летних растений он составил 35,3-38,5%, 2-летних – 36,5-38,0%, 3-летних – 35,2-37,3%. При сравнительном изучении семенной продуктивности более высокий КСП был установлен в Шурчи (78-80%), чем в Термезе (55-60%) (2010 г.). Изучение биологии семян показало, что при самосеве всходы появляются при +15-+17°C. Всхожесть семян составляет  $7 \pm 0,77\%$ , выживаемость проростков – 4-5%. Семена, высеванные под пленку в январе-марте, прорастают через 7-8 дней, массовая всхожесть наблюдается через 10-15 дней. У высеванных семян 20 января 2002 г (+13,1°C) всхожесть составила  $18 \pm 2\%$ , 21 февраля (+17°C) –  $15 \pm 1,4\%$ , 22 марта – (+22°C) –  $9 \pm 1,2\%$ . Семена различаются по лабораторной всхожести в зависимости от срока их созревания. У семян, собранных в начале стадии плодоношения (12.10.2009), всхожесть составила  $51 \pm 2,89\%$ , в середине (10.11.2009) –  $44 \pm 2,87\%$ , в конце (02.12.2009) –  $41 \pm 2,84\%$ . Всхожесть сохраняется до 37 месяцев.

**МИКРОКЛОНАЛЬНОЕ РАЗМНОЖЕНИЕ РЕДКОГО ИСЧЕЗАЮЩЕГО  
ВИДА КАУЧУКОНОСА ТАУ-САГЫЗ (*SCORZONERA TAU-SAGHYZ LIPSCH.*  
*ET BOSSE*) С ЦЕЛЬЮ ВОССТАНОВЛЕНИЯ ПОПУЛЯЦИИ В  
КАРАТАУСКОМ ГОСУДАРСТВЕННОМ ПРИРОДНОМ ЗАПОВЕДНИКЕ**

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Растущий спрос в мире на натуральный каучук, в настоящее время, привел исследователей к поиску альтернативных, в отличии от Гевеи (*Hevea brasiliensis*), источников природного каучука. В нашей Республике еще в 1929—1930 гг., при изучении горных систем южного Казахстана было выяснено, что Карагандинский хребет является родиной нового превосходного и непревзойденного до сих пор каучуконосного растения - козлеца тау-сагыз.

Однако, запасы вида сильно сократились в предвоенные и особенно в военные годы (1941-1945гг.), когда было выкопано более 12 млн. корней, сухим весом около 908т. В переводе на каучук это составило 250-300 т.- вклад Казахстана в дело обороны страны. С 1978 вид включен в Красную книгу СССР и Красную книгу Казахской ССР.

Козлец тау-сагыз (*Scorzonera tau-saghyz Lipsch. et Bosse*), (по-казахски тау-сағыз) - представитель семейства сложноцветных (*Asteraceae*), редкий, эндемичный вид с сокращающейся численностью с дизъюнктивным тяньшанско-памироалтайским ареалом, включающий ряд узколокальных рас разного ранга. Многолетник высотой 25—40 см, с мощным ветвящимся каудексом и глубоким стержневым корнем. Каждая ветвь каудекса заканчивается розеткой злаковидных листьев, иногда годовалыми цветоносными побегами. Корзинки одиночные, цветки желтые. При разломе корня и стеблей в млечниках видны эластичные, тянувшиеся нити каучука. Содержание каучука в корнях до 20- 40% от сухого веса корней в зависимости от возраста и сорта.

Ограниченност посадочного материала, практическое отсутствие в Казахстане питомников по их производству делают актуальной задачу разработки технологии массового и ускоренного тиражирования, в частности технологии клonalного микроразмножения ценной каучуконосной культуры *Scorzonera tau-saghyz*. Эксперименты по введению растений тау-сагыза *in vitro* проводили в период активной вегетации растений (май-июнь). В качестве эксплантов для культивирования *in vitro* используются листовые сегменты, взятые с активно вегетирующих 1-2 летних побегов, корневые сегменты этих же растений и семена.

На эффективность культивирования *in vitro* оказывают влияние физиологическое состояние эксплантов и состав питательной среды. Ткани корней однолетних растений тау сагыза более отзывчивы к морфогенезу, чем корни двухлетнего тау сагыза. Ксероморфные листья одно- и двухлетнего тау-сагыза являются высокодифференцированными (высокоспециализированными) не отзывчивы к процессам дедифференциации в условиях *in vitro*. Оптимальной питательной средой для индукции морфогенеза в культуре листовых и корневых эксплантов являлась среда Мурасиге-Скуга, содержащая 1 мг/л БАП, 0,1 мг/л НУК, 0,1 мг/л 2,4-Д. Добавление гибберелловой кислоты оказало хороший эффект на регенерацию растений из каллусной биомассы тау-сагыза. Полученные растения-регенеранты в последующем клонировали для увеличения коэффициента размножения тау-сагыза. Таким образом, представленные результаты подтверждают возможность получения микроклонов тау-сагыза и служат базой для разработки уникальной технологии микроклонального размножения и создания коллекции образцов тау-сагыза, представляющих научный и коммерческий интерес.

**ФОРМИРОВАНИЕ И ИСПОЛЬЗОВАНИЕ НАЦИОНАЛЬНОГО ФОНДА  
ГЕНЕТИЧЕСКИХ РЕСУРСОВ РАСТЕНИЙ В БЕЛАРУСИ**

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Генетические ресурсы растений не только способствуют устойчивому развитию экономики, но и являются залогом благосостояния населения каждой страны. Научные исследования в области сохранения биоразнообразия и его генетического потенциала в Республике Беларусь стали возможны благодаря государственной программе «Генофонд», которая получила свое развитие в начале XXI века и стала основой для формирования Национального фонда генетических ресурсов растений Республики Беларусь. РУП «Научно-практический центр Национальной академии наук Беларуси по земледелию» возглавил эту работу, являясь ведущим научным учреждением в области растениеводства в республике. Рабочие коллекции 11 научно-исследовательских учреждений Национальной академии наук Беларуси и 2 ВУЗа стали основой для создания национального фонда генетических ресурсов растений. Государственная программа «Генофонд» активно стимулирует развитие исследований генетических ресурсов растений как внутри страны, так и на международном уровне. За эти годы Республика Беларусь, стала членом ECPGR и AEGIS, наложен обмен генофондом с зарубежными генбанками и международными научными центрами.

Национальный фонд генетических ресурсов растений в 2013 году составил 40,5 тыс. коллекционных образцов. Среди стран СНГ, Беларусь находится на 5-м месте по количеству образцов и на 3-ем по видовому разнообразию (1695 культурных видов и диких сородичей). Из них полевые культуры представлены 9795 коллекционными образцами 195 видов. На основе ранее накопленного и вновь привлеченного генофонда, с учетом имеющегося мирового опыта, впервые в Беларуси сформированы целевые признаковые, генетические, стерневые и учебные коллекции по наиболее значимым в экономическом отношении полевым сельскохозяйственным, плодовым, ягодным культурам и лесообразующим породам. Важное значение представляют для использования в селекционном процессе генетические коллекции ГНУ «Институт генетики и цитологии НАН Беларуси». Наибольшую ценность среди них представляют хромосомно-дополненные, замещенные и транслоцированные линии, полиплоиды и анеуплоиды, источники самофERTильности и цитоплазматической мужской стерильности, мутанты, рекомбинанты и генетические тестеры. Заслуживает внимания созданная стерневая генетическая коллекция люпина узколистного, представляющая собой систему из 14 –ти комплементарных друг другу по многим генам компонентов. Следует отметить коллекции видов и межвидовых гибридов *Solanum*, депонируемых *in vitro*, насчитывающих более 400 индивидуальных номеров, включающих представителей 48 видов и базисную коллекцию *in vitro* сортов картофеля белорусского происхождения. Образцы рабочих коллекций полевых культур служат исходным материалом в селекционном процессе для создания новых сортов и гибридов сельскохозяйственных культур. С использованием Национального фонда генетических ресурсов растений в Республике Беларусь в период с 2000 по 2013 гг. создано 530 сортов культурных растений. Коллекции ресурсов растений, вошедшие в структуру генофонда Республики Беларусь, в 2012 году признаны объектами национального достояния.

Основная задача исследований на ближайшую перспективу - дальнейшее увеличение генофонда, пополнение признаковых и генетических коллекций, повышение эффективности использования генофонда для практической селекции и народного хозяйства республики.

## ИСТОЧНИКИ ХОЗЯЙСТВЕННО – ЦЕННЫХ ПРИЗНАКОВ ДЛЯ СЕЛЕКЦИИ ЯРОВОГО ТРИТИКАЛЕ В БЕЛАРУСИ

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Яровое тритикале получило распространение в странах Юго-Восточной Азии, Южной Америки, Канаде, Испании, Португалии, Польше, Украине и других регионах. В РУП«НПЦ НАН Беларуси по земледелию» методом внутривидовой гибридизации нами создано 5 сортов ярового тритикале, три из которых включены в Госреестр сортов Беларуси: Лана, Узор, Садко и 2 сорта в России: – Ульяна, Лотас. В условиях Нечерноземья яровое тритикале превосходит озимое по содержанию в зерне белка на 1,5 – 2% и незаменимо в районах с неблагоприятными условиями перезимовки.

Целью изучения коллекции гексаплоидного ярового тритикале было выделить источники хозяйственно – ценных признаков для селекции. Объектом исследования на протяжении 2007 – 2013 года были 150 сортообразцов ярового тритикале из Мексики, Польши, Украины, России, США, Канады, Аргентины, Австралии, Чили, Эфиопии, Испании, Бразилии и других стран.

В результате полевых и лабораторных исследований выделены и используются в селекционном процессе в качестве источников хозяйственно – ценных признаков следующие источники:

- короткостебельности (80-82 см): Nagano, Матейко (Польша), T – 476, Fahad 8-2, T-39 (Мексика);
- скороспелости (90-94 дня): Узор (Беларусь), Гребешок, Норманн (Россия), Легинь Харьковский, Аист Харьковский (Украина), Armadillo (Мексика) и другие;
- высокой урожайности (60-80 ц/га): Мешко (Польша), Узор, Русло, Садко (Беларусь), Амиго (Россия), WS – 104 (Германия) и другие;
- высокого числа зерен в колосе (70-86 шт): Ultima (Канада), Sel – 002 (США), Maja, Andrus (Польша), Chucal – 5, Faca 2/1 (Мексика), Лотас (Беларусь) и другие;
- высокой массы 1000 зерен (50-55г): Fahad 8-2 (Мексика), Русло (Беларусь), Л – 2, Л – 1, ЛТ – F6 540 – 4, Укро (Россия), Каровай Харьковский, Сокол Харьковский (Украина) и другие;
- высокого содержания сырого протеина (15 – 18%): Сокол Харьковский (Украина), Укро (Россия), Whitman (США), OH – 1621 (Китай), Armadillo (Мексика), BreakWell (Австралия) и другие;
- комплекса хозяйственно – ценных признаков: Узор, Рубин (Беларусь), Nagano (Польша) и другие.

Наряду с перечисленными источниками хозяйственно – ценных признаков ярового тритикале в гибридизации широко используются лучшие сорта озимого тритикале и яровой пшеницы, что обеспечивает значительное увеличение продуктивности колоса и улучшение качества зерна. Например, с участием сортов озимого тритикале созданы высокопродуктивные яровые сорта Лотас, Садко, Русло.

В рамках проекта МЦП ЕврАЗЭС «Инновационные биотехнологии» исследуются ДНК- маркеры генов короткостебельности и качества зерна тритикале.

## АРЕАЛЫ РАСПРОСТРАНЕНИЯ И ГЕНЕТИЧЕСКОЕ РАЗНООБРАЗИЕ ДИКОГО ЯЧМЕНИ КАЗАХСТАНА

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Дикорастущий вид *H. spontaneum* K. является прямым предшественником культивируемого ячменя и важным источником повышения разнообразия культурных форм, в том числе и для повышения устойчивости растений к стрессовым факторам. По современной классификации дикий двурядный ячмень отнесен как подвид к виду *H. vulgare* (*H. vulgare* ssp. *spontaneum* K.). Одной из задач наших исследований было изучение ареалов распространения однолетнего вида *Hordeum spontaneum* K., для которого Казахстан является периферийной зоной.

Результаты анализа сбора 209 образцов 14 популяций, собранных в 2008-2012, позволили установить ареалы распространения *H. spontaneum* в Казахстане – в Южно-Казахстанской области (Сарыагашский, Казыгуртский и Толебийский районы). Результаты экспедиционных работ в Тюлькубасском, Мактаральском и Шардаринском районах дали нам основания предположить о том, что *H. spontaneum* не произрастает в этих регионах Южно-Казахстанской области.

Для изучения хозяйствственно-ценных признаков дикорастущего ячменя из Казахстана семенной материал всех популяций *H. spontaneum* выращивали в озимом посеве на экспериментальных участках Казахского НИИ земледелия и растениеводства (Алматинская область).

Для осуществления генетического анализа дикорастущего ячменя было выделено и очищено 96 образцов ДНК. Оптимизированы ПЦР условия для 18 SSR-маркеров, равномерно локализованных во всех 7 хромосомах генома ячменя. Все 18 пар SSR-праймеров были разделены на три группы в зависимости от температуры отжига – 50<sup>0</sup>C, 55<sup>0</sup>C и 60<sup>0</sup>C, подобранный в ходе оптимизации ПЦР и скрининга праймеров.

В результате статистического анализа для 18 полиморфных SSR-локусов выявлено 58 аллелей, со средним значением аллелей на локус 3,1. При этом количество эффективных аллелей варьировало от 1,2 до 3,9. Индекс генетического разнообразия Шеннона варьировал от 0,606 до 0,867, индекс разнообразия Нея от 0,364 до 0,497, PIC от 0,219 до 0,710.

Данная работа является одним из этапов исследований в области молекулярной систематики дикорастущих видов злаковых Казахстана. Актуальность использования данного подхода как для развития генетики и селекции зерновых культур в целом, так и для формирования и сохранения коллекций генетических ресурсов растений, документирования, создания информационного банка данных, организации хранения генофонда заключается в том, что комплексное изучение и характеристика генетических ресурсов ячменя, и в том числе использование методов молекулярных маркеров, эффективны для пополнения, оценки, поддержания и рационального использования ценных генетических коллекций.

## МАҢҒЫШЛАҚ ЭКСПЕРИМЕНТАЛЬДЫҚ БОТАНИКАЛЫҚ БАҒЫНЫҢ ЖАҒДАЙЫНДАҒЫ ӨРІКТІҚ ТЕКТІК РЕСУРСТАРЫ

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Маңғышлақ экспериментальдық ботаникалық бағында жеміс ағаштарының сұрыптары мен бөгдеаудандық түрлерін интродукциялық сынаққа тарту және аридті аймақтар жағдайында жеміс дақылдарын отырғызудың жиынтығын жасау бойыншағылыми материалдар мен бай тәжірибе жинақталды.

Сұрыптану жұмыстары үшін кәдімгі өріктің (*Armeniaca vulgaris* L.) 16 сұрып-клондарының көшеттері (авторы -академик А. Джанғалиев) қамтылды: «Шымкенттің ерте өрігі», «Есік төзімдісі», «Жонғар сұлуы», «Өрік жұзімі», «Майда Кармин», «Кішіалматылық домалак», «Катюша», «Қабырғалы іріжемісті», «Қотырбұлақ албыбы», «Қотырбұлақ нәзігі», «Қотырбұлақ сұлуы», «Белбұлақ Рекорды», «Спутник», сонымен бірге, кәдімгі өріктің 3 сұрпы: «Никита қызылбеттісі», «Колхоздық» және «Сарыөрік».

Көшеттер бақтың жиынтық жасау телімшелері мен жылыжайларында әр сұрып пен сұрып-көшірмелерінен 10 – 20 дана мөлшерінде отырғызылды. Өсімталдықтың жоғары деңгейі (80%) «Никита қызылбеттісі» сұрыптарында, «Қотырбұлақ сұлуы», «Қотырбұлақ нәзігі», «Шымкенттің ерте өрігі», «Белбұлақ Рекорды» сұрып-көшірмесінен байқалды. Визуальды бақылау нәтижесінде рік сұрыптары мен сұрып-клондарының қабығының, сүрегінің, біржылдық өркенінің, гүл бүршіктерінің төмен температурадан закымдалуы байқалмады, бұл соңғы жылдардағы қыстың жылы болуымен және наурыз – сәуір айларындағы ауаның жоғары температурада болуымен байланысты екендігі түсінікті. Өрік сұрыптарының бүршік жаруы орташа алғанда 27 наурыз бен 3 сәуір аралығында байқалады. Ең ерте өсіп-өну кезеңі «Никита қызылбеттісі» сұрыптарында байқалды. Өрік сұрыптарында жапырақтың пайда болуы 10 сәуір мен 15 мамыр аралығында байқалды. Өркендердің өсіп шығуы 23 сәуірден мамырдың соңы – маусымның басына дейінгі аралықта көрінеді. Орталық өркеннің орташа бой салуы 24 – 30 см/ді құрайды, ең биік өскен өркен «Никита қызылбеттісі» сұрыптарында - 49 см, «Есік төзімдісі» - 44 см, «Көкбастау сұлуында» - 41 см байқалды. Ең қысқа өркен «Қабырғалы іріжемісті» - 8 см, «Катюша» - 11 см, жиынтық жасау телімшесіндегі «Қотырбұлақ нәзігінде» - 11 см. Белгіленді. Өріктің гүлдеуі 15 – 20 сәуірден 5 мамырға дейін өтеді. Гүлдеу мерзімінің жалғасуы бойынша коптеген сұрыптарда гүлдің мол ашылуы 20 күн төңірегінде өтеді.

Маңғыстаудың табигат жағдайында өрік сұрыптары мен сұрып-клондарының ерте жеміс беруімен ерекшеленеді: 2–3 жылдық жасындағы ағаштарында жемістер пайда бола бастайды. Жемістерінің пісіп жетілуі 20 – 25 маусым аралығында жүреді, піскен жемістердің үзіліп түсі 24 – 26 маусым аралығында басталады. Жемістері тым ұсақ болады: әр түрлі сұрыптардың бір жемісінің салмағы – 10 – 18 грамм аралығында болады. Барынша ірі жемістер «Көкбастау сұлуы» сұрып-көшірмелерінде байқалды. Өріктің 3 түрінің сұрып пен сұрып-клондарының өнімберушілігі анықталды: «Жонғар сұлуының» орташа салмақтағы жемісі 7,5 г болатын бір ағашынан - 12 кг, орташа салмақтағы жемісі 16 г болатын «Қызылбеттісінен» - 15,6 кг, орташа салмақтағы жемісі 18 г болатын «Көкбастау сұлуынан» - 25,5 кг жеміс алынды.

Осылай алғанда, Маңғышлақ экспериментальдық ботаникалық бағындағы өріктің тектік қорының мол қоры мен қуаты бар, сондықтан коллекциялық бөлімшелерде болашақта зерттеуге және асылдандыру жұмыстарына пайдалану үшін өріктің тектік қорын сақтап қалу басты мақсат болып табылады.

**ГЕНЕТИЧЕСКИЕ РЕСУРСЫ АБРИКОСА В УСЛОВИЯХ  
МАНГЫШЛАКСКОГО ЭКСПЕРИМЕНТАЛЬНОГО БОТАНИЧЕСКОГО  
САДА**

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В Мангышлакском экспериментальном ботаническом саду накоплен научный материал и богатый опыт по привлечению и интродукционному испытанию инорайонных видов и сортов плодовых растений, созданию коллекционных насаждений плодовых культур в аридных условиях. Для сортоизучения были привлечены саженцы 16 сортов-клонов (автор академик А. Джангалиев) абрикоса обыкновенного (*Armeniaca vulgaris* L.): «Чимкентский ранний», «Иссыкский устойчивый», «Краса Джунгарии», «Абрикосовый виноград», «Мелкий Кармин», «Малоалматинский круглый», «Катюша», «Крупноплодный ребристый», «Гигант Котурбулака», «Котурбулакский нежный», «Красавица Котурбулака», «Рекорд Бельбулака», «Спутник», а также 3 сорта абрикоса обыкновенного «Никитинский краснощёкий», «Колхозный» и «Курага».

Саженцы были высажены на питомниках и коллекционных участках Сада в количестве от 10 до 20 экземпляров каждого сорта и сорта-克лона. Высокая приживаемость (80%) отмечена у сорта Краснощекий, сортов-клонов Краса Джунгарии, Котурбулакский нежный, Чимкентский ранний, Красавица Котурбулака и Рекорд Бельбулака.

При проведении визуальных наблюдений у сортов и сортов – клонов абрикоса не отмечено повреждений коры, древесины, однолетних побегов, цветковых почек от низких температур, что последние годы вполне объяснимо, учитывая теплые зимы и высокую температуру воздуха в течение марта – апреля.

Распускание почек у сортов абрикоса наблюдалось в среднем с 27 марта по 3 апреля. Самое раннее начало вегетации отмечено у абрикоса сорта «Никитский краснощекий». Появление листьев у сортов абрикоса отмечено с 10 апреля по 15 мая. Рост побегов проходило в период с 23 апреля до конца мая – начала июня. Средний прирост центрального побега составил 24 – 30 см, максимальный прирост отмечен у абрикосов «Никитский краснощекий» - 49 см, «Иссыкский устойчивый» - 44 см, «Красавица Кок-Бастау» - 41 см. Минимальный прирост отмечен у сортов «Крупноплодный ребристый» - 8 см и «Катюша» - 11 см, на коллекционном участке – у сорта «Котурбулакский нежный» - 11 см. Цветение у абрикосов, с 15 – 20 апреля по 5 мая. По продолжительности цветения наблюдается, большой разброс, у большинства сортов – около 20 дней.

Сорта и сорта-клоны абрикоса в условиях Мангистау отличаются ранним вступлением в пору плодоношения – уже в 2-х – 3-х летнем возрасте на деревьях появляются плоды. Созревание плодов происходило в период с 20 по 25 июня, опадение зрелых плодов началось 24 – 26 июня. Плоды довольно мелкие; вес одного плода – от 10 до 18 граммов у разных сортов. Наиболее крупные плоды отмечены у сорта – клона «Красавица Кок-Бастау».

Урожайность определяли у 3-х сортов и сортов – клонов абрикоса: «Краса Джунгарии» - 12 кг с одного дерева при среднем весе плода 7,5 г; «Краснощекий» - 15,6 кг при среднем весе плода 16 г; «Красавица Кок-Бастау»- 25,5 кг при среднем весе плода 18 г.

Таким образом, генофонд абрикоса в Мангышлаком экспериментальном ботаническом саду обладает большим потенциалом, поэтому главной задачей является сохранение генетических ресурсов абрикоса в коллекционных участках для дальнейшего изучение и селекционного использования.

## КРИОКОНСЕРВАЦИЯ И ХЛАДОХРАНЕНИЕ ГЕРМОПЛАЗМЫ ПЛОДОВЫХ, ЯГОДНЫХ КУЛЬТУР И ВИНОГРАДА В КАЗАХСТАНЕ

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Сохранение гермоплазмы вегетативно размножаемых растений биотехнологическими методами было реализовано в двух основных направлениях: Хладохранение – ограничение роста культуры *in vitro*, при температуре 3-4°C, требует периодического субкультивирования и эффективно в случаях коротких и средних сроков хранения. Криоконсервация – проводится в условиях сверхнизкой температуры в жидком азоте или его парах при температуре -165-196°C – позволяет неограниченно долго сохранять жизнеспособность, высокий регенерационный потенциал и генетическую стабильность.

Для надёжного сохранения генофонда плодовых, ягодных культур и винограда в Казахстане в настоящее время помимо содержания полевых коллекций применяется среднесрочное хладохранение *in vitro* и длительная криоконсервация тканей в жидком азоте. Среднесрочное хладохранение растений *in vitro* проводится в камере с температурой +4°C, освещенностью 7  $\mu\text{mol m}^{-2}\text{s}^{-1}$  и 10-ти часовым фотопериодом. Культуры побегов сохраняются в пластиковых воздухопроницаемых пакетах на среде Мурасиге и Скуга (МС), содержащая: 0,5 мг/л 6-бензиламинопурина (БАП), 0,1 мг/л β-индолил-3-масляной кислоты (ИМК) и 3% сахарозу или 2% сахарозу + 2% маннит у плодовых и ягодных культур; у винограда – ½ МС, содержащая: 0,1 мг/л БАП, 0,2 мг/л ИМК, 3% сахарозу. Образцы сортов, гибридов и дикорастущих форм 183 косточковых, 75 семечковых, 142 ягодных культур и 30 винограда хранятся в условиях хладохранения в коллекции.

Криоконсервация гермоплазмы проводится методами витрификации, инкапсуляции-дегидратации, замораживания спящих, зимующих почек и прямого погружения в жидкий азот. У яблони, груши, абрикоса, вишни, чёрной смородины, малины, эффективно замораживание как спящих, зимующих почек так и меристем. У земляники, можно криоконсервировать только меристематические ткани. Выбор метода криосохранения в каждом конкретном случае проводится индивидуально. В случаях необходимости *in vitro* материалов для пополнения коллекции или использования в асептических условиях лучше сохранять меристематические ткани.

Для надёжного сохранения большого количества древесных растений, выращенных в поле – использовать наиболее дешевый и простой способ – метод замораживания спящих почек. Для криосохранения дикорастущих форм и селекций можно использовать замораживание семян и эмбриональных осей прямым погружением в жидкий азот. Криоконсервированная коллекция содержит 126 сортов и гибридов яблони, 21 груши, 42 вишни, 58 черешни, 31 земляники, 20 чёрной смородины 31 малины, а также 4 дикорастущие формы абрикоса (*Prunus armeniaca* L.).

## РЕГЕНЕРАЦИОННАЯ СПОСОБНОСТЬ НЕКОТОРЫХ ЭНДЕМИКОВ ФЛОРЫ ЦЕНТРАЛЬНОГО КАЗАХСТАНА

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Целью исследований являлось оценка каллусообразующей и регенерационной способностей и оптимизация условий для получения асептических культур *in vitro* эндемичных видов флоры Казахстана (курчавка незаметная *Attraphaxis decipiens* Jaub. et Spach., полынь казахская *Artemisia kasakorum*, лысосемянник лысый *Phalacrachena calva* (Ledeb.) Iljin., солонечник бектаутинский *Calatella bectauatensis*, василёк двоякоперистый *Centaurea bipinnatifida* (Trautv.) Tzvel., пиретрум Келлера *Pyrethrum kelleri* (Kryl. et Plotn.).

Изучение влияния гормонального состава питательной среды МС на каллусогенез в течение полного цикла культивирования показало значительные различия между видами по частоте каллусообразования, общей массе и приросту каллуса.

Выявлено, что изолированные ткани *A.kasakorum*, *A.decipiens*, *C. bectauatensis*, *P.calva*, *P.kelleri*, *C.bipinnatifida*, *T.scopulorum* обладали высокой каллусообразующей способностью *in vitro*. Максимальной каллусообразующей способностью характеризовались экспланты полыни казахской, ростовой индекс варьировал от 2,37 до 4,98 в зависимости от гормонального состава среды. У эксплантов пиретрума Келлера интенсивность каллусогенеза составила 33-60% в зависимости от среды.

Высокий прирост каллуса около 4 г отмечался у курчавки незаметной за один цикл пассирования на среде с НУК и БАП. Максимальные биомассы каллусов у эксплантов лысосемянника лысого (3 г) и у василька двоякоперистого (6 г) накапливались на среде с 4,44  $\mu\text{M}$  БАП и 4,52  $\mu\text{M}$  2,4 Д. Интенсивность накопления биомассы каллусов пижмы утесной и василька двоякоперистого на индуцирующей среде достоверно не отличалась.

Индуцирующее действие питательной среды на образование и накопление биомассы каллуса для большинства видов определялось внесением 2,4Д или НУК, или в их сочетании с БАП. Установлено, что гормональный состав индуцирующей среды влиял и на морфологические показатели (цвет, плотность) полученных каллусных тканей.

Проведенная оценка регенерационного потенциала эндемичных видов показала возможность микроклонального размножения полыни казахской, василька двоякоперистого, пиретрума Келлера, лысосемянника лысого. Для этих видов получены асептическая культура микропобегов. В меньшей степени ростовая активность проявлялась у эксплантов курчавки незаметной, пижмы утесной, пиретрума Келлера и солонечника бектаутинского.

Работа проведена в рамках ПФИ 0569 «Поиск новых природных соединений в растениях. Выделение, идентификация компонентов, строение молекул и их биологическая активность»

## ИЗУЧЕНИЕ ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ ВО ФЛОРЕ КАЛБИНСКОГО ХРЕБТА В ВОСТОЧНОМ КАЗАХСТАНЕ

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Природные растительные ресурсы являются одними из главных достояний любого государства. Экономическая независимость каждой страны в значительной степени определяется тем генетическим разнообразием растений, которое в совокупности составляет генофонд растительных ресурсов. Проблема всестороннего изучения, мобилизации и эффективного использования мировых ресурсов, наиболее важных с точки зрения сельскохозяйственного производства видов культурных растений была поставлена Н.И. Вавиловым еще в конце 20-х годов прошлого столетия. Однако, как показал анализ публикаций, опыт комплексного изучения отдельных территорий и выявления на них разнообразия диких сородичей культурных растений с целью мобилизации и сохранения генетических ресурсов растений в Казахстане невелик.

Целью настоящего исследования являлось выявление диких сородичей культурных растений во флоре Калбинского хребта.

Калбинский хребет Восточного Казахстана был выбран для исследования согласно следующего положения: на фоне достаточно хорошей изученности флористического состава, дикие сородичи культурных растений (ДСКР) для данной территории практически не исследован.

Для решения задач по изучению ДСКР на хр. Калбинский исследования проведены в следующих эколого-географических районах: в горно-лесной Восточной Калбе и в горно-степной Западной Калбе. По результатам фактической инвентаризации ботанического разнообразия ДСКР на территории хр. Калбинский установлено произрастание 58 видов, относящихся к 37 родам, 14 семействам. Причем в горно-лесной восточной части хребта зафиксировано 166 местонахождений ДСКР, а в горно-степной западной части -27 местонахождений. Флороценотическое ядро ДСКР Калбинского хребта составляют опушечно-луговые (семейства *Poaceae* Barnhart 36,8% и *Fabaceae* Lindl. 12,8%), опушечно-лесные (семейство *Rosaceae* Juss. 18,4%) виды растений. В экологическом отношении флора ДСКР представлена тремя основными группами: мезофитами, мезопетрофитами и ксеромезофитами. По характеру жизненных форм травянистые многолетники составляют 63,9%, кустарники – 30,5%, однолетники – 5,6%.

Выявленные ДСКР на хр. Калбинский по результатам наших исследований распределены в две группы. В первую группу включены виды, не образующие промышленных запасов, но факт их произрастания зафиксирован во время проведения полевых работ на указанной территории. Вторая группа – это ДСКР, являющиеся ресурсными видами.

Видовой состав ДСКР хр. Калбинский первой группы насчитывает 36 видов, которые в систематическом отношении входят в 13 семейств и 27 родов. Наибольшим количеством видов представлены семейства: *Poaceae* Barnhart – 9 (25%), *Rosaceae* Juss. – 8(22,2%), *Fabaceae* Lindl. – 7(19,4%), *Cannabaceae* Endl. и *Asteraceae* Dumort. – по 2 (11%). На долю этих семейства приходится 77,6%, остальные семейства представлены по одному виду. Ко второй группе отнесены 22 вида, среди которых наибольшее количество выявлено в семействе *Poaceae* Barnhart.

Исследования выполнены в рамках темы «Ботаническое разнообразие диких сородичей культурных растений Восточного Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации продовольственной программы».

## АНТИОКСИДАНТНАЯ АКТИВНОСТЬ ЭКСТРАКТОВ ШАФРАНА АЛАТАУСКОГО

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Фитохимическое изучение рода *Crocus* L. является перспективным, поскольку многие из представителей этого рода являются источниками целого ряда БАВ (фенолов, флавоноидов, ксантонаов, жирных кислот, каротиноидов и др.), которые обладают высокой антибактериальной, противовоспалительной, противовирусной, каппилиароукрепляющей др. видами биологической активности.

Целью исследований являлось количественное определение фенолов в экстрактах крокуса алатауского *Crocus alatavicus* Regel et Semen и изучение их антиоксидантной активности (АОА) в различных модельных системах *in vitro*.

Исходные образцы растений крокуса алатауского *C. alatavicus* были собраны на территории Алматинской области на этапе цветения в конце марта. Сухой растительный материал экстрагировали 50% этианолом или бензолом (1:4), перегоняли на роторном испарителе до получения сухих экстрактов. Содержание фенольных соединений в водно-спиртовых и бензольных экстрактах проводили спектрофотометрическим методом с реактивом Фолина Чокальтеу с использованием галловой кислоты в качестве стандарта. Количество фенолов оценивали как мг эквивалент галловой кислоты на мг экстракта. Антиоксидантную активность экстрактов определяли по способности антиоксидантов восстанавливать стабильный радикал 1,1-дифенил-2-пикрилгидразил DPPH (Amin I. et al., 2002). АОА определяли также по степени влияния исследуемых экстрактов на динамику перекисной деградации β-каротина в системе линолевой кислоты ( $\beta$ -karotene-linoleic acid system) по СВА методу (Hossein S. A. et al., 2012).

Выявлено, что содержание фенолов в экстрактах различно в зависимости от используемой для экстракции части растения. Количество фенолов в надземной части составило 4,07 мг-экв в водно-спиртовом извлечении и 5,08 мг-экв в бензольном. Водно-спиртовый экстракт клубнелукович содержал в два раза меньше фенолов (2,05 мг-экв). Определение АОА данных экстрактов по их способности ингибировать перекисное окисление линолиевой кислоты показало определяющую роль исходной части растения. Высокую АОА проявили бензольный и спиртовый экстракт из надземной части шафрана алатауского, 39,9 % и 37,7 %, соответственно.

Результаты исследований АОК экстрактов по DPPH методу также показали высокую антиоксидантную активность экстрактов из надземной части растений шафрана алатауского. При этом биологическая активность бензольного экстракта была в два раза выше, чем спиртового экстракта.

Таким образом, проведенные исследования позволяют сделать вывод, что спиртовые и бензольные экстракты, полученные из надземной части шафрана алатауского и характеризующиеся относительно повышенным содержанием фенолов, обладают высокой антиоксидантной активностью, что позволяет рекомендовать их как основу для получения лечебных средств с высоким уровнем антиоксидантного действия.

## СИСТЕМЫ СЕМЕННОЙ РЕПРОДУКЦИИ ВИДОВ РОДА TARAXACUM WIGG. ФЛОРЫ КАЗАХСТАНА

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Важной проблемой репродуктивной биологии является изучение особенностей процессов воспроизводства в различных таксонах и экологически дифференцированных группах растений на всех уровнях их организации. Эти процессы во многом определяют генетическую структуру популяций, а также адаптационные возможности и селекционный потенциал растений. Механизмы, или элементы систем размножения, изменение которых оказывает существенное влияние на генетическую структуру популяций вида и характер протекающих в них генетических процессов называют параметрами систем размножения. Особенно важными для системы семенного размножения оказываются такие основные параметры, как способ опыления (аллогамия, автогамия) и тип образования семян (амфимиксис, апомиксис). Однако многие виды рода *Taraxacum* изучены явно недостаточно для того, чтобы с уверенностью судить о способах опыления или образования семян. В связи с этим представляет интерес изучение способов семенной репродукции у видов рода *Taraxacum* во флоре Казахстана.

Род *Taraxacum* Wigg. – один из крупнейших в семействе Asteraceae. Представители рода широко распространены во всех климатических зонах земного шара, за исключением тропиков. В настоящее время род насчитывает около 3000 видов, из которых во флоре Казахстана встречается 73 вида. Виды рода *Taraxacum* во флоре Казахстана имеют 2 типа семенной репродукции – амфимиксис и апомиксис. Амфимиктические виды в большинстве являются диплоидами ( $2n=2x=16$ ): *T. serotinum*, *T. ecornutum*, *T. kok-saghyz*, *T. multiscaposum*, *T. bessarabicum*. Однако среди них обнаружен триплоидный вид ( $2n=3x=24$ ) *T. bicorne*. Апомиктические виды полиплоидны. В основном триплоиды ( $2n=3x=24$ ): *T. brevirostre*, *T. dissectum*, *T. fedtschenkoi*, *T. album*, *T. sinicum*, *T. butkovii*, *T. luridum*, *T. pseudoleucanthum*, *T. leucanthum*, *T. dealbatum*, *T. niveum*, *T. scariosum*, *T. minutilobum*, *T. monochlamydeum*, *T. goloskokovii*, *T. pseudoatratum*, *T. subglaciale*, *T. lilacinum*, *T. pingue*, *T. sumneviczii*, *T. microspermum*, *T. androsssovii*. Вместе с тем встречаются виды, которые могут быть как триплоидными, так и тетраплоидными ( $2n=3x=24$  и  $2n=4x=32$ ): *T. stenolobum*, *T. glabrum*, *T. altaicum*, пентаплоидами ( $2n=40$ ): *T. montanum*, анеуплоидами ( $2n=28$ ): *T. tianschanicum*. Отдельно можно выделить виды *T. brevicorniculatum*, *T. erythrospermum*, *T. officinale* имеющих два типа размножения апо- и амфимиксис ( $2n=16, 24, 32$ .).

Широкое распространение апомиктических видов *Taraxacum* в разных климатических и географических зонах Казахстана указывает на их высокие адаптивные способности которые определяются как генотипической структурой апомиктов (высокой пloidностью, гибридогенной природой), так и лабильностью системы семенной репродукции. Это позволяет одновременно реализовывать апомиксис и амфимиксис, переходить с одного типа репродукции на другой, эффективно используя для адаптации преимущества, как апомиксиса, так и амфимиксиса. Все это позволяет апомиктическим видам рода *Taraxacum* успешно конкурировать с остальными видами локальной экосистемы и, как следствие, занимать широкие ареалы.

Настоящая публикация осуществлена в рамках Подпроекта «Получение высокопродуктивных форм *Taraxacum kok-saghyz* Rodin. – отечественного производителя каучука», финансируемого в рамках Проекта «Коммерциализации Технологий», поддерживаемого Всемирным Банком и Правительством Республики Казахстан.

**ИССЛЕДОВАНИЕ КОМПОНЕНТНОГО СОСТАВА ЭФИРНОГО  
МАСЛА *ARTEMISIA KOTUCHOVII* KUPR., УЗКОЛОКАЛЬНОГО  
ЭНДЕМИКА КАЗАХСТАНСКОГО АЛТАЯ**

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*Artemisia* L. – наиболее крупный род трибы *Anthemideae* и один из самых многочисленных родов семейства *Asteraceae*. Выявлено большое разнообразие этого рода в Азии [1]. Показана разнообразная биологическая активность эфирных масел, выделенных из различных видов *Artemisia*: антибактериальная, противогрибковая, противовирусная, антиоксидантная и антиполовитовая [2, 3].

Проведено исследование химического состава эфирных масел полыни Котухова (*Artemisia kotuchovii* Kupr.), являющегося узколокальным эндемом флоры Казахстанского Алтая [4]. Растительный материал был собран в августе 2013 года в конце стадии цветения на Южном Алтае – хребет Тарбагатай, 1709 м над уровнем моря. Два типа высущенного материала (соцветия с листьями и стебли) подвергались гидродистилляции с последующим анализом на газовом хроматографе с плазменно-ионизационным детектором и масс-спектрометрией. Выявлено, что основными компонентами эфирных масел из соцветий с листьями и стеблей являются метилхавикол (эстрагол) (74,2 и 75,5%, соответственно) и метил эвгенол (4,3% и 4,6%), (Z)-β-оцимен (3,8% и 3,7%) и (E)-β-оцимен (5,2% и 4,4%). В настоящей работе впервые представлены данные о химическом составе эфирных масел *A. kotuchovii*. Интересно отметить что, метилхавикол (эстрагол) является природным компонентом таких растений, как эстрагон, базилик и фенхель, эфирные масла которых широко используются в качестве ароматизаторов продуктов питания. В недавних исследованиях показана инсектицидная активность эстрагола [5].

**Литература:**

- 1) Pellicer J., Garcia S., Garnatje T., Hidalgo O., Korobkov A.A., Dariimaa Sh., Valles J. Chromosome counts in Asian *Artemisia* L. (*Asteraceae*) species: from diploids to the first report of the highest polyploid in the genus // Bot. J. Linn. Soc. – 2007. – V. 153. – P. 301-310.
- 2) Kordali S., Kotan R., Mavi A., Cakir A., Ala A., Yildirim A. Determination of the chemical composition and antioxidant activity of the essential oil of *Artemisia dracunculus* and of the antifungal and antibacterial activities of Turkish *Artemisia absinthium*, *Artemisia dracunculus*, *Artemisia santonicum* and *Artemisia spicigera* essential oils // J. Agric. Food. Chem. – 2005. – V. 53. – P. 9452-9458.
- 3) Seidakhmetova R.B., Beisenbaeva A.A., Atazhanova G.A., Suleimenov E.M., Pak R.N., Kulyyasov A.T., Adekenov S.M., Chemical composition and biological activity of the essential oil from *Artemisia glabella* // Pharm.Chem. J. – 2002. – V. 36 (3). – P. 27-30.
- 4) Куприянов А.Н. Новые виды рода *Artemisia* (*Asteraceae*) из Алтая и Казахстана // Ботан. журн. – 1999. – Т. 84, № 4. – С. 114-116.
- 5) Chiou Ling Chang, Il Kyu Cho, Qing X. Li. Insecticidal activity of basil oil, trans-anethole, estragole, and linalool to adult fruit flies of *Ceratitis capitata*, *Bactrocera dorsalis*, and *Bactrocera curvata* // J. Econom. Entomol. – 2009. – V. 102(1). – 203-209.

Работа выполнена при финансовой поддержке гранта Министерства образования и науки Республики Казахстан №0504/GF3.

## ИЗУЧЕНИЕ МОЛЕКУЛЯРНО-ГЕНЕТИЧЕСКОГО РАЗНООБРАЗИЯ ДИКОЙ ЯБЛОНИ КАЗАХСТАНА

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Одним из центров происхождения дикой яблони является территория Казахстана (Вавилов, 1987). В Казахстане были описаны несколько видов рода *Malus*, в том числе *M.domestica* (Флора Казахстана, 1961). Одним из наиболее значимых является *M.sieversii*, признанный родоначальником и подвоем для культурных сортов. Яблоня Сиверса вместе с яблоней *M. niedzwetzkyana* занесены в Красную книгу Казахстана. Очевидно, что популяции диких яблонь на территории Казахстана являются незаменимыми донорами ряда полезных свойств, которые были утрачены культурными сортами. Правильная молекулярно-генетическая систематика и организация охраны генофонда в природе обеспечат развитие селекционных программ по повышению уровня культуры яблони.

В качестве генетического материала было собрано около 300 образцов листьев из двух регионов страны: Южного и Восточного Казахстана. При сборе материала было зафиксировано местоположение каждого дерева для дальнейшего экологического мониторинга. Собранные листья и выделенная из них геномная ДНК сохранены при -80°C, листья так же сохранены в высушенном, с помощью силикагеля, виде при комнатной температуре. Таким образом, создан банк геномной ДНК диких популяций яблони двух регионов Казахстана. Для оценки полиморфизма исследованных популяций были использованы семь микросателлитных маркеров. С целью точного определения размеров аллелей проверены 3 подхода в проведении ПЦР. Тем самым был выбран наиболее экономичный подход с высокой воспроизводимостью результатов. Все 7 SSR маркеров показали 100 % полиморфность. С их помощью было выявлено 87 аллелей с различной частотой встречаемости. Молекулярно-генетический анализ популяций двух регионов показал высокий уровень гетерозиготности ( $H_o=0.707\pm0.024$ ). Другие параметры генетического разнообразия также высоки, так средний уровень PIC=0.786, индекс Шеннона, отражающий вклад редких аллелей  $I=1.567\pm0.039$ .

Результаты анализа популяций яблони с помощью метода AMOVA (анализ молекулярной вариансы) показали 10% географической изменчивости между регионами Южного и Восточного Казахстана, что выше показателя внутри каждого из регионов. На внутрипопуляционную изменчивость приходится 83%, такой высокий показатель характерен для перекрестноопыляющейся яблони. Результаты AMOVA, также подтверждаются дендрограммой основанной на генетическом расстояние по Нею. Наблюдается четкое разделение исследованных популяций по регионам. Коэффициент корреляции теста Мантелля составил  $R^2 = 0.510$  ( $P < 0.001$ ), что подтверждает взаимосвязь географического и генетического расстояния. Также для каждого из регионов был определен характерный пул редких аллелей. Наибольшее количество редких аллелей пришлось на пять популяций Южного Казахстана  $P_o=14$ , в свою очередь для Восточного региона  $P_o=9$ . Таким образом, существует вероятность определения принадлежности образца дикой яблони к той или иной популяции, либо к региону.

Генотипирование с помощью семи микросателлитных маркеров было проверено на некоторых сортах *M.domestica*. При этом были выявлены различия в генотипе сорта Голден Делишес привезенного из Франции от того же сорта, взятого с питомника Алматы. Такого рода несовпадения были показаны и для других сортов.

## ВЫРАЩИВАНИЕ СОРГО *SORGHUM VULGARE* РАССАДНЫМ СПОСОБОМ

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Укрепление продовольственной безопасности в Таджикистане становится стратегической проблемой. Зерновая проблема страны продолжает оставаться актуальной.

Особое значение в увеличение сбора зерна имеет сохранение ассортимента традиционных зерновых культур. В условиях Центральной Азии, в т.ч. в Таджикистане сорго является засухоустойчивой, высокопродуктивной культурой универсального использования.

Изучение и научное обоснование особенности рассадного выращивания сорго, установление оптимальных способов и густоты стояния рассады, эффективности дробного внесения подкормок азотом обеспечивающих получение высокого урожая зерна и силосной массы пожнивного сорго в условиях Гиссарской долины.

Программой исследований предусмотрено изучение приемов технологии выращивания пожнивного сорго рассадой и изучение способов посева. Экспериментальные исследования проводились в Гиссарской долине, в хозяйстве им. Меликмуродова Гиссарского района по методике Б.А.Доспехова (1985), в 4-х кратной повторности, площадью делянки 36 м<sup>2</sup> (длина рядка 13 м), размещение рендомизированное. Предшественник - пшеница осеннего посева. Во всех опытах под вспашку вносили из расчета 10 т/га навоза, 60 кг фосфора и 40 кг/га д.в. калия. В период вегетации в первом и втором подкормках опыта вносили N<sub>35</sub>P<sub>20</sub> в фазу кущения и N<sub>35</sub> в фазе выхода в трубку. В опыте 3, в фазе кущения вносили N<sub>20</sub>P<sub>20</sub>, в фазе выхода в трубку N<sub>30</sub> и в начале выхода флагового листа- N<sub>20</sub>. Посев и посадку рассады сорго проводили 24 июня, из расчета 10-12 кг/га. Семена до посева против комплекса болезней обрабатывались препаратом ТМТД, 80% (2 кг/т семян). За 37 дней до посадки с целью приготовления рассады высевали семена сорго. При посеве семенами вегетационный период сорго сорта Гиссарское 45 составил 113-117 дней, а в опытах с посадкой рассадой 30 дневного возраста в одинаковый срок посева 91-96 дней, что на 20-21 день короче. Ускоренный рост стебля сорго наблюдалось после выхода в трубку, достигая максимальной высоты (350,1-356,1 см) в конце вегетации. Более высокорослые растения формировались на гребневых посевах при густоте растений до 90 тыс./га и внесении подкормки в начале выхода флагового листа. Максимальная площадь листьев отмечена в фазе цветения растений, которая в зависимости от вариантов составила 42,0-49,8 тыс.м<sup>2</sup>/га. Большее число зерен в метелке, с большей массой образовались при гребневом способе выращивания, густотой стояния 70 тыс./га растений и внесении подкормки растений азотом в начале выхода в трубку (46,1-47,7 г, а в вариантах густоты 70 тыс./га - 45,7- 47,1 г). Повышение урожайности отмечено в вариантах гребневого выращивания сорго (29,8 до 33,2 ц/га) и при увеличении густоты растений с 70 тыс. до 80 тыс./га. Прибавка урожая зерна (2,3 ц/га) отмечено в опыте 3, а по вариантам густоты стояния растений она составляла 4,2-6,8 ц/га.

Преимущество рассадного способа выращивания сорго заключается в следующем: - вегетационный период сокращается, в результате чего на 25-26 дней зерно раньше созревает до наступления осенних заморозков; - поля осенью раньше освобождаются и соответствуют для своевременного проведения зяблевой вспашки; - способствует экономическому использованию поливной воды и посевного материала. Рассадный способ выращивания пожнивного сорго имеет особо важное значение на засоленных землях, где получение дружных всходов затруднено. Таким образом, доказано возможность пожнивного выращивания сорго рассадным способом в условиях Гиссарской долины Центрального Таджикистана, обеспечивающие получения полноценного урожая зерна и сухой биомассы.

## СОЗДАНИЕ КОЛЛЕКЦИИ *IN VITRO* СОРТОВ, ДИКОРАСТУЩИХ ФОРМ И КЛОНОВЫХ ПОДВОЕВ ЯБЛОНИ

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Яблоня – одна из важнейших плодовых культур в мире. В последнее время уникальные формы Заилийского и Джунгарского Алатау, обладающие комплексом ценных качеств: высокой устойчивостью ко многим заболеваниям, высокой морозостойкостью, широкой экологической пластичностью находятся под угрозой исчезновения. В связи с этим, важной задачей является сохранение и восстановление популяций дикоплодовых лесов Казахстана, как источника генофонда культуры яблони мирового значения.

Одним из решений для выполнения данной задачи является сохранение гермоплазмы яблони в культуре *in vitro* и криоконсервация. Для ускоренного клonalного размножения растений в зависимости от видовой или даже сортовой принадлежности необходимо усовершенствование питательной среды. Оптимизация питательных сред проводилась для дикорастущих форм (*Malus sieversii*) (Ledeb.) M. Roem. КГ4, КГ7, КГ13 из питомника Иле-Алатауского национального парка. Испытывали различные концентрации и сочетания фитогормонов: 6-бензиламинопурина (БАП), индолилмасляной кислоты (ИМК) и гибберелловой кислоты (ГК): 1) 0,5 мг/л БАП, 0,1 мг/л ИМК и 0,1 мг/л ГК; 2) 0,5 мг/л БАП, 0,01 мг/л ИМК и 0,1 мг/л ГК; 3) 0,5 мг/л БАП, 0,01 мг/л ИМК; 4) 1,0 мг/л БАП, 0,1 мг/л ИМК и 0,1 мг/л ГК; 5) 1,0 мг/л БАП, 0,01 мг/л ИМК и 0,1 мг/л ГК; 6) 1,0 мг/л БАП, 0,01 мг/л ИМК. Эксперимент проводили в трех повторностях, определяли количество вновь образовавшихся побегов в течение трех пассажей.

Было показано, что ГК способствует усиленному верхушечному росту побегов и снижает кустистость растений, тем самым, понижая коэффициент размножения (КР). Поэтому ГК использовали только на стадии введения в культуру *in vitro*. Увеличение концентрации ИМК стимулировало набухание оснований микропобегов, на отдельных образцах появлялись корни и каллус. Соответственно, для микроклонального размножения пригодны варианты среды МС без ГК и с уменьшенным содержанием ИМК (0,01 мг/л). В литературе приводятся результаты, где КР сортов и клоновых подвоев яблони составлял 3,9-5,1 при концентрации в питательной среде БАП 2 мг/л (Матушкина О.В., 2008). Однако авторы отмечают большое количество витрифицированных побегов (24,4%), что может отрицательно сказаться на эффективности криоконсервации. На двух испытанных вариантах сред: с 0,5 мг/л БАП + 0,01 мг/л ИМК и 1,0 мг/л БАП + 0,01 мг/л ИМК КР варьировал от 2,9 до 3,1, при этом количество витрифицированных побегов было незначительным – от 3,3 до 4,4%. В дальнейшем для культивирования побегов *in vitro* использовали питательную среду МС с меньшей концентрацией БАП (0,5 мг/л). Ранее нами показано, что эта же среда оптимальна и для сортов яблони, однако следует отметить, что дикорастущие формы медленнее развиваются на питательной среде, у сортов яблони несколько выше КР – 3,7 (Ромаданова Н.В., 2006). Данные исследования по созданию коллекции *in vitro* продолжаются также для клоновых подвоев яблони.

Полученные образцы гермоплазмы яблони *in vitro* будут сохранены в криобанке при температуре -196°C, могут быть использованы в селекционном процессе и для закладки элитных питомников, а также для международного обмена генетическими ресурсами.

Работа выполнялась в рамках грантового проекта Министерства образования и науки Республики Казахстан 0491/ГФ3 «Создание криогенного банка перспективных сортов и клоновых подвоев яблони на основе методов биотехнологии».

## РЕГЕНЕРАЦИОННЫЙ ПОТЕНЦИАЛ *CROCUS ALATAVICUS* В КУЛЬТУРЕ *IN VITRO*

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Крокус алатауский *Crocus alatavicus* Regel et Semen – эндемичный вид флоры Казахстана, который обладает высоким биологическим и экономическим потенциалом, что обуславливает перспективность его использования в селекции в качестве источника ценных генов при выведении новых сортов и форм. В настоящее время в результате хозяйственной деятельности человека вид находится под угрозой исчезновения.

В мировой практике для восстановления и сохранения редких видов из малочисленных природных популяций применяется технология клonalного микроразмножения. Микроклонирование позволяет значительно повышать коэффициент размножения и создавать резервный банк образцов эндемичных видов *in vitro*, одновременно проводить оздоровление растений от грибковой и бактериальной инфекций.

Целью исследований являлось изучение особенностей регенерации и оптимизация гормонального состава питательной среды для индукции морфогенеза в культуре изолированных тканей казахстанского вида крокуса *C. alatavicus*.

Исходным материалом служили клубнелуковицы маточных растений, взятые из природных мест произрастания на территории Алматинской области. В качестве эксплантов использованы сегменты клубнелуковиц, цветочные почки, различные части цветка, листьев и др. Для введения *in vitro* были использованы варианты среды Мурасиге и Скуга (МС) с различными концентрациями и сочетаниями фитогормонов: 6-бензиламинопурин (БАП), нафтилуксусная кислота (НУК), 2,4-дихлорфеноксиуксусная кислота (2,4-Д), индолилмасляная кислота (ИМК), кинетин.

Выявлено, что способностью к регенерации и каллусогенезу обладают экспланты изолированные от молодых, вновь образованных клубнелуковиц. На них отмечалось одновременное образование каллуса и развитие дополнительных побегов. Прямая регенерация побегов на эксплантах происходила за счет активации роста пазушных почек, локализованных на поверхности клубнелуковиц в результате индуцирующего действия цитокинина БАП. Количество побегов на первичных эксплантах в течение первого пассажа зависило от гормонального состава среды. Максимальное количество 14 побегов получено при культивировании эксплантов на среде МС с внесением БАП 8,88  $\mu\text{M}$  и 2,55  $\mu\text{M}$  2,4 Д. Одинаковый эффект на побегообразование выявлен у вариантов сред с внесением 8,88  $\mu\text{M}$  БАП + 0,51  $\mu\text{M}$  2,4 Д и 4,44  $\mu\text{M}$  БАП + 1,3  $\mu\text{M}$  2,4 Д.

Формирование каллуса происходило на поверхности среза через три недели культивирования на средах содержащих разные концентрации БАП и 2,4 Д. При дальнейшем пассировании каллуса на те же варианты сред через две недели отмечалось появление адвентивных побегов в каллусной ткани.

Проведенные эксперименты показали, что в условиях *in vitro* реализация регенерационного потенциала у крокуса алатауского определяется фазой развития исходных растений, природой и физиологическим состоянием первичных эксплантов. Индукция роста пазушных почек, адвентивное побегообразование у основания побегов, образование морфогенного каллуса с последующей закладкой дополнительных побегов индуцируется на питательной среде у эксплантов вновь сформированных клубнелуковиц, изолированных на этапе их развития, когда в верхушечной почке происходит закладка вегетативных и генеративных органов.

## ОЦЕНКА РЕСУРСНОГО ПОТЕНЦИАЛА ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ НА ЮГЕ КАЗАХСТАНА

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Природные растительные ресурсы являются одним из главных достояний любого государства, экономическая независимость которого в значительной степени определяется генетическим разнообразием растений, составляющим генофонд растительных ресурсов.

Одной из задач разработанной «Стратегии развития генетических ресурсов растений Казахстана» является обследование и инвентаризация генетических ресурсов растений (ГРР), поиск и сбор семенных коллекций диких, редких эндемичных видов и сородичей культурных растений.

В рамках целевой государственной программы: «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации Продовольственной программы» (2013-2015 гг.) впервые проводились инвентаризация и оценка ресурсного потенциала диких сородичей культурных растений (ДСКР) флоры Казахстана, среди которых лекарственные, пищевые, кормовые и др. группы полезных растений.

В результате маршрутно-рекогносцировочного обследования территории Жамбылской и Южно-Казахстанской областей в пределах Туркестанского флористического района и хребта Карагатай, Западного Тянь-Шаня и Киргизского Алатау было выявлено распространение около 90 видов ДСКР Казахстана. Несмотря на видовое разнообразие и распространение ДСКР по обследованным флористическим районам южного Казахстана заросли промыслового значения образует лишь часть выявленных видов.

Нами учтены запасы воздушно-сухого сырья 17 видов ДСКР из 7 семейств, из которых представлены по одному виду семейства: *Capparaceae*, *Caryophyllaceae*, *Elaeagnaceae*, в остальных семействах: *Hypericaceae* и *Lamiaceae* – по 2 вида, *Fabaceae* – 3, *Rosaceae* – 7 видов. Для промышленных заготовок перспективны выявленные на территории Туркестанского флористического района промысловые запасы солодки голой, лоха остроплодного, верблюжьей колючки обыкновенной, каперсов травянистых. Для аллохрузы качимовидной ежегодный объем заготовки сырья не должен превышать 100 т сухого корня. На подгорной равнине Киргизского Алатау промышленные заготовки возможны для солодки уральской.

Для проведения заготовок в ограниченном количестве и нужд местной аптечной сети можно рекомендовать выявленные на территории Киргизского Алатау, Карагатай и Каржантау виды шиповника, боярышника, зверобоя, рябину тяньшансскую, мяту длиннолистную, душицу мелкоцветковую, зизифору пахучковидную.

Таким образом, из 17 выявленных ресурсных видов ДСКР южного Казахстана обеспечены сырьевой базой и пригодны для проведения промышленных заготовок не менее 35% видов.

Остальные 65% видов ДСКР даже с ограниченными запасами сырья на небольшой территории представляют собой уникальные генетические ресурсы, сформированные в своеобразных и неповторимых условиях обследованных флористических районов южного Казахстана и нуждающиеся в сохранении и рациональном использовании для удовлетворения потребностей ныне живущих и будущих поколений.

**ФЛОРИСТИЧЕСКОЕ РАЗНООБРАЗИЕ ЦЕННОГО ГЕНОФОНДА  
ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ ВОСТОЧНОГО,  
ЗАПАДНОГО И ЦЕНТРАЛЬНОГО КАЗАХСТАНА**

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Ботаническими садами Республики реализуется программа «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации Продовольственной программы» (2013 – 2015). Отправной точкой для формирования программы послужили государственные документы, а также уже имеющиеся научные разработки в этом направлении (Ситпаева, Есимбекова, Моргунов, Карабаев, 2004; Ситпаева, Ламмер, Хусаинова; 2004; 2006). Разработчиком и основным исполнителем программы является РГП «Институт ботаники и фитоинтродукции» КН МОН РК. Наряду с Институтом ботаники и фитоинтродукции (с филиалом – Илийский ботанический сад), в выполнении программы участвуют Алтайский, Манышлакский экспериментальный, Джезказганский ботанические сады.

По результатам экспедиционных выездов в Восточном Казахстане (флористические районы – Алтай (Калбинский хребет) и Семипалатинский боровой) установлено произрастание: на территории Калбинского хребта 58 видов, относящихся к 37 родам, 14 семействам, а для Семипалатинского борового - 18 видов, относящихся к 15 родам, 7 семействам. На территории Западного Казахстана (флористические районы: полуостров Бузачи, полуостров Манышлак, Северный и Южный Устюрт) выделено 118 видов ДСКР, относящихся к 62 родам и 21 семейству. Наибольшее видовое разнообразие ДСКР отмечено на территории полуострова Манышлак (53 вида, 42 рода, 19 семейств). Наименьшее - на полуострове Бузачи (21 вид, 19 родов, 10 семейств). Среди ДСКР полуострова Бузачи наибольшим количеством видов представлены Злаковые – 7 видов (33,3 %) и Маревые – 5 (23,8 %). Для Манышлака наибольшее разнообразие ДСКР сосредоточено в семействах Маревые (13 видов), Злаковые (8 видов) и Бобовые (6 видов); в Северном Устюрте - в семействах Маревые (6 видов), Злаковые (5 видов); в Южном Устюрте – также в семействах Маревые (7 видов), Злаковые и Бобовые – по 3 вида. На территории Центрального Казахстана были обследованы: пустыня Бетпак-Дала (16 флористический район), Западный мелкосопочник (10), горы Улытау (10a), Восточный мелкосопочник (11), Каркаралинский (11a) и Тургайский (9) флористический районы. В результате экспедиционных выездов в Бетпак-Дале выявлены местообитания 9 видов ДСКР, среди которых *Elytrigia repens*, *Leymus angustus* выступают в качестве доминантов растительных сообществ. В Западном мелкосопочнике число видов ДСКР достигает 28, из них - 14 видов являются доминантами. На территории Улытауских гор описано 17 сообществ, в том числе 10 сообществ, в которых доминирующими являются 8 видов сородичей. В Восточном мелкосопочнике обнаружено 14 видов ДСКР, встречающихся в 11 сообществах, в которых 2 вида доминируют: *Festuca valesiaca* в разнотравно-злаковом и *Medicago falcata* в разнотравно-бобовом сообществах. В Каркаралинском массиве описаны 2 сообщества с преобладанием 3 видов ДСКР: разнотравно-злаковое с *Elytrigia repens* и *Festuca valesiaca*, а также разнотравно-злаково-бобовое сообщество с *Trifolium pratense* в качестве доминантов. В восточной части Тургайского флористического района обнаружены 10 видов ДСКР в 3 растительных сообществах.

## ГЕОГРАФИЧЕСКИЕ ЗАКОНОМЕРНОСТИ И ФИТОЦЕНОТИЧЕСКОЕ РАЗНООБРАЗИЕ ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ ЮГО-ВОСТОКА КАЗАХСТАНА

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Оценка пространственного распределения растительности в горах юго-востока Казахстана проводилась в пределах высотных поясов. Растительность горных систем характеризуются высоким фитоценотическим разнообразием, обусловленным геологическими, климатическими и экологическими условиями. Разнообразие местообитаний обуславливает формирование растительных сообществ с участием, а иногда с доминированием диких сородичей культурных растений (ДСКР). В задачу исследований входило также картирование ареалов видов.

Для хребтов Западного Тянь-Шаня, Киргизского Алатау и Сырдарьинского Карагату наиболее высокое флористическое и фитоценотическое разнообразие отмечено в межгорных долинах и поймах рек, где формируется луговая растительность с высоким обилием кормовых (*Elytrigia repens*, *E. trichophora*, *Bromopsis inermis*, *Lathyrus pratensis*, *Vicia cracca*, *Dactylis glomerata*, *Trifolium repens*) и ресурсно значимых (*Mentha longifolia*, *Hypericum perforatum*, *Allium* spp) видов. В галерейных лесах сконцентрировано разнообразие диких плодовых растений таких как: яблоня Сиверса, груша Регеля, виды боярышника, абрикос, рябина танышанская; единично встречаются шелковица белая и черемуха-магалебка. Кустарниковые заросли образуют облепиха, виды шиповника, ежевика.

В горах Тянь-Шаня ДСКР зерновых культур (*Taeniamatherum crinitum*, *Aegilops cylindrica*, *Bromus macrostachys*, *B. japonicus*, *Hordeum leporinum*) приурочены к сухим остеиненным склонам в низкогорном поясе. В Сырдарьинском Карагату с высоким обилием встречаются популяции эгилопса (*Aegilops cylindrica*, *A. triuncialis*) в составе эфемероидно-злаково-каратавскополынных сообществ, травяном ярусе кленово-ясеневых редколесий.

Популяции миндаля и сливы (алычи) распространены в древесно-кустарниковых зарослях Западного Тянь-Шаня, занимают небольшие площади; в Сырдарьинском Карагату на выходах скальных пород в составе кустарниковых сообществ доминируют миндаль колючайший, вишня красноплодная, эфедра хвощевая. Редколесья фисташки (*Pistacia vera*) встречаются по сухим склонам юго-восточной и юго-западной экспозиции в низкогорьях Западного Тянь-Шаня, самое северное местообитание вида обнаружено на западе Киргизского Алатау.

Основное разнообразие ДСКР в Туркестанском флористическом районе сосредоточено в долине реки Сырдарья, где закономерности распределения фитоценозов определяются водным режимом, засолением и гранулометрическим составом почв. В многоярусных тугайных сообществах встречаются кормовые виды злаков (*Leymus multicaulis*, *L. angustus*, *Elytrigia repens*), жантак (*Alhagi pseudalhagi*). Субдоминантом травяного яруса часто выступает солодка голая (*Glycyrrhiza glabra*). Широко распространен тростник. В тугаях с доминированием туранги субдоминантом древесного яруса нередко является лох остролодный (*Eleagnus oxycarpa*). В песчаных и глинистых пустынях левобережья Сырдарьи преобладающая часть ДСКР относится к кормовым растениям (*Haloxylon persicum*, *H. aphyllum*, *Carex pachystylis*, *C. physodes*, *Salsola orientalis*, *Stipa hohenackeriana*), которые являются доминантами и субдоминантами растительных сообществ.

## ДИКИЕ СОРОДИЧИ КУЛЬТУРНЫХ РАСТЕНИЙ ВО ФЛОРЕ ОХРАНЯЕМЫХ ТЕРРИТОРИЙ ЮЖНОГО КАЗАХСТАНА

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Актуальной проблемой не только настоящего, но и будущего является сохранение баланса между необходимостью обеспечения человеческого благосостояния и сохранением биологического разнообразия. Решение проблемы восполнимости природных растительных ресурсов является необходимым условием сохранения генофонда Республики. В этом отношении для Казахстана наиболее приоритетной группой являются злаки (Ситпаева, 2006; 2010).

В РГП «Институт ботаники и фитоинтродукции» с 2013 г. реализуется программа «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации Продовольственной программы» (2013 – 2015), направленная на изучение и сохранение генетических ресурсов суверенного государства. Выполнение программы предусматривает не только поиск конкретных мест произрастания видов диких сородичей культурных растений (ДСКР), но и выявление репрезентативных территорий их сохранения в естественных местообитаниях.

Сохранение *in-situ* является наиболее предпочтительным вариантом для оптимального сохранения генофонда ДСКР, т.к. эволюция видов происходит в биоценозах, то их сохранность в охраняемых биоценозах имеет наибольшую надежность, гарантируя безопасность генофондов, их эффективную поддержку и доступность для использования.

К числу основных объектов, в которых предполагается сохранение компонентов биологического разнообразия, относятся особо охраняемые природные территории (ООПТ): заповедники, заказники, национальные парки, памятники природы и т.п.

В рамках программы - в полевой сезон 2013 г. - обследовано 4 флористических района Южного Казахстана: Туркестанский, Киргизский Алатау, Карагатай (Сырдарынский) и Западный Тянь-Шань. Выявлено 185 видов – диких сородичей культурных растений.

Доля участия видов ДСКР во флоре заповедемых территорий (3 ООПТ: два государственных природных заповедника – Аксу-Джабаглы, Карагатайский, а также Сайрамо-Угамский государственный национальный природный парк) неравнозначна. Наибольшее число выявленных сородичей диких растений отмечено для заповедника Аксу-Джабаглы – 102 вида (47,7% от числа видов-сородичей). Наименьшее число – в Карагатайском заповеднике – 33 (15,43%). На долю Сайрам-Угамского ГНПП приходится 67 видов (31,1%).

Число видов, отмеченных только в Карагатайском заповеднике составляет 8 видов, в Сайрам-Угамском ГНПП – 15 видов. Наибольшее число видов (36 видов) отмечено для заповедника Аксу-Джабаглы.

Следует отметить, что часть видов ДСКР встречается на территории нескольких заповедемых территориях. Так, 4 вида охраняются в Карагатайском заповеднике и Сайрам-Угамском ГНПП. 40 видов сосудистых растений встречаются в заповеднике Аксу-Джабаглы и Сайрам-Угамском ГНПП. Общих видов, охраняемых на территории всех трех охраняемых территориях, лишь 8 видов.

Виды ДСКР, включенные в состав республиканской и региональных Красных книг, находятся под охраной на территории различных ООПТ (*Malus sieversii* (Ledeb.) M. Roem., *Pistacia vera* L., *Armeniaca vulgaris* Lam., *Sorbus persica* Hedl., *Vitis vinifera* L. и некоторые другие).

## ВИДОВОЕ РАЗНООБРАЗИЕ ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ РАСТЕНИЙ ЮГА И ЮГА-ВОСТОКА КАЗАХСТАНА

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Генофонд диких сородичей культурных растений является генетическим потенциалом развития сельского хозяйства. Вопрос о сохранении и использовании такого генофонда Казахстана был поставлен уже достаточно давно (Ситпаева, 2006). Реальное решение вопроса началось с 2013 года, когда стала реализовываться научно-техническая программа «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации продовольственной программы».

По результатам экспедиционного обследования в 2013 году территории Южного Казахстана (Каратай, Западный Тянь-Шань, Киргизский Алатау, Туркестанский флористические районы) по поиску диких сородичей культурных растений было выявлено 185 видов ДСКР (30 семейств с 94 родами). Наибольшее число видов содержится в семействах: *Poaceae* Bernhart – 58 видов, *Rosaceae* Juss. – 39, *Fabaceae* Lindl. – 18, *Alliaceae* J. Agardh – 8, *Asteraceae* Dumort. -11, *Lamiaceae* Lindl. – 9. Наибольшее количество видов содержат роды: *Allium* L., *Rosa* L., *Crataegus* L., *Bromus* L.

Распределение диких сородичей по флористическим районам: Западный Тянь-Шань – 103 вида, Каратай – 93, Киргизский хребет – 75; Туркестанский флористический район – 39 видов.

Из числа выделенных диких сородичей 14 видов входят в состав Красных книг различной региональной принадлежности. Из них 9 видов включены в состав Красной книги РК (*Allium microdictyon* Prokh., *Allium pskemense* B. Fedtsch., *Pistacia vera* L., *Allocnusa gypsophiloides* (Regel) Schischk., *Armeniaca vulgaris* Lam., *Malus sieversii* (Ledeb.) M. Roem., *Sorbus persica* Hedl., *Vitis vinifera* L., *Artemisia cina* Berg ex Poljak.).

В Юго-Восточном Казахстане (Южное Прибалхашье и в долине реки Или – Балхаш-Алакульский фл. р-н) выявлено 23 вида древесных растений, почти половина из которых (11 видов или 47,8 % от общего видового разнообразия) являются дикими сородичами культурных растений. Восемь видов (*Elaeagnus oxycarpa* Schlecht, *Hippophae rhamnoides* L., *Berberis iliensis* M. Pop., *Berberis sphaerocarpa* Kar. et Kir., *B. sphaerocarpa* X *B. iliensis*, *Lonicera iliensis* Pojark., *Nitraria sibirica* Pall., *Nitraria schoberi* L.) является автохтонными. Три вида диких сородичей (*Elaeagnus angustifolia* L., *Morus alba* L., *Armeniaca vulgaris* Lam) представляются натурализовавшимися из садов и лесных культур.

Семена всех выше указанных диких сородичей были собраны для сохранения в банке семян длительного хранения.

## ТЕМПЕРАТУРА И ПРОДУКТИВНОСТЬ ФОТОСИНТЕЗА НА АГРОБИОЦЕНОЗАХ САХАРНОЙ СВЕКЛЫ

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От температуры окружающей среды зависят все процессы жизнедеятельности растений. Сумма температур является показателем теплового ресурса, уровнем которого определяется степень роста и развития растений, интенсивность фотосинтеза и продукционного процесса.

В этой связи, в задачи наших исследований входило установление влияния температуры на величину чистой продуктивности фотосинтеза и урожай корней сахарной свеклы. Для решения данной проблемы были заложены опыты, где температурный режим посева имитировался сроками сева: ранний, оптимальный (рекомендуемый) и поздний.

Следует отметить, что сахарная свекла является относительно холодостойкой культурой, оптимум фотосинтеза у нее находится в пределах от 15 до 30<sup>0</sup>С. Однако при посеве в ранние сроки (6 апреля), часто в зоне ее возделывания (юго-восток Казахстана) отмечаются возвраты холода, заморозков, что тормозит процесс фотосинтеза. В таких условиях образуется площадь ассимиляционного аппарата размером (45,9 тыс. м<sup>2</sup>/га), способная функционировать с интенсивностью продуктивности фотосинтеза порядка 4,98 г/м<sup>2</sup> сутки. Такой уровень величины чистой продуктивности фотосинтеза обеспечивает формирование урожайности корнеплодов сахарной свеклы – 538 ц/га.

При посеве сахарной свеклы в оптимальные сроки (III декада апреля) обеспечивается активный рост и развитие растений с первых этапов онтогенеза. В условиях благоприятного сочетания температурного, радиационного режима окружающей среды и водного режима почвы, растения сахарной свеклы за 55-60 дней развиваются большие по размерам фотосинтезирующий аппарат – 49,6 тыс. м<sup>2</sup>/га, общую надземную биомассу (ботву), работающую активно и продуктивно – 5,18 г/м<sup>2</sup> сутки, что способствует образованию наивысшего по опыту урожай корнеплодов сахарной свеклы – 600 ц/га.

Вместе с тем, сахарная свекла, как ни одна культура орошаемого земледелия, трудно адаптируется к воздействиям высших температур весенне-летнего периода при поздних сроках посева (6 мая). Доказательством этому служит образование площади листового аппарата ограниченных размеров – 41,6 тыс. м<sup>2</sup>/га. Относительно небольшой размер фотосинтезирующего аппарата на поздних сроках посева сахарной свеклы обусловлен также короткими периодами их роста и вегетирования. В эти сроки посева в 1 периода (посев – 15 июня) рост сахарной свеклы искусственно сокращается, что отражается на суммарной площади листовой поверхности и, соответственно, продуктивности фотосинтеза.

В поздние сроки посева высокие температуры окружающей среды, сопровождающиеся воздушной и почвенной засухой, отрицательно влияют не только на размер листа, но и способствуют снижению продуктивности фотосинтеза до 4,70 г/м<sup>2</sup> сутки, тормозящие рост, но ускоряющие развитие растений. При таких температурных условиях окружающей среды на поздних сроках посева сахарной свеклы формируется урожай корней до 383 ц/га.

Таким образом, только при оптимальном сроке посева сахарной свеклы можно без дополнительных материальных и трудовых затрат повысить продуктивность фотосинтеза на 0,20 г/м<sup>2</sup> в сутки по сравнению с ранним и на 0,48 г/м<sup>2</sup> сутки - с поздним сроками посева и получить дополнительную урожайность корнеплодов на 62 и 217 ц/га, соответственно.

## СПОСОБЫ КРИОКОНСЕРВАЦИИ ПЫЛЬНИКОВ И ПЫЛЬЦЕВЫХ ЗЕРЕН РИСА

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Эффективным путем повышения урожайности и качества сельскохозяйственных культур, в том числе риса, является селекция. Для создания новых сортов в первую очередь необходимо надежно сохранять существующие коллекции растений. На ряду с традиционными способами сохранения генетического материала в мировой практике используют методы криоконсервации в жидким азоте ( $-196^{\circ}\text{C}$ ). Культура пыльников и пыльцы *in vitro* представляет интерес как резервный способ размножения, поскольку в результате переключения программы развития с гаметофитного пути на спорофитный возникает возможность получения растения-регенеранта (Батыгина Т.Б. 1994). При работе с культурой пыльников следует учитывать, что растения-регенеранты, происходящие из микроспор гетерозиготных гибридов, являются непосредственными кандидатами в сорта (Бобков С.В. 2007). Пыльца, хранящаяся в банках гермоплазмы, может быть использована в исследованиях по биотехнологии, а также в селекционных программах (AlbaE. и др. 2000). Имеются сведения о криосохранении жизнеспособной пыльцы сахарной свеклы, картофеля, яблони и вишни (ChangY. и др. 1999, PanellaL. и др. 2009, Сафина Г.Ф. 2005, Манжулин А.В. 1986). Целью настоящих исследований являлось изучение условий криосохранения пыльников и пыльцевых зерен риса.

Объектами исследований являлись сорта – Анаит, Баканас, Баракат, Виолетта, Лидер, Мадина и Маржан. Пыльцевые зерна перед замораживанием подсушивали в течение 1 часа над силикагелем, криоконсервацию проводили прямым погружением в жидкий азот. Для криоконсервации пыльников применяли метод витрификации с 0,3М сахарозой (NiinoT. и др. 1992) и криопротекторами PVS2 или 50% глицерина + 50% глюкозы в жидкой среде МС. Пыльники размораживали на водяной бане ( $20^{\circ}\text{C}$ ) в течение 1 мин, пыльцевые зерна – при комнатной температуре 60 мин. Жизнеспособность пыльников и пыльцевых зерен определяли окрашиванием ацетокармином в глицерине (Барыкина Р.П. и др. 2004), а fertильность пыльцевых зерен – опылением произвольно выбранных генотипов.

Результаты исследования показали, что жизнеспособность незамороженных пыльцевых зерен риса не изменялась до и после высушивания и составила от 92,89-100%. После криоконсервации при естественной влажности пыльцевые зерна не выживали, жизнеспособность же высушенных пыльцевых зерен была высокой и составила 92,27-100%. Завязываемость семян после опыления незамороженной пыльцой была 30,1%, а криозамороженной – 15,0%. Выявлены отличия в выживаемости пыльников после криоконсервации в зависимости от примененного криопротектора и генотипа. При криосохранении с криопротектором – 50% глюкозы + 50% глицерин в среде МС жизнеспособность составила 91,48-98,54%, а с PVS2 – 75,46-95,23%. При использовании криопротектора PVS2 наблюдался плазмолиз у сортов Баканас, Виолетта, Лидер, Мадина и Маржан.

Таким образом, из вышеизложенного следует, что оптимальным способом криосохранения пыльцевых зерен риса является подсушивание в течение 1 часа над силикагелем с прямым погружением в жидкий азот. Для криоконсервации пыльников – витрификация с 0,3М сахарозой с криопротектором 50% глицерин + 50% глюкозы в жидкой среде МС.

## ИСПОЛЬЗОВАНИЕ СОВРЕМЕННЫХ ВОЗМОЖНОСТЕЙ БИОТЕХНОЛОГИИ ПРИ ИЗУЧЕНИИ ФОТОСЕНСИБИЛИЗИРУЮЩИХ СВОЙСТВ РАСТЕНИЙ

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Использование методов биотехнологии существенно способствует решению ряда практически значимых задач современной радиобиологии. Новые подходы в изучении растений, которые включают и генетические методы, не только значительно сокращают объемы селекционного материала, но и способствуют модернизации процесса отбора генотипов с желаемыми биохимическими свойствами.

Представители рода *Heracleum* L., как одного из крупнейших родов семейства *Apiaceae*, сегодня широко распространены на территории Евразии и Северной Америки, образуя несколько центров видового разнообразия: Восточно-азиатский, Кавказкий и Южноевропейский.

Наибольшей фотосенсибилизирующей активностью обладают виды – *H. sosnowskyi* Manden., *H. mantegazzianum* Somm. et Levier., *H. lehmannianum* Bunge. Фотосенсибилизирующие вещества данных видов представлены фурукумаринами, которые и обуславливают фотодинамическую активность растений (сок растений), которая коррелируется с интенсивностью и длительностью облучения световым потоком.

Рассмотрены особенности распространения видов рода *Heracleum* L. в пределах естественного и вторичного ареалов в настоящее время, их таксономические и экологобиологические особенности, проведено полное ботаническое исследование роста, развития и жизненного цикла растений в физико-географических условиях центральной Украины.

При помощи RAPD, ISSR – праймеров изучена генетическая изменчивость борщевиков из популяций различных географических зон. Отмечен высокий уровень полиморфности изучаемых видов, произрастающих в географически удаленных друг от друга участках. Детектированы уникальные фрагменты, характерные только для определенных борщевиков, произрастающих в пределах одного географического участка, но в разных зонах, отличающихся степенью антропогенного загрязнения. Дальнейшие исследования по изучению фотодинамически активных соединений видов рода *Heracleum* L. планируются с использованием возможностей современной биотехнологии.

## **Секция 2.**

### **Генетика, селекция и фитопатология растений**

## **МАРКЕР ОПОСРЕДОВАННАЯ СЕЛЕКЦИЯ РАСТЕНИЙ**

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Стремительное развитие методов молекулярной генетики последних десятилетий (включая технологии секвенирования и ПЦР анализа) в селекции дало начало развитию нового подхода к отбору перспективных генотипов. Этот подход в англоязычной научной литературе принято определять, как Marker assisted selection (MAS). Для этого термина еще нет устоявшегося русского эквивалента, но один из распространенных вариантов перевода звучит как Маркер - опосредованная селекция (МОС). Маркер - опосредованная селекция - это метод селекции, при котором отбор нужных признаков и индивидуумов ведется не по морфотипу организма, но непосредственно по генотипу. Принцип МОС, выраженный вышеупомянутым определением, достаточно прост: Если известно местоположение гена, влияющего на проявление того или иного хозяйственного признака, то следить за таким признаком можно не по его собственному фенотипическому проявлению, а по наследованию контролирующего его гена, по наличию нужного аллеля в селекционном материале. Такой отбор особенно эффективен при работе с признаками, контролируемыми генами с не полной пенетрантностью и с количественными признаками, контролируемыми группами генов с достаточно выраженным влиянием каждого гена группы на проявление признака. Работы в области МОС селекции всегда ведутся в тесном взаимодействии молекулярных генетиков и селекционеров. При этом здесь имеет место четкое разделение труда: Генетики выясняют генетический контроль интересуемого признака, ищут, картируют и аннотируют гены, разрабатывают генетические маркеры для целевых аллелей таких генов. Селекционеры применяют разработанные генетиками маркеры и интегрируют их в классические схемы селекции с тем, чтобы оптимизировать отбор. Методы МОС селекции постоянно развиваются и уже сейчас имеются новые сорта растений, созданные с применением таких подходов. Однако, следует отметить, что наиболее эффективно методы МОС работают при отборе по признакам имеющим моногенный контроль, и очень мало практических примеров, когда удается создать маркеры для количественных признаков, хотя работы в области картирования так называемых QTL в мире велись и ведутся достаточно интенсивно. Особенно, на наш взгляд, перспективно использование подходов МОС при создании сортов растений с измененными биохимическими свойствами, которые практически невозможно создать методами классической селекции. В первую очередь это касается сельскохозяйственных видов, имеющих полиплоидную природу. Также методы МОС имеют большое прикладное значение в селекции плодовых растений, где в силу длительного онтогенеза древесных классическая селекция занимает многие годы. Применение здесь методов МОС позволяет осуществлять отбор уже на самых ранних этапах селекции, экономить площади селекционных питомников и время селекционера. Вместе с преимуществами, методы МОС имеют и определенные недостатки, главный из которых – высокая стоимость проведения молекулярно-генетических оценок.

**ИСПОЛЬЗОВАНИЕ SNP ГЕНОТИПИРОВАНИЯ В ГЕНЕТИКЕ  
И СЕЛЕКЦИИ ЗЕРНОВЫХ КУЛЬТУР**

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Одним из современных направлений в геномике зерновых культур является широкое применение методов SNP-генотипирования. Массовое использование SNP-маркеров обусловлено созданием ДНК-анализаторов второго и третьего поколения, позволяющих увеличить количество используемых ДНК-маркеров и скорость эксперимента, и значительно уменьшить ценовые затраты на единицу полученной информации. Одним из примеров таких революционных разработок является 90 тысячный SNP-чип по технологии Infinium от компании Illumina Ltd для геномов гексаплоидной пшеницы. Данный чип был разработан компанией Illumina на основе исследований международного консорциума по идентификации информативных SNP-маркеров геномов пшеницы. Разработка данного чипа уже позволила генотипировать тысячи образцов пшеницы в геномных центрах Америки, Австралии и Европы. В число изученных образцов по данному чипу входит 90 сортов яровой пшеницы Казахстана, зарегистрированных Государственной комиссией по сортоиспытанию Республики Казахстан. В результате нами идентифицировано более 35 тысяч полиморфных SNP-маркеров для казахстанских сортов пшеницы и изучено генетическое родство для 90 анализируемых сортов. Одновременно, в 2012-2013 годах те же изучаемые сорта выращивались в полевых условиях в селекционных учреждениях трех регионов Казахстана – Костанайской, Карагандинской, и Кызылординской областях. Весь экспериментальный материал был изучен по 20 хозяйственно-ценным признакам пшеницы. Таким образом, полученные лабораторные и полевые данные открывают широкие возможности по развитию геномной селекции пшеницы в Казахстане. Аналогичные исследования с меньшим количеством SNP-маркеров нами были осуществлены для 96 сортов и линий ярового ячменя и 96 сортов и линий риса. Другим примером широкого применения SNP-генотипирования является технология KASPar (компания LGC Genomics, Великобритания), базирующаяся на использовании флюоресцентных сканеров, что эlimинирует необходимость использования электрофореза и меченых праймеров. Данный аллель-специфичный анализ характеризуется высокой точностью эксперимента, высокой пропускной способностью, и сравнительно низкими финансовыми затратами на единицу полученной информации. Используя технологию KASPar, нами была изучена коллекция 96 сортов яровой пшеницы Казахстана, включая ранее упомянутые 90 сортов, по специфическим генам и маркерам *Vrn*, *Ppd*, *Rht*, и 1RS:1BL (маркер пшенично-ржанной транслокации). В результате установлено аллельное состояние по всем изученным генам и маркерам яровой пшеницы. Полученные результаты используются для поиска доноров устойчивых генотипов к стрессовым факторам среды и изучения особенностей взаимодействия генотип x окружающая среда.

Работа выполнена в рамках гранта Европейской 7 рамочной программы FP7-KBVE-2011-5, проект №289842 ADAPTAWHEAT; грантов 0049/ГФ и 0084/ГФ-2 по бюджетной программе Министерства образования и науки Республики Казахстан 101 «Грантовое финансирование научных исследований» на 2012-2014 гг.

**ГЕНЕТИЧЕСКОЕ И ФЕНОТИПИЧЕСКОЕ РАЗНООБРАЗИЕ  
КОЛЛЕКЦИИ ПШЕНИЦЫ И ЯЧМЕНЯ КАЗАХСТАНА**

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Мягкая пшеница (*Triticum aestivum* L.) и ячмень (*Hordeum spontaneum* L.) – являются основными зерновыми культурами во многих странах мира, в т.ч. в Казахстане.

Для идентификации, создания, паспортизации и эффективного использования генетических ресурсов необходимо изучение уровня генетического разнообразия в изучаемых коллекциях. Информативные ДНК-маркеры являются эффективным дополнением к используемым ранее морфологическим и биохимическим дескрипторам, позволяют идентифицировать сорта, ценные генотипы даже на ранних этапах селекции, в т.ч. молекулярной селекции; их применение позволяет идентифицировать и картировать новые гены и QTL важных признаков, ассоциированных с продуктивностью, устойчивостью к абиотическим и биотическим факторам среды, качеством зерна.

Изучено генетическое разнообразие 92 сортов яровой мягкой пшеницы, допущенных к производственному использованию в Республике Казахстан по 15000 SNP маркерам, 42 микросателлитным ДНК-маркерам, специфическим генам и маркерам *Vrn*, *Ppd*, *Rht*, *Pin*, *Gli-2*, 1RS/1BL (Abugalieva S., Turuspekov, 2010; Абугалиева С. и др. 2012; Turuspekov *et al* 2013a). Коллекция также проанализирована в условиях Севера, Центра и Юга Казахстана в 2012-2013 гг. с целью изучения генетики продуктивности и адаптации в рамках гранта ADAPTAWHEAT 7-ой рамочной Европейской программы (Turuspekov *et al* 2013a).

Коллекция ярового ячменя Казахстана, состоящая из 96 сортов (в т.ч. районированных) и линий, созданных в 5 НИУ МСХ, выращиваемых в условиях Карабалыкской СХОС (Север), Карагандинского НИИРС (Центр), Актюбинской СХОС и Приаральской ОСГР (Запад) КазНИИЗР (Юго-Восток), КазНИИ рисоводства и Красноводопадской СХОС (Юг) в 2009-2011 гг. проанализирована по более 20 показателям, отражающим морфологию, фенологию, продуктивность (Turuspekov *et al* 2010; 2012; 2013b); по 11 показателям качества зерна (Абугалиева А. и др. 2014), по устойчивости к стеблевой ржавчине и темно-буровой пятнистости (Rsaliev *et al* 2014). Этот же материал проскринирован по 384 SNP маркерам, 60 SSR маркерам, специфическим генам твердозерности (*Hin-a* и *Hin-b*) и устойчивости к стеблевой ржавчине (*Rpg-1*).

В результате анализа осуществлено генотипирование сортов пшеницы и ячменя госреестра РК, подсчитаны генетические расстояния между сортами и построены филогенетические деревья, демонстрирующие кластеризацию сортов Казахстана на основе изученных ДНК-маркеров; создать индивидуальные генетические паспорта, основанные на использовании информативных ДНК-маркеров. Полученные данные использованы для ассоциативного картирования генов продуктивности, качества и устойчивости к болезням. В соавторстве с селекционерами НИУ МСХ РК созданы и переданы на Госсортиспытание сорта яровой пшеницы (Премьера, 2011 г.), ярового и озимого ячменя (Тлек – районирован в ЮКО в 2009 г.; Красноводопад-100, 2011 г.; Казыгурт, 2013 г.; Шахристан, 2013 г.).

Работа выполнена в рамках проектов, осуществляемых в лаборатории молекулярной генетики ИББР, № 0327 и № 0329 Научно-технической Программы О.0492 на 2009-2011 гг.; № 0049 и № 0518 по бюджетной программе 120 «Грантовое финансирование научных исследований» на 2012-2014 гг., финансируемых по линии Министерства образования и науки Республики Казахстан, а также в рамках гранта ADAPTAWHEAT 7-ой рамочной Европейской программы.

**Ключевой**

**СЕЛЕКЦИОННЫЕ ДОСТИЖЕНИЯ КАЗАХСТАНА ПО КАРТОФЕЛЮ  
И ОВОЩЕБАХЧЕВЫМ КУЛЬТУРАМ**

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Казахский научно-исследовательский институт картофелеводства и овощеводства - республиканский научный центр, координирует деятельность 15 научных учреждений по картофелеводству, овощеводству и бахчеводству. Основная цель - научное обеспечение данных отраслей. Приоритетное направление КазНИИКО - селекция и семеноводство.

Селекция ведется по 25 видам культур: картофель, лук репчатый, лук шалот, чеснок, томат (открытый и защищенный грунт), капуста белокочанная, перец сладкий и острый, баклажан, огурец (открытый и защищенный грунт), тыква, кабачок, морковь, свекла, укроп, редис, зеленые и бобовые овощи, арбуз и дыня. Исследования направлены на создание сортов и гибридов разных групп спелости, с выраженным адаптивными свойствами, устойчивостью к стрессовым факторам внешней среды, широкораспространенным вредоносным заболеваниям, с высокой урожайностью, лучшим биохимическим составом, экологичностью, товарностью, сохраняемостью при длительном хранении (7-9 месяцев), пригодностью к промышленной переработке.

В селекционной работе используется богатый генофонд КазНИИКО: 10750 сортообразцов овощебахчевых растений (из 97 стран) и 1860 - картофеля (35 стран).

Результативность селекционной работы за годы независимости Казахстана увеличилась в 10 раз, значительно расширен видовой состав культур. В 1991г было лишь 12 местных сортов по 8 видам культур, в 2013г - более 120 сортов по 25 видам. Только за последние 3 года (2011-2013 гг) селекционерами КазНИИКО создано 45 новых сортов и гибридов, из них районировано 41. Региональными научными учреждениями республики за годы их деятельности районировано около 10 сортов (в основном - картофель).

В «Государственный реестр селекционных достижений Казахстана» включено 114 сортов и гибридов селекции КазНИИКО, в т.ч.: 35- картофеля, 11 - лука репчатого, 2 - лука шалота, 5 - чеснока, 10 - томата для открытого грунта, 8 - томата тепличного, 6 - огурца, 3 - тыквы, 2 - кабачка, 1- редиса, 2-капусты белокочанной, 1 - укропа, 8 - арбуза, 9 - дыни, 3 - перца сладкого, 2 - перца острого, 2 - моркови, 1 - свеклы столовой, 1 - фасоли овощной, 1 - маша овощного, 1 - сои овощной.

Государственное сортоиспытание проходят более 20 новых сортов и гибридов, в т.ч. первые отечественные сорта баклажана, салата, сельдерея, патиссона, базилика, гороха овощного, огурца тепличного.

Казахстанские сорта картофеля и овощебахчевых культур конкурентоспособны на внутреннем рынке, отличаются высокой продуктивностью, лучшими качественными показателями, устойчивостью к неблагоприятным метеоусловиям (жара, засуха и др.) и вредоносным болезням, пригодностью к длительному хранению и промышленной переработке, занимают от 25 до 100% в «Госреестре». Новые сорта КазНИИКО, благодаря высоким хозяйствственно-ценным признакам, пользуются большим спросом у фермеров и овощеводов-любителей.

Селекционные достижения ученых КазНИИКО обеспечивают сортовую независимость Казахстана. Ускоренное размножение и внедрение в производство новых сортов и гибридов будут способствовать устойчивому развитию при высокой рентабельности картофелеводческой, овощеводческой и бахчеводческой отраслей Казахстана.

**УСТОЙЧИВОСТЬ К ГРИБКОВЫМ ЗАБОЛЕВАНИЯМ У КЕДРОВЫХ СОСЕН  
(*PINUS SIBIRICA DU TOUR* И *PINUS KORAIENSIS SIEBOLD ET ZUCC.*)  
В ГЕОГРАФИЧЕСКИХ КУЛЬТУРАХ НА ЮГЕ КРАСНОЯРСКОГО КРАЯ**

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Создание географических культур (выращивание и сравнительная оценка семенного потомства разного происхождения) является основным методом изучения географической изменчивости разных популяций древесных растений. Одной из проблем искусственного выращивания географических культур является их сохранение и выявление у них инфекционных заболеваний на всех стадиях развития. Оценка устойчивости семенного материала к фитопатогенным нагрузкам является важной задачей для получения здорового устойчивого генофонда, что в свою очередь, является показателем, характеризующим целесообразность выращивания его в различных регионах.

Проведены многолетние исследования роста и сохранности географических культур кедровых сосен разных популяций, созданных в 1983 г. на юге Красноярского края в Ермаковском лесхозе, с целью корректировки их лесосеменного районирования. Изучали фенологию, фитопатологическое состояние географических культур кедра сибирского (*Pinus sibirica Du Tour*) и корейского (*Pinus koraiensis Siebold et Zucc*), которые представлены несколькими климатипами: кедр сибирский – таштагольский (Кемеровская область), шегарский (Томская область) и ермаковский (Красноярский край); кедр корейский – облученский (ЕАО, Еврейская автономная область) и чугуевский (Приморский край).

За период 2005-2012 гг. в географических культурах кедровых сосен зарегистрирована мощная эпифитотия. Фитопатологическое обследование всех климатипов в августе 2013 г. выявило обильное смолотечение на большинстве переболевших деревьев. Ежегодное обследование состояния разных популяций кедра сибирского и корейского показало, что инфекционным заболеваниям в большей степени подвергается потомство кедра сибирского таштагольского климатипа. Показано, что в новых условиях произрастания темп роста кедровых сосен обусловлен не только наследственными особенностями, но и адаптацией их к погодным условиям. После 20-лет средние показатели роста у популяций кедра сибирского почти выровнялись, но устойчивость к грибковым заболеваниям у таштагольского климатипа оставалась пониженной. Массовое поражение деревьев таштагольского климатипа было отмечено в 10- и 26 - летнем возрасте. В меньшей мере поражалась хвоя у кедра сибирского ермаковского и шегарского климатипов. У потомства кедра корейского первые очаговые заболевания были обнаружены после 25-летнего возраста. В условиях довольно влажного климата исследуемого района заражение ассимиляционного аппарата и развитие болезни происходят весной во время таяния снега. Погибшие растения выделяются куртинами рыжеватого цвета из-за отмершей хвои, где впоследствии развиваются плодовые тела гриба (апотеции) и хвоя становится пепельно-серой, сохраняясь на ветвях довольно продолжительное время. Возбудителем усыхания хвои кедра является плодосумчатый гриб *Lophodermella sulcigena* (Link) Höhn. 1917 (Ascomycota), вызывающий заболевание серое шютте сосны. Установлено, что наименьшей устойчивостью к данному заболеванию обладает кедр сибирский таштагольского климатипа (заболевание от 4% до 22%), а наибольшей – кедр корейский чугуевского климатипа – около 1%.

Благодарности: Работа поддержана проектом РФФИ №13-04-01671.

**Ключевой доклад**

**УСПЕХИ И ПРОБЛЕМЫ СЕЛЕКЦИИ МЯГКОЙ ПШЕНИЦЫ НА  
УСТОЙЧИВОСТЬ К ВОЗБУДИТЕЛЮ БУРОЙ РЖАВЧИНЫ В РОССИИ**

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В РФ селекция на устойчивость к бурой ржавчине (возбудитель *Puccinia triticina* Erikss.) проводится более полувека, однако заболевание не теряет своей значимости. В результате тестирования рекомендуемых к районированию в РФ сортов мягкой пшеницы выявлено значимое увеличение числа яровых сортов с ювенильной устойчивостью в 2005 г. по сравнению с 1995 г., и эта тенденция сохраняется в период 2005-2013 гг. (Новожилов и др., 1998; Гультьяева, 2012; Гультьяева и др., 2014). В результате оценки взрослой устойчивости показано, что свыше 40% озимых районированных сортов, включенных в Госреестр с 2005 года, характеризовались высоким или умеренным уровнем полевой устойчивости (развитие болезни до 15%). Для большинства озимых сортов результаты полевых оценок устойчивости к бурой ржавчине, проведенных в условиях Северо-Запада РФ, коррелировали с их характеристикой, представленной в Госсортреестре.

Для обеспечения высокого уровня генетической защиты особую значимость представляет разнообразие по *Lr*-генам. С использованием фитопатологических и молекулярных методов выявлено, что большинство яровых сортов с ювенильной устойчивостью содержат гены *Lr9* и *Lr19*, и они преимущественно сконцентрированы в Поволжье, Западной Сибири и на Урале, где их эффективность утрачена. Несмотря на это, наблюдается ежегодное включение в Госреестр сортов с геном *Lr9* в Западно-Сибирском регионе (Гультьяева, 2012; Гультьяева и др., 2014).

У яровых сортов с ювенильной устойчивостью Белянка, Воевода, Фаворит, Тулайковская 5, Тулайковская 10, Тулайковская 100, Тулайковская 110, Тулайковская золотистая, созданных с участием пырея промежуточного, и озимого сорта Поэма не идентифицировано известных *Lr*-генов, переданных от *Agropyron* sp. (*Lr19*, *Lr24*, *Lr29*). У сорта Челяба 75, в родословной которого имеется «линия-кукушка», полученная с участием *Aegilops speltoides*, показано отсутствие спельтоидосных генов *Lr28*, *Lr35*, *Lr47*, при этом у него выявлен характерный продукт амплификации при использовании маркера 16-S13 гена *Lr66*.

В результате полевых оценок выявлена значимая тенденция возрастания в районировании озимых сортов северокавказской селекции устойчивых в фазе взрослых растений. С использованием ПЦР-маркеров у них не выявлено известных генов возрастной устойчивости (*Lr35*, *Lr37*), при этом показано широкое распространение генов, утративших эффективность (*Lr1*, *Lr3a*, *Lr10*, *Lr34* и др.). Можно предположить, что устойчивость этих сортов во взрослых фазах развития обеспечивается определенными сочетаниями малоэффективных генов, однако отсутствие молекулярных маркеров для идентификации большинства *Lr*-генов, не позволяет определенно сказать, какие их комбинации, определяют полевую устойчивость данных сортов.

В результате анализа российских сортов пшеницы выявлены значительные успехи и ряд проблем в селекции на устойчивость к бурой ржавчине в России за последние десятилетие. Проведенный анализ наглядно демонстрирует значимость генетических скринингов *Lr*-генов у используемых доноров и новых сортов пшеницы и необходимость использовать данную информацию при районировании.

**СЕЛЕКЦИОННЫЕ И ГЕНЕТИЧЕСКИЕ ОСОБЕННОСТИ СОРТОВ  
МЯГКОЙ ПШЕНИЦЫ КЫРГЫЗСТАНА**

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В настоящее время в Кыргызской Республике возделываются 48 сортов мягкой пшеницы как кыргызской селекции, так и инорайонные сорта. Занимаемая площадь сортов киргизской селекции составляет около 60%. Эти сорта как факультативного типа, а также сорта озимого типа: Интенсивная, Адыр, Кыял, Азибаш, Зубков, Джамин, Тилек. Потенциальная урожайность созданных сортов в фермерских и крестьянских хозяйствах составляет от 3,0 до 5,0 т/га.

Созданные сорта интенсивного типа. Уровень потенциальной их урожайности в два и даже три раза выше фактически достигаемого в производстве. По высокой урожайности выделяются такие сорта озимого типа как Бермет, Кыял, Адыр, Тилек и т.д. Однако среди даже лучших районированных имеются сорта с невысоким и ниже среднего уровнем данного показателя. Отмечена довольно четкая отрицательная зависимость между высотой растения и технологическим качеством зерна. По этой и ряду других причин многие районированные сорта не отвечает требованиям, предъявляемым к сильной пшенице (Фрунзенская 60, Эритроспермум 760, Адыр, Кайрак)

Определенных успехов добились в селекции короткостебельных сортов. Так, районированный сорт мягкой пшеницы Бермет и Тилек характеризуется оптимальной высотой растений и повышенной устойчивостью к ржавчинным болезням. Генетическая основа этих сортов является поэтапное введение генов Rht пшенично-пырейным формам.

В последнее десятилетие кыргызскими селекционерами создано 16 сортов пшеницы, как по Национальной, так и по Международному сотрудничеству (СИММИТ/ИКАРДА и Казахским ИББР).

Созданные сорта по международному сотрудничеству являются в основном факультативными пшеницами и тритикале. По линии СИММИТ-ИКАРДА созданы следующие сорта: Азибаш, Зубков, Джамин, Ханс, Петр, Алеша, Миссим. Совместно с Казахским ИББР создан сорт факультативной пшеницы «Жаным». Этот сорт в 2013 году районирован по Кыргызской Республике. Потенциал урожайности в озимом посеве составляет более 7,0 т/га, а в яровом посеве – более 5,0 тонн с гектара. Отличаются устойчивостью к абиотическим и биотическим факторам среды, а также высокими технологическими качествами.

**СЕЛЕКЦИЯ СОРТОВ РИСА, УСТОЙЧИВЫХ  
К ПИРИКУЛЯРИОЗУ**

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Для населения России крупа риса является ценным продовольственным, диетическим и лечебным продуктом. Основной зоной рисоводства в стране является Краснодарский край. Здесь производится более 80% российского риса. В последние 5–7 лет рисоводство динамично развивается, ежегодно повышая урожайность и сбор риса-сырца. В 2012 г. на Кубани с площади 133,3 тыс. га получен рекордный урожай за все годы выращивания риса – по 7,11 т/га. Это стало возможным за счет внедрения новых высокопродуктивных сортов и совершенствования технологии их возделывания, включая уборку современными роторными комбайнами.

Дальнейшее увеличение производства рисовой крупы сдерживается рядом факторов, одним из которых являются болезни риса, и, прежде всего, пирикуляриоз, распространенный в большинстве рисосеющих стран. Болезнь вызывается несовершенным грибом *Pyricularia oryzae* Cav. Рис восприимчив к пирикуляриозу во все фазы вегетации. Болезнь поражает все надземные органы растения – листья, узлы стеблей, метелку. Это самое распространенное и опасное заболевание риса в мире.

Потери урожая по разным оценкам составляют в обычные годы от 5 до 25 %, а в годы эпифитотийного развития болезни – до 60 % и даже до 100 %. Вредоносность значительно увеличивается за счет резкого снижения качества зерна, получаемого от пораженных растений. Практически во всех рисосеющих странах наблюдаются большие недоборы урожая риса от пирикуляриоза. Наиболее эффективным способом борьбы с этим заболеванием является создание и внедрение устойчивых сортов.

Целенаправленная работа по селекции риса на иммунитет к этой очень вредоносной болезни у нас в России начата в 1982 г.

Многолетние исследования фитопатологов по изучению структуры популяции гриба *P. oryzae* показали, что расы патогена различаются набором генов вирулентности. Установлено, что в европейской части страны наиболее эффективными являются гены устойчивости *Pi-z*, *Pi-zt*, *Pi-ta2*, *Pi-b*.

На протяжении 30 лет во ВНИИ риса активно ведется селекционная работа по созданию сортов, устойчивых к пирикуляриозу. Лучшие из них внесены в Государственный реестр и допущены к использованию: Славянец (1991), Павловский (1995), Спринт (1996), Курчанка (1997), Лидер (1999), Виола (2001), Снежинка (2003), Виолетта (2007), Атлант (2007), Кумир (2009), Южный (2009), Гамма (2010).

Все эти сорта относятся к числу устойчивых к пирикуляриозу и не требуют химических средств защиты от этой болезни. Из них выделяется сорт Лидер, который внесен в Госреестр в России и в Казахстане, где на засоленных землях при получении всходов из-под слоя воды, он показывает отличные результаты по урожайности и качеству зерна.

Дальнейшим развитием работ по созданию сортов риса, устойчивых к пирикуляриозу, являются совместные исследования биотехнологов и селекционеров ВНИИ риса по пирамидированию генов устойчивости в отечественных сортах.

**МОЛЕКУЛЯРНОЕ ГЕНОТИПИРОВАНИЕ ВИДОВ AEGILOPS L.,  
ПРОИЗРАСТАЮЩИХ В ТАДЖИКИСТАНЕ**

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В настоящее время в области сравнительной генетики пшеницы и их диких сородичей интенсивно проводятся эксперименты с использованием молекулярных маркеров. В результате таких исследований либо строятся практически лишенные функциональных генов карты, либо проводится «сравнительная привязка» того или иного гена разных видов к одним же молекулярным маркерам.

По мнению ряда авторов, при «создании» мягкой пшеницы «природа использовала генетический потенциал рода *Aegilops* L.». Изучение практически всех видов рода *Aegilops* L., развивалось и развивается периодически – только в связи с их высокой устойчивостью к ряду грибных болезней и некоторым насекомым-вредителям. Что касается исследования этого рода с применением новейших молекулярных методов, нельзя говорить о достижениях, поскольку до сих пор молекулярный анализ затрагивал лишь некоторые области генома или отдельных видов этих родов.

В середине 80-х годов XX века открытие полимеразной цепной реакции (ПЦР) стало важнейшим фактором в развитии молекулярной генетики. Современные методы, основанные на применении молекулярных маркеров, позволяют провести изучение организации и изменчивости генома на уровне полиморфизма ДНК. Применение различных типов молекулярных маркеров становится все более обычным при генетических исследованиях и установлении генетического сходства разных видов живых организмов. Разные типы молекулярных маркеров имеют разную разрешающую способность, определенные маркеры используются для решения определенных вопросов.

Для достижения поставленных задач использовали RAPD и SSR молекулярные маркеры для геномного анализа видов рода *Aegilops* L., на основе анализа ПЦР-продуктов. Определили внутривидовой полиморфизм 4-х видов *Aegilops* L., по RAPD маркерам, а также провели анализ при использовании микросателлитов (SSR маркеров) для выявления филогенетических связей и полиморфизма между различными видами родами *Aegilops* L.. На основе полученных данных была построена дендрограмма и определена степень генетического сходства и различия на основе использования SSR и RAPD маркеров.

Использование данных маркеров при генотипировании диких видов *Aegilops* L., выявило определенную закономерность. Так, RAPD-маркеры позволяют выявить межвидовые различия в полиморфизме ДНК. В то же время как SSR маркеры были информативны для установления внутривидовых различий. Результаты могут быть использованы для паспортизации видов, сортов, линий, что необходимо учитывать в селекционных работах. В докладе будут подробно анализированы полученные результаты по молекулярным маркерам видов рода *Aegilops* L., произрастающих в Таджикистане.

**МАРКЕРНАЯ СЕЛЕКЦИЯ НА УСТОЙЧИВОСТЬ К БУРОЙ  
РЖАВЧИНЕ ПШЕНИЦЫ**

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Регион Центральной Азии и Казахстана является одним из важнейших мировых производителей пшеницы, которая выращивается на площади 15 млн. га. На этой территории в последние годы получила распространение бурая ржавчина пшеницы *Russinia recondita* f. sp. *tritici*, которая наносит серьезный экономический ущерб, снижая на 30-50% урожай и качество зерна. Особая опасность бурой ржавчины обусловлена способностью патогена к мутации и быстрой смене генераций, что ускоряет расообразовательный процесс. Методы ДНК-генотипирования и селекции при помощи молекулярных маркеров (*Marker-Assisted Selection — MAS*) позволяют ускорить перенос хозяйствственно ценных генов и локусов количественных признаков в процессе селекции и обеспечить создание новых сортов с комплексом полезных свойств. Генетико-селекционное и фитопатологическое изучение образцов пшеницы показало, что наиболее устойчивыми к бурой ржавчине являлись белорусские перспективные линии КСИ 2/12, КСИ 8/12 и КСИ 21/12. Из районированных сортов высоким уровнем устойчивости к ржавчине характеризовались казахстанские сорта Ырым, Самад, Женис, а также белорусские сорта Виза, Рассвет, Ростань, Сабина и Тома. С использованием молекулярных маркеров в селекционном материале пшеницы идентифицированы гены устойчивости к бурой ржавчине. При использовании для ПЦР праймеров Lr29F/R18 установлено, что носителями гена *Lr29* являются 2 линии пшеницы казахстанской селекции (1026 и 1207). При использовании праймеров к локусу F1.2245/Lr10-6/r2 формировались ампликоны размером 300 п.н. Фрагменты, указывающие на присутствие гена *Lr10*, выявлены в 3 казахстанских гибридах: Babax 1 x 133-3-2006/2, Babax1x137.2006/3 и BEZOSTAYA1/6/BHR\*5/AGA...TRK13/4/PEHLIVAN/5/F6038W12-1. В результате ПЦР с маркером Sr39#50R/F, идентифицировано 35 образцов (20 белорусских сортов и линий КСИ, 2 казахстанских сорта, 6 турецких и 7 российских линий), являющихся носителями комплекса генов *Lr35/Sr39*. При использовании STS маркера Sr24#12 фрагменты ДНК, характерные для носителей комплекса генов *Lr24/Sr24*, выявлены у сортов Сударыня и Eagle. Молекулярный скрининг 26 образцов пшеницы белорусской селекции на наличие гена *Lr26*, позволил идентифицировать искомый ген у 2-х белорусских линий КСИ 4/12 и КСИ 5/12. С использованием молекулярного маркера Iag95 идентифицировано 12 образцов пшеницы с транслокацией 1BL/1RS, и комплексом генов устойчивости *Lr26/Sr3/Yr9/Pm8*. В селекционных питомниках младшего звена изучаются гибриды с участием этих линий. Для ускорения селекционного процесса нами будет продолжен отбор устойчивых к болезням линий с использованием молекулярных маркеров, сопряженных с этим признаком. Результаты нашей работы создают возможность для перехода селекционного процесса в Казахстане на новый научный уровень за счет применения молекулярно-генетических методов.

Работа выполнена при финансовой поддержке МОН Республики Казахстан в рамках проекта грантового финансирования № 0053.

**ХАРАКТЕРИСТИКА ЗАРУБЕЖНЫХ СОРТОВ ПШЕНИЦЫ  
С SR-ГЕНАМИ ПО УСТОЙЧИВОСТИ К СТЕБЛЕВОЙ РЖАВЧИНЕ  
В КАЗАХСТАНЕ**

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В последние годы во многих зерносеющих странах мира, в том числе в Казахстане обострилась фитосанитарная обстановка в связи с появлением и распространением новых вирулентных патотипов возбудителя *Russinia graminis* f.sp. *tritici*. Общепризнанно, что для снижения темпов эволюции патогенов наиболее оправдано использование сортов с различными генами устойчивости, защищенных различными механизмами иммунитета. При этом многие исследователи с помощью традиционных методов селекции и молекулярно-генетических маркеров создали сорта пшеницы с генетическим контролем устойчивости к болезни. Однако успех селекционного использования генов устойчивости зависит от изученности носителей этих генов. В связи с этим, в полевых условиях на искусственном инфекционном фоне гриба нами изучены коллекционные и новые зарубежные сорта яровой пшеницы с Sr-генами устойчивости к стеблевой ржавчине.

В результате исследований источники устойчивости, обладающие несколькими генами, которые представляют сорта пшеницы из США, Мексики и Австралии показали устойчивые типы реакции к популяции патогена в течение всего периода вегетации растений: Line S с генами Sr13, 17; W2402 – Sr7b, 9b; Renown – Sr7b, 17; Gatcher – Sr2, 5, 6, 8a, 12; Comb X – Sr5, 7b, 9b; Cook – Sr5, 6, 8a, 36; Banks – Sr5, 8a, 9b, 12; Egret – Sr5, 8a, 9b, 12; Mendos – Sr11, 17, 36. Известно, что гены устойчивости Sr5, Sr6, Sr7a, Sr8a, Sr9b, Sr12 и Sr23 имеющиеся в исследуемых сортах, в условиях Казахстана не являются эффективными, так как они по отдельности не обеспечивают наиболее прочную устойчивость к стеблевой ржавчине. Данный случай контроля генов устойчивости в сортах со слабой эффективностью, по-видимому, является результатом кумулятивного эффекта их взаимодействия. Кумулятивный эффект проявляется в том, что два или несколько генов в совокупности обеспечивают более высокую устойчивость, чем каждый из генов по отдельности. Следовательно, благодаря наличию нескольких генов устойчивости, отмеченные сорта эффективно защищаются от местной популяции стеблевой ржавчины. В ходе экспериментов также выявлены сорта пшеницы дальнего зарубежья (Kite носитель гена Sr26, Timson – Sr36, McMurchy – Sr6, Barleta – Sr8), обладающие высокой устойчивостью к стеблевой ржавчине. Необходимо отметить, что высокая устойчивость сортов McMurchy и Barleta не может контролироваться только единичными генами (Sr6 и Sr8), поскольку эти сорта поражаются стеблевой ржавчиной значительно слабее, чем изогенные линии ISr6-Ra и ISr8-Ra. Возможно, это связано с тем, что в геноме этих сортов имеются 1 или 2 не идентифицированных дополнительных гена, обеспечивающих защиту от болезни в фазе взрослых растений.

Высоким типом восприимчивости (3 и 4 балла) обладали сорта Norka (Sr15), Trident (Sr38), Arnautka (Sr9d) и Kubanka (Sr9g), при этом развитые пустуллы гриба в период налива зерна занимали 30-50 % площади листьев и стеблей. Причиной восприимчивости указанных источников, возможно, является одиночные неэффективные гены устойчивости в генотипе.

Таким образом, результаты опыта подтверждают, что для предотвращения болезни на производственных посевах необходимо создавать и внедрять новые сорта пшеницы с несколькими генами устойчивости к болезни.

**ФИТОПАТОГЕННЫЕ ГРИБЫ ФИЛЛОСФЕРЫ ХВОЙНЫХ В СРЕДНЕЙ СИБИРИ И ИХ РОЛЬ В СИСТЕМЕ «РАСТЕНИЕ-ПАТОГЕН»**

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Наши исследования посвящены изучению видового состава грибов, вызывающих заболевания хвои на территории лесных питомников, искусственных насаждений и естественных лесах Средней Сибири. Рассматривая дерево, как систему «эпифитные микроорганизмы – растение-хозяин – патоген» наше внимание сконцентрировалось на сопряженном развитии этих компонентов через взаимодействие фитопатогенов, банальных эпифитов и летучих соединений растений.

Идентифицирован 21 вид грибов, вызывающих 19 заболеваний хвои на территории Средней Сибири: *Lophodermium pinastri* (Schard.) Chev., *L. seditosum* Mint. Stal., *L. abietis Rostr.*, *L. macrosporum* Hart. (=*Lirula macrospora* (R. Hartig) Darker), *L. juniperinum* Fr. de Not, *Hypoderella laricis* Tubeuf, *Lophodermella sulcigena* (Link) Tubeuf (=*Hypoderella sulcigena* (Rostr.) Tub.), *Cyclaneusma minus* (Butin) Di Cosmo, Peredo & Minter, *Phacidium infestans* Karst. *Chrysomyxa abietis* Wint., *Ch. ledi* DB., *Melampsorella caryophyllacearum* Chroet., *Coleosporium* sp., *Pucciniastrum* sp. *Melampsora larici-populina* Kleb., *Meria laricis* Vuill., *Rhizosphaera pini* (Corda) Maub, *Pestalotia hartigii* Tubeuf Sacc. Syll. (=*Truncatella hartigii* (Tubeuf) Steyaert), *Sclerophoma pithyophila* (Corda) Hohn. (анаморфа *Sydowia polyspora* (Bref. & Tavel) E. Müll.), *Hendersonia acicola* Munch. et Tub.

Изучен количественный состав и основные группы микроорганизмов, входящих в эпифитный комплекс здоровой и пораженной грибами-патогенами хвои сеянцев и взрослых деревьев в Средней Сибири. Установлено, что здоровая филлосфера каждого вида растения обладает своеобразным эпифитным сообществом. При протекании инфекционного процесса различия нивелируются: эпифитные комплексы имеют близкий микробный состав в количественном и качественном аспектах. Таким образом, эпифитное сообщество может использоваться в качестве индикаторов состояния растения.

На примере *M.caryophyllacearum* показано влияние облигатного паразита на компонентный состав летучих соединений, выделяемых филлосферой. Данный патоген вызывает у пихты ржавчину хвои, образование «ведьминых метел» и раковых ран. За период с мая по сентябрь включительно выявлены 75 соединений в образцах здоровой хвои и 47 в образцах хвои, пораженной ржавчиной. Обнаружены 24 вещества, являющиеся общими как для контрольных, так и для опытных образцов: монотерпены (трициклен, α-пинен, β-пинен, α-фелландрен, β-фелландрен, камfen, 3-карен, о-цимен, лимонен, терпинолен), сесквитерпены (юнипен, кариофиллен, α-кариофиллен, α-лонгипинен, α-химачален, δ-селинен, β-бисаболен), спирты (борнеол, фитол, α-бисаболол, транс-неролидол), эфиры (борнилацетат, геранилацетат) и алкан (эйказан). При поражении ржавчиной наблюдается уменьшение процентного содержания большинства летучих соединений в пробе по сравнению с контролем. Идентифицированы соединения, характерные только для здоровой и только для больной хвои. Среди специфических соединений здоровой хвои преобладал β-мирцен, а у хвои с «ведьминых метел» — биформен.

Выявлены различия в содержании полимерных фенольных соединений (проантоцианидинов) в связанной и свободной формах в здоровых тканях хвои и зараженной *M.caryophyllacearum*. Обнаружено, что хвоя пихты, зараженная ржавчиной, обладает пониженней фитонцидной активностью по отношению к эпифитным микромицетам, но оказывает выраженное бактериостатическое воздействие по отношению к бактериям (включая актиномицеты).

**УСТОЙЧИВОСТЬ СОРТООБРАЗЦОВ ТЕТРАПЛОИДНОГО ВИДА  
*TRITICUM CARTHPLICUM NEVSKI.* (*T.PERSICUMVAV.*) К МУЧНИСТОЙ  
РОСЕ**

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Одним из путей создания устойчивых к болезням и вредителям сортов пшеницы является трансгрессия генов устойчивости от диких видов и сородичей пшеницы в культурные сорта. Одним из источников таких генов является *Triticum carthlicum* Nevski. (=*T. Persicum* Vav.). Исследования Н.И. Вавилова, проведённые в 1912-1913 годах показали, что пшеница, названная им в последствие персидской *Triticum persicum* Vav., абсолютно не поражалась мучнистой росой (*Erysiphe graminis*).

Иммунологический анализ образцов разных видов пшениц проведенный в отделе иммунитета ВИР в 1968-1973 гг. В.И. Кривченко, В.Ф. Дорофеевым, О.Г. Григорьевой и другим также показал, что сортообразцы персидской пшеницы практически не поражались мучнистой росой. Большинство из них было устойчиво к расам 14, 16, 32, 34 и 35.

В связи с этим целью наших исследований было изучение устойчивости сортообразцов тетраплоидного вида пшеницы *T. carthlicum* к мучнистой росе в условиях северной лесостепи Тюменской области для отбора наиболее перспективных форм.

Мониторинг развития болезней на посевах пшеницы в Тюменской области с 1995 по 2012 годы показал, что наибольшее распространение получили септориоз, корневые гнили и мучнистая роса. Пороговое значение вредоносности по мучнистой росе было превышено только в 2000 году (19,0%). В остальные годы процент развития болезни колебался от 0% до 10% в 2006 году, при среднем значении развития болезни 4,7%.

Учет болезни у сортообразцов карталинской пшеницы проводили в полевых опытах 1992-2009 годов в соответствии с общепринятыми методиками. Сложившиеся погодные условия позволили оценить коллекцию карталинской пшеницы наиболее полно. Для биохимического маркирования проводили одномерный электрофорез глиадина в полиакриламидном геле (ПААГ), согласно принятой методике (Bushuk, Zillman, 1978) с модификациями по (Metakovskiy, Novoselskaya, 1991).

Наибольшую устойчивость к мучнистой росе сортообразцы карталинской пшеницы имели в 1995 году - 8,2 балла (Cv=11,9%), и в 2002 году - 8,4 балла (Cv=11,2%). Высокая патогенная нагрузка эпифитотий 2000 и 2006 годов сказалась на полевой устойчивости, которая была снижена до 7,7 - 7,6 баллов, соответственно.

Практически не поражались мучнистой росой образцы: К-36064 (var. *stramineum*) - 8,8 балла (Cv=8,1%); К-13815 (var. *rubiginosum*), К-18621(var. *stramineum*), К-18771 (var. *rubiginosum*) - 8,5 балла; К-13822(var. *stramineum*) – 8,4 балла (Cv=11,5%).

Сравнительный анализ электрофореграмм глиадина индивидуальных зерновок сортообразцов показал, что они различались по количеству и интенсивности компонентов. Сортообразцы с высокой устойчивостью к мучнистой росе имели в спектре почти идентичные компоненты.

Следовательно, при создании устойчивых к мучнистой росе сортов пшеницы возможно использование электрофоретического спектра глиадина в качестве биохимического маркера на ранних этапах селекции.

**Ключевой доклад**

**ИТОГИ И ПЕРСПЕКТИВЫ СЕЛЕКЦИИ ЯЧМЕНЯ НА ЗАСОЛЕННЫХ ПОЧВАХ ПРИАРАЛЬЯ**

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Засоление почв является основной проблемой сельского хозяйства, лимитирующей рост и продуктивность растений во всем мире. Если учесть, что высокое содержание солей в пахотном горизонте почвы (содержание плотного остатка 0,68 – 1,2 %), засушливость климата Кызылординской области являются главными лимитирующими факторами, а наиболее эффективный и экономичный способ снижения их негативных воздействий на культурную растительность – селекционно-генетический, то исследовательские работы по созданию новых резистентных сортов ячменя, сочетающих в себе желаемую комбинацию хозяйственных признаков с высокой адаптивностью к условиям стресса позволит вовлечь в сельскохозяйственную практику новые земли и снизить потери урожая от неблагоприятных климатических условий. Соответствие экологических условий биологическим требованиям генотипа наиболее полно раскрывают его генетически обусловленный потенциал продуктивности, то есть для его максимальной реализации важна адаптация сортов к конкретным агроэкологическим условиям. Одним из примеров такой работы является создание новых солеустойчивых сортов ярового ячменя Сыр Аруы и Инкар, полученные в результате селекционной работы, которая впервые была организована и развернута по полной схеме селекционного процесса на засоленных почвах Кызылординской области. Эти сорта характеризуются высокой продуктивностью (1,5 – 1,9 т/га), формируют дружные всходы, устойчивы к засолению, атмосферной засухе и к поздним весенним заморозкам, а также обладают хорошими качественными показателями зерна кормового направления с содержанием белка выше 15%. Создана рабочая коллекция из 250 образцов с полной хозяйствственно-биологической характеристикой. Ежегодное проведение скрещиваний по топкроссной схеме позволяет создавать новые формы и выявлять донорские свойства привлекаемых в процесс гибридизации перспективных генотипов. В начальных звеньях селекционного процесса ежегодно изучается не менее 3000 линий, проводится жесткий отбор (до 85 %) в полевых и лабораторных условиях, и далее поэтапно изучаются в последующих питомниках. Исследования показали, что признак «содержание белка» является одним из наиболее важных параметров адаптивности к неблагоприятным факторам среды, а наиболее эффективным при создании сортов с высоким качеством зерна ячменя кормового направления является обязательное определение особенностей генетической структуры признака и эколого-географический принцип подбора родительских форм, используемых в гибридизации. Созданы новые ценные формы с высоким содержанием белка, отличившиеся стабильно высокими значениями общей комбинационной способности, являющимися надежными донорами в селекции сортов ячменя кормового направления. Известно, что влияние разных по составу, но выровненных по осмотическому давлению засоляющих компонентов на продуктивность растений одинаково, следовательно, в селекционной и агрохимической работе оценку солеустойчивости растений можно проводить на каком-то одном типе засоления, а не варьировать его состав применительно к разным типам естественного засоления почвы. В связи с этим, возделывание новых солеустойчивых сортов ячменя не ограничивается одним регионом Приаралья и найдут свое применение в других экологически неблагоприятных регионах Казахстана.

**Специальный доклад**

**АКТУАЛЬНЫЕ ПРОБЛЕМЫ КОММЕРЦИАЛИЗАЦИИ  
СЕЛЕКЦИОННЫХ ДОСТИЖЕНИЙ И СБОРА «РОЯЛТИ»**

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Селекция и семеноводство основная наиболее важная и эффективная отрасль аграрной науки и производства.

Для основных зон возделывания пшеницы Республики Казахстан созданы и на сегодня возделываются более 150 сортов, из них Казахстанской селекции (74,3%), характеризующихся различной интенсивностью, скороспелостью, устойчивостью к болезням и климатическим стрессам.

Теперь задача селекционных учреждений Казахстана добиться наиболее полного освоения ими отведенных всех зон при районировании, используя систему патентования и лицензирования, и, в конечном счете, получения «Роялти» от товаропроизводителей за возделывания новых лицензированных сортов и гибридов растений. Во всех развитых государствах эти системы работают весьма эффективно в течение вот уже 50-70 лет. Данный вопрос на сегодня является архиважным не только в растениеводстве и селекции, но в целом в Агропромышленном комплексе.

Для тесного взаимодействия науки и производства необходимо в стране нададить стройную систему менеджмента и маркетинга.

Менеджеры работают по многим направлениям:

- внедрение сортов и гибридов, клонов, линий сельскохозяйственных, лесных и декоративных растений в производство с целью извлечения «РОЯЛТИ» от товаропроизводителей (лицензиаты);
- внедрение новых пород, линий животных, кроссов птиц, насекомых, а также ветеринарных препаратов;
- внедрение патентов по переработке и хранению, а также достижений инженерной науки (новые машины, оборудование, электрические системы, схемы и т.д.);
- менеджеры по внедрению новых агротехнологий (агрономия, защита растения, семеноводство, плодоовоощеводство, виноградарство и их питомниководство);
- распространение новых знаний в других важных отраслях АПК (рыбоводство, мелиорация, водное хозяйство, лесное хозяйство, декоративное ботаническое хозяйство и цветоводство).

Предлагается схемы и механизмы выплаты РОЯЛТИ, а также система элитного семеноводства в новых условиях взаимодействия.

Таким образом, менеджеры совместно с патентообладателями определяют политику между заказчиками и исполнителями.

**ОЦЕНКА ЭФФЕКТИВНОСТИ IRAP-МАРКЕРОВ ДЛЯ  
МОЛЕКУЛЯРНО-ГЕНЕТИЧЕСКОЙ ИДЕНТИФИКАЦИИ СОРТОВ  
МЯГКОЙ ПШЕНИЦЫ**

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В последнее время для генотипирования и идентификации сортов и внутрисортовых форм различных культур широко используются методы геномного фингерпринта – IRAP (*Inter-Retrotransposon Amplified Polymorphism*) и REMAP (*Retrotransposon-Microsatellite Amplification Polymorphism*), основанные на полиморфизме ретротранспозонов – мобильных элементов генома. К основным достоинствам этих методов анализа генома относятся их информативность, способность выявлять полиморфизмы на внутри- и межвидовом уровне и, при этом, относительная простота выполнения, высокая воспроизводимость и экономичность. Это связано с тем, что ретротранспозоны рассеяны по всему геному, включая теломерные и центромерные участки хромосом, кодирующие участки и гетерохроматин. Поскольку последовательности ретротранспозонов могут быть эффективно использованы для выявления внутривидовых генетических различий между линиями, сортами и популяциями, а также для близких видов, например, других злаковых, что чрезвычайно расширяет возможности направленной селекции растений. Методы IRAP и REMAP могут использоваться одновременно как на мягкой пшенице, так и на других видах пшеницы, также ячмене, ржи и овсе.

Целью проводимых исследований был поиск наиболее информативных IRAP - маркеров для выявления генетической оригинальности сортов пшеницы. В качестве объектов исследований использованы семена яровой мягкой пшеницы различных сортов казахстанской и зарубежной селекции. В качестве праймеров были использованы универсальные и видоспецифичные праймеры к LTR ретротранспозонов пшеницы. Для проведения амплификации использовали ПЦР-смесь следующего состава: ДНК 25 нг; Tris HCl – 20 mM (рН 8,8); 2 mM MgSO<sub>4</sub>; 10 mM KCl; 10 mM (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>; 0,5 μM праймеров; 200 μM dNTP, 1 е.а. полимеразы. Оптимизацию условий амплификации по каждому праймеру проводили эмпирически или с помощью программы FastPCR (<http://www.primerdigital.com>).

В результате исследований полиморфизма ДНК 44 сортов мягкой пшеницы с использованием 19 праймеров было получено 217 ампликонов, размер которых варьировал от 100 до 3000 bp.

При использовании универсальных IRAP-праймеров наибольшее количество ампликонов (12) было детектировано у праймера *Sukkula*, при этом количество полиморфных фрагментов составило 83,3%. Видоспецифичные праймеры обладали незначительным уровнем полиморфизма (14,3% - 58,1%). Из этой группы праймеров наиболее эффективным оказался праймер 2109 *Daniela*, который позволил генерировать 26 ампликонов, из которых 15 были полиморфными.

В результате для дальнейших исследований по идентификации генотипов пшеницы были выделены наиболее информативные праймеры, обладающие наиболее высокими значениями индекса полиморфизма: 2109 *Daniela* (PIC равен 0,875), *Sukkula* (PIC равен 0,731), и 1095 (PIC равен 0,718). Оценка разрешающей способности каждого праймера показала, что этот показатель находится в прямой корреляционной зависимости от индекса полиморфизма PIC.

**Ключевой доклад**

**ГЕНЕТИЧЕСКИЕ ОСНОВЫ БИОСИНТЕЗА ФЛАВОНОИДОВ  
ПШЕНИЦЫ**

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Флавоноиды – это широкий класс соединений фенольной природы, синтезируемый в клетках растений. Флавоноидные соединения участвуют во многих процессах жизнедеятельности растений, в том числе обеспечивают защиту растений от различных факторов биотического и абиотического стресса, влияют на рост и развитие растений. В наших исследованиях впервые выделены и охарактеризованы основные компоненты генетической сети биосинтеза флавоноидов пшеницы. Выявлены особенности регуляции биосинтеза флавоноидов пшеницы по сравнению с другими видами растений. В работе активно использовались чужеродно-замещенные и интровергессивные линии пшеницы, что позволило расширить круг исследуемых генов, включив в анализ гены других злаков: ячменя, ржи, эгилопсов. Особое внимание удалено изучению экспрессии генов на чужеродном генетическом фоне. Исследована взаимосвязь между экспрессией некоторых, выделенных нами генов биосинтеза флавоноидов пшеницы, и такими признаками как засухоустойчивость и сохранение всхожести семян после длительного хранения.

## **СЕЛЕКЦИЯ ПШЕНИЦЫ НА КАРАБАЛЫКСКОЙ СХОС**

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Пшеница является основной зерновой культурой Казахстана. Селекция остается наиболее эффективным методом повышения урожайности и экспортного потенциала культуры.

На Карабалыкской опытной станции селекционные исследования ведутся по трем видам пшеницы: яровой мягкой и твердой, и озимой мягкой пшеницы.

Создание новых сортов ведется методом традиционной селекции, челночной селекции и экологическим испытанием. Приоритетными направлениями селекции являются продуктивность, качество, устойчивость к стрессовым факторам среды (засуха, полегание, прорастание зерна на корню), устойчивость к болезням (бурая листовая и стеблевая ржавчина, септориоз).

Основным методом традиционной селекции является гибридизация, проводимая с использованием, как местного материала, так и с привлечением экологически отдаленных форм из коллекций ВИР и СИММИТ. Ежегодно проводится от 150 до 200 комбинаций скрещиваний. В селекционных питомниках ежегодное изучение проводится по 50 тыс. сортообразцам трех видов пшеницы.

За период 2010-2013 гг. на государственное сортоиспытание переданы сорта яровой мягкой пшеницы Карабалыкская 20, Тумар, Галатея, ФантАЗия; яровой твердой пшеницы Асангали 20, Нурлы, Карабалыкская черноколосая 20; озимой мягкой пшеницы Аяз. В государственный реестр селекционных достижений допущенных к использованию в 2012 году внесен сорт яровой твердой пшеницы Алтын Даля.

Метод челночной селекции основан на получении гибридных популяций из международного центра улучшения кукурузы и пшеницы СИММИТ. Работы ведутся по схеме «Карабалык → СИММИТ → Карабалык». Из полученных комбинаций проводимых СИММИТ на основе нашего материала и мирового генофонда, проводится индивидуальный отбор и дальнейшее испытание по полной схеме селекционного процесса. Ежегодно испытывается до 3 тыс. популяций. В результате проведенных исследований по методу челночной селекции в государственное сортоиспытание передан сорт яровой мягкой пшеницы СимКар 20.

Экологическое сортоиспытание проводится, как совместно с селекционными учреждениями Казахстана, так и с НИУ ближнего Зарубежья. Целью проведения экологического испытания является выделение адаптированных к местным агро-климатическим условиям сортов пшеницы. С этой целью станция является членом сети КАСИБ (Казахстанско-Сибирский питомник пшеницы) в которую входят ведущие селекционные учреждения Казахстана и России.

**РЕЗУЛЬТАТЫ ЭКОЛОГИЧЕСКОГО ИСПЫТАНИЯ ЯРОВОГО  
ЯЧМЕНЯ НА КАРАБАЛЫКСКОЙ СХОС**

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В Государственном реестре селекционных достижений Республики находится более 30 сортов ярового ячменя, допущенных к использованию в различных регионах Казахстана. При этом новые сорта внедряются в производство и находят свое распространение в основном в тех регионах, где имеются селекционные учреждения, занимающиеся созданием новых сортов ярового ячменя. В регионах, где селекция ячменя не ведется, до сих пор большие площади занимают стародавние сорта, такие как, Донецкий 8, Донецкий 9, Медикум 85 или новые сорта зарубежной селекции. Сложившаяся ситуация по созданию и внедрению новых сортов требует от селекционных учреждений создания сортов с высокой адаптивной способностью, достичь которой возможно с помощью проведения экологической селекции, суть, которой заключается в оценке параметров сортов в различных климатических условиях. В настоящее время функции экологического испытания сортов выполняет Государственное сортоиспытание (ГСИ), имея большое количество испытательных участков, расположенных во всех агро-экологических точках Республики, оно является наиболее обширной совокупностью сред для оценки генотипов. Однако, оценка адаптивности сортов по данным ГСИ имеет и ряд недостатков. Как правило, в ГСИ попадают сорта, выделенные из питомников конкурсного сортоиспытания (КСИ), находящихся в агро-климатической зоне расположения селекцентра, и по этой причине вероятность высокой продуктивности сорта в других экологических точках не велика.

С целью определения степени пригодности возделывания новых сортов в том или ином регионе Республики нами проводятся исследования по экологическому сортоиспытанию (ЭСИ), создаваемых сортов и линий ярового ячменя. Данная работа началась нами с 2009 года с испытания сортов и линий КСИ в условиях Уральской СХОС (Западный Казахстан). В результате исследований была выделена линия 40-177-01, превышение зерновой продуктивности которой над стандартом за 3 года составило 1,6 ц/га при НСР<sub>05</sub> – 0,8 ц/га (по данным Г. Шектыбаевой). Данная линия, получившая название Жаик-2 была передана на ГСИ с 2012 года.

Начиная с 2011 г., по инициативе, научного координатора селекции ячменя Б.С. Сариева, был создан питомник экологического испытания лучших линий ярового ячменя из всех селекционных учреждений Казахстана. В питомник вошло 40 сортов и линий. По результатам двух лет испытаний, в Павлодарском НИИСХ выделилась линия нашей селекции 31-44-72 превысившая стандартный сорт Целинный 91 на 4,2 ц/га (по данным Д. Мергалимова). Линия готовится к передаче на ГСИ с 2014 года.

В рамках мероприятия по экологическому испытанию, нами совместно с Институтом биологии и биотехнологии растений (ИББР) проводится испытание 97 линий ярового ячменя селекции США, полученных от Е.К. Туруспекова и С.И. Абугалиевой, которыми осуществляется общее научное руководство испытанием в рамках проекта МСХ. Питомник состоит из 55 линий двурядного и 42 линий многорядного ячменя. В результате среди двурядных линий выделился номер 2386, среди многорядных 2700. По итогам испытаний 2014 г. линия 2386 будет передана на ГСИ. За период с 2011 по 2014 годы Карабалыкской СХОС совместно с другими НИУ участниками экологического испытания (ИББР, Уральская СХОС, Павлодарский НИИСХ) на ГСИ передан 1 и готовятся к передаче 2 сорта ярового ячменя имеющие высокие шансы на внедрение и распространение в зонах испытаний. Это свидетельствует о высокой эффективности исследовательских работ в плане экологического испытания как мероприятия по созданию и внедрению новых сортов не только ярового ячменя, но и других с/х культур.

**СЕМЕЙСТВО ГЕНОВ ХАЛКОНФЛАВАНОНИЗОМЕРАЗ  
У ЗЛАКОВ ТРИБЫ TRITICEAE**

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Халконфлаванонизомераза (CHI; EC 5.5.1.6.) катализирует изомеризацию халкона в (2S)-нарингенин, участвуя, таким образом, в биосинтезе девяти основных классов флавоноидных соединений у растений. Было показано, что данная группа соединений играет важную роль в защитном ответе растений пшеницы (*Triticum aestivum*,  $2n = 6x = 42$ ) в условиях стресса. Однако до сих пор нуклеотидные последовательности ключевого гена биосинтеза флавоноидов *Chi* не были выделены из генома пшеницы, а также не была исследована их функциональная активность в условиях стресса.

В данной работе, впервые были выделены полноразмерные нуклеотидные последовательности трех копий гена *Chi* пшеницы и ортологичных им генов *T. timopheevii* ( $2n = 4x = 28$ , GGAA), *T. urartu* ( $2n = 2x = 14$ , AA), *Aegilops speltoides* ( $2n = 2x = 14$ , SS), *Ae. tauschii* ( $2n = 2x = 14$ , DD) и *Secale cereale* ( $2n = 2x = 14$ , RR).

Гены *Chi* были картированы в сходных позициях длинных плеч ортологичных хромосом пятой группы злаков трибы Triticeae. Нуклеотидные, так же как и предсказанные на их основе аминокислотные последовательности генов *Chi* всех исследованных видов были высокоидентичны и, согласно моделированию 3D-структуры, кодировали функциональные ферменты. Отличия между ортологичными копиями гена *Chi* были обнаружены в регуляторных районах, что может объяснять наблюдаемые различия в транскрипционной активности между копиями генов *Chi* в некоторых органах пшеницы. Более того, три копии гена *Chi* пшеницы по-разному регулировались в условиях солевого стресса: экспрессия гена *Chi-D1* значительно активировалась, экспрессия гена *Chi-A1* активировалась незначительно, тогда как транскрипция гена *Chi-B1* не отличалась от контроля.

В работе был проведен сравнительный структурный анализ генов *Chi* более чем у 15 двудольных и однодольных видов растений, который позволил заключить, что в ходе эволюции генов *Chi* у злаков трибы Triticeae происходила потеря инtronов. Гены *Chi* у большинства видов растений состоят из четырех экзонов и трех инtronов, тогда как у злаков трибы Triticeae в гене *Chi* отсутствует третий инtron, а у ржи отсутствует также второй инtron. Наблюдаемый полиморфизм по наличию/отсутствию второго интрана позволил разработать рожь-специфичный маркер, который был успешно использован для идентификации генетического материала ржи в геномах ряда межвидовых гибридов трибы Triticeae.

Исследование выполнено при частичной поддержке Российского фонда фундаментальных исследований (14-04-31637), Президиума РАН (Программа Молекулярная и клеточная биология) и гранта Президента Российской Федерации для молодых докторов наук (МД-2615.2013.4).

## **УРОЖАЙНОСТЬ И УСТОЙЧИВОСТЬ ОТЕЧЕСТВЕННЫХ СОРТОВ ОЗИМОЙ ПШЕНИЦЫ К ЖЕЛТОЙ РЖАВЧИНЕ**

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Вредоносность желтой ржавчины пшеницы (возбудитель – *Puccinia striiformis f.sp. tritici*) на территории Казахстана очень велика и порой еще стойко держится на посевных площадях южных регионов. Одним из важнейших задач селекции является создание устойчивых сортов, формирующих высокий урожай в благоприятных условиях возделывания и характеризующих достаточно высокие показатели урожайности в стрессовых условиях (Койшибаев М., 2003, Волкова Г.В., 2006). В связи с этим целью наших исследований являлось выявление высокоурожайных и устойчивых сортов пшеницы к желтой ржавчине. В полевых условиях на искусственно-инфекционном фоне желтой ржавчины были изучены 30 сортов озимой пшеницы, рекомендованные в производство, из них 10 допущены к использованию с 2002 по 2011 гг.

Результаты опыта показали, что большинство возделываемых сортов озимой пшеницы в сильной степени поражаются местной популяцией желтой ржавчины. При этом на листьях сортов Актерекская, Алия, Наз и Расад в середине мая отмечены восприимчивые типы реакции болезни и через 10 дней флаговые листья были покрыты пустулами гриба на 30-70 %. А к концу первой декады июня на этих сортах из-за сильного развития болезни флаговые листья засыхали. Такому сильному развитию инфекции, возможно, способствовало благоприятные условия (частые дожди, прохладная ночь и длительный период росы), которая сложилась весной в 2013 году. Среди изученных сортов на фоне сильного развития гриба выделились устойчивые сорта казахстанской селекции Егемен, Рамин и Мереке 70.

Известно, что в формировании биомассы растений большое значение имеет развитие флагового листа, который является основным источником ассимиляントов для колоса и поставляет около 60 % продуктов фотосинтеза для образования зерновок. Вследствие этого в наших опытах основное внимание уделялось флаговому листу, поскольку за счет него формируется 40 % урожай зерна (Юсов В.С. и др., 2011). Высокие значения этого признака отмечены в основном у устойчивых сортов Егемен, Рамин и Мереке 70, при этом они имели достаточно крупные листья и сформировали высокую площадь флаг листа ( $25,7-30,6 \text{ см}^2$ ). Выделенные сорта по устойчивости и признаку флагового листа так же отличились по урожайности ( $216,4-289,1 \text{ г}/\text{м}^2$ ), и превзошли стандартный сорт Стекловидную 24 ( $173,0 \text{ г}/\text{м}^2$ ). Среди изученных сортов самый низкий урожай зерна реализовали Наз и Расад, у которых данный показатель составила  $116,4$  и  $158,4 \text{ г}/\text{м}^2$ . В ходе экспериментов выявлены толерантные формы пшеницы, к ним относятся сорта Актерекская, Алмалы и Алия, которые не зависимо от поражения флагового листа желтой ржавчиной дали стабильный урожай.

Таким образом, на фоне сильного развития желтой ржавчины в условиях юго-востока определились устойчивые сорта (Егемен, Рамин и Мереке 70). Данные сорта по морфофизиологическим характеристикам соответствуют перспективным типам растений с оптимальной динамикой ростовых процессов, хорошо развитым листовым аппаратом и повышенной зерновой продуктивностью. А также выделены толерантные сорта пшеницы Актерекская, Алмалы и Алия, которые отличались по показателю продуктивности и они являются ценным исходным материалом для селекции.

**ОЦЕНКА СЕЛЕКЦИОННОГО МАТЕРИАЛА К ОСНОВНЫМ  
БОЛЕЗНЯМ ПОДСОЛНЕЧНИКА В УСЛОВИЯХ ВОСТОЧНО-  
КАЗАХСАНСКОЙ ОБЛАСТИ**

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Болезни растений в современном сельскохозяйственном производстве являются серьезным препятствием для получения ожидаемых урожаев. В некоторой степени в этом есть вина и самих аграриев, которые могут нарушать севооборот, агротехнику. Но немало также зависит и от других факторов. В частности и таких, как сильная поражаемость различными патогенами. Поражение подсолнечника болезнями приводит не только к значительному снижению урожая, но и ухудшению его качества. Снижается полевая всхожесть семян, масса и масличность семянок, возрастает кислотное число масла и как результат ограничивается его использование на пищевые цели. Поэтому наши исследования были посвящены определению видового состава патогенов на подсолнечнике и в первую очередь на семенах, т.к. они являются основным источником инфекции. Анализ семян и растений проводился методами фитопатологической экспертизы. Определение грибов проводилось по ряду определителей соответствующих классов грибов.

Нами были проанализированы семена из четырех питомников испытания в количестве 149 образцов (селекционный питомник (СП) – 64 образца, предварительное испытание гибридов (ПИГ) – 25 образцов, конкурсное сортоиспытание (КСИ) – 14 образцов, экологическое сортоиспытание (ЭСИ) – 46 образцов). По результатам микологического анализа в лабораторных условиях было определено и зарегистрировано пять видов патогенов, это *Whetzelinia sclerotiozum* – белая гниль, *Botritis cinerea Pers.* – серая гниль, *Alternaria tenuis Nees* – альтернариоз, *Plasmopara helianthi Novot.* – ЛМР и *Fusarium sp.* – розовая сухая фузариозная гниль. На всех изученных образцах наибольшее развитие наблюдалось гриба *Alternaria tenuis*, пораженность которым достигала до 60%. Развитие серой гнили варьировало от 5% до 50% семян в образце. Белая гниль отмечалась на 1-25% семян, а пораженные образцы составляли до 10-15%. Поражение семян *Fusarium sp.* было незначительным. Из всего изученного нами материала можно выделить 48 образцов, как наиболее устойчивые (СП – 12 образцов, ПИГ – 8 образцов, КСИ – 6 образцов, ЭСИ – 22 образца), где степень поражения различными патогенами не превышала 20%.

Все семена зараженные белой и серой гнилями теряли всхожесть из-за чего весь материал выбраковывался. Присутствие *Alternaria tenuis Nees.* на семенах не снижало их всхожести. Поэтому основными самыми вредоносными возбудителями, снижающими как общий урожай и его качество, так и семенные качества являются серая и белая гнили.

Таким образом, в условиях Восточно-Казахстанской области наиболее распространенными болезнями подсолнечника являются *Whetzelinia sclerotiozum (dBy)* – белая гниль, *Botritis cinerea Pers.* – серая гниль, *Alternaria tenuis Nees* – альтернариоз, *Plasmopara helianthi Novot.* – ЛМР. По результатам исследований наибольшую вредоносность оказывают серая и белая гнили.

**СЕЛЕКЦИЯ ОЗИМОЙ ПШЕНИЦЫ НА ЗАСУХОУСТОЙЧИВОСТЬ  
ПРОДУКТИВНОСТЬ И КАЧЕСТВО ЗЕРНА**

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Все большее значение для засушливых, малообеспеченных осадками, высокотемпературных климатических условий Южного Казахстана приобретают проблемы засухо- и жароустойчивости, повышения качества зерна и продуктивности. Они становятся более актуальными на фоне отмечаемых за последние годы признаков всеобщего глобального потепления. Климат Юга Казахстана характеризуется резкими колебаниями суточных, сезонных и годовых температур, отличается сухостью воздуха и неравномерным распределением атмосферных осадков. На Красноводопадской селекционной станции, расположенной в полуобеспеченной зоне, осадков выпадает 421 мм в среднем за многолетие с сезонным распределением: зимой 160 мм, весной 172 мм, летом 15 мм и осенью 74 мм. Как правило, распределение осадков по месяцам крайне редко бывает оптимальным для весенней вегетации озимых культур, что лимитирует урожайность их на богарном фоне. Отсутствие атмосферных осадков, высокие температуры, низкая влажность воздуха, горячие ветры ускоряют потери почвенной влаги, что усугубляет воздушно-почвенную засуху. В связи с этим, создание новых, более продуктивных и засухоустойчивых сортов озимых зерновых, совмещающих в едином генотипе такие признаки, как раннеспелость, жаро- и засухоустойчивость, продуктивность, качество зерна, отвечающих требованиям перерабатывающей промышленности, по-прежнему остается актуальным для богарного земледелия юга Казахстана. Чтобы решить эти проблемы мы на протяжении многих лет изучали более тысячи сортообразцов коллекции озимой пшеницы из различных стран мира. Для целенаправленной гибридизации были подобраны исходные формы, получены гибридные популяции, отобраны константные линии, которые прошли конкурсное сортоиспытание в богарных условиях. В результате за 5 лет созданы и переданы в ГСИ уникальные по скороспелости и засухоустойчивости сорта, формирующие зерно сильных пшениц, Дастан, Дала и Шөл бидай.

Как видно из данных таблицы 1 новые сорта Дастан, Шөл бидай и Дастан за три года испытания в КСИ достоверно превышают по урожайности стандарт Красноводопадская210 от 1,1 до 3,3 ц/га. По количеству сырой клейковины (32,9-36,6%) и натуре зерна (793,7-805,6 г/л.) они также превысили стандарт. Сорт Дастан с 2012 года признан перспективным для возделывания на богаре Южноказахстанской области. Сорт Дастан успешно проходит ГСИ, Шөл бидай – передан для Государственного сортоиспытания в 2013 году. Благодаря своей раннеспелости новые сорта богарного экотипа успевают до весенне-летней засухи сформировать полноценное зерно, в результате чего стабильно показывают высокие урожаи. Таким образом на Красноводопадской станции успешно проводится работа по селекции жаро-засухоустойчивых сортов озимой мягкой пшеницы.

**МОЛЕКУЛЯРНЫЙ АНАЛИЗ СОМАКЛОНАЛЬНЫХ ЛИНИЙ  
ЯРОВОЙ МЯГКОЙ ПШЕНИЦЫ С ИСПОЛЬЗОВАНИЕМ IRAP  
и REMAP МАРКЕРОВ**

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Созданные в результате использования биотехнологических методов новые формы растений с ценными технологическими признаками представляют собой сочетание уникальных комбинаций аллелей генов, которые невозможно добиться при традиционной селекции. Генетическая дифференциация полученных новых уникальных форм растений от исходного сорта на молекулярном уровне позволяет составить «паспорт» материала и тем самым обеспечить надежную защиту авторских прав.

Благодаря легкой выявляемости и воспроизводимости результатов в последнее время для изучения полиморфизма ДНК исходных сортов и линий, полученных биотехнологическими методами, успешно используются новые технологии в виде IRAP и REMAP методов (Созинова и др., 2008). Данные маркерные системы основаны на анализе полиморфизма наиболее вариабельных фрагментов ДНК, flankированных фрагментом LTR-ретротранспозона и его инвертированным повтором либо участками микросателлитов (Brik et al., 2006).

При помощи клеточной технологии длительной регенерации растений ранее нами получены сомаклональные линии пшеницы, отличающиеся от прототипа – по срокам созревания, по количественным (высота растений, длина главного колоса, число зерен в колосе, масса зерен с колоса, продуктивная кустистость) и качественным признакам (окраска зерен, форма и окраска колосовых чешуй) (Бишимбаева и др., 2005).

С целью паспортизации этих новых линий выделена ДНК сомаклональных вариантов пшеницы и исходных сортов и проведен ПЦР анализ с использованием IRAP и REMAP-маркеров. Для генетической дифференциации сомаклональных вариантов яровой мягкой пшеницы использовали следующие комбинации IRAP-маркеров: PawS 5 + PawS 16; PawS 6 + PawS 17; Nikita C0699 + Sabrina C0945; Nikita C0699 + Sukkula 9900. При использовании IRAP маркеров наиболее полиморфными оказались комбинации праймеров PawS 5 + PawS 16 и Nikita C0699 + Sabrina C0945.

Для REMAP-анализа использовали комбинации праймеров PawS 5 + (CT)<sub>9</sub>G; PawS 6 + (CT)<sub>9</sub>G; Nikita C0699 + (CA)<sub>9</sub>G. Среди REMAP-маркеров комбинация праймеров PawS5 + (CT)<sub>9</sub>G отобрана как наиболее полиморфная и пригодная для молекулярно-генетической характеристики скороспелых сомаклональных форм пшеницы.

Показано, что скороспелые сомаклональные линии сортов Отан и Целинная 3С R8 поколения отличаются от исходных сортов по 2-4 ампликонам. Молекулярно-биологический анализ с использованием IRAP и REMAP маркеров позволил выявить различия сомаклональных линий как по сравнению с исходным сортом, так и между собой.

Работа выполнена в рамках проекта 1911 программы ГФ1 МОН РК (2012-2014 гг.).

## **ОСОБЕННОСТИ СЕЛЕКЦИИ ЧУМИЗЫ В БЕЛАРУСИ**

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Климатические изменения, характер которых достаточно широко дискутируется в научной печати, предполагает некоторые корректизы в растениеводстве, в число которых входит расширение посевов под новыми, достаточно перспективными культурами, в частности просовидными и сорговыми. Среди этих культур чумиза выделяется тем, что ее зерно можно рассматривать как концентрат витамина F, придающего продуктам свойства стимулятора обмена протеина и жира. Однако проведение интродукции зарубежных сортов не дало положительных результатов.

Сложность организации селекционного процесса по чумизе состоит, главным образом, в ограниченности ее исходного материала и слабой его изученности. Это характерно и для России, и для Украины, где селекционная работа с этой культурой начата более столетия назад, а в Республике Беларусь она ведется лишь второе десятилетие.

Основным недостатком сортообразцов чумизы, находящихся в селекционной проработке, является нестабильность формирования урожая зерна, которое существенно зависит от сложившихся погодных условий, размах изменчивости этого показателя находился в пределах от 33,9 до 66,3%, при средней величине урожайности 2,0-2,3 т/га.

Одним из наиболее простых способов повышения урожая зерна в процессе селекции является удлинение вегетационного периода. Анализ признака скороспелости у образцов чумизы выявил, что у них позднеспелость существенно выше по сравнению с просом. Сравнение межфазного периода выметывание-созревание показало, что формирование зерна у чумизы протекает в том же темпе, что и у проса, однако приходится на менее благоприятный период конца августа – начала сентября, для которого характерна возможность ранних осенних заморозков. Это может повлечь за собой снижение качества зерна на крупяные и семенные цели. Однако, благодаря большей продолжительности межфазного периода всходы-выметывание чумиза формирует относительно высокий урожай зеленой массы в среднем 52,5 т/га при невысоком размахе изменчивости 15,1% вне зависимости от погодных условий. Основная сложность в селекции чумизы – найти оптимальный баланс между урожайностью зеленой массы и зерна.

Использование метода внутрипопуляционного отбора на различных анализирующих фонах (сроки сева, уровень азотного питания и их сочетание) позволило выявить генотипы, формирующие урожайность зерна 4,0-4,5 т/га при его удовлетворительном качестве. Масса 1000 зерен составляла 3,1-3,2 г, что на 10,7-18,9% выше по сравнению с исходными популяциями. Повышение крупности зерна при сохранении его устойчивости к дроблению при производстве крупы является одним из основных признаков ценности сырья для перерабатывающей промышленности.

Использование модификаций отбора с многократной оценкой по потомству образцов чумизы в условиях Беларуси позволило выявить исходный материал с повышенной адаптивностью к условиям республики и сформировать из отобранных линий несколько сортовых популяций, одна из которых (Золушка) уже районирована, другая (Красуня) находится в государственном сортоиспытании Республики Беларусь и еще 3 популяции проходят селекционную доработку по улучшению комплекса хозяйствственно полезных признаков.

**ИЗУЧЕНИЕ ГЕНЕТИЧЕСКОГО ПОЛИМОРФИЗМА КОЛЛЕКЦИИ  
НУТА И ГОРОХА**

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Зернобобовые (соя, горох, нут и др.) культуры, наряду с зерновыми, являются наиболее важными культивируемыми генетическими ресурсами растений (ГРР) в Казахстане и широко возделываются во многих странах.

Изучение, сохранение и рациональное использование генетических ресурсов растений является одной из актуальных проблем всего мирового сообщества. Исследование генетического разнообразия и паспортизация ценных сортов и форм важных сельскохозяйственных культур является обязательными условиями успешного сохранения и использования различных сортов сельскохозяйственных видов растений.

Коллекция генофонда зернобобовых культур лаборатории молекулярной генетики ИББР, сформированная в рамках проекта ЕврАЗЭс, составила 39 образцов нута (*Cicer arietinum* L.) – 8 сортов Госреестра селекционных достижений Казахстана, 13 сортов Госреестра России и других стран; 36 сортов гороха (*Pisum sativum* L.) (7 сортов Казахстана и 29 госреестра сортов России); 124 сортов и линий сои (*Glycine max* L.Merr.), в том числе 13 коммерческих (ГСИ РК) и 27 перспективных сортов и линий Казахстана, 63 сорта государственного реестра России, а также 9 сортов Украины, 6 сортов США, 4 Японии, по 1 сорту Молдавии и Хорватии.

Целью данной работы явилось изучение генетического разнообразия сортов гороха посевного и нута казахстанской и российской селекции с использованием микросателлитных ДНК-маркеров.

Сорта гороха Казахстана и России были проанализированы по 14 SSR-маркерам, нута – по 15 микросателлитным маркерам. При использовании 15 микросателлитных маркеров нута было выявлено от 2 (ICCM0123a) до 6 (TA64) аллелей на локус. При использовании 14 микросателлитных маркеров гороха наблюдали было выявлено от 2 (Pr 1188) до 5 (Pr 636) аллелей на локус. Определены частоты аллелей вовлеченных в анализ микросателлитных локусов, индексы генетического разнообразия анализированных коллекций по Nei и PIC, индекс информативности маркеров. Установлены генетические расстояния между анализированными сортами, на основе которых построены дендрограммы по методу UPGMA, отражающие филогенетические сходства и различия анализированных сортов, как гороха, так и нута Казахстана и России. Для каждого коммерческого сорта гороха и нута Казахстана разработаны генетические паспорта на основе использования информативных SSR-маркеров. Полученные результаты могут быть использованы в селекционно-генетических программах и охране прав селекционеров и селекционных достижений.

Работа выполнена в рамках проекта «Изучение генетического разнообразия и паспортизация коммерческих сортов зернобобовых культур» по Межгосударственной Целевой Программе ЕврАЗЭС МГ.0591 «Инновационные биотехнологии» на 2012-2014 годы.

**ПОИСК НОСИТЕЛЕЙ SR-ГЕНОВУСТОЙЧИВОСТИ К СТЕБЛЕВОЙ РЖАВЧИНЕ ПШЕНИЦЫ**

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Пшеница является главной экспортной культурой в Казахстане. Дальнейшее увеличение производства зерна в стране возможно, главным образом, за счет повышения урожайности. Виды ржавчины пшеницы являются главными факторами, снижающими урожайность этой культуры. Стеблевая ржавчина *Russinia graminis Pers.f.sp. tritici* - одна из наиболее вредоносных болезней пшеницы (Воронкова, 1974). Ржавчина пшеницы распространена на всех континентах земного шара (Койшибаев, 2002). Ржавчинные болезни пшеницы наносят серьезный экономический ущерб сельскому хозяйству. Ежегодные потери от ржавчины в среднем достигает 10% мирового производства зерна .

В селекции наустойчивость к патогенам важно иметь генетические маркеры, сопряженных с этим признаком, позволяющие отобрать устойчивые образцы на ранних этапах селекционного процесса.Наиболее эффективным способом защиты растений является использование устойчивых к болезням сортов. Применение молекулярно-генетических маркеров позволяет идентифицировать эффективные гены устойчивости в сортах и гибридах, что ускоряет отбор целевых генотипов и повышает эффективность селекционного процесса (Кохметова, 2012). Цель настоящей работы - идентификация источников с эффективными генами устойчивости к стеблевой ржавчине пшеницы.

Объектами исследования служили 38 образцов пшеницы, включающих местные и белорусские перспективные линии. Для идентификации носителей *Sr*-генов устойчивости проведен ПЦР - анализ. Целью исследований являлась идентификация носителей эффективного гена *Sr22*. Ген *Sr22* локализован на коротком плече хромосомы 7A. В работе использованы праймеры SSR типа (Simple Sequence Repeats – амплификация простых повторяющихся последовательностей). Для разделения фрагментов амплифицированной ДНК электрофорез проведен на 2%-ном агарозном геле, окрашивание осуществляли с использованием бромистогоэтидия. С целью идентификации носителей гена *Sr22* проведен ПЦР-анализ с праймерами к SSR-локусу *Xcfa2123*, расположенному на расстоянии 6 cM от гена *Sr22* (Khan et al., 2005). ПЦР-анализ показал, что из 38 изученных образцов, фрагмент ДНК, характерный для носителей гена *Sr22* размером 245 п.н., формировался у 13 образцов. Ген *Sr22* идентифицирован у 5 казахстанских линий F<sub>4</sub>, а также у 8 белорусских образцов пшеницы. Эти генотипы предлагаются в качестве доноров в программах по маркер-сопутствующей селекции Marker Assisted Selection (MAS) для повышения устойчивости к стеблевой ржавчине.

Работа выполнена при финансовой поддержке МОН Республики Казахстан в рамках проекта грантового финансирования № 0086.

## **ЭКОЛОГИЧЕСКИЕ ИСПЫТАНИЯ СКОРОСПЕЛЬНЫХ ФОРМ ПШЕНИЦЫ, ПОЛУЧЕННЫХ МЕТОДАМИ БИОТЕХНОЛОГИИ**

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Основные площади возделывания яровой пшеницы находятся в северных областях Казахстана, характеризующихся поздней весной, ранней осенью, коротким и засушливым летним периодом. Ввиду растянутости вегетационного периода в этих условиях большинство коммерческих сортов попадает под осенние осадки и невзгоды (заморозки и т.д.), в силу чего значительная часть урожая имеет повышенную влажность, и, как правило, загнивает, что естественно, приносит большой экономический ущерб. Поэтому создание скороспелых форм основной продовольственной культуры – яровой пшеницы, является весьма актуальной задачей.

Экологические испытания в условиях Юго-Востока Казахстана скороспелых линий с. Целинная 3С и с. Отан, полученных ранее в ИББР на основе технологий длительной регенерации растений, показали опережение по срокам созревания. Так, фенологические наблюдения линий, изучаемых в питомнике конкурсного сортоиспытания показали, что вегетационный период (91-93 дня) короче на 2-7 дней по сравнению со стандартным сортом Казахстанская раннеспелая (98 дней) и исходными сортами Целинная 3С (96 дней) и Отан (95 дней). В Северном и Центральном Казахстане изучаемые линии также показали опережение по срокам созревания: в Кустанайской области – на 2-4 дня у линий с. Отан, на 7 дней – у линий с. Целинная 3С по сравнению с исходными сортами и стандартным сортом Казахстанская раннеспелая; в Карагандинской области – на 1 день по сравнению с исходными сортами (2013 г.). В 2012 году Карагандинской области эти линии показали себя как скороспелые (опережение на 2-5 дней), что свидетельствует о том, что проявление признака скороспелости зависит от особенностей погодных условий года. Испытания линий с. Целинная 3С на в Северном Казахстане выявили различия в сроках созревания на 3-4 дня. В Павлодарской области две линии с. Отан опережали исходный сорт по срокам созревания на 2 и 4 дня, две линии с. Целинная 3С – на 2 дня. В результате оценки качества зерна испытуемых линий выделены линии с высокой натурой зерна, превышающей стандартный сорт Казахстанская раннеспелая – 752 г/л: выровненная линия с. Отан, раннеспелая линия с. Целинная 3С, и по содержанию белка - стекловидная короткостебельная линия с. Отан. Показано, что одни и те же линии проявляют признаки продуктивности, скороспелости и качества зерна по-разному в зависимости от региона, что свидетельствует о взаимодействии «генотип-среда».

В целом, предварительные экологические испытания в Центральном и Северном Казахстане показали, что скороспелые линии с. Целинная 3С можно отнести к разряду средне-раннеспелых и перспективных для районирования в северных областях Казахстана. Положительным моментом является сохранение у скороспелых форм выявленных ранее показателей более высокой урожайности по сравнению с исходными сортами и высокого качества зерна на уровне характерном для «сильных пшениц». Учитывая, что все районируемые на Севере Казахстана пшеницы делятся на средне-раннеспелые, среднеспелые и средне-поздние, полученные формы представляют интерес.

Работа выполнена в рамках проекта программы ГФ1 МОН РК (2012-2014 гг.).

**АНАЛИЗ СКОРОСПЕЛЬНЫХ СОМАКЛОНАЛЬНЫХ ЛИНИЙ  
ПШЕНИЦЫ С ИСПОЛЬЗОВАНИЕМ АЛЛЕЛЬ-СПЕЦИФИЧНЫХ  
ПРАЙМЕРОВ К ГЕНАМ PPD И VRN**

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Одними из ключевых генов, детерминирующих основные хозяйствственно ценные признаки зерновых культур, являются гены *Ppd* (Photoperiod response) и *Vrn* (Vernalization response), ответственные за реакцию растения на фотопериод и яровизацию, контролирующие рост и фазы развития растений (Стельмах и др., 1987). Известно, что комбинация аллелей генов *Ppd* и *Vrn* влияет на скорость развития растений (сроки колошения и созревания), структуру урожая, морозо- и зимостойкость, потребность в яровизации, засухоустойчивость, «уход» от высоких летних температур, устойчивость к болезням (Потокина и др., 2012).

В данной работе созданные нами ранее скороспельные сомаклональные линии яровой мягкой пшеницы были проанализированы на присутствие аллелей генов *Ppd* и *Vrn*. В результате молекулярного анализа аллелей гена *Ppd-D1*, ключевого локуса фотопериодической реакции гексаплоидных пшениц, не выявлено различий между исследуемыми сомаклональными линиями и их исходными сортами (Целинная 3С, Отан). У всех генотипов показано наличие ПЦР продукта размером 414 п.н., соответствующего аллелю *Ppd-D1b*, и отсутствие ампликона 288 п.н., соответствующего аллелю *Ppd-D1a*.

Проведен ПЦР анализ исходных сортов и сомаклональных линий на наличие трех основных генов *Vrn-A1*, *Vrn-B1* и *Vrn-D1*, определяющих реакцию на яровизацию. В результате, идентифицировано существование двух биотипов сорта Отан: биотип, содержащий два доминантных аллеля *Vrn-A1a* и *Vrn-B1* и биотип, содержащий один доминантный аллель *Vrn-A1b*. Сомаклональные линии сорта Отан отличаются от исходного сорта наличием аллеля *Vrn-A1a* и отсутствием аллеля *Vrn-B1*.

Выявлена идентичность между исходным сортом Целинная 3С и скороспелой неполегающей линией сорта Целинная 3С по наличию доминантного аллеля *Vrn-A1a* и различия по доминантному аллелю *Vrn-B1*. Так, у скороспелой неполегающей линии сорта Целинная 3С выявлен доминантный аллель *Vrn-B1* (709 п.о.), отсутствующий у исходного сорта. Данная линия отличается от исходного сорта Целинная 3С ранними сроками колошения и созревания. Рецессивный аллель *vrn-B1* (1149 п.о.) не выявлен ни у одного из исследованных сортов и сомаклональных линий.

У всех проанализированных нами исходных сортов и сомаклональных линий выявлено присутствие рецессивного аллеля *vrn-D1* и отсутствие доминантного аллеля *Vrn-D1*.

В целом, показано, что скороспельные сомаклональные линии отличаются от исходных сортов по присутствию или отсутствию доминантного аллеля *Vrn-B1*, что позволяет отобрать специфичные к нему праймеры для дальнейшей молекулярно-генетической характеристики скороспельных форм. Полученные данные указывают на наличие генетических изменений, вызванных культивированием тканей *in vitro*.

Работа выполнена в рамках проекта 1911 программы ГФ1 МОН РК (2012-2014 гг.).

**ОСОБЕННОСТИ ФОРМИРОВАНИЯ ИСХОДНОГО  
МАТЕРИАЛА ДЛЯ СОЗДАНИЯ ОТЕЧЕСТВЕННЫХ СОРТОВ  
САФЛОРА**

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Исходный материал сафлора был посевен в двух регионах Казахстана – Алматинской и Южно-Казахстанской областях. В каждом регионе экспериментальные участки были поделены на две части с поливом и без полива. В качестве исходного материала испытывались 9 сортообразцов. Определено, что сорта сафлора четко делятся по типу возделывания на интенсивные, у которых количественные показатели увеличиваются, а качественные показатели улучшаются при поливном выращивании и экстенсивные сорта, у которых количественные и качественные показатели ухудшаются при поливе во время вегетации растений. К сортам интенсивного типа возделывания относятся сорта Saffere и К-129, у которых при поливе увеличивался не только рост растений, но и масса семян с растения, а также масса 1000 семян. В тоже время, практически у всех остальных изучаемых сортов, интенсивный полив ухудшил количественные показатели. Так у линии К-129 и сорта Акгуль масса 1000 семян выше без полива, чем при поливе. В семенах изучаемых сортов учитывалось содержание четырех основных жирных кислот: ненасыщенных – линолевой и олеиновой, а также насыщенных стеариновой и пальмитиновой. Как и следовало ожидать основной жирной кислотой в составе масла семян изучаемых сортов является линолевая кислота. Наиболее богатыми на олеиновую кислоту являются сорта Saffere (13,14%) и сорт Центр 70 (13,70%). При этом содержание олеиновой кислоты у сорта Saffere и линии К-129 повышается при выращивании в условиях полива. В тоже время, наблюдалась ожидаемая тенденция, когда при увеличении процентного содержания линолевой кислоты в условиях богары, содержание олеиновой кислоты уменьшалось, вне зависимости от региона возделывания. Кроме того, содержание насыщенных кислот, как правило, понижается при выращивании растений в богарных условиях, за исключением сорта Акмай при выращивании в условиях Южно-Казахстанской области. Проведенный анализ полученных данных также показал высокую внутрисортовую гетерогенность изучаемых сортов практически по всем изучаемым показателям.

Гибридизация сафлора проводилась в полевых условиях. В ходе подготовки к гибридизации выбирали родителей, которые были самоопылены течении 1-2 поколений. В первый день гибридизации проводилась кастрация. Предварительно убирали наружную оболочку венчика каждого цветка. Незрелые пыльники в центре корзинки были удалены с помощью пинцета. Затем корзинки закрывали изолятором из полиэтилена и бумаги, для сравнения влияния влажности на завязываемость. На каждом бутоне подвергалось кастрации от 5 до 10 цветков. В случае, если на следующий день тычиночные нити значительно удлинялись, это свидетельствовало том, что рыльца восприимчива к опылению. В этом случае цветок, на второй день опыляли пыльцой отцовского родителя. Всего удалось получить семена 12 гибридных комбинаций. Процент завязываемости в цветках закрытые изолятором из бумаги был довольно низким и не превышал 10%. В то же время цветки закрытые изолятором из полиэтилена, показали 80% завязываемости. Результаты гибридизации показали, что влажность воздуха после кастрации является важным фактором для завязываемости семян сафлора.

**ВАРИАБЕЛЬНОСТЬ ХОРДОИНДОЛИНОВЫХ ГЕНОВ  
В КОЛЛЕКЦИИ ЯРОВОГО ЯЧМЕНЯ КАЗАХСТАНА**

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Твердозерность является важным признаком, определяющим качество зерна зерновых культур. У ячменя (*Hordeum vulgare* L.) этот признак связан с присутствием и разнообразием триптофан-богатых полипептидов, называемых хордоиндолинами (HIN). Кодирующие их хордоиндолиновые (*Hin*) гены, являющиеся гомологами пуроиндолиновых генов (*Pin*) пшеницы, расположены на коротком плече хромосомы 7 (5Н) ячменя, как известно, играют ключевую роль в структуре зерна. Среди них выделяют три специфических гена *Hina*, *Hinb1* и *Hinb2*. Вариабельность аллелей этих генов влияет на изменение экспрессии данного признака.

В нашей работе, впервые была изучена вариабельность *Hin* генов в коллекции ячменя Казахстана. Материалом исследования служили 96 сортов и перспективных линий ярового ячменя, созданные в 6 селекционных учреждениях Казахстана. Прямое секвенирование образцов проводили с использованием анализатора Genetic Analyser 3130 (Applied Biosystems, USA). Генетические расстояния между сортами по анализируемым генам были подсчитаны, с использованием Neighbor-Joining метода (Saitou и Nei, 1987). Филогенетическое древо было построено с использованием метода Neighbor-Joining и программы MEGA, version 5 (Tamura K. et al., 2011).

Полученные результаты показали наличие полиморфизма нуклеотидных последовательностей ДНК по всем трем вовлеченным в анализ генам хордоиндолинов. Сравнительный анализ аминокислотных последовательностей генов *Hin* в казахстанской коллекции ячменя позволил выявить 10 изоформ. Для гена *Hina* было идентифицировано всего 4 аллеля (*Hina-1*; *Hina-2*; *Hina-3*; *Hina-4*), для *Hinb1* – 3 аллеля (*Hinb1-1*; *Hinb1-2*; *Hinb1-3*), и для гена *Hinb2* – 6 аллелей (от *Hinb2-1*; до *Hinb2-6*, соответственно). При этом, по гену *Hina*, исследуемые генотипы содержали только ранее опубликованные аллели (Turusperekov et al., 2008), в то время как по *Hinb*, нами были обнаружены и охарактеризованы 4 потенциально уникальных аллелей – 1 аллель для *Hinb1* и 3 аллеля для *Hinb2*. По сочетанию аллелей трех генов 58% генотипов имели сходный гаплотип - *Hina-1* / *Hinb1-1* / *Hinb2-1*. Таким образом, впервые была исследована вариабельность хордоиндолиновых генов *Hina*, *Hinb1* и *Hinb2* в коллекции ярового ячменя Казахстана. Полученные данные позволили идентифицировать аллели и гаплотипы исследуемых сортов и линий. Полученная информация может быть использована в генетико-селекционных исследованиях, нацеленных на улучшение качества зерна создаваемых сортов.

Работа выполнена в рамках проекта 0049/ГФ «Ассоциативное картирование генов качества зерна ячменя» по программе МОН РК «Грантовое финансирование научных исследований» на 2012-2014 гг.

## **МОЛЕКУЛЯРНАЯ ХАРАКТЕРИСТИКА ИЗОЛЯТОВ ВИРУСА МОЗАИКИ ЯБЛОНИ**

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Вирус мозаики яблони (*Apple mosaic virus*, ApMV), относится к роду *Pilarvirus*, и является одним из основных патогенов яблони. ApMV распространен повсеместно, поражая целый ряд растений относящихся к более чем 65 видам из 19 семейств, включая: *Fragaria* (землянику садовую), *Humulus lupulus* (хмель), *Betula* (березу), *Corylus avellana* (лещину), *Malus pumila* (яблоню), *Prunus armeniaca* (абрикос), *Prunus avium* (черешню), *Prunus dulcis* (миндаль), *Ribes rubrum* (красную смородину), *Rubus idaeus* (малину красную) и *Rubus occidentalis* (малину черную). ApMV переносится механически, прививками, возможно пыльцой, но не переносится с помощью семян.

У яблони симптомами поражения вирусом ApMV является мозаика листьев ( пятна кремового цвета). Пораженные листья могут встречаться как на отдельной ветви, так и равномерно по всему дереву. Большинство промышленных сортов яблони подвержены заражению, но различаются в степени развития симптомов.

Геном ApMV представлен 3 молекулами одноцепочечной РНК: РНК-1, РНК-2 и РНК-3. РНК-1 (3,4 кБ) имеет единственную рамку считывания и кодирует полипептид, несущий домены метилтрансферазы и хеликазы. РНК-2 (2,9 кБ) также несет одну рамку считывания и кодирует РНК зависимую РНК полимеразу. РНК-3 (2,0 кБ) содержит гены, кодирующие белок оболочки (CP) и белок, ответственный за движение вируса (MP). Белок оболочки вируса также экспрессируется с субгеномной РНК-4.

Многие вирусы, поражающие яблоню, слабо охарактеризованы и информация о их генетической вариабельности довольно ограничена. Дополнительная информация о вирусе ApMV, включая изоляты из разных стран, может помочь в понимании генетического разнообразия данного вируса. Знание изменчивости вируса и определение консервативных и вариабельных областей вирусного генома является важным для диагностики и контроля вируса.

Целью данного исследования являлось изучение генетической вариабельности изолятов вируса мозаики яблони, выделенных из разных сортов яблони в Беларуси и Польше.

В результате исследований фрагменты генома (CP- и MP-гены) изолятов ApMV были амплифицированы, клонированы и секвенированы.

RFLP анализ MP- и CP-генов позволил разделить изучаемые изоляты вируса.

Филогенетический анализ нуклеотидных последовательностей CP-гена изолятов ApMV показал, что исследуемые изоляты, совместно с изолятами вируса, представленными в базе данных EMBL/GenBank, группировались независимо от их географического происхождения.

**КҮЗДІК БИДАЙДЫ ҚОҢЫР ТАТ АУРУЫНА ТӨЗІМДІЛІГІН  
СКРИНИНГТЕУ**

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Бидай Қазақстандағы ең маңызды тағамдық дақылдардың бірі болып табылады. Әлемде ол өндірілетін егістік көлемі бойынша басты орын алады. Бидайдың кең қолданыс табуы, қоректік құндылығының жоғары болуымен және әртүрлі түрде қолданыс табуында. Бидай өндірісін ұлғайту, өнімділікті арттыру, әсіресе ауруларға байланысты шығымды азайту арқылы қол жеткізуге болады. Қазіргі уақытта қоңыр таттың қауіпті рассасының таралуына байланысты тат ауруынан бидайдың өнімділігінің төмендеуінің басты себепшісі болып отыр.

Патогендерге тәзімді бидай сорттар шығару үшін біздің аймақтардағы тиімді тәзімді ата-анасын нақты анықтау керек. Сол үшін 2011-2013 жылдар аралығында Қазақ егіншілік және өсімдік шаруашылығы ғылыми зерттеу институтының егістік алқабында халықаралық зерттеу тәлімбағынан (ICARDA) алынған 28 бидай коллекциясын қоңыр тат ауруына тәзімділігі зерттелінді. 2011-жылы барлық 28 бидай үлгілері қоңыр татқа тәзімділік танытты, зақымдалу көрсеткіші 0-R аралығында. Бұлай болу себебі бұл жылы қоңыр тат аурудың дамуына ауа-райының қолайсыз болуынан. 2012-жылы UIIAGEC-18 бидай үлгісі қоңыр татқа 20MS реакциясымен орташа тәзімсіздік көрсетті, аурумен зақымдануы 20%-ға дейін болды. 2013-жылы өсімдіктер қоңыр татпен ең қатты зақымдалды. Бұл жылы қоңыр татқа тәзімсіз деп UIIAGEC-16, UIIAGEC-18 бидай үлгілерін көрсетуге болады. Осы линиялар 40-50%-ға дейін зақымдалды. Зерттеудің нәтижесінде ең жоғары тәзімді деп 21 үлгіні көрсете аламыз. Олар: UIIAGEC-1, UIIAGEC-2, UIIAGEC-3, UIIAGEC-4, UIIAGEC-6, UIIAGEC-7, UIIAGEC-9, UIIAGEC-10, UIIAGEC-11, UIIAGEC-12, UIIAGEC-14, UIIAGEC-15, UIIAGEC-17, UIIAGEC-20, UIIAGEC-21, UIIAGEC-22, UIIAGEC-24, UIIAGEC-25, UIIAGEC-27, UIIAGEC-28, UIIAGEC-29. Бұл бидай материалдардың тат ауруына тәзімділік көрсеткіші 0-R аралығында болды. 5 бидай үлгілері қоңыр тат ауруына тәзімділігін орташа деп баға беруге болады, өйткені олардың зақымдалу көрсеткіші 10-30% аралығында болды. Сонымен, ауруга ең тәзімді деп тапқан 21 бидай үлгілерін селекциялық бағдарламаларға қоңыр тат ауруының доноры ретінде ұсынуға болады.

Зерртеу жұмысы ҚР БФМ колдауымен гранттық каржаландыру бағдармасының негізінде № 0053 жобасы бойынша жүзеге асарылды.

## **БОЛЕЗНИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ КУЛЬТУР В ЗАКРЫТОМ ГРУНТЕ ЗАПАДНОЙ ГРУЗИИ**

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Поскольку выращивание большинства растений в открытом грунте возможно только в теплое время года, когда суточная температура выше 5°C, большая роль в снабжении овощами населения круглый год принадлежит выращиванию в закрытом грунте. В последние годы в Грузии увеличиваются площади под овощными культурами закрытого грунта, где поддерживаются оптимальные условия для развития культур, однако эти же условия в большинстве случаев являются благоприятными и для вредных объектов - фитопатогенов в течение всего года.

В 2012 – 2013 гг. провели обследования овощных культур (томата, перца, баклажана, тыквенных культур) в тепличных хозяйствах в Кобулетском, Самтредском, Цкалтубском и Ланчхутском районах. В результате мониторинга болезней овощных культур и лабораторного анализа были выявлены и идентифицированы следующие болезни: корневые гнили (фузариозная, ризоктониозная и питиозная), серая гниль (*Botrytis cinerea*), увядание (*Fusarium spp*, *Verticillium spp*), фитофтороз томатов (*Phytophthora infestans*), перца (*Phytophthora capsici*), альтернариозная пятнистость (*Alternaria solani*) и переноспороз тыквенных культур (*Pseudoperonospora cubensis*).

**МАРКЕР-ОПОСРЕДОВАННАЯ СЕЛЕКЦИЯ ТРИТИКАЛЕ  
НА УСТОЙЧИВОСТЬ К ПОЛЕГАНИЮ**

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Полегание посевов считается одной из основных причин недобора урожая зерновых злаковых культур, в том числе тритикале. Оно приводит к нарушению фотосинтеза, ухудшает налив зерновок, повышает поражаемость болезнями и существенно затрудняет уборку. Приоритетным направлением устранения склонности к полеганию является селекция на создание короткостебельных сортов.

В сообщении представлены результаты скрининга по аллельному составу генов короткостебельности сортов тритикале из различных селекционных центров и сортообразцов, созданных в НПЦ НАН Беларусь по земледелию и КазНИИ земледелия и растениеводства, а также синтезированных в ИГЦ НАН Беларусь рекомбинантных форм тритикале с интродукцией хромосом 2D и 4D. Включение этих форм в скрещивания позволяет вовлечь в селекцию тритикале гены короткостебельности *Rht8* и *Rht-D1*, локализованные в перечисленных хромосомах, что существенно расширяет возможности отбора.

Наличие в кариотипах рекомбинантных форм тритикале хромосом D-генома было подтверждено нами с помощью метода С-бэндинга. Исходя из того, что большинство современных сортов тритикале имеют вторичную гибридную природу, анализ хромосомного состава был проведен у всех включенных в эксперимент образцов. Было установлено, что сорта и большинство белорусских сортообразцов имеют полные наборы хромосом A-, B- и R-геномов. В кариотипах двух яровых сортообразцов было обнаружено 6D(6A)-замещение хромосом. Аналогичное межгеномное замещение присутствовало у всех казахских озимых сортообразцов.

Для выявления аллельного состава генов короткостебельности использовались праймеры в модификации Zhang et al. (2006). В ходе анализа аллельного состава гена *Rht-B1* наличие в гомозиготном состоянии мутантного аллеля *Rht-B1b*, обеспечивающего снижение высоты растения, было установлено у 6 сортов из 9 проанализированных, 8 из 10 яровых и 11 из 14 озимых белорусских сортообразцов, 14 из 20 озимых казахских сортообразцов и одной рекомбинантной формы тритикале. Что касается генов *Rht8* и *Rht-D1*, то, к сожалению, выяснилось, что все созданные нами рекомбинантные формы содержат дикие аллели данных генов. В связи с этим начата работа по интродукции мутантных аллелей генов *Rht8* и *Rht-D1* в рекомбинантные формы путем гибридизации их с сортами мягкой пшеницы, несущими целевые аллели.

Сорта и сортообразцы тритикале с наличием мутантного аллеля гена короткостебельности *Rht-B1* включены в селекционный процесс.

*Работа выполнена при частичной финансовой поддержке Белорусского республиканского фонда фундаментальных исследований (договор № Б12-042).*

**ИСХОДНЫЙ МАТЕРИАЛ ТЕТРАПЛОИДНОЙ ГРЕЧИХИ ДЛЯ  
СОЗДАНИЯ СОРТОВ ИНТЕНСИВНОГО ТИПА С ВЫСОКИМИ  
ТЕХНОЛОГИЧЕСКИМИ КАЧЕСТВАМИ ЗЕРНА**

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В семействе Polygonaceae ряд видов имеют как диплоидные, так и тетрапloidные формы. Это характерно и для гречихи посевной, вовлечение полиплоидных форм которой в селекционный процесс позволяет решать вопросы ее продуктивности иначе, чем на диплоидном уровне, поскольку искусственная полиплоидизация у гречихи является эффективным приемом получения селекционно-значимых форм. Опыт белорусской селекции гречихи позволяет заключить, что селекцию автополиплоидов можно рассматривать как этап в логической схеме селекционных методов проработки исходного материала: формирование морфологических особенностей сорта фенотипическим отбором – улучшение урожайных свойств сортовой популяции или гибрида на анализирующих фонах – полиплоидизация. Однако использование полиплоидов в селекции показало, что их потенциальные возможности в наибольшей степени реализуются при достаточной влагоемкости почв и высокой культуре земледелия, как в Беларусь, так и за ее пределами.

Установлено, что существенное увеличение урожайности гречихи невозможно без введения в ее сортовые популяции генетического контроля за неограниченными ростовыми процессами, характерными для данной культуры. Поэтому ее дальнейшее совершенствование должно предусматривать изменение морфотипа с традиционного (индетерминантного) на детерминантный.

Ограничение ростовых процессов у растений тетрапloidной гречихи оказывает влияние не только на абсолютные величины признаков, определяющие урожайность и крупность зерна, но и на их реакцию в меняющихся условиях внешней среды. Изменение удельного веса фракций зерна под влиянием внешних условий меняется не более чем на 10%. При формировании благоприятных условий для формирования крупного зерна (5,5 мм) увеличение идет равномерно, за счет сокращения меньших по размеру фракций (4,0 и 4,5 мм).

При повышении крупности зерна снижается способность к стабилизации данного показателя в меняющихся условиях среды. Изменения удельного веса наиболее крупной фракции носят более выраженный характер и могут обеспечиваться увеличением не ядра, а пленки. Поэтому в процессе селекции крупнозерных форм, к которым относятся образцы тетрапloidной гречихи, необходимо больше внимания уделять проработке технологических качеств зерна.

Пленчатость у тетрапloidной гречихи мало изменяется под влиянием внешних факторов, однако наблюдается тенденция возрастания данного показателя в условиях, способствующих снижению массы 1000 зерен, причем намного сильнее она проявляется у форм с ограниченным типом роста

Внесение в генотип тетрапloidной гречихи ограничений ростовых процессов, как детерминацией апикальных меристем, так и снижением количества узлов в зоне ветвления стебля приводит к сходным реакциям на условия произрастания по признаку масса 1000 зерен. При возрастании урожайности до уровня 32-33 ц/га у форм с ограниченными ростовыми процессами масса 1000 зерен повышается медленнее, чем у неограниченно растущих форм, а затем, при дальнейшем росте урожайности снижается более быстрыми темпами по сравнению с образцами неограниченно растущего морфотипа.

**ИДЕНТИФИКАЦИЯ УСТОЙЧИВЫХ ФОРМ ДИКОРАСТУЩЕГО  
ЯЧМЕНИ (*Hordeum vulgare ssp. spontaneum* Koch) К СТЕБЛЕВОЙ  
РЖАВЧИНЕ *Puccinia graminis***

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Растения дикорастущего ячменя *Hordeum vulgare ssp. spontaneum* Koch были собраны в Южно-Казахстанской области в 2009-2012 гг. (Туруспеков, 2010). Всего было собрано 250 растений в 14 различных локальностях Южного Казахстана. Отобранные 96 растений 14 популяций были изучены в полевых условиях Казахского научно-исследовательского института земледелия (п. Алмалыбак, Алматинская область) и тепличных условиях Института проблем биологической безопасности (г. Отар, Джамбульская область). В результате все 96 линий были изучены по компонентам урожайности и морфологическим признакам (всего 10 признаков) и по устойчивости к стеблевой ржавчине, обуславливаемой *Puccinia graminis* f. sp. *tritici*, являющейся одной из наиболее опасных болезней культивируемого ячменя в Казахстане. Устойчивость к стеблевой ржавчине изучали в контролируемых тепличных условиях на ювенильной стадии развития растений, где в качестве инокулюма были использованы местная популяция и высоковирулентный патотип RRR/KH. В результате комплексного анализа было идентифицировано 12 линий дикорастущего ячменя, отличающихся высокими показателями компонентов урожайности (масса зерна на растение, количество зерен на колос, продуктивная кустистость, высота растений, масса 1000 зерен) и устойчивостью к стеблевой ржавчине. Идентифицированные линии будут использованы в проектах по селекции ячменя, направленных на повышение устойчивости к стеблевой ржавчине. Также, поскольку все 96 линий были генотипированы с использованием 384 SNP маркеров (технология Illumina) результаты будут использованы для поиска новых генов ячменя, обуславливающих устойчивость к *Puccinia graminis*.

Работа частично выполнена в рамках гранта №0518 в рамках грантового финансирования Министерства образования и науки Республики Казахстан на 2013-2015 гг.

**САРЫ ТАТ АУРУЫНА (*Puccinia striiformis* West. f.sp. *tritici*) ТӨЗІМДІ YR  
ГЕНДЕРІН КҮЗДІК БИДАЙ ЛИНИЯЛАРЫНАН АНЫҚТАУ**

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Бидай Қазақстанның оңтүстік және оңтүстік-шығысында негізгі астық дақылы болып саналады және егістік аймақтарының 800-850 мың гектарына өсіріледі. (Р.А. Уразалиев 1999, 2008). Эпифитотия жылдары сары тат ауруы (*Puccinia striiformis* West. f.sp. *tritici*) бидай сорттарының өнімділігін 50-60%-ға төмендетіп еліміздің экономикасына үлкен шығын әкелуде. Сары тат ауруымен күресудің ең тиімді жолы ауруға төзімді жаңа сорттарды шығарып өндіріске енгізу болып табылады (Кохметова А.М., Рсалиев Ш., 2009). Сары татқа төзімділіктің ресми немесе уақытша белгілері бар 80-нен аса ген гендер каталогына енгізілді (McIntosh et al., 2012).

Бидайдың *IBS* хромосомасында локализацияланған сары тат ауруына төзімді эффективті *Yr10* генін тасымалдаушыларын анықтау жұмысымызыңың басты мақсаты болып табылады. Молекулалық маркерлердің көмегімен әртүрлі бидай материалдары зерттелді. Қазақстанның 19 сортына, Ресейдің 17 сортына, Өзбекстанның 30 линиясына, халықаралық ICARDA орталығының 47 линиясына сары тат ауруына төзімді *Yr10* генін анықтау жұмыстары жүргізілді. СТАБ әдісімен бөлінген бидай ДНҚ ларына ПТР реакциясын жүргіздік. Бақылау сорты ретінде *Avocet* сортынан алынған *Yr10* изогенді линиясы мен генотипінде *Yr10* гені бар француздық *Moro* сорты алынды. Теріс бақылау ретінде *ddH<sub>2</sub>O* болды. Аталған генді табу үшін эффективті *Yr10* гені ассоциацияланған микросателлитті SSR<sub>psp3000</sub> праймері қолданылды (<http://www.shigen.nig.ac.jp>). ПТР өнімдеріне 1,5% агароза гелінде электрофорез жүргізіліп, этидий бромиді бояуымен боялды. ПТР протокол бояынша доминантты *Yr10* гендери бар ПТР өнімдері 260 жұп нуклеотид, ал *Yr10* ген рецессивті болған жағдайда 240 жұп нуклеотид аймағында синтезделінді. Зерттеудің нәтижесінде 2 Қазақстандық сорттарында (Наз, Мереке), шетелдік 11-линиясында, 2 Өзбекстан линияларында (U11AGEC-7, U11AGEC-23) және 2 Ресейлік (Курант, Горельформе) сорттарында *Yr10* гені бар екендігі анықталынды. А.М. Кохметованың 2005 жылғы монографиясында, Наз сортының генетикалық анализі бойынша *Yr10* гені болуы мүмкін деген болжам айтылған болатын. Молекулалық зерттеулердің нәтижесінде Наз сортының генотипінде *Yr10* генінің бар екендігі дәлелденді. Сонымен қатар рекомбинантты инбректі линияларының RILs Алмалы/*Yr10* комбинациясының 178 линиясының ішінен 86 линиялардың генотиптерінен *Yr10* генінің енгізілгені анықталды. Осы алынған мәліметтерді сары тат ауруына төзімді линияларды шығару үшін селекция деңгейінде жұмыстарды жылдамдатуға қолдануға болады.

Зерттеу жұмысы Қазақстан Республикасының Білім және Ғылым Министрлігінің қаржылық қолдауымен МЦП ЕврАЗЭС «Инновационные биотехнологии» аясында 2012-2014 жылдар аралығында жүзеге асырылды.

**НАУЧНАЯ ОСНОВА СЕМЕНОВОДСТВА МНОГОБИОТИПНЫХ СОРТОВ  
ЯРОВОЙ ПШЕНИЦЫ В СЕВЕРНОМ ЗАУРАЛЬЕ**

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За 75 лет Государственного сортоиспытания на сортоучастках Тюменской области испытано 1004 сорта яровой пшеницы отечественной и зарубежной селекции. Из них 38 сортов (3,78 %) включены в Государственный реестр РФ по Тюменской области и допущены к возделыванию в производстве. Необходимо отметить, что за отмеченный период времени уровень культуры земледелия на сортоучастках возрос значительно сильнее, чем в производстве. Урожайность многих испытуемых и стандартных сортов пшеницы на сортоучастках составляет 6-7 т/га и более, хотя в условиях производства в 3-4 раза ниже.

Изучение выделенных сортов с использованием метода электрофореза запасных глиадиновых белков показало, что преимущественно они состоят из одного биотипа и реализуют свои потенциальные возможности в хозяйствах с высоким уровнем культуры земледелия. К сожалению, таких хозяйств в области 10-15 %. В основном хозяйства имеют средний и ниже среднего уровень культуры земледелия, поэтому сорта пшеницы интенсивного типа в таких хозяйствах реализуют свои потенциальные возможности на 30-40 % и часто уступают многобиотипным сортам. Последние сорта в ближайшем будущем должны занять значительные площади посева яровой пшеницы в области. Таким образом, многобиотипные сорта пшеницы – один из основных резервов повышения урожайности. Для введения семеноводства таких сортов нужны новые научные методы, одним из которых является электрофорез запасного белка в зерновке. С использованием отмеченного метода популяционные сорта пшеницы раскладывают на биотипы и размножают их в чистоте. При производстве элитных семян, в зависимости от особенности природно-климатических условий зоны выращивания и уровня культуры земледелия хозяйств объединяет биотипы в соотношении, при котором сорт обеспечивает получение высокой урожайности. В сравнении с методом визуального отбора элитных растений, который считается основным в семеноводстве пшеницы и других зерновых культур, метод электрофореза позволяет надёжно контролировать стабильность генетической основы сортов и тем самым продлить время использования их в производстве.

В агрономической практике есть много примеров ухудшения многобиотипных сортов. Например, в Тюменской области это относится к сортам Скала, Тюменская 80, Тюменская ранняя, Лютесценс 70, которые в ходе традиционного семеноводства утратили один-два биотипа, что привело к снижению их урожайности в хозяйствах со средним и низким уровнем культуры земледелия. Из сортов, районированных в последние десятилетия, можно отметить Ирень, который состоит из двух биотипов, дополняющих друг друга по биологическим свойствам. По морфологическим признакам они практически не отличаются, поэтому методом визуального отбора элитных растений не возможно сохранить необходимое соотношение биотипов в сорте. С использованием в семеноводстве метода электрофореза нам удалось восстановить генетическую основу сортов Скала и Тюменская 80. Обновлённые сорта дают урожайность в рядовых хозяйствах на 25-30 % выше. В этой связи необходимо сделать вывод, что наступило время перевести семеноводство пшеницы на новую научную основу. В Сибири функционируют три лаборатории с использованием метода электрофореза запасных глиадиновых белков, в том числе в ГАУ Северного Зауралья (г. Тюмень). Кроме того, в Государственном сортоиспытании, наряду с высоким фоном питания растений, необходимо испытывать сорта на жёстком фоне, приближённом к производственным условиям, а также возобновить производственное испытание лучших сортов, выделившихся на сортоучастках. К моменту включения нового сорта в Реестр селекционных достижений желательно иметь сведения по его биотипному составу. В докладе будет приведён экспериментальный материал по производству элитных семян многобиотипного сорта Тюменская 80 за 28 летний период с использованием метода электрофореза.

**ПОДБОР НАИБОЛЕЕ ЭФФЕКТИВНЫХ МОЛЕКУЛЯРНЫХ  
МАРКЕРОВ, ВЫЯВЛЯЮЩИХ ГЕНОМНЫЕ РАЗЛИЧИЯ ОБРАЗЦОВ  
КАРТОФЕЛЯ**

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В последние годы в мире все больше внимания уделяется использованию ДНК-маркеров в селекционных процессах для быстрого эффективного отбора нужных генотипов растений. С использованием ДНК-маркеров связаны реальные практические достижения в идентификации и регистрации сортов и ценных форм картофеля, в семеноводстве и семенном материале. Методы молекулярного анализа позволяют эффективно сопоставлять геномы, оценивать степень генетического сходства/различий образцов, выявить селекционно-перспективные генотипы, и эффективно производить отбор желаемого генетического материала на уровне ДНК. Кроме того, молекулярные маркеры позволяют проводить точную сортовую идентификацию, контроля генетического засорения и экологического мониторинга.

В работе был использован растительный материал (молодые листья) и пробирочные растения стародавних и современных сортов и форм картофеля казахстанской и зарубежной селекции. Использовали следующие методы исследований: выделение и очистка ДНК из сортов картофеля, определение количества и чистоты выделенной ДНК, тестирование AFLP комбинаций EcoRI/TruI праймер/фермент, амплификация ДНК с SSR-праймерами, электрофорез в полиакриламидном геле, статистическая обработка данных.

Подобрано и охарактеризовано 42 сорта *S. tuberosum*, охватывающих широкое эколого-географическое и морфо-биологическое разнообразие этого вида. Из 126 образцов 42 сорта картофеля была экстрагирована ДНК необходимого качества и количества. Сформирована коллекция ДНК препаратов из 126 образцов для последующего молекулярного анализа. Проведен подбор наиболее информативных 8 микросателлитных SSR локусов и 10 AFLP комбинаций праймер/фермент для последующих работ.

Для подбора оптимальных микросателлитных праймеров тестирано 14 пар праймеров на 10 генотипах картофеля, из них отобрали 8 пар праймеров с подобранный температурой отжига для идентификации и генотипирования образцов картофеля. Длины амплифицированных фрагментов соответствовали диапазону 87-291 п.н. Число полиморфных фрагментов в зависимости от праймерной пары варьировало от 2 (для локусов STG0010 и STI0012) до 5 (для локуса STI0033). Уровень полиморфизма изученных локусов оказался достаточно высоким и составил 90,6%.

Всего было протестировано 20 AFLP комбинаций EcoRI/TruI праймер/фермент. Из них были отобраны 10 наиболее информативных комбинаций для дальнейшей работы с полным набором образцов *Solanum*. С использованием этих комбинаций для каждого образца выборки были получены воспроизводимые полиморфные спектры AFLP-фрагментов. Длины амплифицированных фрагментов соответствовали диапазону 80-450 н.п. Число полиморфных фрагментов в зависимости от праймерной пары варьировало от 89 (для E12/T55G) до 106 (для E41/T61C).

В настоящее время проводим SSR-маркирование и AFLP-генотипирование коллекции стародавних и современных сортов и форм картофеля казахстанской и зарубежной селекции, возделываемых в Казахстане.

**ОЦЕНКА ИСХОДНОГО СЕЛЕКЦИОННОГО МАТЕРИАЛА  
ОЗИМОГО ТРИТИКАЛЕ НА КАЧЕСТВО ЗЕРНА**

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В селекции тритикале большое значение имеет оценка исходного материала на качество зерна (содержание сырого протеина и сырой клейковины с оценкой её качества, число падения) для отбора лучших образцов с целью дальнейшей селекционной работы.

Исследования проводили в 2007 – 2009 гг. Объектом исследований были семена 100 образцов озимого гексаплоидного ( $2n=42$ ) тритикале отечественной и зарубежной селекции. Определили содержание сырого протеина на ИК-анализаторе NIRS 5000 (США), число падения - методом Харберга-Пертена на приборе Falling Number 1500 (Швеция), содержание сырой клейковины - в соответствии с действующим стандартом (ГОСТ 13586.1), качество клейковины - на приборе ИДК-4 (Россия).

Результаты исследований. Среднее значение содержания сырого протеина у изучаемых образцов составило 13,8 %. Максимальное значение данного показателя было отмечено у российского сорта Рондо (16,5 %).

Среднее значение показателя «число падения» составило 82 с, что характерно для зерна низкого хлебопекарного качества. Максимальное значение показателя определили у польского сорта Витон – 147 с, что также не соответствует высокому качеству.

Содержание сырой клейковины, значение ИДК в среднем для всех образцов равнялось 16,8 % и 81,4 ед. соответственно. Максимальное содержание сырой клейковины определили у украинского сорта АДМ 12 – 24,8 %. Лучшая клейковина была у польского сорта Вольтарио – 66,7 ед. (I гр. качества – хорошая). Мука данного сорта может быть использована в кондитерской промышленности.

«Содержание сырого протеина» (коэффициент вариации V – 6,5 %) и «значение ИДК» (V – 8,1 %) – слабо варьирующие признаки, формирующиеся преимущественно под влиянием генотипа сорта, а не условий окружающей среды. «Число падения» (V – 25,8 %) и «содержание сырой клейковины» (V – 32,3 %) – сильно варьирующие признаки, формирующиеся при более значительном влиянии условий окружающей среды, чем генотипа сорта. В данном случае нужно учитывать взаимодействие «генотип-среда».

Приведённые выше сорта с лучшими значениями изучаемых признаков могут быть рекомендованы в качестве источников для последующей селекционной работы.

## **ЛАБОРАТОРНЫЕ МЕТОДЫ ОЦЕНКИ УСТОЙЧИВОСТИ ПШЕНИЦЫ К ЛИСТОВОЙ РЖАВЧИНЕ**

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В северном регионе республики - основной зоне производства зерна, листовая или бурая ржавчина (возбудитель - *Puccinia recondita* Desm.) является наиболее распространенной болезнью яровой пшеницы. В период 2000-2013 гг. умеренное и эпифитотийное ее развитие в отдельности или совместно с септориозом происходило 5 раз и при этом урожай зерна снижался от 7-10 до 20-25%. Среди допущенных к использованию сортов мягкой пшеницы (*Triticum aestivum*) практически нет устойчивых к этой болезни. Для создания устойчивых или выносливых к видам ржавчины сортов необходимо широко использовать источники или доноры устойчивости для скрещивания с местными сортами, и провести оценку и отбор гибридных популяций на инфекционном фоне. В полевых условиях не всегда возможна объективная оценка селекционного материала из-за неблагоприятных для патогена условий погоды, особенно в июле, когда наступает наиболее уязвимая фаза развития растений.

В связи с этим, в период 2012-2013 гг. проводили исследования с целью совершенствования лабораторных методов оценки устойчивости пшеницы к листовой ржавчине. Сорта, коллекционные образцы и линии пшеницы высевали на пластиковые вазончики (по 15 шт. семян), наполненные почвой. Определено влияние сроков инокуляции всходов (в фазу 2-3 листьев и в начале стеблевания), температуры и режима освещения (естественное и искусственное) на инкубационный период болезни. Использованы коммерческие сорта Акмола 2, Астана, Казахстанская раннеспелая, которые восприимчивы к бурой ржавчине, а качестве инокулюма - урединиоспоры гриба, смывы из пораженных болезнью листьев, собранных из Северо-Казахстанской области. После инокуляции растения выдерживали во влажной камере 14-16 часов. При температуре 25-28<sup>0</sup> С инкубационный период бурой ржавчины составлял 7-8 суток, а при 19-23<sup>0</sup> С – удлинялся до 10-12 суток. Сорта, испытанные в качестве стандарта, поразились болезнью до 25-50%, что свидетельствует о высоком инфекционном фоне.

Параллельно проверяли возможность лабораторной оценки устойчивости коллекционных образцов и селекционных линий яровой пшеницы к бурой ржавчине на срезанных отрезках листьев, помещенных в раствор бензимидазола. Они инкубировались в лаборатории при естественном освещении или под лампами дневного света. Листья сохраняли зеленую окраску до 15 суток. Анализированные линии заметно отличались по степени поражаемости бурой ржавчиной и реакцией на патоген. У испытанных линий проявились четкие реакции на патоген: от полной (R) или промежуточной резистентности (MR) до высокой восприимчивости (S). При скрининге бензимидазолным методом на инокулированных отрезках листьев гибридных популяций урединии гриба развивались от 62,2-72,7%, а на стандартных сортах - до 100%.

Использованием указанных методов из международных питомников Septon и TSRM отобраны 25 устойчивых к листовой ржавчине образцов, а из 70 гибридных популяций F<sub>5</sub>, F<sub>6</sub> и F<sub>7</sub> - 22 линий.

**ПОЛИМОРФИЗМ МИКРОСАТЕЛЛИТНЫХ МАРКЕРОВ  
В КОЛЛЕКЦИИ СОРТОВ И ЛИНИЙ РИСА**

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Рис *Oryza sativa* L. является одной из важнейших стратегических сельскохозяйственных культур Казахстана. Целью данного исследования было изучение генетического разнообразия коллекции сортов риса с помощью микросателлитных маркеров. В коллекцию анализированных сортов риса входили 96 сортов и линий, среди которых 64 являются отечественными сортами и линиями, остальные образцы - из Европы, Ближнего Востока, Центральной и Юго-Восточной Азии. Всего в микросателлитном анализе было использовано 39 SSR-маркеров, равномерно локализованных по всем 12 хромосомам риса. В результате проведенных исследований изучен уровень генетического разнообразия коллекции риса, подсчитаны генетические расстояния между сортами, выявлены наиболее информативные микросателлитные маркеры риса, и составлен генетический паспорт всех коммерческих сортов Казахстана, допущенных к производству в Республике Казахстан. На основе полученных результатов построено филогенетическое древо изученных образцов и определены основные кластеры коллекции. Кроме того, осуществлен анализ внутрисортовой гетерогенности риса Казахстана. Результаты могут быть использованы в генетико-селекционных исследованиях при создании новых сортов риса Казахстана.

Работа выполнена в рамках проекта №0084/ГФ-2», поддержанного Министерством Образования и Науки Республики Казахстан по программе «Грантовое финансирование научных исследований» на 2012-2014 гг.

**ҚОҢЫР ТАТ (*PUCCINIA RECONDITA ROB. EX DESM.*) АУРУЫНА  
ТӨЗІМДІ ГЕНДЕРДІ ИДЕНТИФИКАЦИЯЛАУ**

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Бидай (*Triticum*) әлемнің көптеген елдерімен, оның ішінде Қазақстан үшін әлеуметтік және экономикалық тұрғыдан маңызды дақыл. Дәнді дақылдардың өнімділігінің төмендеуінің басты себепшісі тат ауруы және оны тудыруши санырауқұлақтар болып табылады. Соның ішінде Қазақстанның бидай еgetін аймақтарында қоңыр тат жыл сайын дамиды және жылма-жыл ауданының 4-тен 61% дейін тарайды, бұл шамамен 0,4-0,5-дан 2-3 дейін млн. га жерді құрайды (Қойшыбаев, 2008).

Тат ауруының қоздырығыштарымен химиялық әдіс арқылы құресу қымбат әрі нәтижесіз, сонымен қатар қоршаған органдың экологиялық балансын бұзып, ластануына әкеледі. Сондықтан тат аурулармен құресудің ең нәтижелі әдісі – бидай өнімін генетикалық тұрғыдан қорғау. Бұл мақсатқа жету үшін бидайдың тат ауруына төзімді донорларын, жаңа линиялары мен формаларын идентификациялау қажет. Әдебиет бойынша 67 ден аса қоңыр татқа төзімді ген табылып McIntosh каталогына енгізілген. Өкінішке орай бұл гендер тиімділігі жер шарының әртүрлі аймақтарында бірдей бола бермейді. Сондықтан бидай еgetін әртүрлі аймақтарға тиімді гендер мен донорларды анықтап генетика және селекция процесіне енгізіп, эффективті гендерді үнемі іздестіріп отыруымыз қажет.

Зерттеу объектісі ретінде 69 бидай үлгілері алынды. Соның ішінде халықаралық зерттеу тәлімбағынан (ICARDA) 47 линия, беларусиядан алып келген 22 бидай үлгілеріне зерттеу жүргізілді. Төзімді *Lr* гендерінің тасымалдаушыларын идентификациялау үшін ПТР анализі жүргізілді. Зерттеу жұмысының мақсаты *Lr10* және *Lr29* гендерінің тасымалдаушыларын анықтау. *Lr10*, *Lr29*, гендерін идентификациялау үшін STS (Sequence tagged site) *F1.2245/Lr10-6/r2* және SCAR (Sequence-characterized amplified region) *Lr29 F/R18* маркерлері қолданылды. *Lr29* 7DS хромосомада (*Procunier, 2004*), ал *Lr10* 1AS хромосомада (*Schachermayr et al. 1994*) локализацияланған. Амплификацияланған ДНҚ фрагменттерін бөлу үшін электрофорез жұмысы 2% агароза гелде жүргізілді. Бақылау ретінде *Lr10* (TC\*6/Exchange), *Lr29* (TC\*6/CS7AG#11(RL6080) изогенді линиялары қолданылды. *Lr29* ген тасымалдаушыларында 900 жұп нуклеотид, ал *Lr10* гені 310 жұп нуклеотид ДНҚ фрагменттінде амплификацияланды. ПТР нәтижесінде ICARDA линияларынан 21, ал Белорусиядан келген үлгілерден 14 бидай үлгісінің құрамында *Lr29* гені анықталды. Сонымен қатар зерттеуге алынған 15 бидай линиясында *Lr10* гені идентификацияланды. Анықталған генотиптерді будандастыру және қоңыр тат ауруына төзімділікті арттыру мақсатында селекция және молекулалық биология жұмыстарында қолдануға болады.

Зерттеу жұмысы Қазақстан Республикасының ауыл шаруашылық министрлігінің қолдауымен 212 қаржыландыру бағдармасының негізінде № 0112 РК014229 жобасы бойынша жүзеге асырылды.

**ГЕНОТИПИРОВАНИЕ КОЛЛЕКЦИИ КАРТОФЕЛЯ МЕТОДАМИ  
SSR- И SCAR-АНАЛИЗА**

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Коллекция картофеля, депонируемая *invitro* в лаборатории биотехнологии РУП «Научно-практический центр НАН Беларуси по картофелеводству и плодоовоощеводству», насчитывает более 400 образцов и включает в свой состав дикие виды картофеля, соматические гибриды и их потомство, первичные и вторичные дигаплоиды *Solanum tuberosum*, сорта и сортобразцы.

Для оценки генетического полиморфизма и идентификации образцов диких видов коллекции использован метод микросателлитного анализа. Оценивали полиморфизм 11 SSR-маркеров 41 образца 21 дикого вида картофеля, представляющих 16 серий по классификации С.М. Букасова (1971) и 10 серий – по классификации J.G. Hawkes(1990). Для анализа подобраны наиболее полиморфные по данным литературы SSR-маркеры, локализованные на всех 12 группах сцепления картофеля: STI005 (III и VIII хромосомы), STI009 (I), STI004 (VI), STI046 (XI), STI058 (V), STM 1106 (X), STI033 (VII), STI030 (XII), STM3023 (IV), STM1052 (IX), STM1064 (II) (Feingold et al., 2005; Ghislain et al., 2004, Milbourne et al., 1998). В общей сложности идентифицировано 117 аллелей в диапазоне 70-284 п.н., в том числе 24 – редких и 18 – уникальных. Наиболее полиморфным в данной выборке образцов является маркер STM1106 (19 аллелей), наименее - STM1052 (4 аллели). Максимальное количество редких и уникальных аллелей выявлено с помощью STM1106 (по 5 аллелей). Количество образцов, которое можно определить с помощью одного маркера, варьировало от 29 (для STI005) до 2 (STM1052). Для однозначной идентификации образцов этой выборки минимальный набор маркеров составили STI005, STM1106 и STI046. С помощью одного маркера – STI005 – можно различить образцы, не являющиеся потомством одной комбинации скрещивания. Исключением являются два образца вида *S.simplicifolium*, ведущих свое происхождение из разных источников.

SSR-анализ незаменим при изучении родства между образцами коллекции, в том числе для доказательства гибридности растений, регенерировавших после процедуры слияния при соматической гибридизации. Те же 11 SSR-маркеров, а также STM037 (XI), использованы для идентификации соматических гибридов в 3 комбинациях слияния: 7D, 8D, 12D. Анализ показал наличие нестабильности генетического материала растений-регенерантов, однако гибридов среди 36 проанализированных образцов не выявлено, все они являются протоклонами одного из родителей.

Для создания признаковой коллекции, в которой депонируемые образцы охарактеризованы по присутствию у них важных для селекции генов, отвечающих за устойчивость к болезням или за признаки качества, применяются SCAR-маркеры. Проведен скрининг более 90 образцов 23 диких видов на наличие восьми SCAR-маркеров к последовательностям, связанным с устойчивостью к золотистой (маркеры TG689 (Бирюкова и др., 2008), Gro-1-4 (Paal et al, 2004)) и бледной (Gpa2 (van der Voort et al, 1997), SPUD1636 (Bryan et al, 2002), HC (Achenbach et al, 2007)) картофельным нематодам, фитофторозу (RB629 (Pankin et al., 2011)), ВСЛК (NL27 (Marczewski et al, 2001), UBC864 (Marczewski et al, 2004)).

**ОТАНДЫҚ ПЕРИКАРПЫ БОЯЛҒАН КҮРІШ СОРТЫ  
СЕЛЕКЦИЯСЫНА ҚАЖЕТТІ БАСТАПҚЫ ЛИНИЯЛАРДЫ АЛУ**

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«Кара күріш» басқа күріш түрлерінен перикарпynyң «қою құлғін» немесе «қара» түске боялуымен ерекшеленеді. Перикарпynда көптеген пайдалы биологиялық белсенді қосылыстар (проантоксиандтер) болғандықтан қоректік құндылығы жоғары, дәні тек қана аршылады, бірақ түбекейлі ақталмайды. Құрамындағы клетчатка астың қорытылуына оң әсер етеді. Ақталған ақ күрішпен салыстырғанда витаминдер (В, Е, PP – тобының витаминдері) мен минералдарға, антиоксиданттарға, белокқа және макро-, микроэлементтерге өте бай. Луизиана университетінің ғалымдары (АҚШ) қара күріштегі антиоксиданттардың адам ағзасындағы «бос радикалдарды» шығару қабілетіне байланысты «жастық эликсирі немесе қарттықтың дәрісі» деп атады. Сонымен қатар, қара күріштегі проантоксиандар қан құрамындағы холестерин деңгейі мен триглицеридтер концентрациясын төмендетеді. Қара күрішті анемияны емдеуде, шаш тұсу, көз көруінің нашарлауы кезінде қолдануға болады. Жапон ғалымдары ішектер таза болу үшін таңғы асқа бір-екі қасық қара күріш өскінін немесе ұнын жеуді ұсынады. Ишектер таза болу үшін таңғы асқа қасық қара күріш өскінін немесе ұнын жеуді жапон ғалымдары ұсынады.

Қазақстан Республикасы аумағында егілуге рұқсат етілген Ауыл шаруашылығы дақылдарының реестріне күріштің 27 сорты енгізілген, бірақ перикарпы боялған күріш сорттары мүлде көрсетілмеген. Сонымен қатар, крахмал құрамында амилозасы көп ақ күрішпен салыстырғанда амилопектині көп перикарпы боялған қара күріштің нарықтық бағасы 5-6 есе қымбат. Бұл экономикалық пайда іздену тақырыбының өзектілігін арттырады. Осы мәселелерді ескере отыра, көзделген жұмыс мақсаты – перикарпы боялған алғашқы отандық күріш сортын шығаруға қажетті бастапқы линияларды дәстүрлі сұрыптау (будандастыру) жолымен алу.

Өсімдіктер биологиясы және биотехнологиясы институтының оранжереясында пневмокастрация және «ТВЕЛ» тозаңдандыру әдістері бойынша перикарпы боялған күріштің генотиптерін будандастыру жұмыстары жүргізілді. Дәннің технологиялық жәнебиохимиялық қасиеттерін арттыру мақсатында, аналық генотиптегінде перикарпы боялған күріштің ресейлік «Мавр» сорты және филиппиндік «Қара күріш» сорт үлгілеріпайдаланылды. Атальқ генотип ретінде Қазақстанның күріш еgetін аймақтарының экологиялық жағдайына бейімделген, жергілікті тәжірибелерінің нәтижесінде 43 түрлі комбинациядан 1879 күріш масақшалары тозаңдандырылып, F<sub>1</sub> ұрпақтың 607 гибридтік дәндер алынды. Гибридтік дәндер қалыптасу көрсеткіші – 30,1 %. Будандастыру міндеттерінің бірі – перикарпы боялған бастапқы глютинозды формалар алу. Бұл мақсатта глютинозды Виолетта және Мавр қара күріш сорттары реципрокты будандастырылды. Будандастару барысында гибридтік дәндердің түзілуі ♀Мавр x ♂Виолетта комбинациясында -27 % және ♀Виолетта x ♂Мавр комбинациясына – 16% құрды.

Жүргізілген жұмыстар нәтижесінде алынған гибридтік дәндер перикарпы боялған күріш селекциясына қажетті бастапқы құнды материал болып табылады.

**СРАВНИТЕЛЬНЫЙ АНАЛИЗ ГЕНЕТИЧЕСКОГО РАЗНООБРАЗИЯ  
КОММЕРЧЕСКИХ СОРТОВ СОИ *Glycine max* L.MERR.  
ИЗ КАЗАХСТАНА И РОССИИ**

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Соя является наиболее важной зернобобовой продовольственной, кормовой, а также технической культурой мирового земледелия. Селекции и семеноводству этой культуры придается особое внимание вследствие ее высокого экономического значения. Изучение генетического разнообразия и характеристизация сортового генофонда Казахстана и России проводились в основном только с использованием морфологических и биохимических маркеров. Однако развитие методов молекулярного маркирования позволяет использовать ДНК-маркеры, в том числе микросателлитные маркеры, как надежные дескрипторы для различения сортов паспортизации, генетического картирования, молекулярной селекции и др.

Основной целью работы является сравнительный анализ генетического разнообразия казахстанских и российских сортов сои с использованием SSR-маркеров. Проведена сравнительная оценка полиморфизма коллекции сои, состоящей из 15 сортов и 22 перспективных линий сои казахстанской селекции и 35 российских сортов на основе использования 29 полиморфных микросателлитных (SSR) маркеров, локализованных во всех 20 хромосомах генома сои. Определены индексы генетического разнообразия анализированной коллекции по Nei и Shannon, PIC, индекс информативности маркеров сои Казахстана и России. Установлены генетические расстояния между казахстанскими сортами с использованием 29 микросателлитных маркеров. На основе подсчета генетических расстояний между сортами построена дендрограмма по методу UPGMA, отражающая филогенетические различия анализированных сортов сои Казахстана и России. Разработаны генетические паспорта для каждого коммерческого сорта сои Казахстана на основе использования SSR-маркеров. Полученные результаты могут быть использованы для эффективной дискrimинации образцов сои из Казахстана, в усилении селекционных программ и охране прав селекционеров и селекционных достижений.

Работа выполнена в рамках проекта «Изучение генетического разнообразия и паспортизация коммерческих сортов зернобобовых культур» по Межгосударственной Целевой Программе ЕврАЗЭС МГ.0591 «Иновационные биотехнологии» на 2012-2014 годы.

## **АНАЛИЗ БЛОКОВ КОМПОНЕНТОВ АВЕНИНА ОВСА ПОСЕВНОГО И ОВСА ВИЗАНТИЙСКОГО В УСЛОВИЯХ ЛЕСОСТЕПИ ЗАУРАЛЬЯ**

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Гексаплоидные виды овса имеют один кариотип и характеризуются наличием одинакового генома ACD. Формирование гексаплоидных видов овса произошло в западной части Средиземноморья, откуда получил распространение культурный вид *Avena byzantina*. Продвигаясь на восток, они занимали всё большие пространства в районе Переднеазиатского центра, где появились мелкоплодные формы дикорастущих видов, образовавшие большое разнообразие дикорастущих и переходных сорных форм к культурным видам овса – *Avena sativa* (Лоскутов, 2007). Для анализа генетического разнообразия овса и идентификации биотипного состава современных сортов успешно применяется электрофорез запасных белков зерна – проламинов. Электрофоретические спектры проламина овса – авенина очень полиморфны, что позволяет использовать их для выявления видовой, внутривидовой и сортовой дифференциации. При изучении характера наследования и генетического контроля компонентов электрофоретических спектров авенина в результате гибридологического анализа было установлено, что выделенные компоненты наследуются группами (блоками) и контролируются тремя независимыми локусами: Avn A, Avn B, Avn C. Предположительно авенинкодирующие локусы находятся в трех гомеологичных хромосомах генома культурного гексаплоида (Портянко, Поморцев, 1987).

Целью наших исследований было изучение генетического разнообразия сортов овса посевного (*Avena sativa* L.) и овса византийского (*Avena byzantina* C. Koch.) по компонентному составу авенина методом электрофореза в полиакриламидном геле и описание полученных электрофореграмм в соответствии с каталогом генетической номенклатуры. Для одномерного электрофореза запасного белка овса применяли стандартную методику (Бушук, Зильман, 1978) с некоторыми модификациями. В качестве стандарта использовали зерновки овса посевного сорта Астор.

Сравнительный анализ полученных электрофореграмм показал, что все сорта имели отличный друг от друга и от стандартного сорта индивидуальный спектр авенина. У 65,9% изученных сортов овса посевного по локусу *Avn A* определен аллель 2. Аллель 1 был идентифицирован у четырех сортов, а аллель 3 у одного. По локусу *Avn B* самым распространенным оказался аллель 1, который обнаружен у 29 сортов. Аллель 4 встречался в спектрах у 43,9% сортов овса посевного, аллель 2 был обнаружен только у шести сортов. Среди аллелей локуса *Avn C* наиболее часто встречался в спектре сортов аллель 6. Аллель 1 определен у 14,6% исследуемых сортов. Аллель 2 идентифицирован у сортов Monida, RA 8098-9033, R0 ABDH, Краснообский, СИГ, Спринт 3, Таежник, Уран и Эльбрус. Аллель 3 – RA 8098-9033, Avalanche, Riby A, Slawko, Спринт 2, Спринт 3, Универсал 1, Дедал, Льговский 9 и Фобос. Аллель 5 определен у сортов Negrita, R0 ABDH, Аргумент, Креол и Спринт 2. Изученные сорта овса византийского имели те же аллели, что и сорта овса посевного, но частота их встречаемости заметно отличалась. По локусу *Avn A* был идентифицирован только аллель 2, который встречался у всех сортов. По локусу *Avn B* у овса византийского определены те же аллели, что и у овса посевного, но преобладал аллель 2 (62,5% исследуемых сортов), а аллель 1 был идентифицирован только у сорта 69G04. Наиболее распространенным аллелем по локусу *Avn C* был аллель 3, который встречался у 75% исследованных образцов. Аллель 6 был выявлен у 60% сортов овса византийского, а аллель 2 – у 12,5%. Возможно, полученные различия в электрофоретическом спектре авенина вызваны географической обособленностью вхождения видов *A.sativa* и *A.byzantina* в культуру.

**СЕЛЕКЦИОННО-ГЕНЕТИЧЕСКОЕ ЗНАЧЕНИЕ ФОРМИРОВАНИЯ  
ГЕНЕРАТИВНОЙ СИСТЕМЫ КАРТОФЕЛЯ В ГОРНОЙ ЗОНЕ  
ТАДЖИКИСТАНА**

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Сообщается о результатах исследований особенности формирования генеративных органов различных сортообразцов картофеля (*Solanum tuberosum L.*) в условиях горной зоны Таджикистана на высоте более 2700 м над уровнем моря. Здесь наблюдается различия по характеру формирования генеративной системы растений картофеля в зависимости от генотипа сортообразцов. Установлено, что образование цветков от общего количества бутонов составляет от 5 до 95%, а количество сформировавшихся ягод от 1 до 10 шт./растение или от 7,7 до 20,6% от общего количества цветков. Формирование ягод у сортов картофеля мало связано с количеством жизнеспособных пыльцевых зёрен в цветке.

Число семян в ягодах варьирует от 51 до 150 шт. и оно связано с жизнеспособностью пыльцевых зёрен картофеля. Одна ягода картофеля в среднем содержит около 96 шт. семян. Определено, что 16% сортообразцов картофеля образуют менее 10% жизнеспособных пыльцевых зёрен, что, это возможно, обусловлено частичной цитоплазматической стерильностью пыльцы. Как показали исследования, фертильность пыльцевых зёрен сортообразцов картофеля также сильно варьирует в зависимости от генетической особенности сортов.

Число семян в ягодах в определенной степени зависит от количества жизнеспособных пыльцевых зёрен у различных сортообразцов картофеля. Например, в одном ягоде у таких сортообразцов, как Кардинал, Клон 36/6 и Таджикистан содержится соответственно 51, 55 и 70 шт. семян, которые имеют от 25,3 до 80,3% жизнеспособных пыльцевых зёрен, когда у сортов Зарина, Пикассо и Дусти образуются соответственно 105, 115 и 150 семян в одном ягоде, которые имеют соответственно 83,7, 86,0 и 95,0% жизнеспособных пыльцевых зёрен.

Таким образом, полученные нами результаты свидетельствуют о том, что формирование и развитие таких генеративных органов картофеля, как бутоны, цветков, ягод, количество семян в ягодах, а также жизнеспособность пыльцевых зёрен на высоте 2700 м над уровнем моря вероятно, больше обусловлены генетическими особенностями сортообразцов картофеля. Эти признаки картофеля в горной зоне нашей республики подвержены большой изменчивостью, обусловленной взаимодействием экологических факторов и генотипов растений.

Знание особенности формирования генеративной системы картофеля, степени изменчивости и её полиморфизма в горной зоне представляет особый научный интерес для селекционно - генетических работах в будущем.

**СЕЛЕКЦИЯ ОЗИМОЙ ПШЕНИЦЫ НА ГОМЕОСТАЗ  
ДЛЯ УСЛОВИЙ БОГАРЫ КЫРГЫЗСТАНА**

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Пшеница в Кыргызстане выращивается во всех агроклиматических зонах и занимает большую часть пашни как не орошаемых, так и орошаемых земель. Богарные земли Кыргызстана различаются по влагообеспеченности – от обеспеченных осадками горной и предгорной зон, до засушливой богары в низинной зоне. Наиболее обеспеченные осадками (650 – 800 мм в год) богарные земли находятся в Иссык – Кульской долине, а наиболее засушливые земли (с количеством осадков 200 - 300 мм. в год) в Джалах Абадской, Баткенской и Ошской областях. Высокие урожаи пшеницы в Чуйской долине (7,0 – 8,0 т/га) можно получать в предгорной зоне, где выпадает достаточное количество осадков в весенний период. В зоне с недостаточным количеством осадков урожай не превышает 1,5 – 2,5 т/га, а засуха, проявляющаяся через каждые 2 – 3 года, часто сводит на нет все усилия хлеборобов. Получение стабильно высоких урожаев в условиях богары Кыргызстана возможно только путем создания засухо - и жаростойких сортов.

Селекционная работа по созданию засухоустойчивых сортов озимой пшеницы в Кыргызском НИИ земледелия ведется для условий обеспеченной и полуобеспеченной осадками богары. При этом основным направлением является создание сортов, отличающихся интенсивным развитием в весенний период, что позволяет уходить от «запала».

Адаптивный рекомбиногенез в селекции озимой пшеницы на гомеостаз позволил создать сорта с высоким потенциалом урожая и высокими технологическими показателями качества зерна.

В настоящее время на богарных землях республики возделываются следующие сорта озимой пшеницы селекции Кыргызского НИИ земледелия: Фрунзенская 60, Интенсивна, Эритроспермум 80, Эритроспермум 13, Эритроспермум 760, Адыр, Кайрак, Радюб и ЭХОЛ.

Урожай и качество зерна ЭХОЛ на сортоучастках Кыргызской Республики, 2011 – 2012 гг.

Таблица

Сорт	Ак - Суйская госсортстанция				Сокулукский сортоучасток				Бакай – Атинский сортоучасток			
	Уро- жай ш/га	Белок %	Клейко- вина, %	ЧП, сек	Урожай ш/га	Белок%	Клейко- вина, %	ЧП, сек	Уро-жай ш/га	Белок %	Клейко- вина, %	ЧП, сек
ЭХОЛ	4,871	13,1	27,4	320	3,92	11,3	23,0	327	4,18	15,8	29,0	270
Кыял, станд.	4,72	13,6*	31,3*	317*	3,78	11,2	23,2	321	3,80	15,5	34,2	220
Откл от станд.	0,15	-0,5	-3,9	3	0,14	0,1	-0,2	6	0,38	0,3	-5,2	50

\*Стандарт - Эритроспермум 760

## **ПОЛИМОРФИЗМ ДНК У СОРТООБРАЗЦОВ АБРИКОСА**

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В настоящее время решение современных генетико-селекционных задач связано с разработками и использованием эффективных методов анализа генетического полиморфизма. Одним из таких методов для идентификации сортов и гибридов косточковых культур является использование RAPD-маркеров. Как указывается в работе В.А.Высоцкого, О.В. Арклис, И.А. Цветковой (2007) на современном этапе идентификация растений построена с использованием ряда генетических методов.

Молекулярные маркеры, количество которых постоянно расширяется на основе развития ДНК-технологий, находят широкое применение для изучения генетического разнообразия растений (Анисимов, 2005).

В ходе экспериментальной работы при сравнении двух протоколов экстракции нуклеиновых кислот, на основе СТАВ метода при выделении нуклеиновых кислот из абрикоса по протоколу Thomas T.A. and Tanksley S.D. (1990), выявлено, что этот метод способствовал получению более «чистой» ДНК. Дополнительную очистку выделенной ДНК во всех случаях осуществляли хлоридом лития (Фортэ и др., 2002).

Для амплификации ДНК использовали праймеры: Paw S5, Paw S6, Paw S11, Paw S16, а также их комбинации: PawS5+PawS6, PawS5+PawS11, PawS6+PawS11, PawS6+PawS16, PawS11+PawS16. В результате исследований показано, что наиболее эффективной в выявлении полиморфизма ДНК абрикоса оказалась комбинация праймеров – PawS5+PawS11. С использованием остальных праймеров и их комбинаций полиморфизм был выражен слабо или не выявлен.

Режим амплификации для PawS5+PawS11 по программе: 5 мин. при 94°C – начальная денатурация, следующих 35 циклов: 30 сек. денатурация ДНК – 94 °C, 30 сек. отжиг праймеров – 54 °C, 1 мин. синтез комплементарной цепи – 72 °C, последний цикл синтеза 7 мин. – 72°C.

В качестве ПЦР смеси использовали коммерческий набор «PCR core» (ООО «Компания Биоком») содержащий ингибиранную для "горячего старта" Таq ДНК полимеразу, дезоксинуклеозидтрифосфаты и хлорид магния с конечными концентрациями, соответственно, 1μ 200 мКМ и 2,5 mM, а также оптимизированную буферную систему для проведения одной стандартной PCR. Электрофорез продуктов амплификации проводили в 1,7% агарозном геле в присутствии бромистого этидия. Визуализацию результатов электрофореза осуществляли в ультрафиолете.

На основе праймеров PawS5+PawS11 проанализированы 4 сорта абрикоса: Графиня, Кунач, Саровский, Орловчанин и две формы: абрикос №2 из Красноярска, 6-47 Байкалова.

У сортов абрикоса основные фрагменты находятся в зоне работы маркера от 200 до 1250 п.н. Для большинства исследованных генотипов характерно наличие фрагментов в зоне 200-350 п.н., у сорта Графиня и Саровский таких фрагментов нет. Вторым характерным моментом является наличие фрагмента в зоне 400-500 п.н., кроме образцов взятых с формы 6-47 Байкалова, Кунач, Саровский. В зоне 750 п.н. обнаружены сходные фрагменты у всех сортообразцов. Фрагмент в зоне 1050 п.н. присутствует только у абрикоса Саровский и Орловчанин, в зоне 1150 п.н. у формы 6-47 Байкалова и у сортов Саровский, Орловчанин.

**ОСНОВНЫЕ БОЛЕЗНИ ДИКИХ СОРОДИЧЕЙ КУЛЬТУРНЫХ  
РАСТЕНИЙ ХРЕБТА КАРАТАУ**

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Для получения новых высокопродуктивных и устойчивых сортов культурных растений необходимо изучение патогенной микобиоты их диких сородичей, используемых в селекции. Материалом для настоящей публикации послужили результаты ревизии образцов Гербарного фонда Института ботаники и фитоинтродукции, анализа литературных данных и собственные сборы авторов на территории хребта Карагатау, выполненные по целевой программе «Ботаническое разнообразие диких сородичей культурных растений Казахстана как источник обогащения и сохранения генофонда агробиоразнообразия для реализации Продовольственной программы».

На территории хребта Карагатау отмечено 9 наиболее вредоносных болезней диких сородичей культурных растений.

Для яблони на территории хребта Карагатау наиболее вредоносна мучнистая роса, (возбудитель - *Podosphaera leucotricha* (Ell. et Ev.) E.S.Salmon). Распространенность мучнистой росы в ущелье Итмурын достигает 20% при интенсивности поражения 10-15%. На всех видах сливы отмечены так называемые «кармашки» или «дутики», вызываемые *Taphrina pruni* Tul. Распространенность болезни составляет 30,5% при интенсивности поражения от 20 до 40%. На плодах груши Регеля наблюдается парша (возбудитель - *Venturia pyrina* Aderh.) с распространностью 20,5% и интенсивностью поражения от 0 до 20%. Большинство экземпляров ежевики поражается ржавчиной (возбудитель - *Phragmidium bulbosum* (Fr.) Schltl.). Распространенность болезни составляет от 35,5 до 60% с интенсивностью поражения 25-45%. На представителях рода *Rosa* повсеместно наблюдается поражение ржавчиной, возбудителями которой являются 3 вида рода *Phragmidium* (*Ph. devastatrix* Sorokin, *Ph. rosae-acicularis* Liro, *Ph. tuberculatum* Jul. Müll.). Из них поражение *Ph. devastatrix* легко отличить по образующимся «ведьминым метлам», распространность этой болезни составляет 10-35,5% с интенсивностью поражения 1-5%. Остальные два вида при поражении дают сходные симптомы, распространность болезни 35,5-40% с интенсивностью поражения 10-15%. В ущелье Узын-Каракуыз отмечено единичное поражение жимолости черной пятнистостью (возбудитель - *Rhytisma lonicerae* P. Henn.), в ущелье Киши-Каракуыз (урочище Тесиктас) обнаружена пятнистость листьев, вызываемая двумя представителями редкого рода грибов: *Kabatia periclymeni* (Desm.) M. Morelet var. *periclymeni* и *K. persica* (Petr.) B. Sutton.

На многочисленных представителях злаков обнаружена мучнистая роса (возбудитель - *Blumeria graminis* (DC.) Speer). В ущельях реки Коктал и Итмурын, почти в чистых зарослях эгилопса, расположенных в густой тени, распространность болезни составляет 100% с интенсивностью поражения от 60 до 100%. Распространенность мучнистой росы на ячмене и мяты достигает 62,4% и 10-25% с интенсивностью поражения 20-40% и 10-80%, соответственно. Отмечено поражение головней (возбудитель - *Ustilago cynodontis* (Pass.) Henn.) свинороя в урочище Кок-Булак, ущелье Байжансай, ущелье реки Кошкар-ата, г. Кентау, распространность болезни составляет 43,7% с интенсивностью поражения 30-80%. Пятнистость листьев мяты (возбудитель – *Ascochyta graminicola* Sacc.) отмечена в ущельях Итмурын и Киши- Каракуыз. Распространенность болезни составляет не более 10% с интенсивностью поражения 10-50%. На образцах амории в ущелье Итмурын обнаружена ржавчина (возбудитель - *Uromyces trifoli-repentis* Liro), распространность болезни составляет 3,5% с интенсивностью поражения от 5 до 50%.

**ЭКОЛОГИЧЕСКИЕ ИСПЫТАНИЯ ОБРАЗЦОВ ЯЧМЕНЯ ИЗ ШТАТА МОНТАНО (США) В УСЛОВИЯХ АЛМАТИНСКОЙ ОБЛАСТИ**

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Н.И. Вавилов в 30-х годах XX-столетия разработал и реализовал экологическое испытание образцов сельскохозяйственных культур. Основной принцип экологического испытания образцов сельскохозяйственных культур в различных почвенно-климатических условиях - это изучение одинакового набора образцов конкретной культуры по единой методике и выделение высокопродуктивных форм, адаптированных к конкретной почвенно-климатической зоне.

Создание новых сортов для конкретных регионов Казахстана обусловлено с тем, что они резко отличаются по почвенно-климатическим условиям. Учитывая особенности почвенно-климатических условий регионов Казахстана, создание новых сортов ячменя является актуальной проблемой.

Почвы стационара отдела зернофуражных культур ТОО «КазНИИЗиР» в Алматинской области - светло-каштановые, суглинистые. Содержание гумуса в пахотном слое достигает 1,9-2,0%. Климат резко-континентальный.

За вегетационный период (с апреля по июль) развития растении ячменя в 2012 году температура воздуха в среднем за вегетацию составила 17,9°C, относительная влажность воздуха 55%, количество осадков за весь период вегетации растении ячменя 263,0 мм, а в 2013 году 18,9°C, влажность 54%, 369,4 мм соответственно.

Согласно вышеуказанным данным по количеству атмосферных осадков и температурного режима, относительной влажности воздуха в период вегетации растении ячменя имеются резкие различия, которые существенно повлияли на количественные и качественные признаки растении и в целом на урожайность изучаемых номеров.

В результате полевых и лабораторных исследований, несмотря на резкие различия погодных условий по годам, из 96 номеров ячменя стабильно высокую кустистость и высокую урожайность зерна показали следующие номера: 2083, 2091, 2200, 2213, 2217, которые имеют большую практическую ценность для использования в селекционной работе.

## **СКРИНИНГ СОЛЕУСТОЙЧИВЫХ ОБРАЗЦОВ ЯРОВОЙ МЯГКОЙ ПШЕНИЦЫ**

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В Республике Казахстан в областях Приаралья, Прикаспия и Прибалхашья наблюдается интенсивное засоление, что приводит к увеличению площади солончаковых пустынь в бессточных бассейнах и вторичному засолению орошаемых земель. В связи с этим перед агропромышленным комплексом страны стоит задача повышения урожайности зерновых культур и введения в культурное земледелие солеустойчивых форм, в том числе и главной продовольственной культуры – пшеницы с использованием достижений современной биологической науки (Cramer и др., 2002; Sharma, и др., 2013; Shahzad и др., 2013).

Скрининг перспективных солеустойчивых образцов яровой мягкой пшеницы, проведен на образцах, находящихся на заключительных этапах селекционного процесса. Материалом для исследования послужили 77 перспективных образцов яровой мягкой пшеницы, отобранные по продуктивности в селекционных питомниках: КП, ПСИ, КСИ. Хотя все стадии развития растений чувствительны к засолению, у большинства видов растений наиболее чувствительна стадия проростков (Удовенко, 1977; Munns, и др., 2002; Арипов и др., 2006; Терлецкая, 2012).

Нами для оценки солеустойчивости образцов использованы разработки ВИРа – метод оценки энергии прорастания и определения процента всхожести семян при солевом стрессе на растворах солей NaCl и Na<sub>2</sub>SO<sub>4</sub>. Определяли относительный прирост биомассы проростков в условиях солевого стресса, а также проводили оценку всхожести семян перспективных образцов в полевых условиях на участках с повышенным содержанием соли в условиях Кызылорды.

Установлено, что в условиях солевого стресса имеют место межсортовые и внутрисортовые различия. Наибольшее подавление ростовых процессов отмечено на хлоридном типе засоления. Кроме того, выявлена зависимость энергии прорастания и всхожести семян от концентрации солей, что свидетельствует о степени солеустойчивости перспективных образцов.

В лабораторных условиях и в условиях повышенного содержания солей на полевых участках в Кызылорде наиболее устойчивыми были образцы 363/975 (Мироновская-808 x Лютесценс-719/99), 371/959 (Актюбинка x Саратовская-42), 1841 (Стекловидная-24 x Саратовская-29), 1844 (Мироновская юбилейная x Женис), 1254/2341 (Лютесценс-782/153 x Омская-18), 1880 (Мироновская-808 x Казахстанская-10), 1851 (Мироновская-808 x Казахстанская-10), которые показали высокий процент всхожести (80-100%). Образцы из питомника конкурсного сортоиспытания (227 (Целинная-60 x Женис), 222 (Целинная-3С x Женис), 289 (Целинная-3С x Лютесценс-719/99) по приросту биомассы проростков в условиях солевого стресса превысили стандартные сорта Целинная-3С и Казахстанская-10. Эти образцы отнесены к потенциально солеустойчивым.

В результате проведенных исследований экспериментально показано, что отбор перспективных солеустойчивых образцов с использованием лабораторных методов, а затем их полевое испытание в стрессовых условиях и экологическая оценка выделенных образцов позволяют за короткое время достичь положительных результатов и создать солеустойчивые сорта пшеницы.

Работа выполнена при финансовой поддержке МОН Республики Казахстан в рамках проекта грантового финансирования № 0085.

**СЕЛЕКЦИОННОЕ ИЗУЧЕНИЕ КОЛЛЕКЦИИ ДВУРЯДНОГО  
ЯЧМЕНИ В УСЛОВИЯХ ЦЕНТРАЛЬНОГО КАЗАХСТАНА**

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Важное значение в селекции ячменя является знание характера изменчивости количественных признаков в зависимости от генотипа и факторов среды, особенно при работе с новой коллекцией. Результаты наших исследований коллекции ячменя из США (578 образцов) 2010-2013 гг. показали, что более высокой продуктивностью в условиях Центрального Казахстана выделялись образцы двурядного ячменя разновидности нутанс и медикум. У этих образцов наиболее сильно варьировали по годам масса зерна с растения и колоса ( $V=71,0\%$  и  $V=67,7\%$ ). В меньшей степени варьировали значения таких признаков, как продуктивная кустистость ( $V=46,2\%$ ) и длина верхнего междоузлия ( $V=38,6\%$ ); в значительно меньшей степени - признаки масса 1000 зерен ( $V=19,3\%$ ) и высота растений ( $V=13,3\%$ ). Существенное влияние на изменчивость элементов структуры урожая оказывали погодные условия и генотип сорта. Определение корреляционных связей показало, что между основными хозяйственными признаками и урожайностью у двурядных ячменей наблюдается устойчивая положительная связь. Отмечена достоверная, положительная корреляционная между урожайностью зерна и массой зерна с колоса ( $r=0,760\pm0,138$ ). Выявлена достоверная средняя положительная связь между урожайностью зерна, с одной стороны, и числом зерен в колосе ( $r=0,495\pm0,185$ ), крупностью зерна ( $r=0,366\pm0,198$ ), высотой растений ( $r=0,347\pm0,200$ ), с другой. Слабая корреляционная связь наблюдалась между урожайностью и продуктивной кустистостью ( $r=0,207\pm0,209$ ), длиной верхнего междоузлия ( $r=0,152\pm0,210$ ) и вегетационным периодом ( $r=0,152\pm0,210$ ).

Для количественной оценки стабильности урожая 10 лучших образцов двурядных ячменей США, выделившихся по урожайности зерна в 2011-2013 годах, использовались параметры-коэффициент регрессии их урожая на изменение условий года ( $bi$ ) и среднее квадратическое отклонение ( $Si^2$ ) фактических урожая от линии регрессии. Эти показатели позволили выделить лучшие образцы, наиболее стабильные по продуктивности в различных условиях среды. Коэффициент регрессии ( $bi$ ) характеризует отзывчивость образцов, как на улучшение, так и ухудшение условий выращивания. К первой группе были отнесены образцы 2131, 2091, 2114, у которых коэффициент регрессии ( $bi$ ) оказался больше единицы - 1,36; 1,39; 1,34, соответственно. Эти линии в благоприятные годы формировали довольно высокую урожайность, однако в засушливые годы резко снижали её. Самым нестабильным по продуктивности оказался номер 2091, у которого  $Si^2$ , равнялся 14,09. Образцы 2131, 2117 имели низкий показатель стабильности ( $Si^2$ ) - 3,17; 4,53, соответственно, поэтому урожайность их более прогнозируемая. Ко второй группе отнесены образцы с  $bi=1$ , это - 2637, 2266, 2367. Они хорошо отзываются на изменение условий среды, также незначительно отличаются между собой по средней урожайности (17,4 ц/га и 18,1 ц/га, 17,6 ц/га), характеризуются невысокими показателями  $Si^2$  - 0,19; 2,80; 3,82, соответственно, и представляют интерес для дальнейшей селекционной проработки.

В результате исследований выделена линия 2637, со средней урожайностью за годы испытания 17,4 ц/га, коэффициентом регрессии  $bi=1,09$  и самым минимальным показателем  $Si^2=0,19$ , характеризуется хорошей засухоустойчивостью, экологической пластичностью и его продуктивность, можно прогнозировать с большей вероятностью. По итогам испытаний 2014 г. линия 2637 будет передана на испытание ГК СИСК РК.

**СЕЛЕКЦИЯ ЯЧМЕНЯ НА ПОНИЖЕННОЕ СОДЕРЖАНИЕ  
ФИТИНОВОЙ КИСЛОТЫ В ЗЕРНЕ КУЛЬТУРНОГО ЯЧМЕНЯ  
*HORDEUM VULGARE L.***

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Одним из признаков полноценного кормового ячменя является повышенное содержание неорганического фосфора в зерне. Содержание неорганического фосфора в зерне отрицательно коррелирует с содержанием фитиновой кислоты. Пониженное содержание фитиновой кислоты (ПСФК) является важным признаком сбалансированного зерна ячменя, предназначенного для кормления сельскохозяйственных пород животных. Мутантная форма *lpa1* (*low phytic acid*, пониженное содержание фитиновой кислоты) американского сорта Харрингтон был скрещена с высокоурожайным японским сортом Мисато Голден. В результате скрещивания были получены 124 F<sub>2</sub> линии, которые сегрегировали по признаку ПСФК. В результате анализа было отобрано 12 высокоурожайных линий с ПСФК и повышенным содержанием фосфора в зерне. Полученные образцы введены в селекционный процесс и скрещены с отечественными районированными сортами ярового ячменя.

**СКРИНИНГ КОММЕРЧЕСКИХ СОРТОВ ПШЕНИЦЫ  
С ИСПОЛЬЗОВАНИЕМ SSR МАРКЕРА УСТОЙЧИВОСТИ  
К ФУЗАРИОЗУ КОЛОСА**

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Во всем мире фузариоз колоса относится к одному из самых опасных заболеваний зерновых. Наряду с потерями урожая, вызванными снижением полевой всхожести семян, уменьшением количества зерен в колосе, а также массы тысячи зерен, заражение приводит к ухудшению хлебопекарных или пивоваренных качеств зерна. Заболевание отмечается на пшенице и ржи в основном в северной части Казахстана во влажные годы с пониженной температурой, что удлиняет сроки созревания хлебов. Возбудителями болезни являются несовершенные грибы из рода *Fusarium* — чаще всего *F. graminearum* Schw. и *F. avenaceum* Sacc. К моменту вызревания хлебов грибы образуют грибницу и конидиальное спороношение в виде красноватых подушечек локализованных не только на колосе и зерне, но и на влагалищах листьев, узлах и изредка у основания стеблей. При прорастании зерна грибница фузариозных грибов может проникать в стебель и развиваться в нем, однако вне проводящей системы. Фузариоз колоса может быть причиной шуплости зерна и потери его всхожести. Наибольшая опасность грибов *F. graminearum* и *F. culmorum* связана с тем, что они приводят к продуцированию в пораженном зерне опасных для человека и животных токсинов, таких как деоксинаваленол, зеараленон и др.

Целью исследования было проанализировать коллекцию коммерческих сортов на наличие генов устойчивости к фузариозу с использованием микросателлитного маркера *Xgwm533-3B*. В ходе исследования был проанализирован 81 коммерческий сорт пшеницы, обладающих разной степенью устойчивости к грибным заболеваниям. В ходе анализа было выявлено семь специфичных аллельных вариантов (98, 118, 120, 130, 140, 145 и 175) для данного маркера в исследуемых сортах. Также в четырех сортах был обнаружен неспецифический аллель 300 (300 п.н.): два сорта были получены из питомника “Septmon”, другие два сорта/линии имели в своем геноме Lr-гены. Наиболее часто встречающимся аллельным вариантом оказался аллель 130, он был выявлен в 71 сорте, как в гомозиготном состоянии, так и в комбинациях с другими аллелями. Наибольший интерес в нашей работе представлял поиск сортов, имеющих в своем геноме аллели 98 и 145, как наиболее перспективные маркеры устойчивости к фузариозу. Аллельный вариант 98 был выявлен в 16 сортах, из них в 4 сортах — в гомозиготном состоянии. В случае аллеля 145, он был выявлен всего в одном сорте/линии LR23. Также к наиболее редким аллельным вариантам можно отнести аллели 118 (в четырех сортах), и аллели 120 и 140 в двух отдельных сортах. Выявленные аллели в изученных сортах встречались как в гомозиготном, так и гетерозиготном состоянии. Большинство из изученных сортов (66) имели всего один аллель, в основном аллель 130. В остальных пятнадцати сортах было обнаружено по несколько аллельных вариантов. Из казахстанских сортов искомый аллель 98 был выявлен в сортах Прогресс, Женис, Акмола 2, Целинная-Юбилейная, Карабалыкская 19, Дербес и Сапалы.

**СЕЛЕКЦИЯ УСТОЙЧИВЫХ СОРТОВ ХЛОПЧАТНИКА  
К ЧЕРНОЙ КОРНЕВОЙ ГНИЛИ**

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Одним из путей решения проблемы устойчивых форм хлопчатника является повышение адаптивного потенциала хлопчатника, т.е. создание устойчивых или слабовосприимчивых сортов, которое во многом зависит от изучения взаимодействия генотипа и среды, выявления генетических и морфофизиологических механизмов, обеспечивающих адаптивные способности к устойчивости стрессовым фактором среды, поиска доноров высокоустойчивых или хотя бы слабовосприимчивых форм хлопчатника среди существующего ассортимента сортов, линий, образцов, гибридных популяций и включения их в селекционный процесс.

Устойчивость к черной корневой гнили сортов и гибридов хлопчатника определяли по степени их поражаемости в весенний период вегетации.

Вовлеченный в эксперимент набор сортов достоверно различались между собой по устойчивости к черной корневой гнили. Слабая поражаемость отдельных гибридных комбинаций: М-4007 x Мырзашөл-80, Атакент-2010 x М-4007, хотя и превышало родительские показатели, но разница была в пределах НСР.

Из изученных 15 прямых гибридных комбинаций в 10 случаях доминировала высокая поражаемость черной корневой гнилью, в одном случае доминировал лучший родитель и два гибрида проявили негативный гетерозис, что в нашем опыте положительно для донора устойчивости.

Лучшими сортами по ОКС оказались М-4007, Мырзашөл-80, Атакент-2010, т.е. у этих сортов их абсолютные показатели соответствовали эффектам ОКС. Анализ соотношения варианс ОКС к вариансам СКС позволяет считать, что устойчивость форм Атакент-2010 и М-4007 управляема аддитивными генами. У остальных сортов восприимчивость к этому заболеванию контролируется неаддитивными генами. Проведенный полигенный анализ по модели Хеймана позволяет предположить, что для наследования устойчивости к черной корневой гнили характерно явление неполного доминирования. Линия регрессии ось коварианс выше начало координат, отношение НД = <1. В генотипе сортов М-4005 и Береке-07 расположенных в нижней части графика Хеймана, высокая восприимчивость к этой болезни управляема в основном доминантными аллелями. В генотипах сортов Мырзашөл-80, М-4007, Атакент-2010 преобладают рецессивные аллели.

Таким образом, из экспериментальных данных следует, что устойчивость к черной корневой гнили является рецессивным признаком и в F<sub>1</sub>, доминирует восприимчивость к черной корневой гнили.

В гибридных комбинациях с участием сортов, обладающих устойчивостью к черной корневой гнили, отмечена более частая вероятность последующего выделения растений и семян с повышенными хозяйствственно-ценными признаками и наследуется в F<sub>2</sub> в пределах 0,38-0,42, а в F<sub>3</sub> – 0,38-0,43. Из чего видно, что действительно имеется возможность выявления растений и семян слабо восприимчивых к черной корневой гнили.

В результате исследований получены более 20 семей и линий слабо поражающихся черной корневой гнилью, как весной, так и осенью. Все эти семьи и сортообразцы могут быть использованы в качестве исходного материала для селекции сортов устойчивых к черной корневой гнили.

**МЕЖДУНАРОДНОЕ СОРТОИСПЫТАНИЕ ОЗИМОЙ ПШЕНИЦЫ  
КАЗАХСКОЙ И КЫРГЫЗСКОЙ СЕЛЕКЦИИ**

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Озимая пшеница в странах Центрально-Азиатского региона в основном возделывается на богарных землях (необеспеченная, полуобеспеченная и обеспеченная). На орошении же она возделывается на небольших площадях – Узбекистане, Таджикистане, Туркменистане, Кыргызстане и очень в небольшом объеме в Казахстане, которые не превышают в целом 5-6% что составляет порядка 50 тыс. га. Тем не менее, урожайность на орошении намного превышает урожай на богарных землях (4-5 раз). Однако качество зерна не высокое, в основном относится к филлеру реже к ценной пшенице. Высокое качество зерна, как правило, формируются на богарных землях и в основном на полуобеспеченной и жесткой богаре. Последние два десятилетия мы ведем Международное сортоиспытание на Госсортов участках Кыргызстана и Таджикистана благодаря этому выделены новые адаптированные к различным экологическим зонам этих республик 17 сортов озимой мягкой пшеницы селекции КазНИИЗиР. В статье приведены данные урожайности и составляющие основных показателей продуктивности, а также качественные показатели полутора десятков сортов Кыргызской и Казахской селекции последних лет экологического испытания (2006-2012гг).

Отмечено, что уровни урожайности сортов интенсивного типа достаточно высоки и составляет от 87 ц/га до 94,4-95,3 ц/га у сортов Карасай и Алия, у стандарта Киял до 70 ц/га, а на богаре от 42,5 до 58,3 ц/га.

Среди возделываемых сортов как на орошении, так и на богаре следует особо отметить высокопродуктивный сорт Казахской селекции - Карасай, как по урожайности, так и высокому содержанию белка и клейковины, которые соответственно составляют: урожайность - 94,4 ц/га, а на богаре 58,3 ц/га, содержание белка 15,9% и содержание клейковины 35,4% и число падения по фориногрофу 359 е. Это в селекции явление очень редкое, так как с повышением урожайности адекватно падает качество.

Думается, что этот новый сорт редкостный генотип, где интегрированы два очень важных показателя - высокая продуктивность и высокое качество.

Автор благодарит работников Государственной комиссии по сортоиспытанию с.-х. культур МСХ Кыргызской Республики О.А. Тен, Н.Г. Аубекерову и М.К. Джунусову, Н.Н. Позднякову за проведенную большую работу по сортоиспытанию и проведенные многочисленные анализы, рекламацию сортов в престижных сборниках Республики и Международных конференциях.

**СОПРЯЖЕННОЕ ДАВЛЕНИЕ ЕСТЕССТВЕННОГО И  
ИСКУССТВЕННОГО ОТБОРОВ И ЭВОЛЮЦИЯ СОРТОВ  
ЗЕРНОВЫХ КУЛЬТУР**

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Адаптивное растениеводство основывается на эффективном использовании глобальной закономерности это – «генотип х средовое взаимодействие», т.е. нахождение оптимальной экологической ниши для каждого агроэкотипа и внутри его сортов и линий. Это закономерность установленная учеными в различных контрастных регионах нашей планеты есть и работает независимо от желаний человека. Вся эволюция живого биоразнообразия в нативной природе происходит под давлением естественного отбора, а в деле создания культиваров идет сопряженное действие естественного и искусственного отборов. В силу этого происходит сильное и значительное дифференциация генотипов внутри сорта и гибридных популяций. В зависимости от особенностей почвенно-климатических условий той или иной экологической зоны естественный отбор селектирует группу сходных, наиболее адаптивных к тем или иным особенностям среды генотипы, где опытный селекционер лишь фиксирует этот генотип.

Считается, что генетическая устойчивость сорта поддерживается стабильностью, составляющих сорт биотипов и, как правило, она контролируется главными олигогенами, а фенотипическая часть изменчивости, в основном, зависит от действия геномодификаторов, которые, в свою очередь, также зависят от напряженности давления естественного отбора конкретной экологической ниши. Сорта самоопыляющихся культур в связи с глобальными и локальными изменениями климата во времени и пространстве испытывают сопряженное давление этих отборов и сорт, как динамическая система не может 100% сохранить свой первоначальный вид, т.е. свои мажорные и минорные биотипы. Однако это не следует понимать превратно, что оригинальный генотип сорта с течением времени изменяется. Сорт всегда сохраняет свою внутреннюю структуру, но лишь в зависимости от локальных и годовых изменений климата те или иные биотипы несколько ингибируется, но не исчезают.

Даются определения: видов адаптации в целом и относительно к отдельным генотипам. Независимо от почвенно-климатических особенностей агроэкологических зон, генотипов сортов и агроэкотипов, в целом, такие базовые показатели как: вегетационный период, фотoperиодизм, морфо-анатомические параметры, генетически сформировавшиеся в течение филогенеза являются в основном консервативными и менее подвержены влиянию временных флуктуаций и, наоборот, многие количественные признаки продуктивности в той или иной степени подвержены давлению естественного и искусственного отборов.

**НЕСПЕЦИФИЧЕСКАЯ УСТОЙЧИВОСТЬ СОРТОВ ОЗИМОЙ  
ПШЕНИЦЫ К ВОЗБУДИТЕЛЯМ ЖЕЛТОЙ И СТЕБЛЕВОЙ  
РЖАВЧИНЫ ПШЕНИЦЫ**

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Экономически выгодным, экологически безопасным приемом борьбы с болезнями растений является селекция и использование сортов, защищенных различными типами неспецифической устойчивости, длительно сохраняющими этот признак и положительно влияющими на стабилизацию популяций фитопатогенов (Анпилогова и др., 2002).

Цель: определение типов устойчивости сортов озимой пшеницы к возбудителям желтой и стеблевой ржавчинам пшеницы в условиях камеры искусственного климата.

Методы проведения исследований: типы устойчивости сортов пшеницы к возбудителям желтой и стеблевой ржавчинам в условиях камеры искусственного климата определяли по критериям: продолжительность латентного периода (сутки); доля проявившихся пустул на единицу листовой поверхности (%); тип реакции (балл) (Макаров и др., 1998).

Результаты исследований:

На основании качественной и количественной полевой характеристики сортов, а также данных литературы (Волкова, 2005; Волкова, Анпилогова, 2006; Волкова и др., 2008; 2009; 2012) к желтой ржавчине отобрано 12 сортов озимой пшеницы (Зимница, Иришка, Краснодарская 99, Кремона, Ласточка, Первница, Победа 50, Ростислав, Селянка, Соратница, Старшина, ЮМПА) для дальнейшего изучения в камерах искусственного климата, к стеблевой ржавчине отобраны 9 сортов озимой пшеницы (Аксинит, Аскет, Верта, Brule, Золотко, Коллега, Красота, Первница, Юнона).

На основании полученных данных можно предположить, что по отношению к желтой ржавчине сорта Зимница, Иришка, Первница защищены специфическим типом устойчивости, по отношению к стеблевой ржавчине этим типом устойчивости характеризуются сорта пшеницы Верта, Золотко, Коллега, Первница, Brule. Эти сорта не будут поражаться патогенами до тех пор, пока в популяции не появятся новые фенотипы, способные поразить эти сорта (в среднем 3-5 лет). Сорта Краснодарская 99, Кремона, Ласточка, Победа 50, Ростислав, Селянка, Соратница, Старшина, ЮМПА обладают неспецифической устойчивостью к желтой ржавчине. По отношению к стеблевой ржавчине неспецифическим типом устойчивости обладают сорта Аскет, Аксинит, Красота, Юнона. Эти сорта будут снижать риск возникновения эпифитотии изучаемых патогенов и рекомендуются для использования в сельскохозяйственном производстве и в селекции, как источники неспецифической устойчивости.

**СТЕКЛОВИДНОСТЬ ЗЕРНА У СОРТОВ, ВИДОВ И МЕЖВИДОВЫХ  
ГИБРИДОВ ПШЕНИЦЫ**

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Стекловидность пшеницы является одним из важных признаков качества зерна. Она характеризует мукомольные достоинства пшеницы — крупообразующую способность и выход высоких сортов муки.

Стекловидность зерна характеризует консистенцию его эндосперма. Стекловидность указывает на белковый или крахмалистый характер зерна. Показатель стекловидности наряду с цветом положен в основу деления пшеницы на подтипы. По стандарту на пшеницу продовольственную, заготовляемую в I и IV типах, чем выше подтип, тем выше ее стекловидность: в 1-м подтипе - не менее 75%, во 2-м - не менее 60%, в 3-м и 4-м - не менее 40% и в 5-м - менее 40%. Пшеница с преобладанием стекловидных зерен обычно отличается сравнительно высоким содержанием белка, клейковины и хорошими хлебопекарными качествами. Пшеница, состоящая в основном из крахмалистых зерен, бедна белком, и ее лучше использовать для хлебопечения в подсортировке к другой более богатой белками пшенице.

Общую стекловидность зерна ( $O_c$ ) в процентах вычисляют по формуле:

$$O_c = \frac{P_c + \frac{Q_c}{2}}{2}$$

где:  $P_c$  – количество полностью стекловидных зерен, шт.;  $Q_c$  – количество частично стекловидных зерен, шт

Общую стекловидность вычисляют до первого десятичного знака с последующим округлением результата до целого числа.

В наших опытах виды *Triticum turgidum* L. ( $A^uA^uBB$ ), *Triticum macha* Dek. et. Men. ( $A^uA^uBBDD$ ) и *Triticum compactum* Host. ( $A^uA^uBBDD$ ) относятся к разным подтипам пшеницы по стандарту – от I до V, а сорта Саратовская-29, Мироновская-808 и Ленинградка – вид *Triticum aestivum* L. ( $A^uA^uBBDD$ ) – относятся к I подтипу, т.е. имеют высокое качество зерна.

Самый высокий процент общей стекловидности – 97% был в комбинации *T. turgidum* L. x Мироновская-808 (самоопыление), 1 тип (по расщеплению морфологических признаков),  $F_4$ , а самый низкий – у вида *T. turgidum* L. – 26%. Однако при скрещивании вида *T. turgidum* L. с видом *T. aestivum* L. – сорта Саратовская-29, Ленинградка, Мироновская-808, процент общей стекловидности был высоким, он колебался от 43% до 96%, с преимуществом в сторону стекловидных зерен.

В комбинациях (*T. turgidum* x Саратовская-29) x свободное опыление,  $F_2$ , *T. turgidum* x Ленинградка (самоопыление),  $F_4 BC_1$ , *T. turgidum* x Мироновская-808 (самоопыление),  $F_4$ , (*T. turgidum* x *T. macha*) x самоопыление,  $F_6 BC_1$  зерно относится к I подтипу, т.е. имеет высокое качество, что делает работу с ним перспективной. Кроме того, потомства от скрещивания культурных сортов с дикорастущими формами пшеницы, как правило, являются устойчивыми к грибным болезням, что в сочетании с высокой урожайностью и высоким качеством зерна делает их перспективными донорами новых сортов пшеницы.

Низкое качество зерна было в комбинациях *T. turgidum* x Ленинградка (самоопыление), 3 тип (по расщеплению),  $F_4 BC_1$  и *T. compactum* x Ленинградка, 2 тип (по расщеплению),  $F_4 BC_2$  – зерно по стандарту относилось к III, IV подтипам. Однако и такое зерно было по внешнему виду отличным, урожайность растений высокой, и, таким образом, эти потомства можно с успехом использовать для получения фуражных сортов пшеницы.

## **Секция 3.**

# **Физиология и биохимия растений**



## ОСОБЕННОСТИ БИОСИНТЕЗА ИЗОПРЕНОИДОВ В КУЛЬТУРЕ КЛЕТОК РАСТЕНИЙ

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Культура растительной клетки является уникальной, экспериментально созданной биологическая система, представляющая собой гетерогенную популяцию дедифференцированных соматических клеток. Принципы развития этой системы основаны на автоселекции клеток по признаку интенсивной и/или устойчивой пролиферации. Вторичный метаболизм в клетках *in vitro*, очевидно, должен отличаться от такового в клетках интактных растений. В культуре клеток все соединения должны образовываться в пролиферирующей гетеротрофной клетке с относительно небольшим количеством пластид и вакуолей. Можно предполагать, что МВА путь образования изопреноидов, проходящий в цитозоле, будет более интенсивен, чем МЕР путь, протекающий в пластидах. Также можно предположить, что при отборе клеток по интенсивности пролиферации будут активно и стабильно образовываться соединения, способствующие росту и делению клеток.

Для культур клеток *Dioscorea deltoidea* было показано, что в клетках *in vitro* образуются только фуростаноловые гликозиды, которые имеют антиоксидантные свойства и способствуют пролиферации клеток. Содержание фуростаноловых гликозидов в биомассе клеток находится на уровне 6 – 12% к сухой биомассе и стабильно в течение почти 40 лет выращивания культуры. Основными гликозидами клеток *in vitro* являются протодиосцин, находящийся в листьях интактных растений, и дельтозид, который характерен для корневищ. Важно отметить, что в культивируемых клетках диоскореи дельтовидной появляются 26-S-изомеры протодиосцина и дельтозида, которые в интактных растениях в детектируемых количествах не обнаружены.

В культурах клеток двух видов женьшения *Panax ginseng* и *Panax japonicus* образуются как минимум семь тритерпеновых гликозидов (гинзенозидов), содержание которых в клетках *in vitro* может достигать 5 -8% в сухой биомассе. Однако, в отличие от фуростаноловых гликозидов диоскореи, их содержание часто нестабильно и сильно зависит от условий выращивания культуры. Известно, что в культивируемых клетках женьшения гинзенозиды представлены преимущественно гинзенрзидами Rg-группы (агликон - протопанаксатриол). В исследовании последних лет установлено, что гинзенозиды Rb-группы также присутствуют в клетках *in vitro* в значительных количествах, но находятся в виде сложных эфиров с малоновой кислотой, что связано, вероятно, с необходимостью их вакуолярной компартментации.

В отличие от образования тритерпеноидов, формирование дитерпеноидов (стевиол-гликозидов) в культурах клеток стевии *Stevia rebaudiana*, начинается только в миксотрофных культурах клеток и коррелирует с формированием в них хлоропластов.

Несмотря на особенности вторичного метаболизма в клетках высших растений *in vitro*, а во многом благодаря им, культуры клеток являются перспективными источниками промышленно-ценных вторичных метаболитов для медицины, пищевой и косметической промышленности. Обсуждаются проблемы выращивания культур клеток в биореакторах промышленного объема для получения коммерчески– ценных изопреноидов.

**СИСТЕМА ОЦЕНКИ И ОТБОРА ГЕНОТИПОВ ПО КАЧЕСТВУ  
ЗЕРНА ПШЕНИЦЫ: ГЕНЕТИЧЕСКИЙ, БИОХИМИЧЕСКИЙ И  
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Разработана система оценки качества зерна в селекции, включающая биологический(генетический) потенциал и фенотипическая его реализация по данным о белковых системах) и технологический уровень (характеристика пригодности зерна как сырья промышленности).

Эффективность отбора наиболее качественных форм и их контроль в процессе селекции осложнены комплексностью оценки по качеству зерна и необходимостью значительного объема селекционного материала.

Обоснована перспектива развития оценки качества зерна по двум параллельно прогрессируемых направлениям, не исключающим друг друга: создание и внедрение скоростных аналитических систем, позволяющих в значительной степени повысить экспрессность традиционных трудоемких, массовых и длительных методов; поиск и адаптация новых методов прогнозирования качества, в том числе и маркерных.

Принципиально выбор уровня интерпретации данных по качеству зерна определяется целями и задачами селекционной программы, генетических исследований. В свою очередь, они обуславливают перечень методов и их оптимальную регламентацию использования по этапам процесса браковки и отбора в селекции. Для каждого уровня интерпретации характерны свои признаки, методы их определения и селекционные параметры.

В представленной серии работ осуществлены: 1) методические разработки2) маркирование генетических систем качества зерна и совершенствование системы его оценки обеспечивающей дифференциацию селекционных программ по конечному типу использования зерна (пшеница – хлебопекарное, кондитерское, макаронное, ячмень – пивоваренный, крупяной, кормовой, кукуруза, сорго – пищевое, кормовое, техническое и т.д.) с учетом кормового и непищевого (биотехнологического) использования и перевода селекции на MAS-уровень, 3) мониторинг формирования качества зерна в стрессовых условиях действия засухи, вредителей и болезней и оптимизация его использования; 4) мониторинг качества сельскохозяйственной продукции в системе почва-растение-продукт (зерно) по биохимическим, технологическим свойствам и параметрам экологической безопасности и питательной ценности; 5) создание базы данных по высококачественным образцам (доноры и источники) для формирования и регистрации коллекций генетических ресурсов пшеницы, ячменя, овса, тритикале, кукурузы, сорго, сои, сафлора, риса и др. 6) определение и оптимизация зон выращивания сельскохозяйственных культур различного технологического типа стабильных по урожаю и качеству на основе моделей генотип средовых взаимодействий.

На основе использования разработанной системы оценки и интерпретации качества зерна созданы сорта с/х культур, ранжированные по технологическому типу на базе биохимических и технологических свойств зерна и генетической классификации как гаранта его воспроизведения.

**ПРОДУКТИВНОСТЬ ЯРОВОЙ ПШЕНИЦЫ В ЗАВИСИМОСТИ ОТ ПОГОДНЫХ УСЛОВИЙ И УСЛОВИЙ ВЫРАЩИВАНИЯ****К. А. Акшалов**

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Посевы яровой пшеницы в структуре посевных площадей Северного Казахстана занимают до 87,5 % (Статистические данные Р.Казахстан, 2013г.). Яровая пшеница, возделываемая в засушливых условиях, потенциально обладает высоким содержанием протеина и обладает высокой конкурентоспособностью на мировых рынках (Кузьмин, 1978, Бараев, 1988). Яровая пшеница является главной и более устойчивой денежной культурой по сравнению с другими культурами. В зависимости от погодных условий в течение вегетационного периода содержание клейковины в зерне яровой пшеницы изменяется от 30-35 % до 19-20 % и, в зависимости от технологии возделывания, содержание клейковины изменяется от 30-32 % до 19-20% (Сулейменов, Акшалов, 2011). Интенсивные и почво-, ресурсосберегающие технологии возделывания в благоприятные по увлажнению годы повышают урожайность яровой пшеницы до 3,5-4,0 т/га, но не всегда повышают количество и качество клейковины. В среднем за много лет в зависимости от условий выращивания урожайность яровой пшеницы колеблется от 0,5 т/га до 2,4 т/га. При посеве яровой пшеницы по паровому полю в благоприятные по увлажнению годы урожайность ее повышается до 4,0 т/га, однако количество клейковины снижается до 18-20% и ниже. В отдельные годы вегетация яровой пшеницы затягивается до октября месяца и при недостатке солнечной радиации и высокой урожайности яровой пшеницы формируется зерно низкого качества. Такие научные данные были получены 2009, 2013 гг. В засушливые годы содержание клейковины несколько выше по паровому полю, чем по стерневым предшественникам, однако уровень содержания клейковины высокий как по паровым полям, так и по стерневым предшественникам. При технологии прямого посева складываются особые условия развития растений яровой пшеницы по сравнению с традиционными методами возделывания. Яровая пшеница при прямом посеве развивается медленнее в первые фазы развития, особенно в засушливые годы. Содержание клейковины в зерне яровой пшеницы ниже при прямом посеве по сравнению с традиционными методами возделывания сравнительно ниже. Применение азотных удобрений несколько повышает содержание клейковины, но в увлажненные годы способствует растягиванию вегетационного периода и созреванию зерна пшеницы. В благоприятные по увлажнению годы при высоком коэффициенте кущения яровой пшеницы формируется ярусность стеблестоя и колосьев и неравномерное созревание зерна в нижних и верхних колосьях стеблестоя. Устойчиво высокое качество зерна пшеницы формируется при определенном, но невысоком уровне урожайности. В более засушливой зоне на каштановых почвах формируется более устойчивое и стабильное по качеству зерно пшеницы, но производство зерна пшеницы - неустойчивое.

Длительные исследования показывают, что устойчивое получение зерна пшеницы высокого качества зависит как от погодных условий, так и от уровня урожайности. Климатические ограничения, связанные с резкими изменениями погодных условий и возможными изменениями климата в целом, усугубляют данные проблемы. В связи с изменением методов выращивания меняются условия развития растений яровой пшеницы. Необходимы совместные исследования физиологов, климатологов, биотехнологов и земледельцев для разработки более устойчивых технологий и выведения сортов, направленных в большей степени на устойчивое производство зерна высокого качества.

## ВЛИЯНИЕ АБИОТИЧЕСКОГО СТРЕССА НА АНТИОКСИДАТНУЮ СИСТЕМУ РАЗНОТОЛЕРАНТНЫХ ГЕНОТИПОВ КАРТОФЕЛЯ

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Стрессовые условия, такие как засуха, высокая температура, накопление соли в почве провоцируют в клетках растений сверхпродукцию активных для кислорода в виде синглетного кислорода, супeroxидрадикала, перекиси водорода и гидрооксида радикала являющихся сильными окислителями, накопление которых повреждают структуру белков, ДНК и мембран хлоропластов, митохондрий и цитозоля. О степени повреждения мембранны в условиях стресса, обычно судят по накоплению малоновогодиальдегида продукт перекисного окисления липидов мембран (ПОЛ). Образующийся при стрессе супeroxидрадикале нейтрализуется при участии супeroxиддисмутазы (СОД) с образованием перекиси, которые ликвидируются с участием комплекса ферментов таких как каталаза, пероксидаза, аскарбатоксидаза и др. Вместе с тем показана роль перекиси водорода в передаче сигналов включающих защитные системы растений от стрессовых воздействий.

Показана, также роль каротиноидов в ослаблении генерации синглетного кислорода в процессе фотосинтеза, защищающего растения от гибели. Имеются работы, указывающие на важную роль СОД в антиоксидантной защите при действии стрессов, однако данные об изменениях СОД в тканях солеустойчивых и температура устойчивых растений картофеля практически отсутствует. Для этого у растений клон гибридов картофеля выращенных на средах с 300 mMNaCl в условиях *invitro*, исследовали реакцию на окислительный стресс.

В результате 4-х недельного действия засоления происходила деградация хлорофилла и накопление МДА – малоновогодиальдегида. У одних клон гибридов засоление и высокая температура не вызывала большого накопления МДА, у других происходило резкое увеличение уровня окислительных реакций. Показано, что высокая концентрация NaCl внесенная в среду культивирования картофеля *invitro* вызывала колебательный процесс ПОЛ при длительном их культивировании. Устойчивые клон гибриды к NaCl в меньшей степени повреждались и имели низкий уровень активности ПОЛ, чем уклон гибридов неустойчивых к NaCl. Для клон гибридов, устойчивых к засолению показано значительное превышение активности супeroxиддисмутазы (СОД), чем для клон гибридов не обладающих устойчивостью к NaCl. При повышении температуры до 47<sup>0</sup>C в течение 24 ч, у всех клон гибридов наблюдали колебательную динамику ПОЛ к температурному фактору, но размах колебаний у температуруустойчивых был меньше выражен, чем для клон гибридов не устойчивых к этому стрессовому фактору. Для клон гибридов устойчивых к высокой температуре показана высокая активность супeroxиддисмутазы (СОД) по сравнению с клон гибридами.

Таким образом, устойчивость к засолению и температуре связана с низким и/или отсутствием реакции перекисного окисления липидов (ПОЛ) и повышенным уровнем активности супeroxиддисмутазы (СОД), что можно объяснить высокой устойчивостью некоторых клон гибридов к окислительному стрессу, что имеет большое фундаментальное и практическое значение.

## КУМАРИНЫ В КОРНЯХ И КОРНЕВИЩАХ ДЯГИЛЯ *ARCHANGELICA OFFICINALIS*

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Обычно в литературе рассматривают результаты исследований высушенного сырья лекарственных растений. Поскольку в процессе хранения нередко происходит изменение состава генуинных биологически активных веществ, нами изучено содержание кумаринов в свежеотобранных образцах корней и корневищ дягиля лекарственного. Образцы растений *Angelica archangelica* L были заготовлены за несколько дней до промерзания почвы на территории опытного участка Башкирского госуниверситета. Свежие корни и корневища измельчали при комнатной температуре и заливали 96% этанолом. Через два часа первую порцию экстракта, содержащую гликозиды, замораживали в холодильнике, а оставшийся материал повторно экстрагировали в течение суток 96% этанолом для выделения кумаринов. Вторая порция представляла экстракт в 80% этаноле, его упаривали под вакуумом при комнатной температуре до состояния «смолки», которую растворяли в  $\text{CHCl}_3$ , затем помещали его в холодильник. Через сутки выдерживания хлороформного экстракта при -10°C наблюдалось его расслоение на две фракции: верхнюю, окрашенную в желто-оранжевый цвет, и нижнюю со слабо выраженной окраской.

После разделения был проведен анализ с использованием хромато-масс-спектрометра *Thermo Finnigan* – *Finnigan 800*, масс-спектрометра высокого разрешения МАТ-95XP ЭВМ “Delta” с системой обработки данных “Data Sistem”.

В окрашенной фракции обнаружены 0,41% бергаптола, 0,41% мармезина, 0,20% ороселона, 0,07% необиакангеликола. В этой же фракции было отмечено высокое содержание этилглюкопиранозида - 35%. Не исключено, что в процессе экстракции гликозидированные кумарины подверглись гидролизу.

Основная часть кумаринов (61,3%) была сосредоточена в нижней фракции, где идентифицированы: остол, ороселон, ороселол, гидрат оксипеуцеданина, метоксипрангенин, геракленола-эфир, прангенин (эпоксид императорина), изоимператорин (4-пренилоксипорален), биак-ангелицин, 5-гидрокси-7метокси-2-метил-6-(3-метил-2-бутенил)-4Н-1-бензопиран-4-он, императорин (8-пренилоксипорален), изопимпинеллин, ангелицин, бергаптен (5-метоксипорален), метоксален (8-метоксипорален).

Идентифицированные фуранокумариновые соединения обладают противоопухолевой и противовирусной активностью. В частности, прангенин подавляет репродукцию респираторно-синцитиального вируса (RS-вируса), являющегося наиболее частой причиной воспалительных реакций у детей. Представляет интерес наличие в корнях дягиля императорина и изоимператорина, блокирующих L-потенциалзависимые кальциевые каналы, снижающих концентрацию ионов  $\text{Ca}^{2+}$  в кардиомиоцитах, и оказывающих сосудорасширяющее действие. Императорин подавляет также активность матриксных металлопротеиназ, препятствуя апоптозу нейронов после временной ишемии мозга.

Таким образом, свежеотобранные корни и корневища дягиля, выращенного в Уральском регионе характеризуются высоким содержанием пренилированных фурокумаринов, сопоставимым по составу с азиатскими видами *A.sinensis*, *A. keiskei* и *A. daurica*. Полученные результаты позволяют рассматривать подземные органы дягиля как перспективное сырье для получения препаратов для профилактики когнитивной дисфункции, нейроповеденческих нарушений и гипертонии.

**Ключевой доклад**

**РОЛЬ ПРОГРАММИРОВАННОЙ ГИБЕЛИ КЛЕТОК  
В ИНДУКЦИИ И ДЛИТЕЛЬНОМ ПОДДЕРЖАНИИ ТОТИПОТЕНТНОСТИ  
*IN VITRO* У ЗЕРНОВЫХ ЗЛАКОВ**

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Принципиально важным моментом в изучении процесса соматического эмбриогенеза является изучение самых ранних его этапов. При этом важно выяснить не только сигналы и индукторы этого процесса, но и механизмы, заставляющие дифференцированную клетку *in vitro* переключаться на другой путь развития (Бутенко, 1999). Длительно культивируемые рыхлые эмбриогенные (РЭ) каллусы являются удобными модельными системами для изучения этих вопросов, так как они имеют одноклеточное происхождение эмбриоидов и отзывчивы к регуляции морфогенеза при помощи фитогормонов и трофических факторов.

Методами световой и электронной микроскопии проведено исследование влияния фитогормонов на состав клеточных популяций длительно культивируемых РЭ каллусов пшеницы и ячменя в сравнении с неэмбриогенными тканями (рыхлыми и компактными). В результате, нами выявлены особенности эмбриогенных каллусов, резко отличающие их от неморфогенных тканей: наличие клеток с признаками программируемой клеточной смерти (ПКС) или апоптоза, накопление густой сети кислых мукополисахаридов в межклеточном пространстве, обособление сферических эмбриогенно-компетентных клеток при помощи каллозной оболочки. Показано, что возрастание пропорции клеток с признаками ПКС в РЭ тканях под действием 2,4-Д сопровождается усилением накопления экстрацеллюлярных полисахаридов (ЭПС) и стимуляцией роста и эмбриогенного потенциала каллусов. Методами гистохимии и цитохимии (электронная микроскопия) обнаружено, что ЭПС имеют протеогликановую природу и секрецииются клетками с признаками ПКС в процессе их гибели. При помощи биотестов *in vivo* и *in vitro* установлено, что кислые фракции секреции ЭПС обладают антиауксиновой активностью, т.е. ингибируют рост клеток растяжением, стимулируемый 2,4-Д; повышают устойчивость растений к стрессам; приводят к обособлению клеток каллуса при помощи каллозной оболочки и перепрограммированию их на эмбриоидогенный путь развития; стимулируют рост каллусных тканей.

На основании проведенных исследований предложена гипотетическая схема, демонстрирующая цикличность процессов инициации и дезинтеграции соматических эмбриоидов (СЭ) в длительноtotипотентных эмбриогенных каллусах. Высокие концентрации 2,4-Д (5,0-7,0 мг/л) оказывают стрессовое действие на клетки каллусов, блокируют процесс дальнейшей дифференциации 4-х, 8-ми клеточных проэмбрио и глобул, вызывая их дезинтеграцию. При этом эмбриоиды распадаются на клетки с признаками ПКС и одиночные клетки, которые под действием секреции ЭПС детерминируются и вступают на путь эмбриоидогенеза. Инициированные проэмбрио также могут вновь диссоциировать на клетки с признаками ПКС и одиночные клетки. Так в ходе многократного субкультивирования каллусов поддерживается их эмбриогенный потенциал. При снижении концентрации 2,4-Д до 1,0 мг/л стрессовое действие фитогормона снижается, ПКС не происходит, и СЭ полностью дифференцируются вплоть до формирования целого растения.

В целом, нами показана важная роль апоптоза и секреции ЭПС в ходе этого процесса полисахаридов в переключении клеток каллусов на эмбриоидогенный путь развития, в регуляции формы и размеров клеток, в поддержании пула эмбриогенно компетентных клеток при субкультивировании, а также процессов дифференциации СЭ и роста каллусных тканей.

Работа поддержана грантами ПФИ МОН РК (2003-2005г.), (2006-2008г.).

**РЕГУЛЯЦИЯ СИНТЕЗА БЕЛКОВ ТЕПЛОВОГО ШОКА И  
ТЕРМОУСТОЙЧИВОСТИ ПРОРОСТКОВ *ARABIDOPSIS THALIANA*  
БЕЛКАМИ HSP90**

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Активный синтез белков теплового шока (*heat shock protein*, HSP) является частью стрессовой реакции и способствует повышению термоустойчивости у различных организмов. Их генная экспрессия индуцируется путем взаимодействия транскрипционных факторов теплового шока (HSF) в форме активных тримеров с элементами теплового шока (HSE), расположенными в промоторе генов *HSP*. Существуют генетические доказательства отрицательной регуляции этого процесса по принципу обратной связи. Одним из гипотетических механизмов поддержания HSF в неактивной мономерной форме является их связывание с цитозольными HSP90. Изучение этого вопроса проводилось на проростках *Arabidopsis thaliana* путем ингибиторного анализа с использованием гелданамицина (ГДА) - специфического ингибитора HSP90. Изучали влияние ГДА на синтез HSP70 и HSP90 и теплоустойчивость проростков. При этом ожидалось, что ингибирование функциональной активности шаперона приводит к высвобождению HSF и образованию ими активных тримеров, способных индуцировать экспрессию генов *HSP*. Накопление HSP, в свою очередь, должно вызывать повышение устойчивости растений к стрессам.

Проростки выращивались в стерильных условиях на агаризованной среде при  $24 \pm 1^{\circ}\text{C}$  и 16-ч фотопериоде. ГДА использовали в концентрациях 1, 10 и 100 мкМ. С использованием метода иммуноблотинга показано, что обработка антибиотиком проростков вызывает дозозависимую активацию синтеза HSP70 и HSP90 в нестрессовых условиях. К увеличению содержания этих белков в проростках приводила и обработка антибиотиком семян. В том случае, когда проростки, выращенные из обработанных семян, подвергали тепловому стрессу, уровень индукции синтеза HSP70 и HSP90 был значительно выше, чем без обработки. Результаты анализа этих белков апроксимируются на другие семейства HSP. Кроме того, обработка семян ГДА приводила к дозозависимому усилению термоустойчивости проростков. В целом, полученные результаты подтверждают роль белков HSP90 в негативной авторегуляции стрессового ответа и термоустойчивости растений.

## МИНЕРАЛЬНОЕ ПИТАНИЕ *IN VITRO* НЕКОТОРЫХ ЯГОДНЫХ КУЛЬТУР

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Выращивание растений в закрытой системе на искусственных питательных средах и использование современных методов анализа (атомно-эмиссионной спектрометрии, ионной хроматографии, CHNS-анализатора) позволит создать полезную модель для изучения системы минерального питания плодовых и ягодных культур. Искусственные питательные среды для выращивания *invitro* позволяют полностью контролировать качественный и количественный состав макро- и микроэлементов при посадке растений и в конце пассажа на этапах размножения и укоренения.

Объектами исследований явились растения-регенеранты сортов смородины черной (Церера, Память Вавилова) и аронии черноплодной (Вениса) на различных этапах культивирования *invitro*; агаризованные питательные среды.

Методы проведения исследований- биотехнологический (культура апикальных меристем и микроразмножение *invitro*) и физико-химические: ионная хроматография, атомно-эмиссионная спектроскопия, CHNS-анализатор.

Культивирование смородины чёрной на питательной среде для микроразмножения в течение 5 недель привело к существенному снижению концентрации большинства ионов в питательной среде. Максимальное уменьшение отмечено для  $\text{NH}_4^+$  (80,11 – 87,17 %),  $\text{H}_2\text{PO}_4^-$  (58,48 – 62,28 %) и  $\text{NO}_3^-$  (56,75 % – 62,02 %), на  $\frac{1}{3}$  часть уменьшается количество  $\text{K}^+, \text{Mg}^{2+}, \text{Cl}^-$  и  $\text{SO}_4^{2-}$ .

На этапе укоренения растения-регенеранты смородины чёрной максимально поглощают из питательной среды  $\text{H}_2\text{PO}_4^-$  - в среднем 88,5 % от исходного количества в среде. Хорошо усваивается азот, как в нитратной (до 64,37 %), так и в аммонийной форме (до 76,88 %). Поглощение иона  $\text{SO}_4^{2-}$  составляет более  $\frac{1}{2}$  от исходного количества в среде. На этапе ризогенеза уменьшается относительное потребление аммонийного азота, калия и хлора, в то же время увеличивается - магния, кальция, серы и фосфора, по сравнению с этапом микроразмножения.

На этапе микроразмножения *invitro* регенерантами аронии и черноплодной массовом отношении максимально используется нитратная форма азота ( $\text{NO}_3^-$ ), затем в порядке убывания:  $\text{K}^+, \text{NH}_4^+, \text{H}_2\text{PO}_4, \text{SO}_4^{2-}, \text{Cl}^-, \text{Ca}^{2+}, \text{Mg}^{2+}$ .

В процессе культивирования эксплантов происходит существенное снижение концентрации основных элементов питания, концентрация ионов, которые незначительно расходуется эксплантами в процессе роста, через месяц культивирования становится выше первоначальной.

Из изученных микроэлементов ( $\text{Mn}, \text{Zn}, \text{Fe}, \text{B}, \text{Cu}$ ) смородина черная максимально потребляет марганец, арония – железо. Накопление микроэлементов в растениях-регенерантах, соответствует их потреблению из питательных сред.

## СРАВНИТЕЛЬНОЕ БИОХИМИЧЕСКОЕ ИЗУЧЕНИЕ ОСОБЕННОСТЕЙ СОРТОВ ПШЕНИЦЫ И ЕЕ ДИКИХ СОРОДИЧЕЙ

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Стратегия современной селекции направлена на создание сортов и гибридов сельскохозяйственных культур, сочетающих высокую продуктивность и качество урожая с повышенной адаптивностью к неблагоприятным условиям среды. Успех селекционной работы во многом зависит от наличия исходного материала для селекции, а также от эффективных методов их оценки и знания физиологического-биохимических механизмов, определяющих качество урожая и устойчивость к стрессовым факторам различной природы.

Объектами исследования служили дикорастущие виды рода *Aegilops L.* (*Ae. cylindrica*, *Ae. crassa*, *Ae. tauschii*, *Ae. triuncialis*) и четыре сорта мягкой пшеницы (сорта Пандаки, Бобило, Сафедак и Марви).

Содержание крахмала и белка в зернах пшеницы зависит от генотипических и природного климатических факторов. Однако строгой закономерности не наблюдается, хотя намечается некоторая тенденция к увеличению содержания крахмала и белка при более оптимальных условиях.

Биохимическому составу виды *Aegilops L.*, изучено недостаточно. Отсюда вызывает большой научный интерес изучение некоторых видов эгилопса, собранных в различных экологических зонах Таджикистана.

Полученные результаты показали, что у всех изученных четырех образцов эгилопса, содержание крахмала в зерне варьировало в пределах от 20.2 до 25.7 соответственно.

По содержанию белка в зерне дикорастущие виды имели большие пределы изменчивости – от 24.0 до 34.5%.

Относительно низкое значение данного показателя установлено у образца *Ae. tauschii* и *Ae. cylindrical*, произрастающего в условиях Файзабадского района (24.0 – 25.2%), а наибольшее - у *Ae. triuncialis*, произрастающего в условиях Эсанбайского района (34.5%).

Интересно отметить, что у изученных видов эгилопса по уровню накопления основных компонентов зерна (крахмала и белка) по сравнению с изученными сортами пшеницы наблюдалась противоположная картина. У видов эгилопса во всех случаях содержание белка в зерне было больше, чем содержание крахмала.

Таким образом, изучение содержания крахмала и белка их содержания в зерне различных сортов пшеницы и видов эгилопса выявили неоднозначное в проявление этих показателей в зависимости от видового состава растений и условий. Показано, что экологические условия мест произрастания, наряду с генетическими особенностями каждого вида, оказывают влияние на биосинтез и уровень накопления главных компонентов зерна. При этом некоторые сорта пшеницы и отдельные образцы эгилопса по содержанию белка в зерне сильно отличаются и могут быть использованы в селекционном процессе как доноры по показателю высокой белковости зерна.

## ПЕРСПЕКТИВНЫЕ ГИБРИДЫ САХАРНОГО СОРГО ДЛЯ РЕСПУБЛИКИ КАЗАХСТАН

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Обладая значительным потенциалом продуктивности биомассы с содержанием сладкого сока на уровне сахарного тростника, гибридное сахарное сорго приобрело всемирный интерес в качестве растения с большими экономическими возможностями. К такому заключению пришли специалисты стран Северной Америки и Европы, а также из ряда других стран (Китай, Индия, Бразилия). Проблема возделывания и промышленной переработки сахарного сорго выносится на более высокий уровень, поскольку успешностью данной культуры, особенно в странах с континентальным и засушливым климатом, каким является Республика Казахстан, становится возможным в короткие сроки решить возникшие проблемы, относящиеся не только к земледелию, сохранению почвенного плодородия, зоотехнии, но и к пищевой промышленности, восстановлению экологического равновесия и т.д. В этих целях, традиционными методами селекции, в Республике Молдова выведены гибриды сахарного сорго, которые по своим морфологическим и хозяйственным признакам: толщина стебля 30 - 45 мм, его высота 3,7 - 4,5 м и увеличенные размеры листьев, % клетчатки (35-38 %) и содержание сахаров в соке стебля до 16-20%, являются аналогами сахарному тростнику. Из них, гибриды Порумбень 4 и Порумбень 5, SAŞM 1 и SAŞM 2 районированы в РМ и в соседних странах. Данный тип гибридов обеспечивает получение урожаев биомассы до 80 - 90 т/га на богаре и свыше 130 - 140 т/га при орошении. Гибрид Порумбень 4 в сортоиспытании ЕС в 2008 году стал лидером по урожайности биомассы- 184 т/га. В сравнении с сахарным тростником, вегетационный период этих гибридов в 3-4 раза короче, а растения в 7-8 раз экономнее используют почвенную влагу, удовлетворительно переносят засоление почв, не поражаются болезнями и вредителями, устойчивы к полеганию стеблей при ветрогонах и передержке урожая на корню, хорошо приспособлены для комбайновой уборке (Г. Морару, 2000; 2012).

Из 100 т биомассы, переработанной на технологической линии сахарного сорго, можно получать до 50-55 т сусла 14-16% сахаристости и 25-30 т сухой биомассы- багасса, а в варианте силосования- до 19-23 т кормовых единиц или свыше 25 тыс. м<sup>3</sup> биогаза. Переработка отжатого сока обеспечивает получение 8-10 т/га сахарного сиропа, близкого по качеству к пчелиному мёду или 4,5-5 т/га биоэтанола (в варианте пиролиза всей массы с 1 га - до 11 т биосолярки или 18 т биоэтанола). Из 30 т багассы сорго можно получать 16 - 18 тыс. м<sup>3</sup> биогаза или количества брикетов достаточного для выработки 15- 17 тыс. квт/ч электрической энергии с побочным получением столько же тепловой энергии. Один гектар гибрида сахарного сорго молдавской селекции за вегетационный период, поглощает из атмосферы до 55 т CO<sub>2</sub> (широколиственный лес умеренных широт всего 16-18 т/га/год), а в результате контролируемого разложения сильно развитой корневой системы (до 14-16 т/га сухой массы) обеспечивается улучшение плодородия почвы положительным балансом гумуса до 1,5-2 т/га/год. При орошении гибридов возможна монокультура, а в варианте без орошения приемлемо следующее чередование культур: сахарное **сорго**- горох (другие бобовые)- озимая пшеница и опять сорго. Технология возделывания этих гибридов аналогична технологии силосной кукурузы.

**ВЛИЯНИЕ ПРИРОДНЫХ ФАКТОРОВ НА СО<sub>2</sub>/Н<sub>2</sub>О ОБМЕН  
ДРЕВЕСНЫХ РАСТЕНИЙ ТАЕЖНОЙ ЗОНЫ СЕВЕРО-ЗАПАДА  
РОССИИ**

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Происходящие изменения климата и антропогенная деятельность оказывают заметное влияние на наземные экосистемы. Прогноз реакции растений на эти изменения имеет, несомненно, первостепенное значение для оценки вероятных последствий глобального изменения климата на биосферу. Однако до сих пор вопрос о возможных ответных реакциях видов, сообществ и экосистем в разных регионах на прогнозируемые изменения среды остается открытым. Основной целью исследования была количественная оценка масштабов природной изменчивости эколого-физиологических показателей (СО<sub>2</sub>-газообмен, водный обмен, минеральное питание) сосны обыкновенной (*Pinus sylvestris* L.), ели европейской (*Picea abies* (L.) Karst.) и березы повислой (*Betula pendula* L.) в условиях европейской части среднетаежной зоны России (Республика Карелия). В результате исследования динамики переменных СО<sub>2</sub>/Н<sub>2</sub>О и минерального обменов на фоне изменяющихся гидрометеорологических переменных установили диапазоны факторов среды (температура, относительная влажность воздуха и интенсивность солнечной радиации), обеспечивающие максимальную интенсивность основных физиологических процессов сосны, ели и березы. Показано, что высокая интенсивность этих процессов наблюдается в широких пределах варьирования гидрометеорологических переменных, что свидетельствует о приспособленности исследуемых видов к широкому диапазону условий вегетации. Полученные отличия исследуемых показателей хвойных и лиственных растений при варьировании внешних условий обусловлены различиями эколого-биологических характеристик и поведенческих стратегий исследуемых видов.

По результатам проведенных измерений для сосны, ели и березы провели параметризацию фотосинтеза и устьичной проводимости для использования в модели Mixfor-SVAT (Olchev et al., 2002, 2008). Программа измерений в полевых условиях включала получение углекислотных и световых кривых фотосинтеза листьев при разных температурах воздуха и температурных зависимостей темнового дыхания. По углекислотным кривым по методике (Sharkey et al., 2007) рассчитывали значения максимальной скорости карбоксилирования ( $V_{C_{max}}$ ), скорость переноса электронов для регенерации акцептора при световом насыщении ( $J_{max}$ ), а также скорость утилизации триозофосфатов ( $TPU$ ), что характеризует доступность внутренних неорганических фосфатов ( $Pi$ ) для цикла Кальвина. Температурные зависимости  $V_{C_{max}}$ ,  $J_{max}$  и  $TPU$  были получены путем статистического анализа множества значений  $V_{C_{max}}$  и  $J_{max}$  при разных температурах листа с использованием уравнений, предложенных группой исследователей (Medlin et al., 2002). На основании температурных зависимостей были получены предварительные оценки  $V_{C_{max}}$ ,  $J_{max}$  и  $TPU$  для выбранной референтной температуры 25°C. Полученные результаты использованы в процесс-ориентированной модели MixFor-SVAT для определения возможного отклика СО<sub>2</sub>/Н<sub>2</sub>О бюджета лесных экосистем Карелии на будущие климатические изменения.

Работа выполнена при финансовой поддержке РФФИ (грант 13-04-00827-а).

## РАСТЕНИЯ РОДА *ARTEMISIA* L. – ПЕРСПЕКТИВНЫЕ ИСТОЧНИКИ БИОЛОГИЧЕСКИ АКТИВНЫХ ВЕЩЕСТВ

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Растения рода *Artemisia* (Полынь) – перспективные источники биологически активных веществ, некоторые виды, такие как полынь эстрагон *Artemisia dracunculus* L., полынь горькая *Artemisia absinthium* L., полынь обыкновенная *Artemisia vulgaris* L. широко используются в народной, традиционной медицине и пищевой промышленности. Полынь однолетняя *Artemisia annua* L. успешно введена в культуру во многих странах и в 2001 году была рекомендована ВОЗ как основной источник артемизинина - средства первой линии терапии для борьбы с малярией. В Бурятии п. однолетняя является дикорастущим видом. Наряду с п. однолетней в Бурятии широко распространена полынь Сиверса *Artemisia sieversiana* Willd., которая также является перспективным для медицины видом. В траве полыни Сиверса содержатся флавоноиды, кумарины и эфирное масло, в основном представляющее интерес как источник хамазулена.

Объектами исследования служили образцы травы п. Сиверса и п. однолетней, собранные в различных районах Республики Бурятия (Иволгинском, Прибайкальском, Селенгинском, Тункинском, Закаменском, Курумканском), Иркутской области (о. Ольхон) и Монголии (Селенгинский аймак), в период с 2008 по 2013 годы. Проведено изучение химического состава травы п. Сиверса и травы п. однолетней. Установлено содержание эфирных масел, флавоноидов, жирных кислот, макро- и микроэлементов в указанном сырье.

Выход эфирного масла из травы п. Сиверса варьирует от 0.1 до 1.9%, п. однолетней – от 0.1 до 4.9%. Накопление эфирного масла в фазу цветения больше (0.7 %), чем в фазу бутонизации (0.3 %). Компонентный состав эфирных масел и жирнокислотный состав исследовали методом хромато-масс-спектрометрии на газовом хроматографе Agilent 6890 с квадрупольным масс-спектрометром (MSD 5973N) в качестве детектора. Константными компонентами эфирного масла п. Сиверса являются 1,8-цинеол, терpineол-4, гермакрен D, β-фарнезен, селина-4,11-диен, нерил-2-метилбутиноат и хамазулен, а эфирного масла полыни однолетней – артемизия кетон, кариофиллен, гермакрен D, β-селинен, окись кариофиллена. Наибольшее количество хамазулена п. Сиверса накапливает в фазы бутонизации (до 62 %) и цветения (до 34 %). Основными жирными кислотами в исследуемых видах полыней являются пальмитиновая, линолевая, линоленовая, в полыни однолетней также обнаружена в значительных количествах 10-октадекеновая кислота.

Для разработки методики количественного определения артемизинина в траве п. однолетней были подобраны условия экстракции, при которых извлечение артемизинина достигает максимального значения. Были проанализированы извлечения, полученные методами – мацерацией, УЗ-экстракцией и докритической CO<sub>2</sub>-экстракцией. Наибольшее количество артемизинина (0.054 %) содержится в извлечении, полученном при докритической CO<sub>2</sub>-экстракции. Разработана и валидирована методика количественного определения артемизинина в полыни однолетней методом ВЭЖХ-МС (относительная ошибка определения ± 1.21 %). Установлено, что наибольшее количество артемизинина в траве п. однолетней накапливается в фазу цветения в соцветиях (0.039 %). Методом ВЭЖХ-МС в указанных растениях обнаружены флавоноиды – лютеолин-7-глюкозид, рутин, кверцетин и хризоэриол.

**РАЗНООБРАЗИЕ РАСТИТЕЛЬНЫХ ТИОНИНОВ -  
ПОЛИФУНКЦИОНАЛЬНЫХ БИОЛОГИЧЕСКИ АКТИВНЫХ  
ПЕПТИДОВ**

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Тионины представляют собой первые антимикробные пептиды, выделенные из растений. В настоящее время они объединены в отдельное семейство антимикробных пептидов, представители которого обнаружены в различных органах (семенах, стеблях, корнях, листьях) растений разнообразных ботанических семейств. Известно более 110 последовательностей тионинов из 20 видов как культурных, так и дикорастущих растений, и локализованных преимущественно в клеточных вакуолях. Данные пептиды являются высокоосновными или нейтральными длиной в среднем 46 аминокислотных остатков, соединенных 3-4 дисульфидными мостами. Тионины синтезируются в виде предшественников с молекулярной массой около 18 кДа, содержащих лидерный и зрелый пептиды, а также С-концевой продомен, удаление которого происходит в результате посттрансляционной модификации молекулы предшественника тионинов. Функция данного продомена может заключаться в нейтрализации токсического действия зрелого пептида до момента поступления предшественника в межклеточное пространство или в вакуоли. Трехмерная структура растительных тионинов образована двумя параллельными альфа-спиралями и короткой бета-складкой, С-концевая последовательность образует петлю.

Антимикробная активность данных пептидов была установлена по отношению к грамположительным и грамотрицательным бактериям, мицелиальным грибам, дрожжам, а также культурам эукариотических клеток. Показано, что они ингибируют рост колоний бактерий, а также высших грибов и оомицетов при действующей концентрации, вызывающей половинный эффект в диапазоне 0,2-3,0 мкМ. Антифунгальную активность тионинов в тестах *in vitro* сильно снижает увеличение концентрации в среде ионов  $\text{Ca}^{2+}$  более 5 мМ, а также одновалентными катионами при концентрации не менее 50 мМ. Растительные тионины оказывают действие на культуры клеток млекопитающих и насекомых, а также способны изменять проницаемость растительных протопластов. Кроме того, последние исследования показывают, что некоторые тионины являются природными антимутагенными соединениями, достоверно снижая уровень экспрессии онкогенов, а также селективно воздействуя на опухолевые клетки.

Тионины являются компонентами как пассивного, так и индуцированного иммунитета растений: они активно синтезируются в ответ на проникновение в растение бактериальных патогенов и входят в состав класса PR-13 защитных белков растений. Биологическая активность тионинов преимущественно реализуется через формирование пор в биологических мембранах, приводящее к нарушению их структурной целостности, затрагивании ключевых процессов в клетке и возможной их последующей гибели.

## **БИОЛОГИЧЕСКИЕ ОСОБЕННОСТИ СОРТОВ САХАРНОГО СОРГО В УСЛОВИЯХ ЮГО-ВОСТОКА КАЗАХСТАНА**

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Глобальное изменение климата, которое сопровождается увеличением температуры, уменьшением водных ресурсов, снижением выпадения атмосферных осадков, расширением площадей районов засух и опустыниванием является одной из ключевых экологических проблем Земли. Это является серьезным основанием для поиска и выявления наиболее засухоустойчивых, жаростойких и в то же время высокопродуктивных культур для обеспечения потребностей пищевой, кормовой промышленностей и альтернативной возобновляемой энергетики в новых формирующихся условиях окружающей среды. Этим требованиям отвечает сорго сахарное (*Sorghum saccharatum (L.) Pers.*) который относится к роду *Sorghum (L., Moench.* – сорго.

Сахарное сорго является перспективной культурой с высоким потенциалом для выращивания в южных засушливых, малоплодородных и засоленных землях. К сахарному сорго относится большое количество разновидностей, характеризующихся тем, что у них в отличие от зернового и веничного в соке стебля содержится до 20% и более растворимых сахаров. Это редкое растение, которое могло бы так интенсивно синтезировать углеводы. Растение отличается эффективным использованием почвенной влаги благодаря уникальному механизму регуляции водного режима. Несмотря на это, в республике недостаточно уделяется внимание на эту культуру.

В работе приводятся результаты исследований биологических особенностей сортов сахарного сорго отечественной и зарубежной селекции. Выявлено, что изучаемые сорта существенно отличались между собой по ряду биологических параметров как продолжительность периода вегетации, темпы роста и развития, побегообразование, накопление биомассы и их распределение по органам, а также по биологической и зерновой продуктивности. Получены экспериментальные данные, отражающие биологическую продуктивность, сахаристость, сочность, а также устойчивость сортов сорго к неблагоприятным факторам окружающей среды как засуха засоление и загрязнение тяжелыми металлами. Показано, что отечественные сорта выгодно отличаются по сахаристости и сочности стеблей, тогда как зарубежные (США, Индия, Россия) –биологической продуктивностью за счет интенсивного роста надземных органов и усиленного побегообразования.

## «СВЕТОВАЯ КРИВАЯ» ФОТОСИНТЕЗА КАЛЛУСНЫХ КУЛЬТУР КАК СПОСОБ ОЦЕНКИ ЗАСУХОУСТОЙЧИВОСТИ РАСТЕНИЙ

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Фотосинтетическую активность (ФА) сельскохозяйственных растений напрямую связывают с их продуктивностью, а влияние любого стрессового фактора отражается в первую очередь на эффективности фотосинтеза. Новые технологии и современные приборы для регистрации ФА позволяют проводить визуальное документирование регистрируемых показателей ФА без разрушения объекта исследования, при этом отслеживать динамику процесса на одном и том же объекте по многим параметрам, таким как максимальный уровень флуоресценции, квантовый выход фотосистемы 2 (ФС2), скорость транспорта электронов (СТЭ) в режиме записи световой кривой через ФС2 и ряд других. Исследование физиологических реакций тканей растений на стресс в стабильных контролируемых условиях культуры *in vitro* нами осуществлялось на каллусах, индуцированных на незрелых зародышах пшеницы. На этапе пролиферации на свету участки каллуса приобретают светло-зеленую окраску, что связывают с началом вторичной дифференцировки этих клеток и возможной регенерацией. Этот процесс слабо изучен с позиции развития фотосинтетического аппарата каллусных клеток.

С использованием флуориметра IMAGING-PAM M-Series MAXI Version методом насыщающих импульсов в режиме «записи световой кривой» (по программе производителя) нами установлено наличие ФА в пролиферирующей каллусной культуре яровой мягкой пшеницы. При исследовании ФА разных генотипов на оптимальных и стрессовых фонах при графическом представлении результатов наиболее репрезентативным и удобным для анализа, оказалась кривая СТЭ. Показано изменение характера этой кривой под действием стресса, индуцированного средой пролиферации, содержащей агенты, имитирующие осмотический стресс (NaCl и полиэтиленгликоль).

При определенной интенсивности актиничного света под действием насыщающих импульсов происходит закрытие всех реакционных центров ФС2, что на графиках световой кривой выражается падением СТЭ до нуля. При этом, удержание реакционных центров ФС2 открытыми для разных образцов значительно варьирует и, вероятно, зависит от степени их устойчивости к нехватке свободной воды. Кривые СТЭ, полученные на каллусах сортов пшеницы с известной степенью устойчивости, подтверждают правомочность данного предположения. Так в условиях осмотического стресса в исследуемом диапазоне интенсивности светового потока быстро снижали до нуля СТЭ влаголюбивые образцы, сорт Снаббе и линия КС-1529, в отличие от среднеустойчивого к засухе сорта Тулунская 12, который удерживал центры открытыми дольше, а солеустойчивый сорт Мильтурум 2419 не снижал СТЭ на всем диапазоне. Исследованная динамика изменения формы кривой СТЭ в ходе пролиферации каллусов свидетельствует о том, что наиболее яркие отличия ответа на стрессовые воздействия наблюдаются на 7-е сутки экспозиции, когда кривые СТЭ контрастных по засухоустойчивости образцов достоверно расходятся по оси ординат.

Таким образом, засухоустойчивость пшеницы предлагается оценивать в культуре незрелых зародышей на этапе пролиферации каллусов на стрессовых фонах, регистрируя показатели ФА, а именно СТЭ, на современных флуориметрах.

## ИНТРОДУКЦИЯ КУЛЬТУРЫ САФЛОР КРАСИЛЬНЫЙ В ЦЕНТРАЛЬНЫЙ РЕГИОН РОССИЙСКОЙ ФЕДЕРАЦИИ

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Н.И. Вавилов является основоположником теории интродукции растений. Он придавал особое значение проблеме новых культур, более полному использованию дикой мировой флоры, как в пределах нашей страны, так и за ее пределами. Следуя этим идеям Н.И. Вавилова, ученые ВИР привлекли в коллекцию ранее неизвестные нашей сельскохозяйственной науке и практике культуры.

В результате многолетней работы в Центре сохранения, поддержания и изучения генофонда ГНУ ВСТИСП Россельхозакадемии, бывшее МОВИР им. Н.И. Вавилова (п. Михнево, Ступинского района, Московской области) создан сорт сафлора красильного КРАСА СТУПИНСКАЯ. Этот сорт используется в качестве сидеральной, фитомелиоративной, кормовой, декоративной и перспективной масличной культуры, как в промышленных масштабах, так и в личных приусадебных хозяйствах. Сорт Краса Ступинская внесен в Государственный реестр селекционных достижений с 01.01.2013 г. Патент № 6930. Авторы сорта: Темирбекова С. К., Куликов И.М., Ионова Н.Э., Курило А.А., Норов М.С., Метлина Г.В., Постников Д.А.

Сафлор красильный (*Carthamus tinctorius L.*) относится к семейству астровых. Родиной является Египет, Индия. Это однолетнее травянистое растение с хорошо развитой, стержневой корневой системой, углубляющейся в почву до 10-20 см (в южных регионах до 1,5-2 м). Вегетационный период от полных всходов до уборочной спелости в различные по метеорологическим условиям годы составляет 105-130 дней. Продолжительность цветения около месяца. Стебель прямостоячий, сильно ветвящийся, голый, высотой до 83-90 см. Листья сидячие, ланцетные, ланцетоовальные или эллиптические, по краям с небольшими зубчиками, оканчивающимися маленькими колючками. Соцветие – корзинка, диаметром 1,5-3,5 см. На одном растении бывает от 5-7 до 20-50 и более корзинок. Цветки трубчатые с пятираздельным венчиком желтой, красной или оранжевой окраски. Плод – семянка, блестящая, напоминающая семянку подсолнечника. Оболочка ее твердая, трудно раскалывающаяся, составляет 40-50 % массы семян. Семена при созревании не осыпаются. Масса 1000 семян – от 48-51 г. Урожайность в нашей зоне 0,8-1,0 т/га (в южных регионах – 1,0-1,2 т/га). Семена сафлора содержат от 32 до 38 % жира. Абсолютное содержание жира в очищенных семенах достигает более 60 % и оно пригодно в пищу. Сафлоровое масло близко к подсолнечному, но более насыщенное линолевой и олеиновой кислотами, используется для пищевых и технических целей. При этом  $\alpha$ - $\gamma$  линоленовая кислота является незаменимой, синтезируется только в культуре сафлор и материнском молоке. Вредителей и болезней пока нет, кроме энзимомикозного истощения семян. Во влажные годы налива зерна. энзимная стадия (ЭМИС), а именно, биологическое травмирование на корню способствует массовому поражению семян альтернариозом, фузариозом и др., что в итоге выращенный урожай имеет плохое качество семян.

## МОДИФИКАЦИЯ АМИНОКИСЛОТНОГО СОСТАВА У ХВОЙНЫХ РАСТЕНИЙ С ЦЕЛЬЮ ПОЛУЧЕНИЯ АРГИНИНОВЫХ КОМПОЗИЦИЙ

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Древесная зелень хвойных растений содержит комплекс веществ, обладающих высокой биологической активностью и представляющих практически все классы органических соединений, обнаруженных в растениях (Ягодин, 1981; Ушанова и др., 1998). Значительное количество биологически активных веществ древесной зелени сосны (до 30%) составляют водорастворимые фракции, к которым относятся и свободные аминокислоты, использующиеся при лечении многих заболеваний. L-аргинин относится к группе полунезаменимых аминокислот и играет важную роль в жизнедеятельности организма, являясь предшественником оксида азота — NO, обладающего широким спектром биорегуляторных действий (Граник, 2003; Марков, 2005; Ульянов и др., 2010). L-аргинин у хвойных растений участвует в различных метаболических процессах, в том числе в детоксикации избыточного аммония. При этом возможно значительное (свыше 100-кратного) повышение содержания свободного L-аргинина у хвойных растений при внесении в почву избыточных доз азота (Nasholm, Ericsson, 1990). Внесение в почву кроме амиачной селитры также борной кислоты в определенных дозах под сосну обыкновенную (*Pinus sylvestris L.*) и ель европейскую (*Picea abies L.*) значительно (в десятки раз) увеличивает содержание L-аргинина в хвое уже за один вегетационный период (Чернобровкина и др., 2010, 2013).

Высокий уровень L-аргинина и других аминокислот в органах растений можно рассматривать как биохимический индикатор разбалансированности их минерального питания. При высоком по сравнению с другими элементами минерального питания поступлении азота в хвойное растение, часть его органы и ткани не способны использовать для синтеза белков и запасают в форме аминокислот с высоким содержанием азота, прежде всего в форме L-аргинина. Дополнительное обеспечение бором хвойного растения ускоряет процессы роста и вместе с тем усиливает дефицит других элементов питания, что приводит к повышению интенсивности накопления L-аргинина в хвое. Необходимо учитывать, что разбалансированность минерального питания в результате внесения избыточных количеств азота может оказаться в будущем на различных аспектах метаболизма растительного организма. Такая схема внесения удобрений может применяться для древостоев, планируемых под вырубку, при возможности использования недревесных лесных ресурсов (сосновой лапы с хвоей, обогащенной L-аргинином), а не в качестве способа ухода.

Для получения обогащенной L-аргинином древесной зелени эффективно использование отходов при рубках 10–15-летних деревьев хвойных растений, произрастающих на территории ЛЭП, в лесных культурах (Робонен и др., 2012). Разработаны схемы внесения удобрений в почву под сосну обыкновенную с учетом фенофазы хвойного растения, а также способы и сроки отбора растительного материала в годичном цикле. Предлагается использовать обогащенную L-аргинином древесную зелень хвойных пород в качестве сырья для получения этой аминокислоты и в ветеринарии в качестве биологически активных добавок животным (Чернобровкина и др., 2010). Разработана технология получения аргининовых композиций из отходов обогащенной L-аргинином древесной зелени сосны обыкновенной. Получены положительные результаты испытаний препаратов в качестве кормовой добавки: курам на примере ремонтного молодняка и кур-несушек кросса Ломанн Браун – повышение интенсивности роста молодняка и яйценоскости кур, щенкам американской норки (*Mustelavison Schr*) – повышение интенсивности роста и сохранности животных. Определены сроки и дозы применения препаратов для домашней птицы и пушных зверей.

## ВЛИЯНИЕ ПРАЙМИНГА СЕМЯН МОЛИБДЕНОМ НА АДАПТАЦИЮ РАСТЕНИЙ ЯРОВОЙ ПШЕНИЦЫ К БИОТИЧЕСКОМУ СТРЕССУ

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Известно, что молибдоферменты - нитратредуктаза (НР; ЕС 1.6.6.1), альдегидоксидаза (АО, ЕС 1.2.3.1) и ксантиндегидрогеназа (КДГ; ЕС 1.2.1.37) - играют важную роль в устойчивости растений к абиотическим и биотическим стрессам. Согласно данным Института почвоведения НАН РК, почвы Казахстана содержат в 3-5 раза меньше молибдена, чем это необходимо для нормального роста и развития растений. Недостаток молибдена в почве снижает или инактивирует активность молибдоферментов. Однако, одним из дешевых и экологически чистых способов обеспечения растения этим металлом может послужить предпосевной прайминг семян в растворе молибдата. Листовая ржавчина пшеницы, вызываемая грибом *Puccinia triticiana Eriks.*, наносит существенный урон производству зерна в Казахстане, где потери урожая при эпифитотийном развитии гриба достигают 10-20% и более, снижая качество зерна. Механизмы ответных защитных реакций растений против ржавчинных грибов еще мало изучены. В связи с этим мы изучили влияние прайминга семян молибдатом и вольфраматом натрия на активность данных молибдоферментов в листьях и корнях яровой пшеницы при воздействии листовой ржавчины.

Объектом исследования служили проростки яровой пшеницы (*Triticum aestivum L.*) сорта Акмола-2. Предварительно семена были простерилизованы 15% раствором гипохлорита натрия в течение 5 мин, а затем промыты дистиллированной водой. Перед посевом семена пшеницы подвергались 6-часовому праймингу в 75 мМ растворе молибдата или вольфрамата натрия при комнатной температуре. Семена контрольного варианта праймировались в дистиллированной воде. Проростки выращивались на искусственном грунте («TERRA VITA», [www.torfo.ru](http://www.torfo.ru)) в пластиковых горшках при 22°C, 70-75% относительной влажности и условиях длинного дня. Недельные проростки инокулировались урединиоспорами гриба *Puccinia triticiana Eriks.* согласно методике Макинтош с соавт. Явные симптомы заражения листовой ржавчиной наблюдались у проростков на 14 день вегетации, именно в этот период отбирались образцы листьев и корней для определения активности молибдоферментов – НР (спектрофотометрический метод), АО и КДГ (метод нативного гель-электрофореза), а также содержания перекиси водорода в растительных тканях (спектрофотометрический метод). Все данные статистически обрабатывались.

Нами показано изменение активности молибдоферментов проростков яровой пшеницы под влиянием прайминга семян молибдатом и вольфраматом при заражении листовой ржавчиной. Активности НР, АО и КДГ у праймированных молибдатом растений возрастили в 1,5-2 раза по сравнению с контролем. Такое увеличение активностей данных ферментов свидетельствует об активной ответной реакции растений на биотический стресс, вызванный заражением листовой ржавчиной. Активности НР, АО и КДГ у праймированных вольфраматом растений снижались в 1,5 раза по сравнению с контролем. Содержание перекиси водорода в тканях растений праймированных молибдатом было ниже по сравнению с контрольными и праймированными вольфраматом растениями, что свидетельствует о том, что эти растения лучше сопротивляются воздействию стресса. Следовательно, можно сделать вывод, что активация данных ферментов у растений с помощью предпосевного молибдо-прайминга семян улучшает сопротивление пшеницы к атаке патогена.

## **СОДЕРЖАНИЕ ФРУКТОЗЫ В СИРОПЕ САХАРНОГО СОРГО**

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Сахарное сорго (*Sorghum saccratum*), как сахарная свекла, является универсальной культурой, сырье которой может использоваться не только в кормопроизводстве, но и в пищевой промышленности и для производства биотоплива. Сахарное сорго по своим биологическим свойствам характеризуется огромными потенциальными возможностями. Этой культуре свойственны засухоустойчивость, солевыносливость, неприхотливость к разным структурам почв, высокая отзывчивость на удобрения и орошение, способность эффективно использовать осадки второй половины лета и высокая урожайность биомассы. Биомассу используют на зеленый корм, для приготовления силоса, а также для получения сахара.

Сахарное сорго – источник таких моносахаридов как фруктоза и глюкоза. Резкое возрастание интереса к фруктозе обусловлено тем, что она обладает рядом преимуществ по сравнению с другими видами сахаров. Фруктоза - природный моносахарид, она является самым сладким сахаром, что позволяет потреблять меньшее количество, и содержащее ее продукты годятся как для здоровых людей, так и для страдающих диабетом. За последние десятилетия происходит интенсивный рост производства заменителей сахара. Замена сахарозы другими веществами связана с её высокой энергетической ценностью и высокой усвояемостью. Известно, что при чрезмерном употреблении сахарозы, в том числе и виде сахаристых продуктов, особенно при низкой физической активности, она может привести к тяжелым нарушениям углеводного и жирового обмена. В связи с этим актуальным является поиск натуральных, экологически чистых сахарозаменителей. К ним можно отнести сироп сахарного сорго, который усваивается организмом легче, чем обычный сахар. По сравнению с традиционными сахарозаменителями, например, фруктозой, он обладает рядом преимуществ. Так, кристаллическая фруктоза не извлекается из фруктов, а синтезируется химическим путём – гидролизом сахарозы и полисахаридов (крахмалов и целлюлозы) и изомеризацией глюкозы. Это не просто рафинированный, а полностью искусственный, техногенный продукт.

В задачу наших исследований входит изучение сиропов некоторых сортов сахарного сорго и выделение для селекции наиболее перспективных форм с высоким содержанием моносахаридов (фруктозы и глюкозы), как наиболее ценных углеводов, используемых в пищевой промышленности.

Из сиропа сортов Ларец, Ростовский, Янтарь ранний, Оранжевое-160 полученный путем тепловой выпарки, определялось содержание общих сахаров и фруктозы. Общее содержание сахара в сиропе (%) определяли рефрактометром, количество фруктозы по методу Селиванова. Выявлено что, содержание общих сахаров в сиропе с. Ларец составляет 70%, с. Ростовский 91%, с. Янтарь ранний 61%, с. Оранжевое-160 73%. Количество фруктозы волях общих сахаров в сиропе с. Ларец 33%, с. Ростовский 42 %, с. Янтарь ранний 18%, с. Оранжевое-160 38 %.

Таким образом, большее количество фруктозы и общих сахаров обнаружено в сиропе трех сортов Ростовский, Оранжевое-160, Ларец и меньшее количество в сиропе Янтарь ранний.

**СКРИНИНГ СОРТОВ И ГИБРИДОВ РИСА НА  
СОЛЕУСТОЙЧИВОСТЬ НА РАННИХ ЭТАПАХ РОСТА**

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Устойчивость растений к засолению имеет большое практическое значение при выращивании сельскохозяйственных культур на засоленных почвах. Одной из проблем рисоводства Казахстана является ухудшение мелиоративного состояния почв под затоплением. На большей части орошаемых территорий Кызылординской области минерализация грунтовых вод изменяется в пределах 5-10 г/л. При этом преобладает по химическому составу сульфатно-хлоридно-натриевое тип засоления, который является токсичным для сельскохозяйственных культур. Поэтому исследования солеустойчивости сортов риса и разработка новых морфологических и физиологико-биохимических методов изучения и оценки селекционных образцов на устойчивость к солевому стрессу представляют большой научный и практический интерес. Материалом исследований служили зарубежные и отечественные сорта и F<sub>2</sub> гибриды риса.

Простой метод оценки толерантности растений к засолению использование проростков. При хлоридном типе засоления накопление биомассы существенно снизилось по сравнению с контролем. Показано, что изучаемые образцы риса различались по устойчивости к засолению, созданном в лабораторных условиях.

В результате проведенных исследований было установлено, что сорта Маржан, Баканас, Серпантин и F<sub>2</sub> гибриды ♀Ханкайский429 x ♂Курчанка, ♀Кубань 3 x ♂Кол.обр. 34-09, ♀Дарий23 x ♂Аналог II, ♀Баканас x ♂Аналог II показали высокие результаты (от 76 до 86%) солеустойчивости при хлоридном типе засоления.

Наименьшим в процентном отношении к контролю накоплением биомассы в условиях хлоридного засоления характеризовались генотипы: Аналог II, Мадина, Дарий, Регул, Кол.обр.49-09, Лиман, Кол.обр. 4-09, ♀Дарий23 x ♂Кол.обр. 49-09, ♀Регул x ♂Курчанка, ♀Соната x ♂Лиман.

Проникновение ионов в клетки и их накопление в тканях при хлоридном засолении вызывают нарушения метаболизма, а, следовательно изменяет физиологическое состояние растения в целом. Эта перестройка обмена веществ приводит к соответствующему снижению темпов роста и накопления биомассы.

Таким образом, в результате проведения скрининга отечественных и зарубежных сортов, гибридов F<sub>2</sub> риса на ранних этапах роста в условиях хлоридного засоления, выявлены существенные различия образцов по солеустойчивости.

**РАСПРЕДЕЛЕНИЕ И АККУМУЛЯЦИЯ НИКЕЛЯ И ЦИНКА  
В РАСТЕНИЯХ *MIMULUS GUTTATUS* DC ПРИ СОВМЕСТНОМ  
ДЕЙСТВИИ  $\text{NiSO}_4$  И  $\text{ZnSO}_4$  В ПИТАТЕЛЬНОЙ СРЕДЕ**

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В настоящее время загрязнение тяжелыми металлами (ТМ), в число которых входят никель и цинк, является серьезной проблемой для окружающей среды. Никель и цинк – эссенциальные микроэлементы. Однако при повышенных концентрациях они оказывают токсическое действие на разнообразные физиологические процессы. Для сохранения жизнеспособности у растений, как и у других организмов, существует несколько механизмов для поддержания ионного гомеостаза. Хотя не менее важными являются механизмы распределения ТМ в растении, но изучению их уделяется меньше внимания. В настоящее время детально не исследованы механизмы распределения ТМ на уровне всего растения, особенно при избытке двух или нескольких ТМ в среде.

Целью исследований явилось определение закономерностей распределения и аккумуляции никеля и цинка при их совместном действии в избыточных концентрациях на модельных растениях *M. guttatus*. Растения анализировали после 28 дней роста на модифицированной питательной среде Хогланда-Снайдерса (без ЭДТА) с внесением  $\text{NiSO}_4$  (20, 80 мкМ) и  $\text{ZnSO}_4$  (50, 100, 200 мкМ),  $\text{NiSO}_4+\text{ZnSO}_4$  (в комбинациях: 20+100, 20+200, 80+50, 80+100 мкМ). Содержание металлов анализировалось методом атомно-абсорбционной спектрометрии. Оценка интенсивности миграции металлов в растении проводилась путем расчета коэффициента транслокации, представляющем собой отношение содержания металла в листе среднего яруса к его содержанию в корне.

Аккумуляция никеля при действии 80 мкМ  $\text{NiSO}_4$  составила в корне 1564 и в листе среднего яруса 176 мкг/г сухой массы. При действии 200 мкМ  $\text{ZnSO}_4$  накопление цинка составило 12404 и 924 мкг/г сухой массы в корне и в листе среднего яруса соответственно. При совместном действии во всех вариантах содержание никеля в корне достоверно падало, при этом содержание цинка достоверно упало лишь в варианте 80+50, где соотношение никель/цинк составило 1,6/1. Падение содержания никеля в корне сопряжено с увеличением его содержания в листе и, соответственно, увеличением его транслокации. Данный эффект систематически повторялся и усиливался при увеличении концентрации цинка соответственно определенной концентрации никеля. Достоверное снижение содержания цинка в листе наблюдалось лишь в варианте 80+50. Никель не влиял на транслокацию цинка. Мы установили, что при отдельном действии никель достаточно равномерно распределялся в наземных органах, а при совместном действии его содержание в стебле не изменилось и стало, соответственно, в 2-3 раза меньше, чем в листьях. Во всех вариантах воздействий наблюдалась тенденция к снижению содержание цинка от листьев нижнего яруса к листьям верхнего яруса, и аккумуляция цинка в стебле была достоверно выше, чем в листьях. Напротив, у контрольных растений максимальное содержание цинка было в листьях верхнего яруса при сохранении его доминирующей аккумуляции в стебле.

Таким образом, при совместном действии Ni и Zn у растений *M. guttatus* обнаружены конкурентные отношения за поглощение корнем и влияние Zn на транслокацию Ni, наблюдается изменение распределения и аккумуляции Ni в корнях и наземных органах.

Работа выполнена при поддержке гранта РФФИ № 11-04-01305-а

## **ИЗУЧЕНИЕ МЕХАНИЗМОВ АДАПТАЦИИ К СОЛЕВОМУ СТРЕССУ НА УРОВНЕ КУЛЬТИВИРУЕМЫХ КЛЕТОК**

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Еще в 70-х годах прошлого столетия было установлено, что при изучении механизмов солеустойчивости растений одним из перспективных подходов является использование метода культуры клеток и тканей (Строгонов и др., 1970). Этот подход актуален и сейчас, т.к. известно, что культивируемые ткани обладают большей пластичностью и адаптивностью к солевому стрессу по сравнению с исходными интактными растениями. Это может быть связано с особенностями цитодифференцировки и межклеточных взаимодействий, включающих обмен биологически активными сигнальными молекулами. Ввиду недостаточной изученности этих вопросов на уровне культуры клеток и тканей, мы поставили перед собой задачи выяснения закономерностей морфогенеза и клеточной дифференцировки и выявления гисто- и цитохимических особенностей культивируемых тканей в процессе адаптации к солевому стрессу.

В результате скрининга более 20 районируемых сортов и перспективных линий пшеницы на уровне проростков и семян отобраны контрастные по солеустойчивости сорта в качестве объектов для изучения механизмов солеустойчивости на уровне культивируемых клеток. Изучено действие солевого стресса (0.1%, 0.25%, 0.5%, 0.75%, 1.0%, 1.68% NaCl) на процессы роста, морфогенеза и клеточной дифференцировки *in vitro* у генотипов контрастных по устойчивости к NaCl. У устойчивого сорта Казахстанская-10 выявлено усиление роста и эмбриогенного потенциала тканей под воздействием концентрации NaCl 0.5%, при которой у чувствительных сортов наблюдали торможение процессов роста и морфогенеза каллусов. Установлено, что отличительными особенностями толерантных к NaCl каллусов устойчивого генотипа является уменьшение длины каллусных клеток, появление эмбриогенных клеток сферической формы, инициация эмбриоидов, появление клеток с признаками программированной клеточной смерти (ПКС) или апоптоза. Гистохимическими и цитохимическими методами выявлены внеклеточные вещества полисахаридной и белковой природы, выделяющиеся клетками с признаками ПКС в процессе адаптации тканей устойчивых сортов к стрессу.

В целом, выявлен один из возможных клеточных механизмов адаптации к солевому стрессу в системе *in vitro*: часть клеток деградирует по пути ПКС и в процессе гибели выделяет внеклеточные вещества полисахаридной и белковой природы, которые могут оказывать протекторный и рострегулирующий эффекты, стимулируя в соседних клетках синтез защитной каллозной оболочки и образование компетентных к эмбриоидогенезу клеток, а также ингибируя рост клеток растяжением и переключая программу их развития на путь митотических делений. Все это может приводить к усилинию роста и эмбриогенного потенциала каллусных тканей устойчивых генотипов в условиях солевого стресса.

Работа выполнена в рамках проектов Программы фундаментальных исследований МОН РК (2003-2005гг.), (2009-2011 гг.).

## ИДЕНТИФИКАЦИЯ ЭКСТРАЦЕЛЛЮЛЯРНЫХ БИОЛОГИЧЕСКИ АКТИВНЫХ ПЕПТИДОВ В КУЛЬТУРЕ КЛЕТОК ПШЕНИЦЫ

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Цель данного исследования заключалась в выделении фракций экстрацеллюлярных пептидов из суспензионных культур клеток пшеницы, выращиваемых в условиях солевого стресса (0,1%, 0,25%, 0,5%, 0,75%, 1,0%, 1,68% NaCl), и изучении их рострегулирующей и протекторной физиологических активностей. При одностадийном анализе фракций внеклеточных пептидов, полученных в условиях с различной концентрацией NaCl, показаны отличия по качественному составу хроматографических профилей обращенно-фазовой высокоэффективной жидкостной хроматографии (ОФ-ВЭЖХ) в вариантах с максимальной (1,68%) и более низкими концентрациями (0,1-1,0%) NaCl между собой и относительно контроля (без соли). Масс-спектрометрический анализ собранных фракций после ОФ-ВЭЖХ позволил установить наличие у них молекулярных масс в пептидном диапазоне (2,0-8,1 кДа).

Дополнительно, с целью улучшения качества разделения компонентов была использована двухстадийная методика анализа, основанная на сочетании методов жидкостной хроматографии по молекулярным массам и гидрофобности. Так, в результате эксклюзационной хроматографии тотального экстракта из внеклеточной жидкости контрольного варианта и вариантов с 0,75 и 0,5% NaCl были собраны преобладающие фракции, которые, по данным масс-спектрометрии, представляли собой компоненты с массами в диапазоне 5,0-7,5 кДа. Данные фракции были рехроматографированы методом ОФ-ВЭЖХ. При сравнении профилей вариантов как по числу компонентов, так и по времени их выхода не обнаружено различий контроля относительно варианта с 0,75% NaCl, при этом спектр компонентов в варианте с 0,5% NaCl отличался от контрольного.

Изучение биологической активности внеклеточных пептидных соединений из варианта с 0,5% NaCl, соответствующих массам в диапазоне 5,0-7,5 кДа и разделенных на фракции методом ОФ-ВЭЖХ на 9 пиков, показало их высокую физиологическую активность, которая проявлялась в увеличении выживаемости тестируемых растений в условиях солевого стресса. Изученные фракции стимулировали всхожесть и энергию прорастания семян горчицы, рост корня, гипокотиля, содержание хлорофилла и накопление биомассы семядолей горчицы в условиях стресса, создаваемого NaCl в сублетальной концентрации 0,75%, по сравнению с контролем (0,75% NaCl, без добавления пептидов). Следует отметить, что активность фракций в условиях солевого стресса проявлялась в нано- и пикомолярных концентрациях, и, в некоторых случаях, носила скачкообразный характер. Обе эти особенности характерны для сигнальных молекул.

Таким образом, нами идентифицированы фракции экстрацеллюлярных биологически активных пептидов, выделяющихся культурируемыми клетками растений в ответ на солевой стресс, которые могут выполнять роль сигнальных молекул, стимулирующих ростовые и защитные процессы в условиях стресса на уровне клеток и целых растений.

Работа выполнена в рамках проекта 11Н Программы фундаментальных исследований (F.0479) МОН РК (2009-2011 гг.).

## ИЗУЧЕНИЕ ХИМИЧЕСКОГО СОСТАВА ЭКСТРАЦЕЛЛЮЯРНЫХ ПОЛИСАХАРИДОВ ИЗ КУЛЬТУРЫ КЛЕТОК ПШЕНИЦЫ

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Методами ВЭЖХ и GC-MS исследовали моносахаридный состав экстрацеллюлярных полисахаридов, выделенных из суспензионной культуры клеток пшеницы в зависимости от гормонального состава питательной среды. Выявлено, что моносахаридный состав полисахаридов (ПС), выделенных из внеклеточной жидкости среды с АБК на 87% состоит из глюкозы и имеет следующее соотношение Ara :Gal :Xyl :Glc :Man :GlcA :GalUA -10: 4: 10: 160: 0,4: 0,02: 0,02. Превалирование глюкозы в составе ПС из среды с АБК позволяет предположить, что АБК может стимулировать выделение во внеклеточную среду  $\beta$ -глюканов.

Анализ моносахаридного состава ПС из внеклеточной жидкости среды с 2,4-Д показал увеличение количества арабинозы в 6 раз, галактозы в 8 раз, ксилозы в 5 раз и глюкуроновой кислоты в 6 раз, по сравнению с внеклеточными ПС из среды с АБК. У внеклеточных ПС из среды с 2,4 D имеет место следующее соотношение моносахаров: Ara :Gal : Xyl : Glc : Man : GlcA : GalUA - 10: 6: 10: 14: 1: 6: 0. Данные ВЭЖХ подтверждают результаты, ранее полученные методом ГЖХ (Сартбаева, Гюнтер, Бишимибаева, 2010), о том, что внеклеточные полисахариды, выделенные из среды с 2,4-Д, состоят из арабиноксиланов, арабиногалактанов и ксилоглюканов.

Проведен анализ кислых и основных фракций внеклеточных ПС, полученных при помощи ионообменной хроматографии, методом ВЭЖХ. Установлено, что в кислой фракции имеет место кумулятивный эффект таких моносахаров, как арабиноза, галактоза, ксилоза и глюкуроновая кислота. В кислой фракции выявлено значительное повышение содержания арабинозы - в 21 раз (с 2,2 до 46,4 мкг/мл), галактозы - в 26 раз (с 1,3 до 34,2 мкг/мл), ксилозы - в 9 раз (с 3,0 до 27,0 мкг/мл) и глюкуроновой кислоты - в 12 раз (с 0,4 до 4,3 мкг/мл), и существенно уменьшилось содержание глюкозы - с 59,7 до 0,6 мкг/мл, по сравнению с тотальной фракцией. В основной фракции, напротив, наблюдали снижение содержания арабинозы, галактозы, ксилозы и повышение содержания глюкозы, отсутствовала глюкуроновая кислота.

Таким образом, нами идентифицированы арабиногалактан обогащенные кислые фракции с примесями ксиланов, основные и нейтральные фракции, обогащенные глюкозой, а также тотальные фракции, представляющие собой смесь арабиноксиланов, арабиногалактанов и ксилоглюканов. Методом масс-спектрометрии на основе газовой хроматографии (GC-MS) подтвержден моносахаридный состав ПС, выявленный методами ВЭЖХ и ГЖХ, а также в показано, что фракции ПС свободны от примесей фитогормонов 2,4-Д и АБК, входящих в состав питательной среды суспензии.

Работа поддержана инновационным грантом НАТР МИТ РК (2012-2013гг.), Международной стипендией «Болашак» для прохождения научных стажировок зарубежом (2012 г.).

**ОСОБЕННОСТИ ФОРМИРОВАНИЯ ПЛОЩАДИ ЛИСТЬЕВ  
РАСТЕНИЙ ГАЛОФИТОВ В УСЛОВИЯХ ЗАПОВЕДНИКА  
«ТИГРОВАЯ БАЛКА»**

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В условиях заповедника « Тигровая балка» (Таджикистан) изучали динамику формирования площади листьев растений галофитов в процессе вегетации. Объектами исследования служили 4 вида растений галофитов: верблюжья колючка (*Alhagi canescens Resel shop.ex Keller et Shop*), тамарикс многоветвистый (*Tamarix ramosissima*), полынь ферганскую (*Artemisia Ferganensis Krasce et poljak*), соляноколосник Беланже (*Halostachys Belangeriana*), которые произрастают на всей территории заповедника, и характеризуются повышенной биологической продуктивностью, являются перспективными кормовыми растениями и поэтому местное население в течение многих лет их используют как высокопитательные корма.

В процессе вегетации, измеряли площадь одного листа (брали средний лист) и площадь всех листьев одного растения.

По площади одного листа между изученными галофитами существенной разницы не наблюдается, при анализе сезонных изменений нарастания (формирования) площади листьев у четырех изученных нами галофитов было выявлено, что максимальная площадь листьев была у растения Верблюжья колючка (янтак)-521 см.2 в 2010г. и 571 см.2 в 2011г., чуть меньше у Тамарикса многоветвистого 396 см.2 в 2010 и 477.2 см.2 в 2011г., а у полыни ферганской и соляноколосника Беланже площадь была в 2.5 -3 раза меньше, чем у янтака и у тамарикса многоветвистого. Если у соляноколосника Беланже площадь была минимальной в начале сезона вегетации(апрель-май), когда листья были редуцированы в мелкие треугольные чешуйки, то у полыни ферганской резкое сокращение площади листьев мы наблюдали в жаркий период сезона (июль) и к концу вегетации, когда уменьшение поверхности листьев происходило за счет высыхания. и отмирания листьев.

Таким образом, наши исследования показали, что растения –галофиты в условиях аридной зоны, сумели приспособиться к формированию небольшой листовой поверхности в период вегетации, вероятно, в результате разнообразных анатомо-морфофизиологических приспособлений, обуславливающих их видовую адаптивность.

## **ВОДНЫЙ РЕЖИМ ГАЛОФИТОВ, ПРОИЗРАСТАЮЩИХ В ЗАПОВЕДНИКЕ «ТИГРОВАЯ БАЛКА» В ТАДЖИКИСТАНЕ**

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Государственный заповедник «Тигровая балка» организован в 1938 г. и расположен на юго-западе Республики Таджикистан в поймах рек Вахш и Пяндж.

В последние годы возобновлены научные исследования заповедника, в частности нами, проводятся изучения морфофизиологических и биохимических показателей у солеи и засухоустойчивых растений для выявления их адаптивности к почвенной и атмосферной засухе. Растения галофиты засухоустойчивы, не требовательны к воде, солеустойчивы, но очень светолюбивы. Объектами исследования служили 4 вида растений – галофитов: верблюжья колючка (*Alhagi canescens Resel shop.ex Keller et Shop*), тамарикс многоветвистый(*Tamarix ramosissima*), полынь ферганская (*Artemisia ferganensis Krasch ex rojjak*), соляноколосник Белянже (*Halostachys Mog.Botsch*), которые произрастают на всей территории заповедника

Определяли водоудерживающую способность и интенсивность транспирации листьев растений –галофитов в дневной динамике и в процессе вегетации

Изучение водоудерживающей способности листьев показало, что листья верблюжьей колючки и тамарикса характеризовались относительно высокой водоудерживающей способностью, а полынь ферганская и соляноколосник Белянже в этих же условиях солончаковой пустыни намного слабее удерживали воду в листьях.

Показано, что самую высокую интенсивность транспирации в листьях в дневной динамике наблюдали в середине светового дня в 11ч и 14 ч, затем к концу дня в 17ч с понижением температуры воздуха, наблюдали уменьшение расхода воды листьями. Среди изученных нами растений - галофитов в процессе вегетации максимально транспирировали растения- верблюжья колючка и тамарикс. Несколько меньше потерю воды мы наблюдали в листьях полыни ферганской и соляноколосника Белянже.

Интенсивность транспирации в сезонной динамике у всех изученных растений возрасала до середины лета в максимальный период засухи, затем потеря воды уменьшалась и проходила по-разному в зависимости от вида растения, от сроков их вегетации и, главное, от способности проявить устойчивость к экстремальным факторам среды.

**ФЕНОЛЬНЫЕ СОЕДИНЕНИЯ В МЕХАНИЗМЕ  
СОЛЕУСТОЙЧИВОСТИ РАСТЕНИЙ**

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Фенольный комплекс растений тонко реагирует на действие засоления среды, отражая степень развития солевого стресса. Полученные результаты позволили выявить один из биохимических механизмов адаптации к засолению среды, обусловленный нарушением фенольного статуса растений. Установлено, что фенольный комплекс (ФК) исследованных растений, различных по видовой и сортовой природе, степени солеустойчивости имеют в целом сходный характер изменчивости, выраженный в нарушении количественного содержания и качественного состава фенольных соединений (ФС), перераспределении их по органам растений и в самой клетке, однозначном нарушении фракционного состава, как правило за счет увеличения менее полярных свободных форм, усиленного образования полимерных форм – лигнина, индукции активности оксидоредуктаз, участвующий в фенольном обмене, в образовании токсических веществ – хинонов при солевой интоксикации. Сказанное выше говорит о единой направленности адаптационного процесса как у несолеустойчивых, так и солеустойчивых растений в условиях засоления. Однако норма ответной реакции ФС, включая отдельные фракции и компоненты дифференцирована в зависимости от видовой и сортовой принадлежности, степени солеустойчивости, концентрации и качества засоления ( $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ ), качественного состава ФК. У менее солеустойчивых растений количественные и качественные нарушения в ФК происходят при более низких концентрациях солей и узком их диапазоне. Показано, что специфика изменения отдельных компонентов ФК может быть использована в оценке различий сортов на солеустойчивость, степень угнетения роста растений и качества засоления. Выявлено, что засоление среды стимулирует образование лигнина и изменяет полимерный состав клеточной оболочки, ускоряет процесс лигнификации и как следствие «старение» клеток растений. Наряду с гликофитами изучали ФК галофитов (более 30 видов) осущененного дна Арала. Найдено, что соленакапливающие виды (эвгалофиты) сем. *Chenopodiaceae* преимущественно синтезируют флавонолы, флавоны т.е. более окисленные формы. Для криногалофитов (сем. *Tamaricaceae* и др.) наряду с флавоноидами характерно накопление гидролизуемых дубильных веществ, для гликогалофитов (сем. *Polygonaceae* и др.) – конденсированных дубильных веществ. Особенности качественного состава ФК в сочетании с типом адаптации галофитов способствовали формированию экологически устойчивой природной популяции. Таким образом, выявленные закономерности в изменении ФК указывают на многоплановый характер участия ФС в адаптации, возможные пути и роль их в механизме солеустойчивости и солевом отравлении растений.

**ПЕРСПЕКТИВНАЯ ТЕХНОЛОГИЯ ВЫРАЩИВАНИЯ СЕЯНЦЕВ  
ДУБА ЧЕРЕШЧАТОГО (*QUERCUS ROBUR L.*) – С ЗАКРЫТОЙ  
КОРНЕВОЙ СИСТЕМОЙ**

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Дуб черешчатый (*Quercus robur L.*) – основная хозяйствственно ценная порода, доминирующая в лесостепной зоне ЦЧО, занимает первое место в полезащитном лесоразведении, эдификатор. Воронежская область расположена на юго-западе Европейской части России, между  $49^{\circ}34'$  и  $52^{\circ}06'$  северной широты и  $38^{\circ}09'$  и  $42^{\circ}54'$  восточной долготы, которая по природному зонированию – типичная лесостепь и степь. Климат – умеренно континентальный. В период осень-зима-весна возможен перепад температур, особенно в ранневесенний период, что является серьезным испытанием для зимующих сеянцев.

Тревожной проблемой современности является прогрессирующая деградация дубрав в пределах всего ареала (отмирание, плохое возобновление, отсутствие качественного посадочного материала и др.) Для производства качественных сеянцев предлагается перспективный способ выращивания контейнеризированных сеянцев дуба черешчатого с закрытой корневой системой с использованием «воздушной подрезки корня» и получения стандартного посадочного материала за один сезон.

Правильный подбор типа и размера кассет является основой технологии выращивания сеянцев дуба с ЗКС в условиях Воронежской области.

Полевые и лабораторные исследования проводили на сеянцах дуба черешчатого, выращенных в кассетах «Quick Pot» с высотой ячеек 16, 18 и 20 см и объёмом торфяного субстрата 330, 300 и 400 см<sup>3</sup>. В качестве контроля использовали кассеты ВСС - Hiko V-150 Side Slit с высотой ячеек 10 см и объёмом 150 см<sup>3</sup>. В качестве субстрата использовали фрезерный верховой торф нейтрализованный низкой степени разложения марки «Агробалт-Н». Все кассеты размещены на специальных подставках. Воздушный зазор между почвой и кассетами составлял 15-20 см, что обеспечивало мягкую воздушную «подрезку» корня с образованием активных корневых кончиков, готовых к росту при высадке. Работу с твёрдыми кассетами из высококачественной пластмассы можно легко механизировать и автоматизировать. Срок службы – более 10 лет.

В результате проведенных исследований установлено, что лучшими по показателям роста и развития для производства сеянцев являются кассеты Quick Pot с высотой 16 см и объёмом субстрата 330 см<sup>3</sup>. К концу вегетации 2012 и 2013 гг могут быть сформированы до 56% высококачественных сеянцев (в контроле – 12-27%) с высокой сохранностью (до 90%) в процессе их перезимовки. Существенными показателями успешности их перезимовки и диагностики на жизнеспособность явились экспериментальные данные, подтверждающие нормальное прохождение физиологического-биохимических фаз развития стебля и корня от глубокого покоя к вынужденному и далее к весеннему росту. Показатели нуклеиновых кислот (ДНК и РНК, их отношение в 2 раз выше в корнях, чем в стебле: 1:14,4-9,5 против 1:5), снижение крахмала и отсутствие нарушений анатомической структуры стебля и корня сеянцев дуба в течение вегетации 2012 и 2013 годов.

**ВЛИЯНИЕ ЦЕОЛИТНОГО БИООРГАНОМИНЕРАЛЬНОГО  
УДОБРЕНИЯ НА ФИЗИОЛОГО-БИОХИМИЧЕСКИЕ ПОКАЗАТЕЛИ  
ОНТОГЕНЕЗА РИСА**

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В Казахстане значительное место отводится рисосиянию солонцеватые и такировидные почвы с избыточным содержанием токсичных солей и характерным низким потенциальным плодородием. Поэтому проблема восстановления засоленных почв имеет первостепенное значение для нашей Республики. Нами в настоящие время испытывается ряд биотехнологических приемов восстановления засоленных почв. Так испытаны более 10 комбинаций различных цеолитно - биоорганиноминеральных смесей для восстановления засоленных почв Кызылординской области. Объективный контроль положительного влияния используемых составов можно обеспечить лишь при использовании надежных физиолого-биохимических методов изучения выращиваемых растений. Дело в том, что растения чувствительны к состоянию почвенного субстрата и любой положительный сдвиг в этом субстрате немедленно оказывается на метabolизме растений. Известно, что продуктивность растений в первую очередь зависит от процесса фотосинтеза. Поэтому содержание хлорофилла может служить объективным критерием для оценки состояния восстановления плодородия почв. Так было установлено, что внесение таких композиций как цеолит с биовермикопостом, а также цеолит с биовермикопостом и бактериальными препаратами увеличили содержание хлорофилла в листьях риса в опытных вариантах на 90%. Следующим объективным показателем уровня интенсивности метаболизма азотного обмена является активность ключевого ферmenta обмена глутамата - ферментного комплекса (ФК), состоящего из малатдегидрогеназы (МДГ) и глутаматоксалоацетат аминотрансферазы (ГОАТ). Было установлено, что внесение цеолитно-биоорганиноминеральных смесей существенно повысило активность ФК в фазу кущения - очень важный этап в онтогенезе риса, который является определяющим для продуктивности риса. Увеличение активности ферментного комплекса играет большую роль в процессах мобилизации запасных веществ из листьев в созревающем колосе, что способствует накоплению запасных веществ в семени культурных растений, а также говорит о высокой устойчивости растений к стрессовым факторам. Наибольший прирост активности наблюдался при внесении цеолита – 2,5 т/га с вермикопостом - 3,0 т/га, а также цеолита – 2,5 т/га с биовермикопостом - 3,0 т/га и ассоциацией бактериального препарата ( $10^9$  млн.кл/мл). Активность МДГ – ГОАТ составило 105,0 и 103,4 мкМ НАДН/мл, соответственно, активность ГДГ в этих же вариантах было равной - 35,0 и 31,0 мкМ НАД/мл, соответственно. Тогда как в контроле, активность ФК МДГ – ГОАТ было равной 80 мкМ НАДН/мл, а активность ГДГ-24,01 мкМ НАД/мл

**АНТИМИКРОБНАЯ АКТИВНОСТЬ СУММАРНЫХ ЭКСТРАКТОВ  
НЕКОТОРЫХ ДИКОРАСТУЩИХ РАСТЕНИЙ ФЛОРЫ  
КАЗАХСТАНА**

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Биологически активные вещества растений представлены разнообразными классами органических соединений, обладающими широким спектром фармакологического действия, что обуславливает к ним постоянный интерес. На территории Республики Казахстан произрастает более 6000 видов растений, способных стать при надлежащем исследовании сырьевой базой для создания и производства новых оригинальных отечественных фитопрепаратов. В связи с этим испытание биологически активных соединений из растений Казахстана представляет собой своевременную и перспективную задачу.

Объектом исследований явились собранные в экспедиционных выездах по Алматинской области дикорастущие растения флоры Казахстана, принадлежащие к разным семействам: *Epilobium hirsutum* (Onagraceae), *Rumex confertus* (Polygonaceae). *Vexibia alopecuroides* (L.) Jakovl. (Fabaceae), перспективность практического использования которых может быть связана с дубильными и другими биологически активными веществами.

Антибиотическую активность суммарных экстрактов из этих растений определяли методом серийных разведений в бульоне, используя в качестве тест-объектов следующие штаммы микроорганизмов: *Staphylococcus aureus* ATCC 29213, *Methicillin-resistant S. aureus* ATCC 43300, *Pseudomonas aeruginosa* ATCC 27853, *Candida albicans* ATTC 90028, *Candida krusei* ATCC 6258, *Candida glabrata* ATTC 90030.

Полученные данные показали, что экстракты обладают избирательной антибиотической активностью, которая варьирует в зависимости от вида растений. Суммарный экстракт *Epilobium hirsutum*, выделенный из надземной части дихлорметановым растворителем, показал хорошую активность по отношению к *Candida glabrata* (50 % ингибирующая концентрация ( $IC_{50}$ ) составила 2 мкг / мл), суммарный экстракт *Rhodiola quadrifida*, выделенный из всего растения дихлорметановым растворителем, показал хорошую активность против *C. glabrata* ( $IC_{50}$  2,9 мкг / мл) и *C. krusei* ( $IC_{50}$  9,2 мкг / мл), дихлорметановый суммарный экстракт *Rumex confertus* (корни) показал хорошую активность против *C. glabrata* ( $IC_{50}$  2,9 мкг / мл), спиртовый суммарный экстракт, полученный из корней *Sanguisorba officinalis* L., показал активность по отношению *C. glabrata* ( $IC_{50}$  2,47 мкг / мл), *C. krusei* ( $IC_{50}$  8,7 мкг / мл), и небольшую активность по отношению *C. albicans* ( $IC_{50}$  19,2 мкг / мл). Антибактериальную активность проявили только два дихлорметановых экстракта, выделенных из корней растений *Rumex confertus* и *Vexibia alopecuroides*. *Rumex confertus* показал хорошую активность против *Staphylococcus aureus* ( $IC_{50}$  10,8 мкг / мл) и *Methicillin-resistant S. aureus* ( $IC_{50}$  16,2 мкг / мл). Самая высокая антибактериальная активность среди растительных экстрактов была получена у *Vexibia alopecuroides* в отношении *Staphylococcus aureus* ( $IC_{50}$  3,05 мкг / мл) и *Methicillin-resistant S. aureus* ( $IC_{50}$  2,9 мкг / мл).

На основании полученных результатов были отобраны растения, экстракты из которых могут быть использованы для создания на их основе лекарственных препаратов.

## ГУМАТЫ ПОВЫШАЮТ ФИТОРЕМЕДИАЦИОННЫЙ ПОТЕНЦИАЛ РАСТЕНИЙ

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Изучение механизмов устойчивости и адаптации растений к ТМ является важнейшей задачей экологической физиологии растений. Несмотря на значительное количество работ, механизмы устойчивости растений к тяжелым металлам остаются невыясненными. Исследования в области влияния гуматов на фитотоксичность тяжелых металлов немногочисленны (Семенов, 2009, Будаева и др., 2005). В то же время, хорошо известна протекторная функция гуминовых веществ, которые связывают тяжелые металлы и радионуклиды, образуя нерастворимые малоподвижные комплексы (Христева, 1977 и др.). В связи с этим, представляет интерес выяснение характера и механизмов влияния гуматов на фитотоксичность тяжелых металлов.

Изучали влияние гуминового препарата из торфа (Калинников, Вашурина, Кирдей, 2007) на адаптацию растений пшеницы (*Triticum aestivum L.*) сорта Приокская к высоким концентрациям нитрата свинца в условиях вегетационного опыта в водной культуре. В опытных вариантах в питательную смесь Хогланда (Hoaglond, Arnon, 1950) добавляли нитрат свинца в концентрациях 1 и 2 мМ/л, гуминовый препарат – в концентрации 0,005% в соответствии со схемой опыта. Степень устойчивости растений определяли по соотношению сухих масс надземных органов растений на опытном и контрольном вариантах (Удовенко, 1977). Коэффициент протекторного действия гумата рассчитывали как соотношение массы органов растений, выращенных при использовании гуминового препарата и без гумата. Регуляцию растением процесса накопления токсичного иона оценивали по соотношению содержания иона в корнях (нижних листьях) и в надземных органах.

В результате исследований установлено, что гуминовый препарат из торфа ускоряет рост растений пшеницы - статистически доказанное увеличение массы (на 56-84 %) наблюдалось до фазы колошения. Устойчивость растений к нитрату свинца снижается с увеличением концентрации соли – при 2 мМ/л степень металлоустойчивости ниже, чем при 1 мМ/л в 2 раза в фазу кущения и в 1,4 раза в фазу колошения. Степень металлоустойчивости повышается в процессе вегетации растений, что свидетельствует об адаптации растений к стрессовому фактору. Коэффициент протекторного действия гумата ниже 1 при концентрации нитрата свинца 2 мМ/л в течение всей вегетации растений, а при 1 мМ/л – в фазы кущения и выхода в трубку. Это свидетельствует об усилении фитотоксичности свинца в присутствии гумата. Очевидно, что при высоких концентрациях токсичных ионов в среде не наблюдается защитного действия гуминовых веществ, характерное для низких концентраций (Кирдей, 2013). В то же время, на всех вариантах опыта получены жизнеспособные семена, а масса зерна с растений, выращенных с использованием гумата, выше, чем без гумата (в 3 раза при 2 мМ/л нитрата свинца).

Обнаружено увеличение содержания свинца в надземных органах растений в 4,6-10 раз при наличии гуматов в корнеобитаемой среде (до 1200 и 4300 мг/кг сухой массы при 1 и 2 мМ/л нитрата свинца соответственно). Таким образом, при высоких концентрациях нитрата свинца – 1 и 2 мМ/л гумат усиливает накопление свинца в надземных органах растений пшеницы, повышая фиторемедиационный потенциал растений.

## **МЕХАНИЗМЫ ОБРАЗОВАНИЯ ПОЛИМОРФИЗМА ПРИ АГАМОСПЕРМИИ**

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Полученные к настоящему времени факты свидетельствуют о том, что полиморфизм в агамоспермных потомствах диплоидных растений обусловлен комбинаторными процессами. К этим комбинаторным процессам прежде всего относится мейоз, происходящий в тетраплоидных материнских клетках мегаспор, присутствующих в качестве примеси среди основной массы диплоидных клеток материнского растения (Малецкий, Малецкая, 1996). Другой комбинаторный процесс происходит в апозиготической клетке перед её вступлением в эмбриогенез и представляет собой случайный равновероятный выбор из множества эндоредуплицированных в результате политенизации копий исследуемого участка хроматид (Levites, 2005, 2007). Выбирается по одной копии от каждой из пары гомологичных хромосом. Начало выбора представляет собой случайное равновероятное прикрепление одной из копий к ядерной мемbrane или к ядерному матриксу. Неприкрепившиеся копии аллелей в ходе первых делений эмбриогенеза теряются из ядра и клетки. Диминуция возможна как из клетки зародышевого мешка, так и из клетки нуцеллуса и интегументов. Различные типы комбинаторных процессов и их сочетание приводят к разным соотношениям фенотипических классов в агамоспермных потомствах. Использование изоферментов в качестве генетических маркеров позволяет по соотношениям фенотипов предполагать ход событий, обеспечивших появление данного потомства, и таким образом классифицировать типы агамоспермного размножения растений.

**ДИНАМИКА НАКОПЛЕНИЯ И РАСПРЕДЕЛЕНИЕ  
РАСТВОРИМЫХ САХАРОВ В СТЕБЛЯХ САХАРНОГО СОРГО**

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В районах с жарким и сухим климатом решить проблему сахара за счет сахарной свеклы трудно, а иногда и невозможно. Сахарное сорго как засухоустойчивая, жаровыносливая и высокоурожайная культура в этих условиях является незаменимым сахароносом. Растение сахарного сорго представляет собой высокорослый куст (200-350 см) с сочными стеблями (до 60% от общей массы). Урожайность стеблей сахарного сорго составляет 50-55 т/га. Биологические особенности этой культуры позволяют получать хороший урожай зеленой массы даже на очень бедных почвах и солончаках в условиях выпадения около 200 мм осадков в год.

Способность растений сахарного сорго аккумулировать большое количество растворимых сахаров делает его потенциальным источником сырья для пищевой промышленности. По содержанию сахаров сок стеблей сахарного сорго не уступает соку сахарного тростника, а вот по составу существенно отличается. Если в соке сахарного тростника содержится только сахароза (кристаллизирующийся сахар), то в соке сахарного сорго кроме сахарозы есть много фруктозы, глюкозы и растворимого крахмала. Высокая биологическая продуктивность и аккумуляция сахаров у сорго связана с особым, C<sub>4</sub> типом фотосинтеза, позволяющим эффективно ассимилировать углекислый газ атмосферы.

В работе представлены результаты исследований по изучению динамики накопления и закономерностей распределения растворимых сахаров по органам и междуузлиям некоторых сортов сахарного сорго выращенных в условиях юго-востока Казахстана. Рефрактометрическое определение количества растворимых сахаров у всех изучаемых сортов показало, что оно плавно увеличивается по мере роста и развития растений, достигнув максимума к концу вегетации, к фазе молочно-восковой и полной спелости зерна. Было замечено, что содержание растворимых сахаров выше в боковых побегах, нежели в главном. Выявлено, что содержание растворимых сахаров возрастает от нижних междуузлий к верхним, достигнув максимума в 7 и 8 междуузлиях. Далее, в 9 и 10 междуузлиях содержание сахаров снова снижается. Отечественные сорта выгодно отличались по сахаристости и сочности стеблей, тогда как зарубежные (США, Индия, Россия) - биологической продуктивностью за счет интенсивного роста надземных органов и усиленного побегообразования.

**ВЛИЯНИЕ ИНОКУЛЯЦИИ СЕМЯН КЛЕТКАМИ  
ЭНДОФИТНЫХ ШТАММОВ *BACILLUS SUBTILIS* НА  
ПОСТУПЛЕНИЕ ИОНОВ КАДМИЯ В *TRITICUM AESTIVUM* L.**

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Изучено влияние инокуляции семян эндофитными штаммами бактерий *B. subtilis* на поступление ионов кадмия в побеги *Triticum aestivum*, выращенных на почве загрязненной солями кадмия. Показано, что инокуляция растений клетками *B. subtilis* снижала токсический эффект кадмия, что проявлялось в показателях лучшего роста при высоких концентрациях металла.

Эксперименты проводили в лабораторных условиях. Семена *Triticum aestivum* L. (сорт Омская-35) стерилизовали 96%-ым этианолом, трижды ополаскивали в дистиллированной воде, подсушивали. В экспериментах использовали бактерии *B. subtilis* шт. 26Д и шт. 11ВМ. Обработку семян бактериями проводили в ламинар-боксе. В опытах использовали 20-часовую культуру бактерий, растущую на мясо-пептонном агаре при +37 °C. Клетки бактерий отмывали раствором 0,001 М KCl. Суспензию клеток доводили до необходимой концентрации по оптической плотности. 1 г семян обрабатывался 20 мкл суспензии бактерий концентрации 10<sup>6</sup> кл/мл. Обработанные семена выдерживали в течение часа, затем использовали в экспериментах. Контрольные семена обрабатывали дистиллированной водой.

Инокулированные и контрольные семена выращивали в вегетационных сосудах. Соли Cd(NO<sub>3</sub>)<sub>2</sub>·4H<sub>2</sub>O в почву металлы вносили в виде раствора, однократно после посадки семян, в концентрации ионов кадмия 10 и 200 мг/кг почвы. Контрольные растения поливали дистиллированной водой. Растения выращивали при температуре 18-20 °C при равномерном освещении. Измерение сырой массы побегов и отбор проб проводили на 30 сутки от начала эксперимента.

Сухие побеги озоляли в смеси азотной и хлорной кислот (5:1 по объему). Кадмий в побегах определяли методом атомно-адсорбционной спектрофотометрии на приборе Spectra AA 200 (Австралия). Все эксперименты проводили в трех биологических повторностях.

В результате проведенных экспериментов было выявлено, что обработка семян бактериями *B. subtilis* положительно влияла на рост растений. Растения, инокулированные клетками *B. subtilis*, имели более высокие показатели биомассы побегов, чем необработанные, и по мере роста растений эти различия становились заметнее. Содержание тяжелого металла в почве в концентрации 10 и 200 мг/кг оказывало слабое стимулирующее действие. Растения, обработанные бактериями, в присутствии кадмия росли лучше необработанных. Так, при концентрации 200 мг/кг масса побегов у обработанных бактериями *B. subtilis* 26 Д и 11ВМ была больше на 14 – 18 %, а при концентрации 500 мг/кг на 10 – 14%, соответственно.

Выявлено снижение содержания кадмия в побегах обработанных бактериями растений в отличие от необработанных. Так, при концентрации 10 мг/кг содержание кадмия в побегах обработанных *B. subtilis* 26Д и 11ВМ растений было ниже на 21,5 % и 14%, соответственно, чем у необработанных, а при 200 мг/кг было ниже на 14,4 и 3,4%, соответственно.

## ВЛИЯНИЕ КРАТКОВРЕМЕННОЙ ГИПОТЕРМИИ НА ФОТОСИНТЕЗ РАСТЕНИЙ КАРТОФЕЛЯ ПРИ ЗАРАЖЕНИИ ФИТОПАРАЗИТИЧЕСКОЙ НЕМАТОДОЙ

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Картофельная цистообразующая нематода (*Globodera rostochiensis* Woll.) принадлежит к числу наиболее серьезных и экономически важных вредителей картофеля, оказывающих негативное влияние на рост, развитие и продуктивность растений. Ранее проведенные исследования показали, что обработка растений картофеля кратковременными ежесуточными снижениями температуры (ДРОП) повышает устойчивость растений к паразиту (Сысоева и др., 2011). Вопрос о механизмах действия ДРОП остается открытым. Известно, что одним из первых действие низкой температуры воспринимает фотосинтетический аппарат растения и, задолго до проявления видимых признаков заражения, могут отмечаться изменения на уровне отдельных реакций фотосинтеза. Целью данной работы является изучение влияния ДРОП-обработки на нетто-фотосинтез и функционирование устьичного аппарата растений картофеля при заражении нематодой.

ДРОП-обработку растений проводили по ранее описанной схеме (Сысоева и др., 2011). Заражение осуществляли цистами в расчете 10 цист/растение. Нетто-фотосинтез, устьичную проводимость, транспирацию листьев и содержание CO<sub>2</sub> в межклеточном пространстве (C<sub>i</sub>) измеряли на 4-м листе у растений сразу по окончании температурного воздействия и на 20 день после заражения при 1000 мкмоль/(м<sup>2</sup>·с) фотосинтетически активной радиации, влажности воздуха 60-70%, содержании CO<sub>2</sub> в воздухе 400 ppm и температурах листа от 10 до 31°C. При заражении растений картофельной нематодой отмечено снижение интенсивности нетто-фотосинтеза, устьичной проводимости, транспирации и C<sub>i</sub> листьев. В тоже время ДРОП-обработка способствовала частичному восстановлению данных показателей. Подобная закономерность была отмечена и при изучении фотохимической активности фотосинтетического аппарата при заражении нематодой (Сысоева и др., 2010). Таким образом, донорно-акцепторные отношения, которые складываются между растением и паразитом могут корректироваться применением ДРОП-воздействия.

Работа выполнена при поддержке Программы фундаментальных исследований ОБН РАН «Биоресурсы 2012-2014» (№ г.р. 01201262103) и Программы «У.М.Н.И.К.».

## ИНДЕКСЫ ЗАСУХОУСТОЙЧИВОСТИ ЗЕРНОВЫХ И ЗЕРНОБОВОВЫХ КУЛЬТУР

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В условиях абиотических стрессов физиологические и биохимические ответы растений могут быть протестированы по многим параметрам: активности антиоксидантных ферментов - пероксидазы (*ПОД*) и супероксиддисмутазы (*СОД*), накоплению пролина, относительного содержания воды (*RWC*). Изучение функционирования антиоксидантных ферментных комплексов, защищающих растения на уровне клетки, позволяет раскрыть потенциальные адаптационные механизмы стресс-устойчивости растений.

В исследованиях были использованы: 1) засухоустойчивые сортообразцы пшеницы: среднеспелые Северянка, Алем и Мирас; в качестве стандарта был использован сорт Казахстанская 10; 2) засухоустойчивые сортообразцы кукурузы из мировой коллекции: раннеспелые ИКВ-6 – Украина, Россия; ИК65-1 – Украина; стандарт 05438 – Казахстан, КазНИИЗиР с периодом вегетации 100-110 дней; 3) сортообразцы культурной сои *Glycine max L.* из мировой коллекции, обладающие признаками засухоустойчивости: сорта Устя (Украина), K589109 (Россия), K583583 IMAS 84 (США), относятся к ультраскороспелой группе с периодом вегетации 85-95 дней. В качестве стандартного сорта использован сорт отечественной селекции – скороспелый Алматы.

В условиях почвенной засухи относительное содержание воды в листьях пшеницы понижалось, однако, обезвоживание происходило менее драматично в клетках растений сортов Алем и Казахстанская 10. Обнаружено, что сорт кукурузы ИК65-1 в меньшей степени испытывал дефицит влаги, в сравнении с сортами 05438 и ИКВ-6, которые оказались менее засухоустойчивыми в наших опытах. Наибольший стресс от недостатка влаги испытывали сортообразцы сои K589109 и Устя, а наименьший – Алматы и K583583.

Значительные изменения в активности ферментов-антиоксидантов были обнаружены для пшеницы в фазе трубкования-колошения: активность *СОД* в условиях стресса засухи повышалась у всех линий, за исключением стандарта Казахстанская10, в то время как активность *ПОД* понижалась; для кукурузы в фазах 3-5 листьев и 20 дней до выметывания активность *ПОД* значительно возрастала, а активность *SOD* для сортов ИКВ-6 и ИК 65-1 повышалась на 25-45% соответственно; для сои в фазе налива бобов наблюдалось повышение активности *СОД*: Устя – в 2 раза, K583583 – на 60%, в то время как активность *ПОД* понижалась для всех сортообразцов сои.

Выявлены коррелятивные связи между физиолого-биохимическими признаками засухоустойчивости и основными элементами продуктивности структуры урожая, что позволяет нам разработать *адекватные индексы засухоустойчивости* для скрининга важнейших сельскохозяйственных культур пшеницы, кукурузы и сои на ранних этапах онтогенеза.

Выявлены генотипы пшеницы, кукурузы и сои, проявляющие устойчивость к стрессу засухи.

## ВЫЯВЛЕНИЕ ПЕРСПЕКТИВНЫХ ВИДОВ РОДА ARTEMISIA L. КАК ПОТЕНЦИАЛЬНЫХ ИСТОЧНИКОВ ФЛАВОНОИДОВ

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В настоящее время большое внимание уделяется поиску растений, содержащих биологически активные вещества (БАВ). Среди БАВ, синтезируемых и накапливаемых растениями, известны такие классы природных соединений, как алкалоиды, фенольные соединения и их гликозиды, терпеноиды, полисахариды, жирные масла, органические кислоты, витамины, микроэлементы. Поиск новых источников флавоноидов путем сравнительного изучения видов рода *Artemisia L.*, (сем. *Asteraceae*), произрастающих в пустынях Алматинской области, является актуальной проблемой отечественной фармакологии.

В результате геоботанических исследований флоры пустынь Алматинской области было собрано около 500 гербарных образцов перспективных видов рода *Artemisia L.*. Проведено морфологическое описание 8 перспективных видов рода *Artemisia* – *A. absinthium*, *A. dracunculus*, *A. sieversiana*, *A. vulgaris*, *A. terrae-albae*, *A. nitrosa*, *A. scoparia*, *A. juncea*.

Для извлечения флавоноидов из растительного материала экстракцию проводили двумя методами: по Сокслету в течение 8 часов (холодная экстракция) и горячей экстракцией в течение 3 часов. Показано, что горячая экстракция более эффективна, чем экстракция по Сокслету. В качестве экстрагентов были апробированы метанол, этанол и ацетонитрил.

Разработан метод предварительной очистки метаноловых и этаноловых экстрактов из растений рода *Artemisia* от матрицы. В качестве метода очистки была предложена колоночная хроматография. В ходе разработки апробированы 2 адсорбента: флокулизил и силикагель. Для очистки экстракты пропускали через колонки, после чего элюировали органическими растворителями, имеющими различную полярность: гексан, хлороформ, изопропанол и ацетонитрил. Элюаты из колонок анализировали с использованием оптимизированной методики на основе ВЭЖХ. Оптимизированные методы экстракции и очистки экстрактов были апробированы на образцах растений, отобранных в ходе экспедиционных работ.

Определение флавоноидов проводили методом высокоэффективной жидкостной хроматографии с диодно-матричным детектированием при оптимизированных параметрах с использованием ранее полученной калибровочной зависимости. Анализ хроматограмм по спектрам поглощения показал, что в образцах присутствуют соединения с двойными спектрами, по максимумам поглощения которых можно предположить, что в данных образцах присутствуют искомые флавоноиды.

Оптимизированы параметры экстракции, разделения и определения флавоноидов из надземной части растений – экстрагент, температура, давление, режим и время экстракции – методом ВЭЖХ и газовой хроматографии с диодно-матричным и масс-спектрометрическим детектированием.

## СВОБОДНЫЙ ПРОЛИН И УСТОЙЧИВОСТЬ ПШЕНИЦЫ И ЯЧМЕНЯ К ТЯЖЕЛЫМ МЕТАЛЛАМ

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Для продвижения зерна на мировые рынки значительный интерес представляет анализ влияния различных ксенобиотиков, в том числе тяжелых металлов (ТМ), на жизнедеятельность зерновых культур. Исследование металлоустойчивости, поиск физиолого-биохимических показателей для оценки экологической безопасности зерновой продукции относятся к работам, приоритетным во всем мире.

Материал ячменя и пшеницы, включающий озимые, яровые формы и двуручки, выращивали в различных экологических условиях на экспериментальных участках КазНИИЗиР. Лабораторные испытания по влиянию ионов  $Zn^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$  металлов (20 мг/л в питательной среде) на изменения физиолого-биометрических параметров прорастание 7 дневных проростков пшеницы проводились в 2010-2013 годах.

Наиболее высокий уровень свободного пролина наблюдался при действии ионов  $Cd^{2+}$ . Ионы  $Cd^{2+}$  являются наиболее сильными токсикантами по сравнению с  $Zn^{2+}$ , что влечет за собой активацию клеточных механизмов стресс-устойчивости. Двуручки отличались высоким содержанием свободного пролина в контроле, что обусловлено сопротивляемостью их экстремальным факторам среды, а значит повышенным адаптивным потенциалом. Под влиянием ТМ происходило значительное накопление свободного пролина у сортов Казахстанская 10, Интенсивная и Память 47 в озимом варианте и Гедера 1225, Арай - в яровом варианте, особенно под влиянием  $Cu^{2+}$  и  $Cd^{2+}$ .

Устойчивость зерновых культур к действию  $Zn^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$  металлов зависит от содержания их в зерне, условий выращивания, имеет сортовую и генотипическую специфичность. Нами выявлен ряд устойчивости анализированных сортов-двуручек озимого варианта к изучаемым металлам: Си: Память 47 > Интенсивная > Гедера 1225 > Гедера 495 > Гедера 152 > Казахстанская 10 > Рута; Zn: Интенсивная > Гедера 495 > Память 47 > Гедера 152 > Гедера 1225 > Казахстанская 10 > Рута; Cd: Интенсивная > Память 47 > Гедера 1225 > Гедера 152 > Гедера 495 > Казахстанская 10 > Рута. Ряд устойчивости сортов-двуручек ярового варианта: Си: Арай > Гуадалуп > Гедера 1225; Интенсивная > Рута > Память 47 > Бонпен; Zn: Арай > Гедера 1225 > Память 47 > Казахстанская 10 > Интенсивная > Гуадалуп > Рута > Бонпен; Cd: Арай > Гедера 1225 > Гуадалуп > Казахстанская 10 > Рута > Интенсивная > Память 47 > Бонпен. Также был построен ряд устойчивости для сортов ячменя: Си: Черниговский-5 > Донецкий-8 > Береке > Арна; Cd: Арна > Черниговский-5 > Донецкий-8. Показано, что для растений-исключателей, в частности пшеницы и ячменя, характерно проявление «барьерной», «накопительной» и «фильтрующей» функции корня.

Познание физиолого-биохимических механизмов металлоустойчивости в обеспечении общей адаптационной способности зерновых культур чрезвычайно важно для установления ведущей роли этого показателя в системе показателей экологической безопасности сельскохозяйственной продукции. В условиях рыночной экономики экологическая безопасность казахстанского зерна приобретает особую значимость, а оценка его по соответствующим общегигиеническим, технологическим и токсикологическим нормативам необходима для определения пищевой и товарной ценности зерна.

**БИОХИМИЧЕСКИЕ СИСТЕМЫ ЗАЩИТЫ В ФОРМИРОВАНИИ И  
РЕАЛИЗАЦИИ МЕХАНИЗМОВ УСТОЙЧИВОСТИ ЗЛАКОВЫХ  
РАСТЕНИЙ К БИОТИЧЕСКИМ И АБИОТИЧЕСКИМ  
НЕБЛАГОПРИЯТНЫМ ФАКТОРАМ СРЕДЫ**

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Одной из приоритетных задач современной биологии является выявление путей формирования устойчивости растений к неблагоприятным биотическим и абиотическим факторам среды, и роли в данных процессах биохимических систем защиты. Известно, что в защитных механизмах растений при стрессах различной природы принимают участие ингибиторы трипсина, лектины, фенилаланинамиаклиаза, дегидрины, сахарозофосфатсингтаза. Одним из индукторов защитных реакций растений является жасмоновая кислота, которая выполняет функции сигнального интермедианта и фитогормона.

В лаборатории биохимии растений СГИ-НЦСС выявлены закономерности изменения активности и компонентного состава ингибитора трипсина, активности лектинов клеточных стенок и фенилаланинамиаклиазы в проростках сортов пшеницы и ячменя, различающихся по устойчивости к возбудителям фузариоза, при инфицировании патогеном и действии жасмоновой кислоты. Установлены оптимальные сроки действия жасмоновой кислоты, при которых наблюдался максимальный эффект ее действия на защитные белки растений. Выявлена связь устойчивости сортов пшеницы к возбудителям фузариоза с уровнем экспрессии генов лектина в растениях.

Показано, что воздействие абиотических стрессоров (водного дефицита, гипергипотермии) приводит к неспецифическим и специфическим изменениям в характере накопления и перераспределения лектинов клеточных стенок и спектрах дегидринов растений пшеницы, различающихся по уровню засухо-жаро-морозостойкости. Высказано предположение, что синтез данных белков находится под контролем абсцизовой кислоты, увеличение количества которой наблюдалось нами в тканях растений пшеницы. Установлены особенности изменения содержания сахарозы и активности сахарозофосфатсингтазы в проростках злаковых растений (пшеницы, ячменя, кукурузы) в условиях водного дефицита и гипертермии в зависимости от уровня засухоустойчивости линий и сортов зерновых культур. Полученные результаты и дальнейшие исследования в этих направлениях позволят усовершенствовать существующие методы оценки селекционного материала на устойчивость к биотическим и абиотическим неблагоприятным факторам, станут основой для создания эффективных индукторов стимулирования и управления защитными системами растений зерновых злаковых культур.

## ВЛИЯНИЕ НАТРИЙ-ХЛОРИДНОГО ЗАСОЛЕНИЯ НА РОСТ СОРТОВ СОРГО САХАРНОЕ

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Солеустойчивость растений является актуальной проблемой растениеводства, привлекающей внимание многих исследователей и практиков сельского хозяйства.

В сельскохозяйственной практике наиболее ценным является однолетнее культурное сорго, подразделяемое на зерновое, сахарное, веничное и травянистое (суданская трава).

К почвам сорго малотребовательно. Оно возделывается даже на засоленных почвах, которые часто встречаются в засушливых зонах. Сорго может расти на разных почвах, от самых тяжелых и даже склонных к заболачиванию до бедных, легких, истощенных многолетним использованием.

Как показали результаты исследований К. К. Мамедбекова (1980) в условиях Дагестана, сорго является хорошей мелиорирующей культурой на засоленных почвах. Сорговые культуры не только дают высокие урожаи зерна и зеленой массы, но они выносят из почвы от 31 до 75 т/га солей, в том числе хлориды и сульфаты. Д. М. Руденко (1980) отмечает что сорговые культуры настолько солевыносливы, что при поливе их соленой водой из Каспия (содержание солей 4,05 - 8,18 г/л, тип засоления - сульфатно-хлоридно-магниево-натриевый), урожай зеленой массы при поддержании порога влажности почвы на уровне 90% НВ составил 527 ц/га, тогда как без орошения - только 40 ц/га.

Существуют различные методы определения солеустойчивости растений. Наиболее распространенными из них являются: 1) учет всхожести семян на засоленном субстрате; 2) многолетнее изучение растений на засоленных почвах; 3) применение скрещивания пыльцой растений, выращенных на засоленных почвах.

В задачу наших исследований входило выявить высокую солеустойчивость образцов сорго, используя указанные выше методы селекционной работы на солеустойчивость, с тем чтобы на солонцах и солонцеватых почвах, повсеместно встречающихся на юге и юго-востоке нашей страны, получать более устойчивые урожаи зерна и зеленой массы.

Целью исследования явилось изучение влияния хлорида натрия ( $\text{NaCl}$ ) на рост и некоторые физиологические показатели сортов сахарного сорго (*Sorghum saccharatum Pers.*).

Объектом исследований были сорта сорго сахарное: Казахстанский- 20, Ростовский, Оранжевое160, Ларец, Кулжа. Растения сахарного сорго выращивали в водопроводной воде в пластиковых сосудах в течение 14 дней. Растения помещали в растворы с содержанием  $\text{NaCl}$  (0,3%; 0,6%; 0,9%) и без  $\text{NaCl}$  (контроль). Увеличение засоленности среды подавляло процесс прорастания семян изучаемых сортов сорго. Исследуемые сорта по-разному реагировали на засоление среды. Растения сорта Ростовский и Казахстанский 20 проявили высокую устойчивость, а сорта Оранжевое160 и Ларец показали большую чувствительность к засолению. Засоление среды подавлял процесс прорастания семян, формирование всходов, накопление биомассы, изменял характер распределения их по органам, снижал содержание фотосинтетических пигментов в листьях, и привело к накоплению пролина в отдельных органах изучаемых сортов сахарного сорго.

## РОСТРЕГУЛИРУЮЩАЯ И ПРОТЕКТОРНАЯ АКТИВНОСТЬ ЭКСТРАЦЕЛЛЮЛЯРНЫХ ПОЛИСАХАРИДОВ ПШЕНИЦЫ

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Исследована рост регулирующая и протекторная активность экстрацеллюлярных полисахаридов (ПС), выделенных из культуры клеток пшеницы, на примере десяти сельскохозяйственных культур (пшеница, ячмень, кукуруза, рапс, томат, огурцы, арбуз, дыня, соя, хлопчатник). Для изучения рост регулирующей активности семена с/х культур предварительно замачивали в растворах полисахаридов, разведенных в различных концентрациях (0,1, 0,01, 0,001 и 0,0001 мкг/мл). После чего семена извлекали из растворов ПС и прорашивали в воде в течение 5 дней при температуре 26° С и 16-ти часовом фотопериоде. В ходе проращивания вели наблюдения за энергией прорастания семян, подсчитывали всхожесть семян, измеряли длину побегов и корней проростков. Для изучения протекторной активности внеклеточных полисахаридов для каждой культуры определяли сублетальные дозы стрессовых факторов - солевого и осмотического, создаваемых различными концентрациями NaCl и сахарозы, соответственно. Семена, предварительно замоченные в различных концентрациях ПС (0,1, 0,01, 0,001 и 0,0001 мкг/мл), прорашивали в растворах с сублетальными концентрациями NaCl и сахарозы.

Показаны существенные различия в рострегулирующей и протекторной активностях ПС в зависимости от вида с/х культур. У всех культур очень низкие (наномолярные) концентрации ПС - 0,001 мкг/мл и 0,0001 мкг/мл, оказывали стимулирующий эффект на рост проростков. Наряду с этими концентрациями средние концентрации ПС - 0,01 мкг/мл, стимулировали рост проростков томата, ячменя, огурцов. У хлопчатника и рапса рост проростков стимулировала высокая концентрация ПС - 0,1 мкг/мл. В целом, под действием ПС рост стеблей усиливается в 2-4 раза, а корней – от 0,5 до 5,5 раз по сравнению с контролем (предварительное замачивание в H<sub>2</sub>O без ПС) в зависимости от культуры. Все испытанные концентрации ПС повышали всхожесть семян при проращивании на воде, в особенности, очень низкие (наномолярные) - 0,0001 мкг/мл. Так, у томата, арбуза и пшеницы всхожесть при этой концентрации повышалась от 50 до 100%, у рапса – от 20% до 75%.

В условиях солевого и осмотического стресса оказались активными все концентрации ПС, в особенности, средние – 0,01 мкг/мл, и очень низкие (наномолярные) – 0,001 и 0,0001 мкг/мл. При осмотическом стрессе рост стеблей под действием ПС возрастает в 2-3 раза, а корней - в 3-4 раза по сравнению с контролем (сахароза, предварительное замачивание в H<sub>2</sub>O без ПС). Также показана способность экстрацеллюлярных ПС повышать всхожесть семян в условиях солевого и осмотического стресса. При солевом стрессе протекторный эффект ПС наблюдается при средних – 0,01 мкг/мл и очень низких концентрациях (0,001 и 0,0001 мкг/мл). Всхожесть семян при этом повышается от 10-40% до 50-100%. При осмотическом стрессе протекторная активность ПС проявляется в очень низких (наномолярных) концентрациях - 0,001 и 0,0001 мкг/мл. Всхожесть семян при этом, повышается от 12-35% до 60-75% по сравнению с контролем (сахароза, предварительное замачивание в H<sub>2</sub>O без ПС), в зависимости от культуры.

Полученные результаты позволяют предложить препараты экстрацеллюлярных полисахаридов к использованию в биотехнологии и сельском хозяйстве в качестве биостимуляторов роста и устойчивости растений с наномолярной активностью.

Работа поддержана инновационным грантом НАТР МИТ РК (2012-2013гг.).

**ВЛИЯНИЕ ПРИРОДНЫХ ФАКТОРОВ НА СО<sub>2</sub>/Н<sub>2</sub>О ОБМЕН  
ДРЕВЕСНЫХ РАСТЕНИЙ ТАЕЖНОЙ ЗОНЫ  
СЕВЕРО-ЗАПАДА РОССИИ**

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Происходящие изменения климата и антропогенная деятельность оказывают заметное влияние на наземные экосистемы. Прогноз реакции растений на эти изменения имеет, несомненно, первостепенное значение для оценки вероятных последствий глобального изменения климата на биосферу. Однако до сих пор вопрос о возможных ответных реакциях видов, сообществ и экосистем в разных регионах на прогнозируемые изменения среды остается открытым. Основной целью исследования была количественная оценка масштабов природной изменчивости эколого-физиологических показателей (СО<sub>2</sub>-газообмен, водный обмен, минеральное питание) сосны обыкновенной (*Pinus sylvestris* L.), ели европейской (*Picea abies* (L.) Karst.) и березы повислой (*Betula pendula* L.) в условиях европейской части среднетаежной зоны России (Республика Карелия). В результате исследования динамики переменных СО<sub>2</sub>/Н<sub>2</sub>О и минерального обменов на фоне изменяющихся гидрометеорологических переменных установили диапазоны факторов среды (температура, относительная влажность воздуха и интенсивность солнечной радиации), обеспечивающие максимальную интенсивность основных физиологических процессов сосны, ели и березы. Показано, что высокая интенсивность этих процессов наблюдается в широких пределах варьирования гидрометеорологических переменных, что свидетельствует о приспособленности исследуемых видов к широкому диапазону условий вегетации. Полученные отличия исследуемых показателей хвойных и лиственных растений при варьировании внешних условий обусловлены различиями эколого-биологических характеристик и поведенческих стратегий исследуемых видов.

По результатам проведенных измерений для сосны, ели и березы провели параметризацию фотосинтеза и устьичной проводимости для использования в модели Mixfor-SVAT (Olchev et al., 2002, 2008). Программа измерений в полевых условиях включала получение углекислотных и световых кривых фотосинтеза листьев при разных температурах воздуха и температурных зависимостей темнового дыхания. По углекислотным кривым по методике (Sharkey et al., 2007) рассчитывали значения максимальной скорости карбоксилирования ( $Vc_{max}$ ), скорость переноса электронов для регенерации акцептора при световом насыщении ( $J_{max}$ ), а также скорость утилизации триозофосфатов ( $TPU$ ), что характеризует доступность внутренних неорганических фосфатов ( $Pi$ ) для цикла Кальвина. Температурные зависимости  $Vc_{max}$ ,  $J_{max}$  и  $TPU$  были получены путем статистического анализа множества значений  $Vc_{max}$  и  $J_{max}$  при разных температурах листа с использованием уравнений, предложенных группой исследователей (Medlin et al., 2002). На основании температурных зависимостей были получены предварительные оценки  $Vc_{max}$ ,  $J_{max}$  и  $TPU$  для выбранной референтной температуры 25°C. Полученные результаты использованы в процесс-ориентированной модели MixFor-SVAT для определения возможного отклика СО<sub>2</sub>/Н<sub>2</sub>О бюджета лесных экосистем Карелии на будущие климатические изменения.

Работа выполнена при финансовой поддержке РФФИ (грант 13-04-00827-а).

## К ПРОБЛЕМЕ УТИЛИЗАЦИИ ФИТОРЕМЕДИАНТОВ

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В настоящее время активно разрабатываются способы фиторемедиации почвы от тяжелых металлов (ТМ), основанные на способности отдельных растений накапливать их в значительных количествах в органах. Было показано, что регулированием вносимых в почву доз борной кислоты можно стимулировать максимальный вынос растениями из почвы определенных ТМ (Чернобровкина и др., 2012). Одним из механизмов, активизирующих вынос растениями ТМ из почвы при внесении борной кислоты, видимо, является участие бора в формировании комплексных соединений с производным полисахаридов – пектином рамногалактуронаном-II при формировании сети в матрице клеточной стенки (Kobayashi et al., 1996; O'Neill et al., 1996). Растения-гипераккумуляторы накапливают металлы преимущественно в надземных органах в высоких концентрациях. Использование метода неизбежно приведет к проблеме утилизации растений – биофильтров, обогащенных загрязняющими веществами, в том числе ТМ. Использование таких отходов в сельском хозяйстве опасно из-за возможности попадания загрязняющих веществ в пищевые цепи. Приготовление субстратов и органических удобрений из подобных отходов для использования в лесном хозяйстве, прежде всего, в лесопитомниках, является предпочтительным (Зайцева, 2004). Для приготовления торфяных субстратов с использованием такого сырья необходимо учитывать диапазоны толерантности сеянцев древесных растений к уровню концентрации химических элементов.

Работу проводили с использованием методики биотестирования по проращиванию семян в инертной среде и в торфе. По экспериментальным данным строили регрессионные кривые частных функций отклика на концентрацию бора, азота, цинка и меди при фиксированных условиях проращивания. Уровни концентраций, соответствующие границам зон, рассчитывали с использованием полученных регрессионных уравнений для каждого из исследуемых элементов. Нижнюю и верхнюю границы диапазона толерантности определяли как точки пересечения линий регрессии, построенных по данным, принадлежащим зонам пессимума, с осью абсцисс. Нижнюю и верхнюю границы диапазонов оптимума определяли по регрессионным уравнениям, построенным по всем наборам данных для данного варианта опыта при значениях всхожести, превышающих 70% от максимальных значений. Показано, что диапазоны оптимума значительно шире в торфе по сравнению с инертной средой, а диапазоны толерантности в этих вариантах не различаются. Наиболее узкий диапазон оптимума отмечен у бора. Исследуемые элементы – бор, азот, цинк и медь оказывают максимальное стимулирующее действие соответственно при концентрациях растворов – 25, 13, 200 и 20 мг л<sup>-1</sup> в инертном субстрате и 31, 159, 40 и 50 мг л<sup>-1</sup> в торфе.

## ИСПОЛЬЗОВАНИЕ МЕТОДОВ БИОТЕХНОЛОГИИ ДЛЯ ВОССТАНОВЛЕНИЯ ВСХОЖЕСТИ СЕМЯН РИСА С ОКРАШЕННЫМ ПЕРИКАРПОМ

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В Казахстане исследования по рису с окрашенным перикарпом не проводились, что привело к отсутствию отечественных сортов красного и черного риса. В отличие от белого шлифованного риса, зерновки риса с окрашенным перикарпом богаты биологически активными веществами, антиоксидантами, витаминами, макро- и микроэлементами. Эти ценные компоненты снижают риск возникновения сердечно-сосудистых, онкологических и ряда других заболеваний.

Период хранения семян риса составляет обычно не более 2-3 лет, после чего происходит резкое снижение всхожести. Некоторые образцы риса с окрашенным перикарпом из коллекции ИББР имелись в ограниченном количестве и характеризовались низкой всхожестью семян.

Целью исследований явилось восстановление всхожести семян биотехнологическими методами для дальнейшего пополнения коллекции и использования в селекции риса с окрашенным перикарпом.

Объектом исследования служили два генотипа риса, семена которых характеризовались нулевой лабораторной и полевой всхожестью: Черный рис, семена которого имели длительный срок хранения, и гибрид F<sub>1</sub> ( $\varphi$ Рубин  $\times$  ♂ВНИИР 10178) с щуплыми зерновками и недоразвитым эндоспермом. Для восстановления всхожести семена Черного риса помещали в криопробирки и погружали в жидкий азот (ЖА) на 1 час. Контролем служили семена, не подвергнутые стрессу. После замораживания в ЖА зерновки риса, предварительно обработанные различными стерилизующими агентами, проращивались в *in vitro* условиях на двух вариантах питательных сред: МС без гормонов; МС с добавлением БАП-2,0 мг/л, НУК-0,5 мг/л, ГК-5,0 мг/л. Выявлены наиболее оптимальные стерилизующие агенты - 75% раствор белизны и 3% раствор TWEEN 20 (экспозиция 20 мин.). Установлено, что на всхожесть семян Черного риса положительно влияет замораживание в ЖА, которая составила 30,0% на среде МС с добавлением гормонов. Полученные регенеранты далее пересаживались в почвенно-торфянную смесь и выращивались до получения зерновок.

Для увеличения всхожести зерновок и получения полноценных растений гибрида F<sub>1</sub> ( $\varphi$ Рубин  $\times$  ♂ВНИИР 10178), их помещали на питательную среду МС с добавлением 0,5 мг/л БАП, 0,5 мг/л ГК и 0,2 мг/л ИМК. При этом была достигнута 100% всхожесть. Проростки далее пересаживались на безгормональную агаризованную питательную среду МС и культивировались до появления 2-3 листочков и корешков. В дальнейшем растения для наращивания корневой массы были помещены в раствор с ИУК-1,0 мг/л. Через 3-4 суток растения пересаживались в вегетационные сосуды и культивировались до полного созревания.

В результате проведенной работы оптимизированы условия для восстановления всхожести зерновок риса, подобраны стерилизующие агенты и питательные среды для проращивания их в условиях *in vitro* и дальнейшего получения полноценных растений, восстановлен исходный материал риса с низкой всхожестью и пополнена коллекция риса с окрашенным перикарпом.

## БИОХИМИЧЕСКИЙ АНАЛИЗ ЗЕРНОВОК ИСХОДНЫХ РОДИТЕЛЬСКИХ ФОРМ И ГИБРИДНЫХ ЛИНИЙ РИСА

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Для стратегического развития сельского хозяйства и продовольственной безопасности Республики Казахстан необходимо создание собственных высокопродуктивных глютинозных сортов риса с полезными хозяйственно-ценными признаками, адаптированных к местным условиям возделывания. В первую очередь необходимо широко развернуть селекционные работы по созданию новых эксклюзивных глютинозных сортов риса, которые ранее в Казахстане не выращивались. Следует отметить, что спрос на глютинозный рис на мировом рынке постоянно возрастает. Глютинозные сорта необходимы для создания продуктов детского и диетического питания, которые обладают свойствами высокой пищевой и биологической ценности по органолептическим, физико-химическим и реологическим показателям. На отечественном рынке полностью отсутствуют глютинозные крупы риса, поэтому создание отечественных продуктов питания на основе глютинозного риса является своевременной и актуальной проблемой.

С целью создания исходного материала для селекции глютинозного риса российские сорта (Виолетта и Виола) были скрещены с отечественными сортами (Баканасский, Маржан, Акдала), которые являются донорами признаков устойчивости к абиотическим стрессам в регионах возделывания риса в Казахстане.

Для установления сходства и (или) различия с родительскими формами был проведен электрофоретический анализ запасных белков семян у глютинозных и амилозных гибридных линий в следующих комбинациях:  $F_2 \text{ ♀ Виола} \times \text{♂ Баканасский}$ ;  $F_2 \text{♀ Виолетта} \times \text{♂ Акдала}$ ;  $F_2 \text{♀ Виола} \times \text{♂ Маржан}$ . Известно, что запасные белки зерновых наследуются кодоминантно и проявляются в спектре гетерозиготного генотипа в зависимости от дозы генов в триплоидном эндосперме: 2 дозы генов материнского и 1 доза генов отцовского генома. В спектре запасных белков семян гибридов отмечается появление интенсивных белковых полос отцовской формы (*Waxy* белок), к примеру, компонента с молекулярной массой 60kDa, что является подтверждением гибридного происхождения данных линий.

С целью выявления перспективных глютинозных форм, проведен скрининг на содержание амилозы у гибридов. По предварительным данным в комбинациях  $F_3 \text{ ♀ Виолетта} \times \text{♂ Акдала}$  и  $F_4 \text{♀ Виола} \times \text{♂ Баканасский}$  идет стабилизация расщепляющихся линий по содержанию амилозы по сравнению с предыдущими поколениями.

Таким образом, в результате комплексной оценки по биохимическим параметрам были выделены и охарактеризованы перспективные глютинозные гибриды разных поколений комбинации. В настоящее время часть выделенных перспективных глютинозных зерен высеяны для ускоренного получения семенного потомства в оранжерейных условиях ИББР.

**ВЛИЯНИЕ ЛИОФИЛИЗАТА ИЗ *AMARANTHUS RETROFLEXUS* L.  
НА ФИЗИОЛО-БИОХИМИЧЕСКИЕ ХАРАКТЕРИСТИКИ  
ПРОРОСТКОВ ПШЕНИЦЫ ПРИ ОСТРОМ  $\gamma$ -ОБЛУЧЕНИИ СЕМЯН**

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Изучение радиомодифицирующего действия различных биологически активных веществ (БАВ), получаемых из растений является одной из приоритетных задач радиобиологических исследований. Для управления радиочувствительностью используют различные радиомодифицирующие агенты. Использование экстрактов из вегетативных частей *Amaranthus. retroflexus* L., содержащих БАВ антиоксидантного действия, могут модифицировать лучевую реакцию при действии острого  $\gamma$ -облучения на животный и растительный организмы.

Целью данной работы являлось изучение влияния лиофилизата *A. retroflexus* L. на физиологические и биохимические характеристики проростков пшеницы сортов «Якутянка-224» и «Приленская-19», выросших из  $\gamma$ -облученных зерновок.

Семена пшеницы были подвергнуты облучению гамма-квантами  $^{60}\text{Co}$  с мощностью дозы облучения 7 рад/с на установке «Исследователь» с дозой облучения 10, 200 и 600 Гр. Вытяжка из вегетативных частей *A. retroflexus* L. была получена путем последовательной экстракции в 40 и 70% водно-спиртовом растворе с дальнейшей её лиофилизацией. Обработку семян подвергнутых предпосевному  $\gamma$ -облучению проводили в водном растворе лиофилизата. Физиологические параметры оценивалась по всхожести семян и сухой массе проростков. Изучены биохимические параметры тканей проростков: активность пероксидазы, супероксидисмутазы, сумма низкомолекулярных антиоксидантов и содержания малонового диальдегида. Радиомодифицирующий эффект оценивался по «фактору изменения дозы» (ФИД), который рассчитывали как отношение равноэффективных доз облучения в присутствии и отсутствии радиомодифицирующего агента.

Пострадиационное влияние лиофилизата на семена исследованных сортов пшеницы оказалось, как радиопротекторное, так и радиосенсибилизирующее действие по показателям массы и общей антиоксидантной защиты клеток проростков. Наблюдалось повышение на 20-30% сухой массы проростков при действии 1.0 и 2.0% водных растворов и увеличение на 20-30% антиоксидантной активности в тканях проростков с понижением на 30-40% уровня перекисного окисления липидов.

Фактор изменения дозы варьировал от 1.0 до 2.5, следовательно, лиофилизат из *A. retroflexus* L., содержащий антиоксиданты, в использованных нами концентрациях обладает радиопротекторным действием, который эффективно снимает пострадиационное поражение, как на физиологическом, так и на биохимическом уровнях.

## ВЛИЯНИЕ ТЯЖЕЛЫХ МЕТАЛЛОВ НА РОСТОВЫЕ ПРОЦЕССЫ В СТВОЛАХ БЕРЕЗЫ ПОВИСЛОЙ *BETULA PENDULA*

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Изучалось воздействие техногенных поллютантов на морфометрические показатели тканей стволов березы повислой *Betula pendula* Roth. Березовые насаждения Красноярской лесостепи, произрастающие по основному ветровому переносу выбросов алюминиевого производства и тепловых станций, работающих на бурых углях, можно отнести к многолетним техногенным резервуарам промышленных потоков. В процессе исследований определялись количественные показатели накопления содержания тяжелых металлов в листьях березы повислой и изучалось их влияние на морфометрические характеристики тканей ствола: ширину годичных приростов ксилемы, частоту расположения ксилемных лучей, частоту расположения сосудов и размеры сосудов.

Исследования проводились в 2006-2011 гг. на мониторинговых пробных площадях в нарушенных березняках разнотравных, произрастающих по основному переносу выбросов металлургического и химического производства, тепловых станций, цементного завода и карьеров по добыче известняка г. Красноярска. В качестве фона были выбраны березовые насаждения, произрастающие соответственно в 40 и 100 км от города вне основного переноса промышленных выбросов.

В исследованиях были использованы стандартные экологические методики и физико-химические методы. Аккумуляция пыли компонентами березовых насаждений изучалась по методике Ж. Детри (1973). На каждой пробной площади образцы листьев отбирали с 5 модельных деревьев. Анализ содержания тяжелых металлов в смывах и образцах листьев проводили на программно-аналитическом комплексе на основе портативного рентгенофлуоресцентного кристалл-дифракционного сканирующего спектрометра «СПЕКТРОСКАН – МАКС Г». Измерения морфологических характеристик древесины проводили методом световой микроскопии на поперечных срезах кернов, взятых на высоте 1,3 м из стволов 5 модельных деревьев на каждой пробной площади (Яценко-Хмелевский, 1954).

Для определения влияния отдельных элементов комплекса тяжелых металлов фолиарной аккумуляции на ростовые процессы, пробные площади были объединены методом кластерного анализа в 4 группы на основе сходства содержания отдельных ТМ в листьях березы. Группа К («контроль») объединяет пробные площади с низкими и средними концентрациями всех четырех элементов. В группу Н («никель») вошли пробные площади, где наблюдается наибольшие из наблюдаемых концентраций никеля при средних концентрациях стронция, цинка и хрома. Группа ЦХ («цинк и хром») характеризуется высоким содержанием цинка и хрома и низким - стронция и никеля. На пробных площадях с высокими концентрациями цинка одновременно наблюдается также и высокое содержание хрома, коэффициент корреляции между содержаниями этих элементов значим ( $R=0,56$ ,  $p < 0,1$ ). Группа С («стронций») характеризуется высоким содержанием стронция при низких и средних концентрациях остальных элементов.

Различия в сочетаниях концентраций изученных тяжелых металлов проявляются в статистически значимых изменениях величины и структуры прироста древесины в стволов деревьев. Повышенное содержание как стронция, так и цинка в листьях березы повислой сопровождается уменьшением ширины годичного слоя, увеличением числа лучей и сосудов, уменьшением диаметров сосудов, а повышенное содержание никеля - уменьшением среднего диаметра сосудов и увеличением числа лучей.

**ПОКАЗАТЕЛИ ВОДНОГО РЕЖИМА ФЛАГОВОГО ЛИСТА  
У СОРТОВ, ВИДОВ И МЕЖВИДОВЫХ ГИБРИДОВ ПШЕНИЦЫ**

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Водный режим играет важнейшую роль в адаптации растений к засухе. На Юго-Востоке Казахстана наибольшее влияние почвенной и атмосферной засухи на зерновые культуры наблюдается в период от колошения до налива зерна. Так как флаговый лист является основным продуцентом ассимилятов, участвующих в наливе зерна, большой интерес представляет показатель оводненности флагового листа при засухе.

Водоудерживающая способность флагового листа при этом в значительной мере отражает адаптивный метаболизм и определяет устойчивость растений, позволяя им противостоять обезвоживанию, различия по этому показателю между контрастными по устойчивости формами сохраняются в любых условиях водообеспеченности.

Проведены эксперименты по определению общей оводненности и водоудерживающей способности изучаемых сортов, видов и гибридов пшеницы в полевых условиях.

Выявлено, что общая оводненность всех изучаемых форм была достаточно высокой, наибольшей – у вида *T. turgidum* L. (75,3%), сорта Ленинградка (73,8%) и гибридов *T.turgidum* x Саратовская-29 F<sub>2</sub> (1 тип по морфологическим признакам расщепления) (73,2%), *T. turgidum* x Ленинградка F<sub>4</sub> BC<sub>1</sub> (1 тип) (74,2%) и *T. compactum* L. x Ленинградка F<sub>4</sub> BC<sub>2</sub> (1 тип) (77,94%).

Однако, при завядании потеря воды флаговыми листьями изучаемых образцов была различной. Наибольшей водоудерживающей способностью листьев в данном эксперименте характеризовались гибриды *T.turgidum* x Саратовская-29 F<sub>2</sub> (1 тип) – 77,8%, *T. compactum* L. x Ленинградка F<sub>4</sub> BC<sub>2</sub> (1 тип) – 70,05% и *T. compactum* L. x Ленинградка F<sub>4</sub> BC<sub>2</sub> (2 тип) – 62,86%. Так как образец, имеющий большую водоудерживающую способность в условиях засухи при одинаковой или более высокой общей оводненности листьев, считается более засухоустойчивым, выделенные в эксперименте гибридные формы следует отнести к категории наиболее засухоустойчивых во второй половине онтогенеза.

## ВЛИЯНИЕ РАЗЛИЧНЫХ КОНЦЕНТРАЦИЙ АЗИДА НАТРИЯ ( $\text{NaN}_3$ ) НА НЕКОТОРЫЕ ФИЗИОЛОГО-БИОХИМИЧЕСКИЕ ПОКАЗАТЕЛИ ГЛЮТИНОЗНЫХ СОРТОВ РИСА

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Необходимым элементом селекции риса в Казахстане является обогащение биоразнообразия в коллекции исходного материала использованием химических мутагенов. Исследования последних лет показывает эффективность применения азид натрия ( $\text{NaN}_3$ ) в селекции риса. Поэтому для увеличения генетического разнообразия и исследования влияния азид натрия на физиолого-биохимические показатели и хозяйствственно-полезные признаки зерновки глютинозных сортов «Виола» и «Виолетта» обрабатывали этим мутагеном в трех концентрациях: 1 mM; 3 mM; 5 mM. После обработки семена промывали проточной водой, проращивали в термостате ( $27^{\circ}\text{C}$ ) в течение 5-6 дней, появившиеся проростки пересаживали в вегетационные сосуды и выращивали в теплице до полного созревания семян. Увеличение концентрации мутагена закономерно снижало процент прорастание семян у всех исследуемых образцов. Азид натрия в концентрации 3 mM вызывал снижение всхожести у сортов до 38/23 % (сорта Виола и Виолетта соответственно), этот показатель при концентрации 5 mM составил 13/14 %. Замер высоты проростков на стадии 4-5 листьев показало, что различные концентрации мутагена существенно не повлияло на высоту растений. Только при концентрации 5 mM фаза полного кущения у сортов Виола и Виолетта наступало на 2 дня позже по сравнению с контролем. Учет площади флагового листа ( $\text{cm}^2$ ) показал, что обработка тремя концентрациями мутагена существенно не повлияла на данный показатель. В фазах кущения и трубкования определено содержание хлорофилла у исследуемых образцов. При концентрации 1 mM у сорта Виола содержание хлорофилла увеличивается в фазе кущения и трубкования в 1,5-2 раза по сравнению с контролем, в то время как у сорта Виолетта при данной концентрации увеличение содержания хлорофилла наблюдалось только в фазе кущения в 3 раза. С увеличением концентрации 3 mM и 5 mM снижалось содержание хлорофилла у обоих сортов. В фазе полной спелости отбирали растения для определения содержания амилозы и анализа элементов структуры урожая (кустистость, высота растений, длина метелки, количество колосков в метелке, количество зерновок в метелке, длина корней, пустозерность, масса 1000 зерен). С увеличением дозы мутагена повышалось содержание амилозы у сорта Виолетта по сравнению с контролем во всех вариантах обработки. Но такая закономерность у сорта Виола не наблюдалась. Установлены отличия между контрольными и обработанными мутагеном формами по количеству стерильных колосков и в массе зерна с главной метелки, массе 1000 зерен и форме зерновки. Дальнейшее изучение и отбор перспективных мутантных форм будут проводится в  $M_2$  поколении в оранжерейных и полевых условиях.

В результате исследований выявлены перспективные образцы для включения их в дальнейший селекционный процесс по созданию отечественных сортов глютинозного риса.

## **ИЗМЕНЕНИЕ АКТИВНОСТИ АНТИОКСИДАНТНЫХ ФЕРМЕНТОВ ПРИ ДЕЙСТВИИ ГЛИФОСАТА НА СУСПЕНЗИОННЫЕ КЛЕТКИ КАРТОФЕЛЯ**

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Одним из ранних неспецифических ответов растительных организмов на абиотические стрессоры, в том числе гербициды, является усиление процессов свободно – радикального окисления, приводящих к накоплению активных форм кислорода (АФК), что может приводить к серьезным функциональным нарушениям, поскольку повреждаются различные компоненты клеток. Основным способом защиты от АФК является их инактивация антиоксидантными ферментами, такими как супeroxиддисмутаза (СОД), аскорбатпероксидаза (АПО) и каталаза (КАТ).

Глифосат относится к неспецифическим гербицидам, действующим после прорастания растений и широко используемым для уничтожения сорняков. Показано, что глифосат вызывает окислительный стресс в растениях гороха, пшеницы и кукурузы. При этом наблюдается увеличение уровня прооксидантов и активация антиоксидантных ферментов.

В связи с этим нами были изучены изменения активности антиоксидантных ферментов в супензионных клетках картофеля при воздействии разных концентраций глифосата ( $10^{-7}$ ,  $10^{-5}$ ,  $2 \times 10^{-5}$  %) через 6, 24 и 48 ч после обработки.

Показано, что активность ферментов изменялась в цитоплазматической и во внеклеточной фракциях в зависимости от концентрации и длительности обработки гербицидом. Установлено, что наибольшее влияние глифосатоказал на СОД и КАТ, при котором произошло увеличение их активности в 2-3 раза на более раннем этапе (через 6ч) при всех испытанных концентрациях по сравнению с контролем. При высоких концентрациях для СОД наблюдали второе (через 48 ч) усиление активности. АПО активировалась через 24 ч в обеих фракциях при всех концентрациях, в 3-5 раз превышая уровень контроля.

Проведенное исследование показало, что антиоксидантные ферменты участвуют в детоксикации АФК для сохранения редокс-баланса, что способствует формированию защитных ответных реакций супензионных клеток картофеля к гербициду.

## РОЛЬ МЕТИЛЖАСМОНАТА В РЕГУЛЯЦИИ РОСТА И УСТОЙЧИВОСТИ РАСТЕНИЙ

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Устойчивость растений к экстремальным стресс факторам и действиям патогенов требуют пристального внимания ученых многих стран. Изменения окружающей среды и инвазия болезнетворных агентов распознаются растениями через сигналы, поступающие из мест непосредственного воздействия фактора или повреждения растений. Растения обладают большей химической защитой главным образом, вторичных метаболитов, токсичных для патогенов или травоядных животных (Рощина В.В. и Рощина В.Д., 2012). Существуют сети сигнальных путей, благодаря которым растение выживает, если выработает стратегию адаптации к действию стрессора. Жасмоновая кислота (ЖК) и метилжасмонат (МЖ) липоксигеназной сигнальной системы, являются регуляторными веществами, инициирующими системную устойчивость растений.

Для того, чтобы понять как растения защищают себя от вредного действия стрессов, в частности соли и ржавчины мы предприняли исследования влияния предварительной обработки проростков пшеницы и подсолнечника метилжасмонатом в концентрациях  $10^{-4}$  мМ и  $10^{-5}$  мМ перед обработкой их растворами NaCl в концентрациях 50, 100 и 200 мМ и инокуляцией уредиоспорами ржавчины. Также нами были проведены исследования влияния метилового эфира жасмоната на накопление биомассы одноклеточной морской водоросли. Изучали скорость растяжения колеоптиля, рост корней и первого листа проростков пшеницы, степень заражения ржавчиной растений подсолнечника и прирост биомассы водоросли в лабораторном биореакторе. В результате получены данные, показывающие активирующие и защитные свойства метилжасмоната на рост проростков пшеницы, на накопление биомассы одноклеточной морской водоросли и степень заражения ржавчиной растений подсолнечника. Жасмонат и ее метиловый эфир являются природными веществами, которые синтезируются из линоленовой кислоты с участием липоксигеназы (Vick and Zimmerman, 1984). Известно, что ЖК и МЖ участвуют процессах роста и развития (Greelman and Mullet, 1997) выполняют сигнальные функции (Тарчевский, 1991; Гречкин, 1992, Wasternack, 2007), так же в ответных реакциях на стресс засоления (Fedina, 1999), и проявляют себя как биохимические инсектициды.

Развитие биотехнологии предусматривает производство новых природных продуктов, среди которых и продукты выделительной деятельности растений – природные инсектициды, гербициды и фунгициды (Рощина В.В. и Рощина В.Д., 2012). Обсуждается роль оксилипина и необходимость ее использования в биотехнологических разработках для поиска новых веществ и композиций, регулирующих рост и устойчивость растений к стрессам.

# **Секция 4.**

## **Клеточная и генетическая инженерия растений**

## ВЗАИМОДЕЙСТВИЯ РАСТИТЕЛЬНЫХ ОРГАНЕЛЛ НА ГЕННОМ УРОВНЕ: РЕТРОГРАДНАЯ РЕГУЛЯЦИЯ И РЕДОКС-СИГНАЛИНГ

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В клетках растений в ходе онтогенеза успешно реализуется механизм координации работы ядерного, пластидного и митохондриального геномов в непрерывно изменяющихся условиях внешней среды. Этот регуляторный механизм, с одной стороны, включает ядерный контроль экспрессии хлоропластных и митохондриальных генов. С другой стороны, существует так называемая ретроградная регуляция, направленная от хлоропластов и митохондрий к ядру, несущая информацию о состоянии этих органелл и обеспечивающая обратную связь между цитоплазмой и ядром. В докладе приводятся результаты исследований ретроградной регуляции экспрессии ядерного гена *gdh2* *Arabidopsis thaliana*, кодирующего α-субъединицу митохондриальной глутаматдегидрогеназы. Обнаружена зависимость экспрессии гена *gdh2* от редокс-состояния электрон-транспортной цепи митохондрий. Обработка суспензии клеток арабидопсиса ингибитором комплекса III дыхательной цепи антиимицином А приводила к увеличению содержания транскриптов *gdh2* уже через 2 часа обработки. Ингибирование комплекса I путем добавления ротенона не оказывала какого-либо действия на уровень содержания транскриптов. В то же время обработка ингибитором комплекса IV цианидом калия вызывала увеличение содержания транскриптов. Таким образом, экспрессия гена *gdh2*, по-видимому, реагирует на изменения состояния дыхательной цепи на участке, локализованном между первым и третьим комплексами. Отсутствие активации экспрессии гена при обработке мумпензии клеток перекисью водорода и прооксидантом паракватом, а также результаты экспериментов с использованием антиоксидантов позволяют считать, что выявленный эффект не связан с увеличением содержания генерируемых при ингибировании электрон-транспортной цепи активных форм кислорода. Установлено, что фосфорилирование белков, осуществляемое серин/треониновыми протеинкиназами – необходимы этап в процессе передачи сигнала об индукции экспрессии гена *gdh2* в ядро. Обнаруженный механизм регуляции экспрессии гена *gdh2* может рассматриваться как еще один пример ретроградной регуляции, продемонстрированный ранее для гена альтернативной оксидазы и генов некоторых других белков. В докладе будут также приведены результаты исследований редокс-сигналов, исходящих из митохондрий и оказывающих влияние на транскрипцию хлоропластных генов в растениях арабидопсиса.

## ИДЕНТИФИКАЦИЯ ВИРУСНЫХ БЕЛКОВ ОТВЕТСТВЕННЫХ ЗА ЗАПУСК ГИПЕРЧУВСТВИТЕЛЬНОГО ОТВЕТА

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В настоящее время стало очевидным, что RNAi является адаптивным защитным молекулярно-иммунным механизмом, направленным против вирусных заболеваний. Вирусные супрессоры действуют на различных этапах RNAi и обладают биохимическими свойствами, которые позволяет им эффективно противодействовать защитной системе растений. Более того, последние данные наших исследований указывают на взаимосвязь защитных механизмов растений от вирусов. Все больше доказательств появляется, что о функциях вирусных супрессоров и все большее внимание ученых направлено на изучение эндогенных компонентов и антивирусных компонентов растений и как они регулируются при вторжении вируса. За последние 10-15 лет стало возможным исследование фитопатогенных инфекций на молекулярном уровне, так как теперь известно, что основную роль в патогенезе выполняют вирусные белки-супрессоры. Структурные особенности вирусных белков-супрессоров обуславливают возможность их взаимодействия с компонентами RNAi. Но помимо белков – супрессоров было показано, что капсидный белок действует в качестве элиситора гиперчувствительного ответа в растениях томата. Тем самым, развивается резистентность к вирусу кустистой карликовости томата в растениях *Solanum lycopersicum*, что допускает существование иных белков – элиситоров запускающих гиперчувствительную реакцию против вирусного патогена.

## ПРЕИМУЩЕСТВА ИСПОЛЬЗОВАНИЯ ГАПЛОИДНЫХ ТЕХНОЛОГИЙ В ПРОГРАММАХ КЛАССИЧЕСКОЙ СЕЛЕКЦИИ ПШЕНИЦЫ

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Внедрение гаплоидных технологий в сочетании с методами классической селекции позволяет отобрать сорта и гибридные особи с ценными хозяйственными признаками.

В настоящее время в Китае зарегистрировано более 20 сортов пшеницы, сорта Jinhya №1, 2, отличаются высокой продуктивностью.

В Европе DH-линии используются для ржи и фуражных трав, селекция которых страдает от депрессии инбридинга.

В России гаплоидные технологии в сочетании с традиционной селекцией успешно применяются в НИИСХ Юго-Востока и ВИЗРе. Саратовские ученые показали, что сорта, созданные с применением DH-линий, обладают высокой засухоустойчивостью в условиях Поволжья.

В Казахстане при творческом содружестве Казахского агротехнического университета им. С. Сейфуллина, Института биологии и биотехнологии растений, НПЦ ЗХ им. А.И. Бараева и Карабалыкского селекцентра проводятся целенаправленные работы по включению дигаплоидных линий в селекционный процесс.

Семенное поколение растений-регенерантов испытывались в полевых условиях в разных экологических зонах.

Для ускорения селекционного процесса проводилась гибридизация с линиями и формами, являющимися донорами признака засухоустойчивости. Линии достоверно превысили стандарт по урожайности на 2,9-3,6 ц/га в условиях Акмолинской области. Линии, превысившие стандарт, переданы на размножение и испытание в ТОО «Карабалыкская СХОС». В условиях Кустанайской области линия AR45 по продуктивности уступила стандартному сорту Карабалыкская 90 и по продолжительности вегетационного периода созревала на 3-4 дня позже и это следовало ожидать, так как другая экологическая зона. Погодные условия Кустанайской области резко отличаются от погодных условий Акмолинской области, а комплексные полигенные признаки зависят от эколого-географической зоны. По мнению В.А. Драгавцева, последствия мультилокусного эпистаза меняются из года в год в одной географической точке и при смене лимитирующего фактора внешней среды меняются число и спектр генов, детерминирующих среднюю величину и генетическую дисперсию признака. Линии в культуре пыльников отбирались на засухоустойчивость, а Кустанайская область является более влагообеспеченным регионом, чем Акмолинская.

Таким образом, на основе проведенных исследований разработана технологическая схема, где умело, сочетаются традиционные и биотехнологические методы, которая может быть применена и к другим сельскохозяйственным культурам для улучшения их генетического базиса.

**ВЛИЯНИЕ МУТАЦИИ В ГЕНЕ AtTOR НА АКТИВНОСТЬ  
ФЕРМЕНТОВ БИОСИНТЕЗА АБК У *ARABIDOPSIS THALIANA*  
ПРИ СОЛЕВОМ СТРЕССЕ**

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TOR (*targetofrapamycin*) киназа присутствует у большинства видов эукариот и играет ключевую роль как в регуляции процессов роста и развития организмов, так и формировании метаболического ответа клетки на действие различных стрессовых факторов. В клетках млекопитающих mTOR (англ. Mammalian *Target of Rapamycin*) существует в виде каталитической субъединицы в составе двух комплексов - mTORC1 и mTORC2.

Некоторые члены TOR комплексов - раптор и *mLST8/GβL* – белки, TOR-субстраты и регуляторы TORсигналинга имеются и у растений. В геноме арабидопсиса, например, представлено два *LST8/Gβl* гомолога (*At3g18140*, *At2g22040*). В свою очередь TORC1-специфический белок Raptor/KOG1 у арабидопсиса представлен двумя вариантами: *AtRaptor1A* (*At5g01770*) и *AtRaptor1B* (*At3g08850*). В растениях не обнаружены TORC2-специфические белки Rictor/AVO3 и hSin1/AVO. Имеются данные об ингибировании киназной активности S6K1 осмотическим стрессом, что позволяет предположить, что TOR - сигнальная система может быть задействована в регуляции метаболизма растительных клеток в ответ на стрессовые воздействия. Установлено, что гипо- и гиперэкспрессия гена AtTOR у арабидопсиса оказывает влияние на размер клеток и органов растений, количество семян и устойчивость к осмотическому стрессу, а рост растений положительно коррелирует с уровнем экспрессии TORкиназы. Подавление AtTOR экспрессии РНК-интерференцией приводит к остановке роста и развития растений. Зародыши семян растений арабидопсиса, несущих мутацию по гену белка - раптор, характеризовались гиперчувствительностью к различным видам стресса. При солевом стрессе нарушается водный и ионный гомеостаз как на клеточном уровне, так и на уровне целого растения. Несмотря на большое количество экспериментальных исследований по изучению TOR регуляции клеточных процессов в растительных клетках некоторые вопросы участия pTOR (от анг. *plantTOR*) сигнальной системы в физиологических процессах растительных организмов остаются малоизученными. Не исследованы, в частности, взаимоотношения систем сигналинга TOR и АБК с точки зрения их участия в процессах адаптации растений к стрессовым условиям окружающей среды.

В связи с этим целью настоящей работы было изучение участия TOR-сигналинга в механизмах адаптации растений к солевому стрессу с использованием мутантных линий *Arabidopsis thaliana* с гипер- и гипоэкспрессией гена AtTOR: *GK-548G07.01*, *GK-548G07.07*, *GK-548G07.12*, *Agrikline - 35-7*, *SALK\_7846C*, *SALK\_147817*, *SALK\_7654*, *SALK\_146186CL*. Относительный уровень экспрессии гена AtTOR в мутантных линиях был определен в режиме RT-PCR. Наблюдалась четкая корреляция между размером листовой розетки, эпидермальных клеток и уровнем экспрессии гена AtTOR. Повышение экспрессии AtTOR приводило к увеличению размера листовой пластиинки и эпидермальных клеток. В случае с мутантами, характеризовавшимися гипоэкспрессией гена AtTOR, наблюдалось уменьшение размеров последних. В условиях солевого стресса в растениях мутантных линий установлено повышение активности альдегидоксидазы и ксантиндегидрогеназы. На основании участия этих ферментов в биосинтезе АБК предположено, что TOR в определенных условиях может выступать в качестве фактора негативной регуляции биосинтеза АБК.

## ВВЕДЕНИЕ В КУЛЬТУРУ ИЗОЛИРОВАННЫХ МИКРОСПОР ПШЕНИЦЫ И ЯЧМЕНЯ

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В качестве исходного материала испытывались сорт Северянка пшеницы, а так же гибридное поколение F<sub>2</sub> ячменя. Исходный материал был посеван в контролируемых условиях. Температура была установлена на уровне 20°C в течении дня и 14°C ночью, фотопериод составлял 16 часов день и 8 часов ночь.

Сбор колосьев проводили рано утром в стадии одноядерной микроспоры в часы интенсивного деления пыльцы. Предобработку колосьев проводили в растворе нитрата серебра в концентрации 40 мг/л, при температуре +4°C в течение 3 недель. Перед изоляцией микроспор, колосья стерилизовали в 5-6%-ом растворе белизы (гипохлорита натрия) в течении 7 минут и в 70%-ом спирте в течение 30 секунд с последующим 3-5 – кратным промыванием стерильной дистиллированной водой и порциями по 10-15 штук помещали на лист стерильной бумаги для удаления воды.

Изоляцию микроспор пшеницы проводили по методу Csaba Lantos (2006) с нашими модификациями. Для эффективной изоляции использовали микросмеситель Waring 31BL92. Колосья помещали в прохладный микросмеситель (10 °C), используя 50 мл 0,3M раствора маннита (10-12 °C), и гомогенизировали 7-9 сек. Суспензию от смесителя пропускали через фильтр размером пор 80μm, и сливали в стерильную 15мл Falcon пробирку. Смеситель промывали дополнительно раствором маннита в объеме 4 мл, и образовавшуюся суспензию тоже фильтровали, сливая в пробирку. Фильтрат центрифугировали в 80g в течение 5 минут, супернатант сливали, к осадку наливали 5мл раствора 0,3M маннита и 21% мальтозы и снова центрифугировали в течении 5 мин. Повторяли промывку микроспор еще один раз раствором 0,3M маннита. После заключительного промывания, микроспоры помещали в среду СНВ<sub>3</sub>. Плотность микроспор составляло 20000-25000 микроспор/мл. Суспензию микроспор разливали по 5 мл в чашки Петри диаметром 60мм. Затем микроспоры помещали в термостат с температурой 32°C на 48 часов. После температурного шока добавляли по 1 мл свежей среды в каждую чашку Петри и помещали в термостат с температурой 28°C.

Изоляцию микроспор ячменя проводили по методу Liu Devaux (2003г) с нашими модификациями. В отличие от пшеницы, после предобработки раствором серебра в течении 3 недель, колосья гомогенизировали в растворе WS (0,3 маннита, 10мM CaCl<sub>2</sub>) 7-9сек. Суспензию от смесителя пропускали через фильтр размером пор 80μm, и сливали в стерильную 15мл Falcon пробирку. После недели предобработки в питательной среде к суспензии микроспор добавляли 21% раствор мальтозы и центрифугировали при 1000грт в течении 10минут. Супернатант сливали, к осадку наливали свежего раствора 21% мальтозы, еще раз центрифугировали при 1000грт для удаления мертвых микроспор. Для последней промывки микроспор использовали раствор WS, центрифугировали при 600грт в течение 3 минут. К осевшему осадку добавляли 10мл среды IMI. Чашки Петри с микроспорами ставили в термостат при температуре 26°C.

В результате проведенных экспериментов получен эмбриогенез у пшеницы и ячменя в размере 1,2% и 0,8% соответственно, от количества культивируемых микроспор.

## МОЛЕКУЛЯРНЫЕ МЕХАНИЗМЫ РЕГУЛЯЦИИ БИОСИНТЕЗА БЕЛКА У РАСТЕНИЙ

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Ранее нами было показано, что у растений молекулярный механизм регуляции активности ключевого фактора инициации трансляции 2 (reIF2) отличается от такового в клетках млекопитающих. Мы впервые установили, что сродство reIF2 к GDP ( $K_{dGDP} = 150 \text{ nM}$ ) лишь в 10 раз выше, чем к GTP ( $K_{dGTP} = 1500 \text{ nM}$ ), тогда как для аналогичного фактора млекопитающих (meIF2) данное превышение составляет два порядка ( $K_{dGDP} = 30 \text{ nM}$ ,  $K_{dGTP} = 2500 \text{ nM}$ ). Вследствие этого, для циклического функционирования растительного фактора reIF2 не требуется фактор eIF2B, который строго необходим у млекопитающих, а также уменьшается роль фосфорилирования reIF2 в регуляции инициации трансляции [Shaikhin e.a., 1992, *Biohimie*, 74:447]. Действительно, у растений до сих пор не обнаружена биохимическая активность и гены eIF2B-подобного фактора. Кроме того, из четырех протеинкиназ (PKR, HCR, PERK, GCN2), фосфорилирующих регуляторную альфа-субъединицу фактора eIF2 в клетках млекопитающих, у растений обнаружены активность и ген только GCN2-киназы, причем мутанты с нарушенным геном *gcn2* вполне жизнеспособны [Zhang e.a., 2008, *J.Exp.Bot.* 59:3131; Lageix e.a., 2008, *BMC Plant Biol.* 8:134; Immanuel e.a., 2012, *Func. Plant Biol.* 39:717].

Также нами впервые установлено, что в клетках растений отсутствует протеинкиназная активность, специфически фосфорилирующая фактор элонгации трансляции 2 (reEF2). Мы показали, что активность reEF2 потенциально может регулироваться фосфорилированием, поскольку этот растительный фактор можно искусственно фосфорилировать meEF2-киназой из клеток млекопитающих, что сопровождается потерей функциональной активности reEF2. Однако, даже используя методы детекции с высокой чувствительностью, нам не удалось обнаружить в клетках растений эндогенную киназу, способную фосфорилировать фактор reEF2 [Smailov e.a., 1993, *FEBS Lett.*, 321:219]. Позднее наши результаты и выводы были подтверждены в работах других групп исследователей.

Эти и другие данные свидетельствуют, что в отличие от животных, у растений отсутствуют механизмы регуляции биосинтеза белка, работающие по принципу «все, или ничего» посредством обратимого фосфорилирования факторов трансляции.

Далее мы впервые для растительных объектов установили кэп-независимый механизм связывания мРНК с 40S рибосомной субчастицей в ходе инициации трансляции, который заключается в комплементарном взаимодействии 5'-нетранслируемой последовательности (5'НТП) мРНК с центральным доменом 18S рРНК. Мы определили важный участок в центральном домене 18S рРНК и экспериментально показали, что искусственное повышение комплементарности в 5'НТП к этому участку 18S рРНК приводит к многократному увеличению эффективности трансляции мРНК [Akbergenov e.a., 2004, *Nucl. Acids Res.*, 32:239].

Кроме того, сами рибосомы могут регулировать трансляцию групп мРНК. Так известно, что фосфорилирование рибосомного белка S6 (RPS6) приводит к увеличению трансляции группы мРНК с 5'-терминалной олигопириимидиновой последовательностью (5'TOP<sup>+</sup>мРНК). Поскольку 5'TOP<sup>+</sup>мРНК кодируют белки аппарата трансляции (рибосом, факторов), а также транскрипционные факторы и регуляторы клеточного цикла, то повышенная трансляция 5'TOP<sup>+</sup>мРНК приводит к росту и делению клеток. Искусственно повышая фосфорилирование RPS6, можно увеличивать продуктивность растений.

## ҚАЗАҚСТАНДАҒЫ ҚЫЗҒАЛДАҚТАРДЫҢ ЭНДЕМИКАЛЫҚ ТҮРЛЕРИН *IN VITRO* ЖАҒДАЙЫНДА ӨСІРУ

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Гүлдердің элиталық санатына жататын *Грейг* - *T. greigii* (*Liliaceae*) қызғалдағы өте сирек кездесетіндіктен Қазақстанның Қызыл кітабына енгізілген. Бұл өсімдіктің вегетативті көбеюі күрделі болғандықтан селекция жүргізу әдісі қазіргі уақытта қыындық тудырыруда. Генофондты сақтау және көбейту мақсатында *Грейг* қызғалдағынан *in vitro* жағдайында каллустық культуралар алуға және аз уақыт ішінде көп мөлшерде көбейтуге клондық микрокөбейту әдісі мүмкіндік береді.

Зерттеудің мақсаты – эндемик түрге жататын *Грейг* қызғалдағының клетка культураларын алу және өсіру үшін қолайлы қоректік орга құрамын оңтайландыру.

Зерттеу нысаны ретінде *Грейг* қызғалдағының гүлдеу фазасы кезіндегі пиязшықтары алынды.

Пиязшықтарды стерилизациялау келесі әдістер бойынша жүргізілді: пиязшықтарды 10%-тік натрий гипохлорид ерітіндісінде 20 минут, содан кейін 5 минут 70%-тік этанолға ауыстырылды және бидистилденген сумен 3 рет шайқалды.

*Грейг* қызғалдағынан каллус культураларын алу үшін стерилизация кезеңінен кейін пиязшықтың жоғарғы бөлігін тілімдеп жарақаттап, құрамында сахароза және өсу реттегіштері - индолилсірке қышқылы (ИУК), кинетин және казеин қосылған Мурасиге-Скуг қоректік оргасына отырғызылды. Эксперименттің 16-шы аптасында қызғалдақтың пиязшығынан алғашқы каллус түзілуі байқалды. Каллустар +26°C температурада, термостатта, қараңғы жағдайда өсірілді.

Қызғалдақтың *Грейг* түрінің вегетативті көбейетін жерасты мүшесі-пиязшықтарын пайдалана отырып *in vitro* жағдайына каллустық культураларын енгізу және көбейту әдістері таңдалған алынды және оңтайландырылды. Бұл әдіс қызғалдақтың *Грейг* түрінің каллустық культураларын *in vitro* жағдайына енгізуге және көбейтуге мүмкіндік береді.

## КЛОНИРОВАНИЕ ГЕНОМА ВИРУСА А ВИНОГРАДА В БИНАРНЫЙ ВЕКТОР И ИЗУЧЕНИЕ ЕГО ИНФЕКЦИОННОЙ АКТИВНОСТИ

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Использование растений как биофабрик для производства целевых продуктов, имеет ряд преимуществ перед другими организмами, где меняются только подходы внесения гетерологичного гена в растение. В настоящий момент широко используются различные методики создания трансгенных растений для экспрессии целевых белков, а также транзиентная экспрессия, осуществляемая благодаря векторам на основе вирусов. Создание векторов на основе вирусов дает возможность эффективно получать целевые продукты при минимальной затрате. Клонирование полного генома вируса А винограда в бинарный вектор с сохранением его инфекционной способности даст возможность путем генной инженерии на основе данного генома создать вирусный вектор, несущий целевой ген для экспрессии гетерологичных продуктов для медицины, сельского хозяйства, биотехнологических производств и научных целей.

Для получения конструкции использовали бинарный вектор pCambia2300, имеющего LacZ сайт множественного клонирования, что позволило отобрать клоны несущие полный геном вируса А винограда по принципу белых и голубых колоний (ферментативное расщепление X-gal β-галактозидазой). Ранее созданная нами конструкция, содержала полный геном вируса А винограда фланкированный регуляторными последовательностями 35S промотором и 35S терминатором, что и было субклонировано в бинарный вектор по рестрикционному сайту EcoI136II. Полученный клон проверяли на присутствие генома вируса А винограда при помощи ПЦР, амплификацией региона генома от OPC3 до OPC5, и рестрикционного анализа, с помощью эндонуклеазы Hind III, в геноме вируса имеются 2 сайта для данного фермента в положении 1978 п.н и 3425 п.н и один сайт в бинарном векторе. Отобранные несколько клонов, содержащих геном вируса А винограда, использовались для трансформации *Agrobacterium tumefaciens* штамм EHA105. Агроинфильтрацию *Nicotiana benthamiana* проводили бактериями различной оптической плотностью (0.4;0.6;1), с целью выявить оптимальную плотность для табака. Через 7-10 дней после агроинфильтрации были замечены первые проявления признаков инфекции в верхушечных листьях у растений (пожелтение околососудистых тканей, деформация листочков), что подтверждает сохранение инфекционной способности вируса, заражение растений было практически одновременным, несмотря на разные оптические плотности бактерий. На 11-20 день признаки инфекции проявились на большинстве листьев.

Данная конструкция первый этап создания вирусного вектора модификацией генома вируса А винограда путем инсерцией гетерологичных генов для получения целевых белков в растениях. Метод агроинфильтрации для инфицирования растений, конструкцией содержащей геном вируса, более эффективный по сравнению с механическим инокулированием. На всех растениях подвергнутых агроинфильтрации проявились признаки инфекции вирусом А винограда.

## ИЗУЧЕНИЕ РОЛИ ВИРУСНОГО БЕЛКА P19 ПРИ ИНФЕКЦИИ ПРЕДСТАВИТЕЛЕЙ РОДА SOLANACEAE

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P19 белок кодируемый вирусом кустистой карликовости томата (*Tomato bushy stunt virus* (TBSV)), молекулярная масса которого 19 кДа, транслируется с субгеномной РНК2 вируса.

Роль P19 белка в супрессии RNAi было впервые продемонстрировано на трансгенных растениях экспрессирующих зеленый флуоресцентный белок (green fluorescent protein (GFP)), инфицированных картофельным вирусом X (*Potato virus X* (PVX)), который использовался в качестве вектора для экспрессии P19. Дальнейшие исследования показали решающую роль TBSV P19 в защите вирусной РНК в ходе системной инфекции в растениях *N. benthamiana*. Более того биологическая активность белка зависела от его количества, т.е. успешная инфекция, сила симптомов, а также стабильность вирусной РНК требуют достаточно высокого уровня экспрессии P19.

Исследования, проведенные двумя независимыми научными группами полученные методом рентгеновской кристаллографии, указали на существование комплекса между димерами P19 и двуцепочечными молекулами siRNA. Данные структурные исследования выдвинули первое объяснение возможного молекулярного механизма работы вирусного супрессора в процессе блокирования RNAi. Более того, прямое физическое взаимодействие между P19 и вирусными siRNAs было также обнаружено в инфицированных растениях. Эти исследования выявили существование корреляции между способностью P19 эффективно связывать siRNA и амплитудой симптомов вирусного заболевания в некоторых растениях.

Полученные нами результаты показали корреляцию между проявлением формы белка в различных тканях растений томата. Хотя при инфицировании ВККТ томаты не показывали системных симптомов заболевания и продолжали свой рост и развитие, в листьях томата белок интенсивно проявлялся в виде мономера. Однако в корнях белок p19 показывал более интенсивный сигнал в виде димера. Исходя из этого, мы предполагаем что белок может быть модифицирован, что негативно влияет на его функцию, а растения в свою очередь не заболевают вирусной инфекцией.

**ПОЛУЧЕНИЕ И АНАЛИЗ ТРАНСГЕННЫХ РАСТЕНИЙ ТАБАКА,  
СОДЕРЖАЩИХ 5'-КОНЦЕВУЮ ПОСЛЕДОВАТЕЛЬНОСТЬ  
ПЕПТИДА М2е ВИРУСА ГРИППА ПТИЦ Н5Н1 В  
ТРАНСЛЯЦИОННОМ СЛИЯНИИ С ГЕНОМ СУБЬЕДИНИЦЫ Б  
РИЦИНА КЛЕЩЕВИНЫ (*RICINUS COMMUNIS*)**

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Перспективным направлением развития современной биотехнологии является использование растительных систем в качестве биофабрик по производству фармацевтически значимых белков. Растительные экспрессионные системы обладают значительным преимуществом перед другими биосистемами поскольку позволяют во-первых, синтезировать практически любые белки, а во-вторых, существенно снизить стоимость конечного продукта. Грипп - одно из самых распространенных вирусных заболеваний, наилучшей защитой от которого считается вакцинация. Традиционные противогриппозные вакцины, основанные на иммунитете против гемагглютинина и нейраминидазы, быстро теряют свою актуальность и должны обновляться регулярно, поскольку эти белки изменчивы. В связи с этим интенсивно изучается возможность создания противогриппозной вакцины широкого спектра действия на основе консервативных антигенов других вирусных белков, таких как пептид M2e.

Целью данного исследования было клонирование и анализ экспрессии в растениях табака пептида M2e белка M2 вируса гриппа птиц A/chicken/Kurgan/5/2005(H5N1) для последующей разработки съедобной вакцины ветеринарного назначения. Последовательность 5'-концевого фрагмента гена M2, включающего пептид M2e, была синтезирована методом лигирования синтетических олигонуклеотидов, с предварительной оптимизацией кодонного состава для экспрессии в растениях. Следующим этапом работы стало клонирование гена M2e в трансляционном слиянии с нуклеотидной последовательностью адьюванта. В качестве адьюванта нами была выбрана последовательность субъединицы Б рицина (RTB) - лектина из клещевины (*Ricinus communis*), которую используют при производстве «съедобных» вакцин растительной природы. Гены субъединицы Б рицина и M130 были клонированы в трансляционном слиянии на основе бинарного экспрессионного вектора pBI121 под контролем 35S промотора вируса мозаики цветной капусты CaMV. Плазмида, обозначенная как pBIspRM130, была использована для трансформации растений табака *Nicotianatabacum*. В результате методом вестерн-блот анализа с использованием антител к целевым белкам было показано присутствие слитого протеина RTB-M130 в трех линиях трансгенных растений табака. Тестирования белковых экстрактов трансгенных растений с помощью асиалофетуина подтвердило корректность процессинга субъединицы Б рицина в отобранных линиях, что позволит в последующем использовать эти линии в экспериментах по иммунизации лабораторных животных.

*Работа была выполнена при поддержке гранта Министерства Образования Российской Федерации №14.B25.310027*

## СОЗДАНИЕ БЕЗМАРКЕРНЫХ РАСТЕНИЙ ТОМАТА С ГЕНОМ СУПЕРСЛАДКОГО БЕЛКА ПОД КОНТРОЛЕМ ЦИС- РЕГУЛЯТОРНЫХ ЭЛЕМЕНТОВ

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Присутствие маркерных генов в ГМ растениях вызывает беспокойство в обществе из-за опасений, связанных с рисками для окружающей среды и здоровья человека. Создание трансгенных растений, не содержащих генетического материала бактериального и вирусного происхождения, во многом позволяет снизить напряжённость, а в будущем, вероятно, станет необходимым условием для коммерциализации ГМ культур.

Наиболее современным и перспективным подходом получения растений без маркеров – использование генетических конструкций, которые после отбора растений на селективной среде позволяют элиминировать ненужный фрагмент ДНК. Эти системы создаются с применением индуцильных сайт-специфических рекомбиназ.

В нашем исследовании для получения безмаркерных трансгенных растений томата мы использовали векторную систему pMF (Plant Research International, Wageningen), содержащую рекомбиназу R из дрожжей *Zygosaccharomyces rouxii* слитую с лиганд-связывающим доменом глюкокортикоидного рецептора, а также бифункциональный селективный ген CodA-prtII, позволяющий проводить отбор растений после удаления из генома нежелательной области ДНК за счет негативной селекции на 5-флюороцитозине (5-ФЦ). В качестве смыслового выступает ген суперсладкого белка тауматина II из тропического растения *Thaumatococcus daniellii* под контролем плодоспецифического промотора из гена ELIP или E8 томата и терминатора из гена RBSC томата. В результате аробактериальной трансформации получено более 170 независимых трансгенных линий томата гибридной линии Ялф, которые были тщательно проанализированы методом ПЦР с использованием семи пар праймеров на наличие всех генов из области Т-ДНК и присутствие обоих сайтов рекомбинации, что является необходимым условием для корректного вырезания ДНК. Выяснилось, что около половины линий содержат неполную последовательность Т-ДНК, выраженную в первую очередь в отсутствии сайта рекомбинации у левого бордера, это согласуется с данными, что для полной интеграции Т-ДНК в геном *S. Lycopersicum* (и, возможно, представителей семейства *Solanaceae*) необходима гомология между растительной хромосомной ДНК и левым бордером Т-ДНК (Thomas and Jones, 2007). Несмотря на это, большинство из проверенных Саузерн-блоттингом линий содержали две и более вставки. Экспрессия гена тауматина II в плодах томата была подтверждена методом ОТ-ПЦР и органолептическим анализом.

После индукции активности рекомбиназы в эксплантах 35 отобранных трансгенных линий, суммарно была получена 121 сублиния (из 18 исходных линий) прошедшая негативную селекцию в присутствии 5-ФЦ. Большинство растений потеряло устойчивость к канамицину, несмотря на подтвержденное ПЦР присутствие участка гена *prtII* в 120 сублиннях. Таким образом, была получена только одна трансгенная линия томата полностью свободная от маркеров (с промотором E8). Мы полагаем, что в остальных случаях имеет место неполное вырезание последовательности ДНК, а также хромосомные перестановки из-за присутствия множественных и/или aberrантных последовательностей Т-ДНК.

Результаты нашего исследования выявили, что система pMF применима для создания безмаркерных трансгенных растений томата, однако для легкотрансформируемых культур и пасленовых работа может быть сопряжена с определенными трудностями.

## ОЦЕНКА ЭФФЕКТИВНОСТИ РАЗЛИЧНЫХ КОНСТРУКЦИЙ С ГЕНОМ БЕЛКА ОБОЛОЧКИ ВИРУСА Б ХРИЗАНТЕМ (CVB) ДЛЯ СОЗДАНИЯ ВИРУСОУСТОЙЧИВЫХ РАСТЕНИЙ

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В настоящее время существует ряд молекулярно-биологических подходов для повышения устойчивости растений к вирусам, в частности, основанных на трансформации растений геном белка оболочки вируса в смысловой или антисмысловой ориентации. Кроме того, активно развиваются методы на основе РНК-интерференции. Цель работы заключалась в сравнении эффективности различных подходов к созданию вирусуустойчивых сортов хризантем.

В данной работе были исследованы растения хризантем сорта White Snowdon, трансформированные следующими конструкциями: ген белка оболочки вируса хризантем Б (CP-CVB) в смысловой ориентации (pBSS), с двойной смысловой последовательностью гена CP-CVB (pBDS), с антисмысловой последовательностью гена CP-CVB (pBAS) и РНК-интерференционной конструкцией на основе CP-CVB (pRNAiVB).

Искусственное заражение вирусом Б трансгенных растений хризантем и нетрансгенной неинфицированной линии, которая использовалась в качестве контроля, проводили методом прививки. Для этого 2 черенка с инфицированных вирусом Б растений хризантем прививали в расщеп к стеблю тестируемых растений, средняя приживаемость прививок составляла более 90%. Детекция вируса после заражения осуществлялась методом иммуноферментного анализа (ИФА). ИФА выполнялась с использованием антител к белку оболочки вируса Б хризантем производства компании «Loewe», Германия.

В результате, было показано, что прививка инфицированных черенков на контрольные растения привела к заражению вирусом всех привитых растений. Из 5 изученных линий pBAS устойчивой к заражению оказалась 1 линия, из 3 изученных линий pBSS- также 1 линия. Все изученные линии pRNAiVB (4 линии) продемонстрировали только частичную устойчивость к заражению. В случае линий pBDS устойчивость к заражению продемонстрировали 3 линии из 6, три другие линии характеризовались повышенной, но частичной устойчивостью к заражению вирусом.

Данные ИФА дополнительно подтверждали методом Вестерн-блот анализа с использованием вышеуказанных антител. В устойчивых к вирусу Б линиях полоса, соответствующая белку оболочки вируса Б не детектировалась. В то же время в контрольных инфицированных растениях и в трансгенных растениях неустойчивых линий использованные антитела специфически узнавали белок оболочки вируса Б молекулярной массой около 37 кДа.

## ЭМБРИОГЕННЫЕ КЛЕТОЧНЫЕ ЛИНИИ ХВОЙНЫХ *IN VITRO* И ИХ ПРОДУКТИВНОСТЬ

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Незрелые зиготические зародыши и мегагаметофиты, *Larix sibirica*, *Larix sukaczewii*, *Larix gmelinii*, *Pinus sibirica*, *Pinus pumila* культивировали на средах ½ LV и АИ (патент № 2456344), дополненных глютамином, гидролизат казеином, аскорбиновой кислотой и гормонами (2.4Д и 6-БАП). Полученные клеточные линии состояли из эмбрионально-суспензорной массы, которая активно пролиферировала на этих средах с уменьшенным содержанием цитокининов. Соматические зародыши вызревали на базальных средах с АБА (60-120 мМ и ПЭГ). Прорастание соматических зародышей происходило на средах АИ и LV свободных от гормонов. Несмотря на видовую специфику, эмбриогенез морфогенных структур шел по одной схеме: растяжение соматических клеток, образование инициальных клеток и эмбриональных трубок, развитие глобулярных, «торпедообразных» и биполярных соматических зародышей, вызревания и прорастания зародышей.

Длительно прилиферирующие клеточные линии были получены у *Larix sibirica*, *L. sukaczewii* (10 линий) и, *Pinus pumila* (2 линии). Эти линии продуцировали 2040-4090 зародышей на 1г. каллуса и самоподдерживались в течении четырех лет. Клеточные линии отличались по эмбриогенной активности, способности зародышей вызревать и прорастать. Микросателлитные маркеры (SSR) анализированные в каллусах полученных из мегагаметофитов *Larix sibirica*, показали неоднородность каллусов. Соматический эмбриогенез идет под строгим генетическим контролем. Эмбриогенные клеточные линии и соматические зародыши продуцировались только от деревьев-доноров с высоким репродуктивным потенциалом. Клональные сеянцы эмбриогенных культур *Larix sibirica* растут в условиях теплицы.

Работа была поддержана грантом р\_сибирь-а, проект № 13-04-98045.

## ИСПОЛЬЗОВАНИЕ БИОТЕХНОЛОГИЧЕСКИХ МЕТОДОВ ДЛЯ СОЗДАНИЯ ЦЕННЫХ ФОРМ КАРТОФЕЛЯ, УСТОЙЧИВЫХ К ФИТОФТОРОЗУ

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Внедрение устойчивых сортов является основным звеном в системе мер защиты картофеля от фитофтороза. Прежде всего, это связано с задачей охраны окружающей среды от загрязнения химическими средствами защиты и повышением рентабельности картофелеводства. На сегодняшний день для выведения новых устойчивых к болезням сортов картофеля наряду с традиционными методами селекции используют биотехнологические методы. Ограниченные возможности используемых земельных и водных ресурсов, стремительный демографический рост населения и растущие нагрузки на окружающую среду побуждают делать упор на использование биотехнологии, как основу для развития сельского хозяйства.

Целью исследований является создание ценных форм картофеля, устойчивых к фитофторозу с комплексным использованием микробиологических, биотехнологических, селекционных и молекулярно-генетических методов.

На начальном этапе эксперимента нами выделены и идентифицированы патогенные и токсичные штаммы гриба *Phytophthora infestans*, вызывающего фитофтороз картофеля. Оптимизированы методы одноступенчатой и многоступенчатой клеточной селекции на устойчивость к фитофторозу для получения устойчивых клеточных линий и растений-регенерантов картофеля.

В результате исследований было высажено 1027 эксплантов и 927 каллусов гибридов картофеля на селективные среды с добавлением КФ гриба *Ph. infestans*, из них пассировано на регенерацию 645 каллусных линий, из которых получено 229 растений-регенерантов (35,5%). Растения-регенеранты 9-10-04, 21-10-06, 26-10-07, 18-10-02, 6-10-03, 2-10-03, 23-10-02, полученных с селективных сред микроклонально размножали до 1166 пробирочных растений.

658 пробирочных растений-регенерантов картофеля высадили в теплицу. Полученные линии регенерантов картофеля, с селективных сред отличались незначительно от контроля по морфометрическим показателям. Проведен структурный анализ растений-регенерантов по фракциям клубней, цвету и форме клубня, массе клубней с одного куста. В среднем число клубней с одного куста у гибридов и растений-регенерантов составило 10,5 штук, в зависимости от генотипа варьировало от 5,8 до 17 клубней.

Проведена оценка на устойчивость к фитофторозу при использовании мицелия и суспензии зооспор гриба *Ph. infestans* гибридов и линий регенерантов картофеля. Сорт Латона, линия 9-10-04 с 30-50% КФ, гибрид 21-10-06 были умеренно-восприимчивыми к фитофторозу. Линия 21-10-06 МС обладала средней устойчивостью. 6 гибридов (9-10-04, 26-10-07, 18-10-02, 6-10-03, 23-10-02, 2-10-03) и 10 линий регенерантов картофеля (9-10-04 МС, 9-10-04 с 5%КФ, 26-10-07 с МС, 26-10-07 с 5%КФ, 18-10-02 с 20%КФ, 18-10-02 с 5-10%КФ, 21-10-06 с 5%КФ, 6-10-03 с МС, 23-10-02 с 5%КФ, 2-10-03 с 10%КФ) были устойчивыми к фитофторозу. В дальнейшем ценные линии регенерантов картофеля будут идентифицированы и паспортизированы с помощью молекулярно-генетического маркера RAPD и переданы в селекционный процесс.

## КУЛЬТУРА ИЗОЛИРОВАННЫХ КЛЕТОК, ТКАНЕЙ И ОРГАНОВ *HEDYSARUM THEINUM* KRASNOB. КАК ИСТОЧНИК БИОЛОГИЧЕСКИ АКТИВНЫХ ВЕЩЕСТВ

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*Hedysarum theinum* (копеечник чайный, красный корень) обладает уникальным фитохимическим составом, что обуславливает широкий спектр его лекарственного действия: противовоспалительного, бактерицидного, спазмолитического, иммунопротекторного, антиоксидантного и др. В результате практики массовой заготовки сырья копеечник чайный находится на грани исчезновения, а чрезвычайно медленный рост делает этот вид особенно уязвимым. Ценные целебные свойства копеечника, ограниченность распространения и биологические особенности являются предпосылками для разработки биотехнологических приемов его культивирования.

Исходным материалом для введения в культуру *in vitro* послужили семена *H. theinum*. Каллусную культуру получали из проростков, их делили на 2 типа эксплантов – побег и корень и культивировали двумя способами – правильное положение экспланта и перевернутое. Для получения каллусной культуры испытаны следующие варианты сред: МС+НУК 20 мкМ+БАП 1 мкМ; МС+2,4-Д 5 мкМ+БАП 1 мкМ; B<sub>5</sub> + НУК 20 мкМ+БАП 1 мкМ; B<sub>5</sub> +2,4-Д 5 мкМ+БАП 1 мкМ; B<sub>5</sub> +2,4-Д 10 мкМ; BDS+НУК 20 мкМ; BDS+БАП 20 мкМ. Каллусы культивировали в колбах в темноте при температуре 24±2°C с интервалом 28 дней.

Культуру «hairy roots» *H. theinum* получали с использованием почвенной бактерии *Agrobacterium rhizogenes* штамм 15834 Swiss. После 24-часовой инкубации эксплантов с агробактерией растительный материал промывали питательной средой МС и переносили на агариованную среду того же состава, содержащую 500мг/л цефотаксима для элиминирования агробактерии. При достижении чистоты культуры «hairy roots», экспланты переносили в жидкую питательную среду S и выращивали на качалке (90об./мин) в темноте при температуре 24±2°C.

Установлено, что ответ эксплантов зависит от всех рассматриваемых факторов (состав питательной среды, тип экспланта и его положение на питательной среде). Стабильно растущую каллусную культуру удалось получить у эксплантов корневого и стеблевого происхождения при перевернутом положении на питательной среде BDS+НУК 20 мкМ и B<sub>5</sub>+2,4-Д 10 мкМ. В экспоненциальную фазу роста клетки вступали на 9-й день культивирования, в стационарную – на 24-е сутки.

Таким образом, подобранные нами питательные среды, типы эксплантов и способы культивирования обеспечивают возможность получения из первичных эксплантов стабильно растущие каллусные культуры, которые в дальнейшем могут быть использованы в работе по селекции высокопродуктивных штаммов супензионных культур копеечника чайного *in vitro*, изучению их свойств и продуктивности. Введение в культуру *in vitro* генетически трансформированных корней копеечника, которые выращиваются в контролируемых условиях, сохраняя при этом высокую интенсивность роста, можно рассматривать как потенциальный биотехнологический источник экологически чистого сырья.

## СОЗДАНИЕ ИСТОЧНИКОВ УСТОЙЧИВОСТИ КАРТОФЕЛЯ К ВИРУСУ Y (YBK) С ИСПОЛЬЗОВАНИЕМ СОМАТИЧЕСКОЙ ГИБРИДИЗАЦИИ И ТРАНСГЕННЫХ РАСТЕНИЙ

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Потери урожая картофеля при повреждении Y вирусом картофеля (YBK) могут достигать 80-90 %. Биотехнологии позволяют создать нетрадиционные для селекции картофеля источники устойчивости к YBK (ИУ-Y) за счёт использования соматической гибридизации и трансгенных растений. Критический момент для соматических гибридов – проблема с фертильностью. В качестве ИУ-Y мы рассматриваем продукты биотехнологии устойчивые к YBK и способные завязывать ягоды с жизнеспособными семенами при свободном опылении и (или) скрещиваниях с культурным картофелем.

Культурный картофель *Solanum tuberosum* L. (tbr) имеет один из самых больших генетических пулов: более 200 дикорастущих сородичей, обладающих устойчивостью к болезням и вредителям, но не доступных для половой гибридизации. Соматическая гибридизация за счёт слияния протопластов позволяет получить гибриды между нескрещиваемыми видами.

Межвидовые соматические гибриды картофеля получили химическим слиянием протопластов из мезофилла листа. Гибриды идентифицировали по электрофоретическим профилям белков и изозимов пероксидазы, ПЦР маркерам на геномы ядра и цитоплазмы, морфологическим признакам. ИУ-Y выделили среди соматических гибридов и их половых поколений для 4 комбинаций соматической гибридизации: 2D – 86-6 (*S. tuberosum* × *S. chacoense*) + *S. etuberosum* (неклубненос), 4D – 86-6 + (*S. etuberosum* × *S. brevidens*) (неклубненос), SB – 78563-76 (tbr, 4x) + *S. bulbocastanum*, F – 78563-76 + *S. polyadenium*. Соматические гибриды комбинаций SB, F, DL, 2D, 4D имеют различные сочетания геномов пластид и митохондрий согласно данным ПЦР с маркерами на хлоропластный (NTCP09, ALC\_1/ALC\_3) и митохондриальный (ALM\_1/ALM\_3, ALM\_4/ALM\_5) геномы.

Для оценки на устойчивость к YBK использовали тест с прививкой на растения томата сорта «Невский» с раздельным инфицированием Y<sup>NTN</sup>, Y<sup>O</sup>, Y<sup>N</sup> с последующим описанием симптомов вироза на подвое и привое через 28-35 суток и анализом ИФА.

Ягоды от свободного опыления собирали с растений, выращенных в теплице и поле. Скрещивания с тетрапloidным картофелем проводили при использовании растений анализируемого генотипа, выращенного в теплице «на кирпиче», в качестве материнской формы, а отцовской формой служили селекционные образцы. Жизнеспособность семян, выделенных из ягод, определяли при проращивании в условиях *in vitro* и (или) *in vivo*.

По результатам оценки межвидовых соматических гибридов и их половых поколений по устойчивости к Y-вирусу и способности завязывать ягоды с жизнеспособными семенами выделено более 25 источников устойчивости картофеля к YBK.

Трансгенные источники устойчивости к YBK отобраны среди линий картофеля сорта Белорусский 3 с геном белка оболочки Y-вируса картофеля (БО YBK), полученными из Центра «Биоинженерия» РФ. Они сохраняли стабильную устойчивость к Y-вирусу после механической инокуляции YBK (Y<sup>O</sup>+Y<sup>N</sup>) два года подряд и при последующем вегетативном размножении в течение 15 лет на жестком инфекционном фоне. Устойчивые к YBK линии выделены в половом потомстве трансгенных ИУ-Y и использованы для отбора кандидатов на трансгенный сорт картофеля с устойчивостью к YBK. Трансгенные ИУ-Y и кандидаты на трансгенный сорт содержат ген БО YBK согласно ПЦР со SCAR-маркером PVYco2.

## ВЗАИМОДЕЙСТВИЕ КОМПОНЕНТОВ ЗАЩИТНОЙ СИСТЕМЫ ВЫСШИХ РАСТЕНИЙ И ВИРУСНОГО БЕЛКА Р19

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Вирус кустистой карликовости томата (ВККТ) - представитель семейства *Tombusviridae*, геномная организация состоит из одноцепочечной РНК молекулы, положительной полярности, длинной в 4800 нуклеотидов, окруженная оболочкой из 180 идентичных белковых субъединиц массой 41 кДа. Впервые вирус был обнаружен в томатах сорта черри, однако имеет широкий спектр природных и лабораторных хозяев. Как и большинство вирусов, ВККТ кодирует пять открытых рамок считывания и экспрессирует пять протеинов, ответственных за репликацию (р33 и р92), за инкапсидацию в вирионы (р41), белок для движение из клетки в клетку (р22), белок супрессор (р19). За последние годы накоплено множество данных о функциональной активности каждого из них.

К примеру, биологическая роль р19 белка заключается в супрессировании механизма РНК-интерференции в растениях *Nicotiana benthamiana*, что приводит к системному коллапсу растения (2006).

Функция р19 белка основана на образовании комплекса с короткими молекулами РНК, длиной 21 нуклеотид, которые в свою очередь являются ключевыми компонентами механизма антивирусной РНК-интерференции. При инфицировании растений *Nicotiana benthamiana* образование данного комплекса приводит к проявлению жестких симптомов заболевания и системному коллапсу растений (2006). Позже было показано, что не все представители рода *Nicotiana* чувствительны к данному вирусу (2012). Недавние исследования в изучении комплекса р19 и коротких молекул РНК при заражении *Nicotiana tabacum* показали, что образование данного комплекса активирует защитную систему индуцированную салициловой кислотой, таким образом растение табака экстремально быстро может блокировать вирус (2013). Далее было доказано, что помимо своей супрессорной функции, р19 белок может регулировать уровень микро РНК, связанных с компонентом РИСК комплекса АГО2 (2013).

Целью нашего исследования является изучение потенциальных растительных компонентов, которые могут действовать против вирусных белков. В наших экспериментах были использованы растения *Nicotiana Benthamiana*, в качестве позитивного контроля, в котором р19 белок может полностью осуществить свою биологическую функцию и *Solanum lycopersicum* (сорт Money maker). Визуально симптомы заболевания у томатов проявлялись локально, в виде пожелтевших участков. Однако иммуноблоттинг белка р19 показал его наличие в системных листьях и корневых тканях. Таким образом, предполагается что, данный сорт томата является толерантным к ВККТ. Отсюда исходит множество вопросов, ответы на которые еще остаются открытыми, такие как почему растение не демонстрирует никаких симптомов и позволяет вирусу экспрессироваться в организме, может ли р19 белок связываться с другими молекулами растительной клетки, которые в свою очередь блокируют его функцию.

**ПРОЦЕССЫ МОРФОГЕНЕЗА У СТРУКТУР *SCABIOSAGUMBETICA*,  
*CRAMBEGIBBEROSA*,*HEDYSARUM DAGHESTANICUM INVITRO*****З.М. Алиева, В.К. Мартемьянова, А.Г. Юсуфов**

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Специфика реализации процессов регенерации у структуродного индивидуума разных видов не вызывает сомнений, хотя ее природа остается не изученной. Для выяснения вопроса о роли генетической и онтогенетической специфики природы морфогенеза сравнивали различия в реализации процессов регенерации *invitro*эксплантов аналогичных и гомологичных структур систематически отдаленных редких растений Дагестана: скабиозы гумбетовской (*Scabiosagumbetica L.*), катрана бугорчатого (*Crambegibberosa Rupr.*), копеечника дагестанского (*Hedysarum Daghestanicum Rupr. Ex Boiss.*). Авторы выражают благодарность сотрудникам кафедры ботаники Дагестанского госуниверситета и Горного ботанического сада Дагестанского НЦ РАН за предоставленный для исследований материал.

Узловые экспланты побегов, экспланты листьев, черешков и корней стерильных проростков помещали на питательную среду Мурасиге – Скуга, содержащую ИМК и БАП в разных концентрациях. Показателями оценки состояния эксплантов служили выживаемость, рост, формирование каллуса, корней, почек и побегов.

Аналогичные и гомологичные структуры в пределах одного объекта и у разных растений отличались по жизнеспособности и реализации потенций к морфогенезу. Так, у узловых эксплантов катрана, скабиозы, копеечника наблюдали рост пазушных почек и формирование каллуса. Однако только у эксплантов узлов катрана и копеечника отмечено формирование корней. При пассировании каллусов отмечено формирование корней, почек и роста побегов. У катрана отмечены различия между ростом побега и активностью пролиферации эксплантов, что не характерно для других объектов.

Почки узловых эксплантов у разных объектов также отличались по активности роста и формирования побегов в зависимости от гормонального состава среды. Формирование дополнительных почек при культивировании *invitro* способствовало увеличению числа пассированных эксплантов (копеечник, скабиоза, катран). На среде с преобладанием БАП отмечено увеличение их числа на узловых эксплантах, в вариантах с ИМК прослеживалась тенденция к формированию корней. У некоторых объектов удалось конкретизировать возможности культивирования эксплантов черешков и пластинок листьев (копеечник, катран) на среде МС с разным соотношением ИМК и БАП. При этом отмечено образование каллуса с дальнейшей дифференциацией в нем корней и почек.

Проявление totipotentности клеток растений определяется не только наследственной детерминацией видов и форм, но и специализацией изолированных структур, причины которой видоспецифичны. Даже у одних и тех же видов и форм растений разные структуры *invitro* проявляют различия в реализации морфогенеза. Подобные и мало еще изученные особенности видов являются одной из причин трудности анализа вопроса происхождения и эволюции явлений регенераций у растений. Таким образом, выявлена специфика реализации морфогенетического потенциала у разных структур одного и того же растения при первичном культивировании и пассировании. У исследованных объектов процессы роста и морфогенеза имеют генетическую и онтогенетическую природу детерминации, по этой причине не отмечена взаимообусловленность между интенсивностью реализации указанных процессов у структур одного и того же объекта и разных видов.

Приведенные результаты служат предпосылкой для разработки биотехнологии микроклонального размножения указанных видов.

**МЕТОДЫ ГАПЛОИДНОЙ БИОТЕХНОЛОГИИ И  
МОЛЕКУЯРНОГО МАРКИРОВАНИЯ В УСКОРЕННОЙ СЕЛЕКЦИИ  
*TRITICUM AESTIVUM L.***

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В настоящее время проблема повышения устойчивости культурных растений к неблагоприятным факторам внешней среды, наряду с ростом численности населения Земли, признана глобальной проблемой. Перед учеными стоит важная задача по ускоренному созданию новых сортов основных продовольственных культур, устойчивых к неблагоприятным факторам окружающей среды.

На первом этапе исследований был проведен мониторинг генотипов пшеницы в условиях Южного Казахстана на устойчивость к ржавчинным заболеваниям в естественном и инфекционном питомнике. В качестве инфицирующего агента использовали расы *Puccinia graminis*, *Puccinia striiformis*, *Puccinia recondita*. Высокую устойчивость к ржавчинным болезням следующие генотипы: *Triticum kihara*, *Triticum diccosum*, *Triticum thimofeevi*, Almaly, Naz, Taza и другие. В исследованиях использованы также источники Lr генов созданных на основе изогенных линий "Thatcher".

Отобранные устойчивые генотипы были использованы для скрещивания и создания перспективных межсортовых и межвидовых отдаленных гибридов. Было создано более 120 гибридных комбинаций. Полученные гибриды были генетически стабилизированы методом гаплоидной биотехнологии на основе культуры изолированных пыльников и микроспор *in vitro*.

Использование гаплоидной биотехнологии, на основе метода культуры изолированных пыльников и микроспор *in vitro*, позволяет создавать константные гомозиготные удвоенные дигаплоидные линии из гибридных популяций растений за 1-2 года, в то время как методом традиционной селекции для получения стабильных линий необходимо затратить 8-10 лет.

Были модифицированы составы питательных сред на основе Blaydes и №6 с добавлением активированного угля и амилодекстрина. В следующей серии экспериментов устойчивые и восприимчивые к ржавчинным болезням родительские формы, созданные гибридные формы и новые гаплоидные линии были проанализированы на уровне ДНК с использованием молекулярных маркеров. В результате SSR-анализа изогенных линий установлено, что устойчивые к ржавчинным болезням генотипы и линии имеют ген Lr 24. В заключительной стадии новые перспективные дигаплоидные линии были тестированы на устойчивость к ржавчинным болезням на естественном и искусственном фонах в двух областях Южного Казахстана (Алматинская и Жамбылская). Среди изученных дигаплоидных линий выделены номера DHL 1057, DHL 1050, DHL 1045 и DHL 1027, которые оказались устойчивыми к ржавчинным заболеваниям и характеризуются высокой урожайностью и качеством зерна. На основе дигаплоидной линии DHL 1050 создан новый высокопродуктивный и устойчивый к ржавчинным болезням сорт пшеницы «Нуреке», который районирован в Алматинской и Жамбылской области Южного Казахстана.

**ISSR И SSR АНАЛИЗ ДЛЯ ПОДТВЕРЖДЕНИЯ ГЕНЕТИЧЕСКОЙ  
СТАБИЛЬНОСТИ МИКРОКЛОНОВ, ПОЛУЧЕННЫХ ИЗ СОДЕРЖАЩИХ  
МЕРИСТЕМУ ЭКСПЛАНТОВ: ИЗОЛИРОВАННЫХ МЕРИСТЕМ, СПЯЩИХ  
ПОЧЕК И АПЕКСОВ ПОБЕГОВ – РАЗЛИЧНЫХ СОРТОВ ВИНОГРАДА**

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Развитие виноградарства в Казахстане началось в 50-ых годах прошлого столетия. Почвенно-климатические условия Южно-Казахстанской, Алматинской, Жамбульской и Кзыл-Ординской областей соответствовали требованиям развития данной культуры. Доля данной отрасли в производстве сельскохозяйственной продукции составляла 10-13,5 %. Однако в 80-ые годы начался постепенный упадок отрасли вследствие экономических и социально-политических причин. Соответствующие Программы и Постановления Правительства Казахстана направлены на восстановление площадей и достижения уровня продуктивности культуры до 200-220 тыс. тонн. Определяющим условием является подбор сортимента перспективных, соответствующих условиям данного региона возделывания зарубежных и казахстанских сортов высокого качества и несущих признаки устойчивости к неблагоприятным биотическим и абиотическим факторам среды данного региона.

Микроклональное размножение сортов винограда казахстанской и зарубежной селекции направлено на создание питомников оздоровленного материала. Генетическое соответствие полученных микроклонов исходным сортам является главным требованием к данному способу вегетативного размножения растений. В настоящей работе для генотипирования сортового материала и подтверждения генетического соответствия ему микроклонов, полученных из содержащих меристему эксплантов были использованы ISSR и SSR маркеры. ISSR маркеры обладают высокой воспроизводимостью благодаря большей длине праймеров по сравнению, например с RAPD праймерами. SSR маркеры высоко вариабельны, мультиаллельны, кодоминантны и высоко воспроизводимы. Из 6-и казахстанских сортов были изолированы меристемы и помещены на 30 дней на среду IM (инициации меристем, Mezzettietal., 2002), содержащую 4,4 мкМ БА с последующим субкультивированием с 8,8 и 13,2 мкМ БА. Три сорта были использованы для оценки влияния различных концентраций и соотношений цитокинина/ауксина на эффективность микроклонального размножения покоящихся почек. Варианты микроклонов, с максимальной эффективностью размножения (4–0,05 мкМ БА–ИУК), а также с увеличенной вдвое концентрацией цитокинина (8–0,05 мкМ БА–ИУК) были генотипированы. Микроклоны из апексов побегов нескольких сортов были также генотипированы. Для генотипирования использовали по 5 представителей микроклонов и исходного сорта. Генотипическое соответствие было оценено с использованием ISSR и SSR маркеров. 9 ISSR маркеров (из испытанных 25-и) и 6 SSR маркеров продуцировали четкие, воспроизводимые для сравнения бэнды. ISSR праймеры продуцировали уникальные наборы продуктов амплификации для индивидуальных сортов и соответствующих им микроклонов в пределах от 350 до 1850 п.о., от 46 до 65 бэндов со средними значениями от 5,1 до 7,2 на маркер. Размеры аллелей для SSR продуктов были: для VVS2 от 131 до 159, для VVMD5 от 228 до 242, для VVMD7 от 239 до 257, для VVMD27 от 181 до 195, для VrZAG62 от 189 до 207 и для VrZAG79 от 243 до 259 п.о. Микроклоны из различных эксплантов, содержащих меристему, были генетически однотипны с соответствующими исходными сортами, подтверждая генетическую стабильность полученных через *in vitro* растений.

## РЕГУЛИРОВАНИЕ ПРОЦЕССОВ СОЗДАНИЯ, ИСПОЛЬЗОВАНИЯ И ОБОРОТА ГМО В КАЗАХСТАНЕ

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На основе обобщения международного опыта регулирования процессов создания, использования и оборота ГМО разработаны соответствующие рекомендации для Казахстана. Принятие Закона «О государственном регулировании генно-инженерной деятельности» должно сопровождаться разработкой ряда необходимых нормативных правовых актов, обеспечивающих надлежащее выполнение данного закона. В связи с этим предлагается разработать положения, правила, процедуры, посвященные оценке рисков, выдаче разрешения на использование и обеспечению биобезопасности ГМО. Эти меры должны быть гармонизированы с международными регулирующими документами: Конвенция по биологическому разнообразию, Картахенский протокол, Кодекс Алиментариус, Конвенция по правам человека и биомедицине, Соглашение о защите прав на интеллектуальную собственность. Следует при этом учитывать также руководящие принципы по регулированию ГМО в Европе, США, России (Директивы и правила Евросоюза, Департамента сельского хозяйства – USDA/AFIS, Администрации по управлению продовольствием и медикаментами – FDA, Агентства по защите окружающей среды – EPA, некоторые постановления Правительства РФ, а также нормативные акты специально уполномоченных органов РФ: Минздрав, Минсельхоз, Минпром).

Для правового обеспечения реализации Закона РК «О государственном регулировании генно-инженерной деятельности» желательно принятие Правительством РК ряда подзаконных актов: «О порядке государственной регистрации ГМО»; «О государственной регистрации новых пищевых продуктов из ГМО»; «Об экспертизе ГМО и ГМ-продуктов». Рекомендуется создать экспертные советы при специально уполномоченных организациях (МОН, Минздрав, Минсельхоз, МООС) и организовать Координационный центр при государственном уполномоченном органе по регулированию генно-инженерной деятельности.

Рекомендуется разработать специальные Положения и Правила по обеспечению биобезопасности при создании, испытании, транспортировке и импорте ГМО, которые рассматриваются Координационным центром и утверждаются государственным уполномоченным органом.

Необходимо разработать Инструкции и Методические указания для надзора за ГМО и пищевыми продуктами, содержащими ГМО, после прохождения государственной регистрации для осуществления мониторинга за их оборотом.

Следует создать Республиканскую базу данных генов, используемых для генетической трансформации и ее интеграция в Международную Систему Регистрации Генов для оперативного определения чужеродных генов и генных конструкций, которые ранее были внедрены в геном сельскохозяйственных культур.

При оценке пищевой безопасности ГМО рекомендуется сопоставлять данные об аллергенности и токсичности продуктов экспрессии трансгенов с международными базами данных: ALLPEPTIDES, ALLERGENS.

Целесообразно проводить периодический пострегистрационный мониторинг для установления факта отсутствия негативного влияния ГМО на окружающую среду, сельскохозяйственную практику и здоровье человека.

Рекомендуется шире использовать цис-генные технологии и методы получения транспластомных растений для предотвращения потока чужеродных генов, придающих устойчивость к гербицидам, вирусам и насекомым-вредителям.

## ВЛИЯНИЕ ЭКСТРАКТОВ СОЛОДКИ НА ПРОЛИФЕРАЦИЮ, КЛЕТОЧНЫЙ ЦИКЛ И ДИФФЕРЕНЦИАЦИЮ КЛЕТОК ОСТРОЙ МИЕЛОИДНОЙ ЛЕЙКЕМИИ

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В опытах по определению клеточной пролиферации были использованы корневые экстракты: Солодка уральская (*Glycyrrhiza uralensis* L.) – в 50%, 80%, 100% этаноле и в 50% ацетоне, солодка фармакопейная (*Glycyrrhiza glabra* L.) – в 50%, 80%, 100% этаноле и в 50% ацетоне.

Установлены отличия в действии этанольных экстрактов солодки фармакопейной и солодки уральской. Так, 100% этанольный экстракт солодки уральской после 24 часов инкубирования уменьшает количество клеток, после 48 часов – вызывает полную гибель клеток, и после 96 часов наблюдается агрегация клеточных остатков. Тоже самое происходило с 50% этанольным экстрактом солодки фармакопейной.

Количественный анализ данных, показывает, что после 24-часовой инкубации 100% этанольный экстракт солодки уральской в концентрации 25 мкг/мл вызывает аккумуляцию клеток в фазе G1, за счет уменьшения популяции S (G1 arrest), и появление небольшой популяции апоптотических клеток (sub-G1). В то же время, более высокая доза 50% этанольного экстракта солодки фармакопейной 50 мкг/мл не вызывает усиление апоптоза, сопровождающееся накоплением клеток в фазе G2/M. 50% этанольный экстракт солодки фармакопейной практически не оказывает влияния на клеточный цикл после 24 часов. Более длительная инкубация 48 часов с 100% этанольным экстрактом солодки уральской привела к полной гибели клеток в результате апоптоза даже в относительно низкой дозе. В то же время наблюдалось лишь небольшое снижение количества клеток в фазе S после инкубации с экстрактом солодки фармакопейной, что указывает на небольшое снижение скорости пролиферации. Наличие апоптоза при этом не наблюдалось.

Таким образом, 100% этанольный экстракт солодки уральской вызывает сильное угнетающее действие на клеточный цикл и индукцию апоптоза в клетках HL60.

Миелобластные клетки HL60 способны дифференцироваться по моноцитарной или гранулоцитарной линиям, в зависимости от действующего на них индуктора дифференцировки. Гормональная форма витамина Д (1,25Д<sub>3</sub>) вызывает моноцитарную дифференацию этих клеток. Концентрации 1,25Д<sub>3</sub>, вызывающие терминалную дифференцировку клеток лейкемии, являются крайне токсичными для организма человека и животных, приводя к летальной гиперкальциемии. С целью снижения токсичности 1,25Д<sub>3</sub> без значительной потери эффективности его противолейкемической активности, разработан способ комбинированного воздействия низких концентраций 1,25Д<sub>3</sub> в сочетании с нетоксичными дозами определенных растительных полифенольных антиоксидантов, к примеру карнозовая кислота.

Обобщенный анализ результатов, полученных в нескольких подобных опытах, показывает, что 100% этанольный экстракт солодки уральской и 50% этанольный фармакопейной в нетоксичных для клеток концентрациях (10 мкг/мл и 50 мкг/мл, соответственно), имеют тенденцию усиливать дифференцию вызванную 1,25Д<sub>3</sub> подобно карнозовой кислоте.

## МЕТОД ПОЛУЧЕНИЯ ДИГАПЛОИДНЫХ РАСТЕНИЙ В КУЛЬТУРЕ ИЗОЛИРОВАННЫХ МИКРОСПОР

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Культура микроспор *in vitro* представляет собой процесс культивирования в жидкой питательной среде генеративных клеток, освобожденных от соматических тканей пыльника. Микроспоры извлекаются из пыльников на поздней одноядерной стадии развития. Основная схема эксперимента по выделению и культивированию микроспор следующая: пыльники извлекаются из фрагментов колосьев, разбиваются блендером несколько секунд в растворе 0,3М маннитола. Полученная суспензия фильтруется через 100 $\mu$ m фильтр и центрифугируется несколько минут. После окончания центрифугирования, осадок из микроспор размешивается в растворе 0,3М маннитола. Затем центрифугирование повторяют, что необходимо для эффективного отмывания клеток микроспор. Дальнейшее культивирование микроспор осуществляется в жидких питательных средах, состав которых различается в зависимости от генотипов или целей эксперимента и обычно содержит мальтозу и, иногда, стимуляторы роста.

Разработанный протокол, результаты совместной работы с Австралийским центром функциональной геномики растений, по созданию процедур культуры микроспор по культивированию изолированных микроспор пшеницы и ячменя важно для РК, так как только массовый выход гаплоидов может обеспечить использование в селекционных программах на уровне удвоенных гаплоидных линий носителей ценных сельскохозяйственных признаков. Поскольку деление микроспор и особенно последующая регенерация растений являются генетически зависимыми стадиями (Touraev et al., 1997; Ferrie and Caswell, 2011), в нашу задачу входили подбор наиболее отзывчивого генотипа яровой пшеницы, и использование его в качестве модельного сорта для ускорения отработки протокола.

По результатам экспериментов на сортах яровой пшеницы сорт Казахстанская 19 оказался наиболее отзывчивым в культуре изолированных микроспор. Таким образом, Казахстанская 19 может быть использован как модельный сорт в дальнейших экспериментах. В культуре микроспор были произведены и получены семена 21 дигаплоидных линий по сортам Астана 2, Казахстанская 19, Казахстанская раннеспелая, Саратовская 29, характеризующим качество зерна, засухоустойчивость, продуктивность. Получено семян у дигаплоидных регенерантов: Казахстанская 19 – от 146 до 288 шт, Астана 2 – 278 шт, Казахстанская раннеспелая – от 15 до 272 шт, Саратовская 29 – 46 шт. В результате проведенных исследований разработан протокол для получения гомозиготных растений-регенерантов из культуры изолированных микроспор, который применим к различным генотипам пшеницы. На основе данного протокола нами подготовлено и издано методическое пособие. Усовершенствованный протокол микроспорной гаплоидной биотехнологии может быть использован и адаптирован и для других важных сельскохозяйственных культур, что показано нашими недавними экспериментами с сортами ячменя (Башбаева Б.М. и др., 2013). Для практического использования разработанных протоколов в селекционной работе будет важна дальнейшая оптимизация выделения микроспор, их культуры и регенерации fertильных растений.

## ИЗМЕНЕНИЕ СВОЙСТВ МЕРИСТЕМНЫХ ЛИНИЙ КАРТОФЕЛЯ ПРИ ДЛИТЕЛЬНОМ КУЛЬТИВИРОВАНИИ IN VITRO

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В настоящее время в научно-исследовательских учреждениях и других организациях, занимающихся производством исходного материала для первичного семеноводства, коллекция оздоровленных сортов картофеля поддерживаются *in vitro*.

Технология размножения и поддержание коллекции посадочного материала постоянно совершенствуется, и имеет несколько модификаций – ретардантами, на базовых и модифицированных питательных сред, в условиях оптимальных и пониженных температур. Однако среди исследователей нет единого мнения относительно возможного срока культивирования оздоровленных сортообразцов *in vitro*. Ряд авторов утверждают, что длительное депонирование культуральных растений *in vitro*, при выращивании в полевых условиях некоторые сорта могут не соответствовать исходным генотипам по сортоотличительным признакам. Наряду с фенотипической изменчивостью, повышением поражаемости и снижением продуктивности в последние годы появляются данные в литературных источниках о возможности появления мутаций. В Казахском НИИ картофелеводства и овощеводства проведены работы по изучению влияния длительности культивирования *in vitro* на фитопатологические и продуктивные признаки сортов картофеля, с целью выявления возможного влияния срока культивирования *in vitro* на стабильность геномной ДНК проанализированы методом ПЦР меристемные линии различных сортов картофеля, культивируемые *in vitro* от 2 до 10 лет. Для изучения полиморфизма использован молекулярный маркер RAPD. Полиморфизм растворимых белков является эффективным направлением при изучении генетической вариабельности, в связи с этим, изучены белковые маркеры методом электрофореза, так как они лучше характеризуют генетическую стабильность исходного материала. Полученные результаты исследований в данном направлении свидетельствовали о том, что длительное культивирование *in vitro* может оказывать существенное влияние на такие показатели растения, как его высота, количество междуузлий на стебле, выход черенков от одного растения на искусственной питательной среде. Поддерживаемые путем последовательных черенкований растения-регенеранты уже на 4 год были поражены комплексом вирусных инфекций. Было выявлено, что у растений, культивируемых *in vitro* более 6 лет, снижается приживаемость в условиях *in vivo*. Меристемные клубни, полученные из растений-регенерантов, культивированных *in vitro* 6-7 лет отличались низким коэффициентом размножения в условиях *in vivo*. В результате проведения молекулярно-генетических анализов не выявлены различия между исходными формами и меристемными линиями картофеля линий коллекции *in vitro*. Однако исследование генотипов сортов картофеля и их линии методом белкового анализа показало, что линии, культивируемые длительное время четко различаются между собой в локусах. У сорта Улан 8 летнего культивирования *in vitro* отмечено появление достаточно интенсивной белковой полосы с молекулярной массой на уровне 32 килодальтонов. Поэтому, проведение исследований по использованию молекулярно-генетических и белковых маркеров для идентификации генотипов подтверждает о необходимости комплексного использования маркеров ДНК и белкового уровня. Таким образом, полученные данные свидетельствуют о целесообразности культивирования растений-регенерантов картофеля *in vitro* не более 4-5 лет.

## СИНТЕЗ В РАСТИТЕЛЬНЫХ СИСТЕМАХ *IN VITRO* И *IN VIVO* БЕЛКА ОБОЛОЧКИ L1R ВИРУСА ОСПЫ ОВЕЦ

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Оспа овец - заболевание мелких жвачных, способное вызывать эпизоотии и наносить большой экономический ущерб. Трансгенные растения, продуцирующие иммуногенные белки оболочки вируса, являются более безопасной и экономически выгодной альтернативой существующим вакцинам на основе аттенуированных штаммов вирусов.

Ген *SPPV-NISKHI-56* (738 пн) вируса оспы овец кодирует ортолог иммунодоминантного белка L1R вируса осповакцины. Последовательность гена с 1 по 564 нуклеотид, кодирующая гидрофильную часть белка (L1RΔ) и содержащая 5 нуклеотидных замен (для удаления двух сайтов *NdeI* и трех сигналов сплайсинга по растительным правилам), была искусственно синтезирована и клонирована в плазмиду pET-19b для экспрессии в бактериях. Замены нуклеотидов не изменили последовательность аминокислот рекомбинантного белка. Очистка белка L1RΔ, синтезированного в клетках *E. coli* осуществлялась с помощью Ni-NTA агарозы благодаря наличию 10 гистидинов (His-Tag) на N-конце. Последовательность His-Tag также использовалась для иммунодетекции белка L1RΔ специфическими антителами (PentaHis-HRP Conjugate).

Для *in vitro* транскрипции мРНК были получены ДНК-конструкции на основе вектора pBluescript II KS(+), содержащие промотор бактериофага T7, различные 5' нетранслируемые последовательности (НТП), выполняющие функцию трансляционных энхансеров, His-Tag и рекомбинантный ген *SPPV-NISKHI-56*. Белок L1RΔ эффективно синтезировался в бесклеточной системе из зародышей пшеницы. Использованные в данной работе 5'НТП геномных РНК (гРНК) Y вируса картофеля (PVY), вируса мозаики люцерны (AMV), вируса гравировки табака (TEV), а также искусственная 5'НТП «ARC1x5» значительно повышали экспрессию белка L1RΔ в сравнении с последовательностью «p1», не обладающей энхансерной способностью.

Для трансформации растений табака (*Nicotiana tabacum* L. cv. Samsun-NN) была получена рекомбинантная ДНК-конструкция на основе вектора pCAMBIA 2300, содержащая 35S промотор вируса мозаики цветной капусты (CaMV), 5'НТП гРНК AMV, нуклеотидную последовательность сигнального пептида малой субъединицы рибулозобисфосфаткарбоксилазы для специфического направления рекомбинантного белка в хлоропласти, His-Tag, ген белка L1RΔ и терминатор транскрипции гена нопалин синтазы (NOS-ter). Трансформированные растения - регенеранты, образовавшие корни на среде с канамицином, были проверены с помощью ПЦР на наличие вставки гена, а также с помощью реакции обратной транскрипции (ОТ-ПЦР) на наличие соответствующей мРНК. Рекомбинантный белок удалось детектировать в нескольких трансгенных растениях с помощью специфических антител к белку L1RΔ.

## ПРЕОДОЛЕНИЕ ГЕНОТИПИЧЕСКОЙ ЗАВИСИМОСТИ РЕГЕНЕРАЦИИ РАСТЕНИЙ ЗЕРНОВЫХ КУЛЬТУР НА ОСНОВЕ ИЗУЧЕНИЯ МЕТАМОРФОЗА IN VITRO

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Основными препятствиями, лимитирующими разработку биотехнологических методов для улучшения зерновых злаков являются зависимость регенерационной способности *in vitro* от генотипа и потеря ее при длительном субкультивировании. Последнее связано с высокой морфологической гетерогенностью и нестабильностью морфотипов каллусных тканей у зерновых культур. Несмотря на то, что во многих исследованиях разработаны пути активации соматического эмбриогенеза и регенерации растений, до сих пор не выработаны общие методологические подходы к регуляции морфогенеза *u in vitro* у зерновых злаков. Вследствие этого, для каждого вида и даже сорта условия регенерации приходится подбирать эмпирически.

Нами проведен цикл исследований по изучению морфологической гетерогенности и метаморфоза в ходе многократного субкультивирования каллусных тканей пшеницы и ячменя. Проведена классификация каллусных тканей на морфотипы, изучено их гистологическое строение, метаморфоз и способность к регенерации при многократном субкультивировании на питательных средах различного состава.

В результате, выявлены универсальные для различных генотипов и стабильные при субкультивировании типы каллусов, клетки которых обладают свойством морфогенетической пластичности или полипотентности: изменяя состав питательной среды, из них можно индуцировать различные типы морфогенеза, в том числе, соматический эмбриогенез и регенерацию растений. Это позволяет, в свете современных представлений, провести аналогию между клетками универсального стабильного меристематически активного типа каллуса и стволовыми клетками.

На этой основе нами разработан подход к решению важной проблемы в области биотехнологии растений – преодолению генотипической зависимости процесса длительной регенерации растений *in vitro*, заключающийся в отборе универсальных для различных генотипов меристематически активных каллусов, которые под действием 2,4-Д и стресса могут проявлять одну и ту же морфогенетическую реакцию у разных генотипов – подвергаться метаморфозу с образованием эмбриогенных тканей, способных к длительному сохранению способности к регенерации растений. При этом, различия в морфогенетических реакциях *in vitro* между генотипами нивелируются. Выяснены процессы клеточной дифференцировки, происходящие в ходе метаморфоза: под действием стресса происходят ингибирование клеточных делений, разрыв межклеточных связей, гибель клеток по пути программированной клеточной смерти (ПКС), усиленная секреция внеклеточных веществ, обособление и перепрограммирование клеток на путь эмбриоидогенеза. После удаления стресса происходит активация клеточных делений, активная пролиферация эмбриогенных клеточных комплексов, инициация и дифференциация эмбриоидов из перепрограммированных компетентных клеток вплоть до регенерации целых растений.

В результате этого исследования нами разработана генотип-независимая технология длительной регенерации растений в культуре тканей пшеницы и ячменя, которая в настоящее время используется в качестве биотехнологического инструмента для улучшения коммерчески важных сортов Казахстана. Работа выполнена в рамках проекта ПФИ МОН РК (2003-2005 гг.).

**ПОЛУЧЕНИЕ ТРАНСГЕННЫХ РЕГЕНЕРАНТОВ РАПСА,  
ЭКСПРЕССИРУЮЩИХ ГЕН ТРАНСКРИПЦИОННОГО ФАКТОРА  
HvNHX2**

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Целью исследований являлось получить трансгенные растения рапса, экспрессирующие кДНК-ген HvNHX2 вакуолярного Na+/H+-антиспортера ячменя, для использования в селекционном процессе на устойчивость к засолению.

Для агробактериальной трансформации растений рапса была использована следующая конструкция: {35S-промотор-5'НТП PVY- (HvNHX2) - 35S-терминатор}, где 35S-промотор - промотор транскрипции 35S РНК вируса мозаики цветной капусты; 5'НТП PVY - 5'-нетранслируемая последовательность геномной РНК Y-вируса картофеля; HvNHX2 - белок-кодирующая последовательность гена HvNHX2 из ячменя; 35S -терминатор транскрипции 35S РНК вируса мозаики цветной капусты. Данная конструкция была клонирована в бинарном агробактериальном векторе pSS, основанном на коммерческом векторе pCambia2000. Отличие плазмида pSS от коммерческого оригинала заключается в наличие транскрипционного терминатора от вируса мозаики цветной капусты (CaMV), а не исходного терминатора нопалинсингтазы (nos).

В качестве эксплантов для трансформации были использованы диплоидные и гаплоидные семядоли и гипокотили семян рапса. При этом определено, что после проведения трансформации из гаплоидных эксплантов получаются мало жизнеспособные регенеранты. Кроме того в результате наших экспериментов выявлено, что наибольшее количество жизнеспособных регенерантов после трансформации можно получать из диплоидных семядолей.

В результате трансформации и последующей селекции получены трансгенные регенеранты рапса, которые были проверены на наличие вставки и экспрессию гена HvNHX2 методом вестерн-блоттинга.

Для проведения эксперимента на солеустойчивость, 3 трансгенных регенеранта (линий) были клонированы *in vitro* и пересажены на среду MS с половинным набором солей, содержащей, 500 мг/л цефотаксима 100мМ NaCl, что соответствует 0,59% содержания соли в среде. Эксперимент проводился в трех повторностях по 10 регенерантов в каждой.

В первые 7 дней выживаемость опытных регенерантов третьей линии составила 75%, а контрольных 67%, через 14 дней 68% и 36,7%, через 67 дней после гибели контрольных регенерантов осталось 33% опытных регенерантов. Клоны первой и второй линии вели себя как контрольные растения и погибли через 58 и 62 дня соответственно.

## ОПТИМИЗАЦИЯ УСЛОВИЙ ГЕНЕТИЧЕСКОЙ ТРАНСФОРМАЦИИ *IN PLANTA* ОТЕЧЕСТВЕННОГО ХЛОПЧАТНИКА

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Преимуществами генетической трансформации *in planta* является преодоление генотипической зависимости процесса регенерации растений и избежание трудоемких этапов селекции тканей в стерильных условиях при трансформации *in vitro*. В задачу данного исследования входила оптимизация условий *in planta* трансформации отечественного сорта хлопчатника с использованием штамма агробактерии, несущего плазмиду с репортерным геном глюкуронидазы (*GUS*-ген) и маркерным геном неомицинфосфотрансферазы (*nptII*-). В качестве реципиентных систем использовали пыльцу цветущих растений и апексы побегов хлопчатника. Объектом исследования служил отечественный сорт хлопчатника Мактаарал-4005.

В процессе оптимизации *in planta* трансформации цветущих растений пыльцу трансформировали кокультивированием с суспензией клеток агробактерии, после чего цветки опыляли трансформированной пыльцой. В результате, из 250 опыленных цветков получено 19 коробочек и 600 семян предположительных трансформантов T0 поколения. Для 25 из них в T1 поколении получено гистохимическое доказательство экспрессии *GUS*-гена, что составляет 4,2% от количества семян предположительных трансформантов. Для 13 из *GUS*-положительных растений методом ПЦР получено молекулярно-биологическое подтверждение встраивания *nptII*- и *GUS*- гена, что составляет 2,2% от количества завязавшихся семян.

В ходе *in planta* трансформации апексов верхушечные почки 14-дневных проростков кокультивировали с суспензией агробактерии, подвергая их вакуум инфильтрации. В результате оптимизации, из 101 апекса получено 6 трансгенных растений, в которых выявлены продукты амплификации *nptII*- и *GUS*- генов, что составляет 5,6 % от количества трансформированных апексов.

В целом, оптимизированы условия получения трансгенных растений хлопчатника с использованием репортерных и маркерных генов, что позволит интродуцировать в геном отечественных коммерчески важных сортов «полезные» гены, контролирующие хозяйственно-ценные признаки. Получены трансгенные растения отечественного хлопчатника, экспрессирующие встроенный репортерный *GUS*-ген.

Авторы выражают благодарность профессору А. Митра ((Nebraska University, Lincoln, USA) за любезное предоставление плазмидных конструкций и штаммов агробактерии, несущих гены *nptII*- и *GUS*-.

Работа была выполнена в рамках проектов НТП МОН РК - 01.01.08.03.P1 (2006-2008 гг.), 02.2.03.P4 (2009-2011 гг.).

## ПОЛУЧЕНИЕ ГИБРИДОВ РАПСА С ГОРЧИЦЕЙ САРЕПТСКОЙ И СУРЕПИЦЕЙ

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В полевых условиях проводили межвидовые скрещивания рапса (*Brassica napus* L., 2n=38) с горчицей сарептской (*Brassica juncea* L., 2n=36) и сурепицей (*Brassica campestris*, 2n=20).

Гибридизацию проводили рано утром в полевых условиях. Перед кастрацией у растений удаляли все пазушные почки и боковые побеги, в центральном кистевидном соцветии удаляли раскрывшиеся и верхние недоразвитые бутоны. Бутоны осторожно раскрывали пинцетом и удаляли пыльники оставляя в бутоне только один пестик. После этого на растения одевали изолятор. Через 3 дня проводили опыление путем нанесения пыльцы на пестик и снова помещали растение под изолятор.

Через 14 дней незрелые зародыши межвидовых гибридов рапса размером 2-3 мм были извлечены из предварительно стерилизованных стручков и посажены на среду MS с гормонами: 1 мг/л кинетин, 0,1 мг/л ИУК, 1 мг/л ГК, 10 мг/л гидролизат казеина по 6 зародышей в пробирку. Зародыши культивировались на данной среде до проклёвывания. Проклонувшиеся зародыши пересаживались на среду MS с гормонами: 0,5 мг/л БАП, 1 мг/л кинетин, 0,5 мг/л ИУК, 0,1 мг/л 2,4-Д для дальнейшего культивирования. Проросшие зародыши были пересажены на среду MS до образования листочков, а затем на безгормональную среду MS с полным составом солей для укоренения. После клонирования 1/3 регенерантов оставляли на дальнейшее клонирование, а 2/3 пересаживали в грунт, поддерживали температуру, влажность, освещенность.

При цветении растений первого поколения гибридов, полученных от скрещивания рапса ярового с горчицей сарептской и сурепицей, определено, что более 80% из них являются стерильными.

Изучены нарушения при мейотическом делении гибридных растений. Из бутона извлекали 2-3 пыльника и помещали их на чистое предметное стекло в большую каплю ацетокармина. Подогревали 3-4 раза над пламенем спиртовки и закрывали покровным стеклом. Просмотр под микроскопом проводили при 100 кратном увеличении. Было выявлено, что во втором мейотическом делении на стадии анафазы II наблюдалось неправильное расхождение хромосом, аномальные веретена деления, а также три телофазные группы хромосом в первом делении. В последствии из трехполюсных веретен во втором мейотическом делении образовались пентады. Данные нарушения приводили к формированию стерильных пыльцевых зерен.

## ОПТИМИЗАЦИЯ СОСТАВА ПИТАТЕЛЬНЫХ СРЕД В КУЛЬТУРЕ ИЗОЛИРОВАННЫХ ПЫЛЬНИКОВ РИСА *Oryza sativa L.*

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В настоящее время для ускорения селекционного процесса применяют метод гаплоидной биотехнологии, которая позволяет получать стабильное растение за одно поколение. Гомозиготные линии могут использоваться селекционерами для изучения взаимодействия генов, определения групп сцепления для создания генетических карт. Наиболее эффективным методом получения гаплоидов риса является культура изолированных пыльников. Гаплоидные растения из культуры пыльников риса обычно получают через каллусогенез или прямой регенерацией в котором формируются проэмбриональные структуры с последующим развитием из них эмбриоидов.

В ходе исследований было проведено сравнение влияния гормонов 2,4-Д и фенилуксусной кислоты (ФУК) на индукцию андроклинических структур у 39 генотипов риса. Было использовано два варианта индукционной среды- N<sub>6</sub> + 2 мг/л 2,4-Д и N<sub>6</sub> + 2 мг/л ФУК. На 20-е сутки культивирования наблюдали появление первых андрогенных структур, т.е. эмбриоидов. Наибольшее количество каллусов было получено у линии F<sub>3</sub>КС6-8 и глютинозного сорта Виолетта. В литературе отмечается, что генотипы глютинозного риса проявляют максимальную отзывчивость в культуре пыльников, далее следует: *japonica*, *japonica/ indica* гибриды, *indica*, *indica* гибриды и подвид *indica*. На индукционной среде, содержащей ФУК, наблюдали прямую регенерацию растений у гибридов F<sub>3</sub>ГС-176-, F<sub>3</sub>ГС-208 и F<sub>3</sub>БР-8. В целом, среда с 2,4 - Д, была эффективнее по индукции каллусов по сравнению со средой содержащей ФУК. Было проведено оптимизация питательный среды для индукции корней у регенерантов. Наиболее эффективной средой для ризогенеза была среда содержащая 1/2 набор микро-, макроэлементов Мурасиге-Скуга, с добавлением стерилизованные мембранным фильтрованием 1 мг/л ИУК, 500 мг/л гидролизат казеина и 0,2 мг/л CuSO<sub>4</sub>. Показано зависимость процессов регенерации от генотипа донорных растений. Наиболее отзывчивыми из испытанных генотипов были сорта Виолетта, Баканасский, гибриды F<sub>3</sub> БР-8, F<sub>3</sub>КС6-8, F<sub>3</sub>ГС-194 и F<sub>3</sub> CCP5-6.

В ходе проведенных исследований выявлено, что для индукции каллусообразования оптимальной средой является N<sub>6</sub> содержащая 2 мг/л 2,4-Д, для ризогенеза среда Мурасиге – Скуга с 1/2 составом микро-, макроэлементов, стерилизованные через мембранные фильтры 1 мг/л ИУК, 500 мг/л гидролизат казеина и 0,2 мг/л CuSO<sub>4</sub>. ФУК в индукционной среде вызывает прямую регенерацию растений в культуре пыльников риса.

## ИССЛЕДОВАНИЕ ИНИЦИАЦИИ ТРАНСЛЯЦИИ НА НЕ-AUG-КОДОНЕ В 5'-НЕТРАНСЛИРУЕМОЙ ПОСЛЕДОВАТЕЛЬНОСТИ ГЕНОМНОЙ РНК У ВИРУСА КАРТОФЕЛЯ

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Синтез белков у эукариот практически всегда начинается с метионина, который кодируется стартовым AUG-кодоном. Однако некоторые вирусные и клеточные мРНК могут эффективно инициировать трансляцию с кодонов, отличных от AUG. Инициация трансляции на не-AUG-кодонах может приводить к синтезу нескольких полипептидов с одной мРНК.

Нами было замечено, что при трансляции в бесклеточной системе из зародышей пшеницы рекомбинантные мРНК, содержащих перед репортерным геном 5'-нетранслируемую последовательность (5'НТП) геномной (г)РНК Y вируса картофеля (PVY), помимо главного продукта трансляции ( $P_0$ ), синтезируется также дополнительный полипептид ( $P_+$ ), который приблизительно на 15 аминокислот длиннее главного. Поскольку в 5'-НТП гРНК PVY нет AUG-кодонов, то, для выявления стартового не-AUG-кодона открытой рамки считывания (ОРС)  $P_+$ , были созданы рекомбинантные мРНК, содержащие перед ОРС  $P_0$  нативный и мутантный варианты 5'НТП гРНК PVY (соответственно «5'Y-[AUG- $P_0$ -6His]» и «5'Y-UAA-[AUG- $P_0$ -6His]»). ОРС  $P_0$  кодирует полипептид размером 14 кДа, содержащий на С-конце шесть гистидинов (6His), что позволяет детектировать  $P_0$  и  $P_+$  с использованием антител (anti-6His-AB). В ОРС обеих мРНК отсутствуют AUG-кодоны, кроме стартового. В мРНК «5'Y-UAA-[AUG- $P_0$ -6His]» перед стартовым AUG-кодоном вставлен стоп-кодон UAA в той же рамке считывания.

Затем рекомбинантные мРНК транслировали в бесклеточной системе из зародышей пшеницы. Показано, что с обеих мРНК транслируется полипептид  $P_0$  (14 кДа). С мРНК «5'Y-[AUG- $P_0$ -6His]», кроме  $P_0$ , транслируется еще полипептид  $P_+$  (15,5 кДа). При трансляции мРНК «5'Y-UAA-[AUG- $P_0$ -6His]», содержащей стоп-кодон перед стартовым AUG-кодоном, дополнительный полипептид  $P_+$  не синтезируется, что свидетельствует о начале его ОРС с не-AUG кодона в 5'-НТП гРНК PVY, расположенного в одной фазе считывания со стартовым AUG-кодоном.

На основе мРНК «5'Y-[AUG- $P_0$ -6His]» и «5'Y-UAA-[AUG- $P_0$ -6His]» были получены соответствующие им мРНК «5'Y-[GCG- $P_0$ -6His]» и «5'Y-UAA-[GCG- $P_0$ -6His]», в которых стартовый AUG-кодон был замещен на GCG-кодон. Как и ожидалось, эти мРНК теряли способность синтезировать полипептид  $P_0$  (14 кДа). При этом с мРНК «5'Y-[GCG- $P_0$ -6His]» продолжал транслироваться полипептид  $P_+$  (15,5 кДа), очевидно, с не-AUG-кодона.

Все описанные выше рекомбинантные мРНК были транслированы *in vitro* в присутствии L-[<sup>35</sup>S]метионина. Продукты трансляции разделяли в полиакриламидном геле и детектировали с помощью радиоавтографии. Полипептид  $P_0$  (14 кДа) был детектирован среди продуктов трансляции мРНК «5'Y-[AUG- $P_0$ -6His]» и «5'Y-UAA-[AUG- $P_0$ -6His]», но не «5'Y-[GCG- $P_0$ -6His]» и «5'Y-UAA-[GCG- $P_0$ -6His]». При этом полипептид  $P_+$  (15,5 кДа), являющийся продуктом не-AUG трансляции, детектировался только при трансляции мРНК «5'Y-[AUG- $P_0$ -6His]», но не «5'Y-UAA-[AUG- $P_0$ -6His]». Эти результаты свидетельствуют, что инициация трансляции на не-AUG-кодоне, происходящая в 5'НТП гРНК PVY, обходится без инициаторной Мет-тРНК<sub>и</sub>.

Регуляторные последовательности, опосредующие не-AUG трансляцию, могут быть использованы в биотехнологии для синтеза рекомбинантных белков, содержащих на N-конце не метионин, а иные аминокислотные остатки.

## УЛУЧШЕНИЕ ЭФФЕКТИВНОСТИ ПОЛУЧЕНИЯ УДВОЕННЫХ ГАПЛОИДОВ В КУЛЬТУРЕ ИЗОЛИРОВАННЫХ ПЫЛЬНИКОВ РИСА *Oryza sativa L.*

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Выведение новых сортов самоопыляющихся растений состоит из трех основных моментов: создание изменчивости путем скрещивания, стабилизация самоопылением или беккроссом в течение нескольких поколений и отбора желательных рекомбинантов. Для ускорения селекционного процесса применяют метод гаплоидной биотехнологии, основным преимуществом которой является быстрое получение константных линий из расщипляющихся гибридов. Для массового получения гаплоидовриса наиболее эффективным является метод культуры изолированных пыльников и микроспор.

Для получения гаплоидов риса использовали 20 гибридов, 6 линии и 10 сортов отечественной и зарубежной селекции. Донорные растения выращивали в оранжерее ИББР. Метелки отбирали в фазе трубкования. Холодовую предобработку пыльников проводили при температуре +4<sup>0</sup>С в течение 3-5 суток. После холодовой обработки, пыльники пассивировали на индукционную среду N<sub>6</sub> содержащая 2 мг/л 2,4-Д, 90 г/л мальтозы. Полученные каллусы переводили на модифицированную среду Мурасиге-Скуга (МС-Р) для регенерации с добавлением 5 мг/л БАП, 0,5 мг/л ИУК, 500 мг/л гидролизат казеина, 500 мг/л глутамина и 30 гр/л сахарозы. В связи с тем, что часть регенерантов не выживают после полиплоидизации колхицинированием и перевода в почву, проводили клonalное размножение регенерантов с целью получения большего количества растений. Растения с мощным кущением в  *invitro* делили на отдельные побеги и культивировали раздельно на среде МС-Р. Растения регенеранты с хорошо развитой корневой системой отмывали от питательной среды и помещали в сосуды с водой на 2 сутки. После адаптации в почвенно-торфяной смеси, через неделю, растения выращивали в теплице для получения зерновок. Среди регенерантов, наряду с фертильными, наблюдались стерильные растения.

В практике, помимо колхицинирования, применяют метод культивирования стеблевых узлов из гаплоидных стерильных регенерантов для получения фертильных растений. В стеблевых узлах находятся меристематические клетки, из которых можно регенерировать целое растение. В результате активного роста меристем в  *invitro* происходит спонтанное удвоение хромосом с высокой частотой. Стеблевые узлы из стерильных регенерантов вычленяли, стерилизовали в растворе препарата «Белизна» и бидистилированной воде в соотношении 1:3 в течении 20 минут. Стерильные узлы культивировали на среде МС с 2 мг/л 2,4-Д. На второй неделе культивирования наблюдали начало регенерации растений из стеблевых узлов. В результате проведенных работ были получены фертильные регенеранты из стеблевых узлов стерильных гаплоидных растений глютинозного сорта Виолетта, гибридов F<sub>3</sub>-БР-3, F<sub>3</sub>-БР-8 и F<sub>3</sub>КС-6-8. Полученные дигаплоиды из этих генотипов риса различались по содержанию амилозы, кустистости, массы 1000 зерен и другими показателями хозяйствственно-ценных признаков.

Таким образом, применение клonalного размножения и удвоение хромосом культивированием стеблевых узлов, значительно повышают частоту получения семенного поколения в культуре изолированных пыльников и микроспор риса.

## ПОЛУЧЕНИЕ СКОРОСПЕЛЬНЫХ ФОРМ ПШЕНИЦЫ НА ОСНОВЕ КЛЕТОЧНОЙ ТЕХНОЛОГИИ

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Получение нами ранее новых скороспелых сомаклональных линий пшеницы на основе двух отечественных сортов при помощи технологии длительной регенерации (ДР) позволило предположить возможность использования данной технологии для получения форм с более ранними сроками созревания из других коммерчески важных сортов. В задачу данного исследования входило изучение возможности получения раннеспельных форм из отечественных хозяйствственно-ценных сортов яровой мягкой пшеницы на основе разработанной нами генотип независимой клеточной технологии ДР, а также возможности передачи признака скороспелости, индуцированного *in vitro*, при гибридизации с другими генотипами.

Из длительно культивируемых каллусных тканей 4-5 пассажа нами получено 196 растений-регенерантов 26 коммерчески важных сортов пшеницы нового поколения (Самгай, Алмакен, Казахстанская 75, Астана-2, Карабалыкская 98, Байтерек, Новосибирская 15, Омская-36, Асар, Арай, Жазира, Казахстанская 17, Казахстанская раннеспелая, Казахстанская 10, Казахстанская 15, Карагандинская 22, Карагандинская 30, Надежда, Ертис 7, Павлодарская 93, Павлодарская 8, Секе, Бекзат, Кондитерская яровая, Павлодарская Юбилейная, Лютеценс 90). В результате, из 127 растений-регенерантов получены семена R<sub>1</sub> потомства от самоопыления, из которых получены семена R<sub>2</sub> потомства от самоопыления, принадлежащие 17 сортам пшеницы. Фенологическое наблюдение за растениями R<sub>1</sub> поколения 127 линий позволило выделить 47, опережающих исходные сорта по срокам созревания на 2-10 дней; из них по продуктивности отобрано 21 линий, по признаку засухоустойчивости – 7 линий. В итоге, по комплексу ценных признаков – скороспелость, урожайность, засухоустойчивость, отобрано 4 линии R<sub>1</sub> поколения.

Получены семена F<sub>2</sub>, F<sub>3</sub> поколений 23 гибридных линий, полученных от скрещивания ранее полученных нами скороспелых сомаклональных линий R<sub>8</sub> поколения сортов Целинная 3С и Отан с перспективными и допущенными к использованию генотипами. Из 23 гибридных линий выделено 6, опережающих по срокам созревания стандарт Казахстанская раннеспелая (98 дней) – на 5-11 дней, исходный сорт – на 3-8 дней, и родительские сомаклональные формы – на 1-6 дней. Из них 2 скороспелые линии отобраны как перспективные по урожайности и засухоустойчивости, 2 – по урожайности.

В итоге, в результате фенологического изучения растений-регенерантов R<sub>1</sub> поколения показана принципиальная возможность получения скороспелых форм из широкого круга коммерчески важных сортов с использованием разработанной нами клеточной технологии ДР. Выявлено, что ранее полученные скороспелые сомаклональные линии могут служить донорами признака скороспелости. Изучение развития признака скороспелости в последующих поколениях будет продолжено.

Работа выполнена в рамках проекта 1911 программы ГФ1МОН РК (2012-2014 гг.).

## ГЕНЕТИЧЕСКИЙ АНАЛИЗ ТРАНСГЕННЫХ РАСТЕНИЙ ЯБЛОНИ, СОДЕРЖАЩИХ ШПИЛЕЧНУЮ КОНСТРУКЦИЮ КОМПЛИМЕНТАРНУЮ ВТОРОМУ ЭКЗОНОУ ГЕНА АСО ЯБЛОНИ

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Проведение генетических исследований на яблоне (*Malus domestica L.*) – трудоемкий и длительный процесс, что связано в первую очередь с продолжительным циклом воспроизведения. Однако, вскоре после первой успешной попытки трансформации яблони, она стала достаточно популярным объектом для исследования регуляции уровня биосинтеза этилена, прежде всего из-за своей экономической значимости и хорошо изученных физиологических аспектов процесса созревания плодов. Одним из направлений генетической трансформации яблони является модификация процесса созревания плодов с целью увеличения сроков их хранения.

Целью данной работы является определение уровня синтеза этилена в растениях яблони, содержащих шпилечную конструкцию комплиментарную 2-му экзону гена АСО яблони (самокомплементарные фрагменты гена АЦК-оксидазы яблони в различных ориентациях antisense-sense и sense-antisense).

В нашей лаборатории были получены линии с использованием шести векторных конструкций, содержащих самокомплементарные фрагменты генов АЦК-оксидазы: три из них содержали целевой ген под управлением CaMV35S промотора – pARTMdACOsa, pARTMdACOas, pCamMdACOsa; другие три вектора содержали плодоспецифичный промотор полигалактуроназы томата - pART PGMdACOas, pARTPGMdACOsa, pARTPGLeACOas. В экспериментах по генетической трансформации яблони использовали сорт Мелба.

На первом этапе нашей работы был проведен ПЦР-анализ полученных линий. В результате, были подтверждены вставки селективных генов *nptII* и *hprt* во всех образцах (всего 62). Наличие смысловой конструкции было подтверждено для 3 из 3 линий растений яблони, полученных с помощью вектора pARTMdACOsa, 9 из 16 линий, трансформированных конструкцией pCamMdACOsa, и 8 из 9 линий, полученных в результате трансформации конструкцией pARTMdACOas. А также для 18 из 20 линий, полученных при помощи pARTPGLeACOas, для 6 из 10 линий - pARTPGMdACOas и 4 из 4 линий, созданных при помощи вектора pARTPGMdACOsa. В растениях, трансформированных векторами pCam, наличие вставки целевых генов было подтверждено не во всех полученных линиях. Это может быть вызвано тем, что смысловой ген в конструкции следует за селективным геном. А также возможно происходит разрыв Т-ДНК при встраивании в растительный геном. На следующем этапе наших исследований планируется проведение оценки уровня экспрессии изоформ гена АСО, измерение уровня синтеза этилена в различных частях растения и оценка его влияния на рост и развитие трансгенных растений.

## КЛОНИРОВАНИЕ ОРС7 ГЕНОМНОЙ РНК М-ВИРУСА КАРТОФЕЛЯ

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В настоящее время РНК-интерференция (RNAi) признана одним из важных клеточных механизмов, участвующих в метаболизме РНК, и рассматривается как основной клеточный механизм защиты от вирусов. Установлено, что многие вирусные белки способны подавлять (супрессировать) клеточный процесс RNAi (RSS-белки – от RNA silencing suppressor proteins) и тем самым обеспечивать преимущество вирусов при размножении в клетках растений. М-вирус картофеля (PVM) является фитовирусом, относящимся к роду *Carlavirus* семейства *Betaflexiviridae*. PVM является экономически важным, так как потери урожая, вызванные инфекцией растений картофеля этим вирусом, составляют около 20%, а в сочетании с другими вирусами могут быть значительно выше (до 80%). Для PVM супрессорные вирусные белки и механизмы их действия остаются мало исследованными.

Пятая открытая рамка считывания (ОРС34К) геномной (г)РНК PVM кодирует белок оболочки размером 304 аминокислоты и молекулярной массой 34 кДа (34К-белок). Эта ОРС начинается с AUG-кодона в положении 7227 и заканчивается терминающим кодоном в положении 8141. Ранее мы показали, что 34К-белок оболочки PVM обладает способностью супрессировать процесс RNAi в клетках табака *Nicotiana benthamiana* линии 16С.

Позднее мы обнаружили, что внутри ОРС34К содержится дополнительная ОРС7 (нуклеотиды 7264-7464), кодирующая предполагаемый белок с молекулярной массой 7 кДа (7К-белок). Аналогичные ОРС, кодирующие небольшие потенциальные белки, были обнаружены также и внутри генов белков оболочки нескольких других карла- и потексвирусов. Функциональная значимость этих ОРС не ясна.

В настоящей работе с помощью реакции обратной транскрипции (РОТ) и полимеразной цепной реакции (ПЦР) амплифицированы ОРС34К гРНК PVM, а также рамка ОРС7К, находящаяся внутри ОРС34К. Проведено клонирование амплифицированных фрагментов сначала в бактериальном (pBluescript SK II), а затем в модифицированном растительном векторе, созданном на основе pCambia 2300. Наличие и корректность целевых вставок после каждого этапа были проверены рестрикционным и ПЦР анализами, а также методом секвенирования с использованием специфических олигонуклеотидных праймеров. Проведен электрофоретический анализ фрагментов ДНК.

Этот этап работы посвящен амплификации целевых фрагментов гРНК PVM и их клонированию для трансформации агробактерий и последующей ко-инфильтрации растений табака *N. benthamiana* линии 16С, с целью выяснения какая ОРС (белков 34К или 7К) ответственна за супрессию RNAi.

Ключевые слова: М-вирус картофеля (PVM), РНК-интерференция (RNAi), клонирование ОРС гРНК PVM, белки PVM - супрессоры RNAi.

## ИНДУКЦИЯ СОМАТИЧЕСКОГО ЭМБРИОГЕНЕЗА У *PINUS SIBIRICA* ДУ ТУР В КУЛЬТУРЕ *IN VITRO*

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Для инициации соматического эмбриогенеза использовали 3 базовые среды MS, (Murahsige et al., 1962), LV(Litvay et all, 1985), DCR (Gupta and Durzan,1985). Все тестируемые среды поддерживали пролиферацию клеток *Pinus sibirica* в культуре *in vitro*. Из исследованных компонентов сред наиболее важной для индукции соматического эмбриогенеза является концентрация фитогормонов (соотношение ауксинов и цитокининов). Большее число эмбриогенных клеточных линий было получено на среде, содержащей 2 мг\л 2,4 Д и 1мг\л 6 БАП.

В результате проведенных исследований установлено, что на индукцию соматического эмбриогенеза у *P. sibirica* оказывают влияние морфофизиологическое состояние экспланта, минеральный и гормональный состав среды, физические факторы (свет и температура). Наиболее успешно формирование эмбрионально-супензаторной массы наблюдали при использовании в качестве эксплантов мегагаметофитов содержащих зародыши на предсемядольной стадии развития. Частота инициации достоверно снижалась по мере созревания зародыша. Частота инициации варьирует от 0 до 3,4% и зависит от генотипа дерева донора.

Воздействие низкими положительными температурами (+3 С в течении 72 часов) оказывало статистически достоверное положительное влияние на частоту индукции эмбриогенеза.

**ИНДУКЦИЯ ПОБЕГООБРАЗОВАНИЯ В КАЛЛУСНОЙ КУЛЬТУРЕ  
РЕДКИХ ВИДОВ РОДА *IRIS* - *I.TIGRIDIA* BUNGE, *I.HUMILIS* GEORGI,  
*I.GLAUCESCENS* BUNGE**

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Род ирис (*Iris L.*) широко распространен в Северном полушарии, в его состав входит около 200 видов. На территории России произрастает 40 дикорастущих видов этого рода, а в Сибири - 22 вида и 2 подвида (Конспект флоры Сибири, 2005). *I. glaucescens* (Касатик сизоватый), *I. humilis* (К. низкий) относятся к азиатской ареалогической группе, *I. tigridia* (К. тигровый) – субэндемичный центральноазиатский вид. Данные виды относятся к подроду *Iris*, являются редкими и включены во все кадастры государственного и общесибирского уровней (Красная книга РФ, 2008; Редкие ..., 1980.). Вследствие затрудненного прорастания семян и невысоких показателей вегетативного размножения для сохранения редких видов ирисов используются методики клonalного размножения. Целью данной работы явилось изучение влияния регуляторов роста на регенерацию редких сибирских видов *I. humilis*, *I. glaucescens*, *I. tigridia* в каллусной культуре. Были использованы растения 3 видов ирисов из природных ценопопуляций Республики Алтай и Новосибирской области в фазе созревания семян, имевшие эндосперм в стадии восковой спелости. Стерилизацию плодов проводили по схеме: 70%  $C_2H_5OH$  – 1 мин.; 4% лизоформин – 15 мин; стерильная  $H_2O$  – 3 раза по 5 мин. Эксплантами для индукции каллусной культуры являлись изолированные зародыши. Культивирование зародышей и каллусов проводили на питательной среде MS, дополненной гидролизатом казеина (500 мг/л), сахарозой (3%), агаром (6 г/л). В качестве регуляторов роста использовали 2,4 – дихлорфеноксикусусную кислоту (2,4-Д), 1-нафтилкусусную кислоту (НУК), 6-бензиламинопурин (БАП), N-фенил-N'-(1,2,3-тиадиазол-5-ил) мочевина (ТДЗ) в различных комбинациях. Незрелые зародыши и каллусы инкубировали в темноте при 22-24° С, регенеранты выращивали на свету (3000 лк), 16 – часовом фотопериоде при той же температуре. Для видов подрода *Iris* способность изолированных зародышей к образованию морфогенного каллуса, была видоспецифичной: образование морфогенного каллуса отмечено у 59,8 % изолированных зародышей *I. glaucescens*, *I. tigridia* – 40 %; *I. humilis* – 31,9 %. Первичный каллус образовывался в апикальной части изолированных зародышей всех трех видов, находившихся в стадии восковой спелости. Для получения регенерантов на этапах культивирования (1 - 4) были испытаны следующие концентрации регуляторов роста: этап (1) - индукция морфогенных каллусов: 1-2 мг/л 2,4-Д + 0,2-0,5 мг/л БАП + 0,2 мг/л ТДЗ; этап (2) - субкультивирование каллусов: 1-2 мг/л 2,4-Д + 0,2-0,5 мг/л БАП; этап (3) - индукция адвентивного побегообразования: 0,5-1 мг/л БАП + 0,3-0,5 мг/л НУК + 0,2 мг/л ТДЗ; этап (4) - укоренение регенерантов: ½ MS + 0,3 мг/л 4-(3-индолилмасляная кислота (ИМК). Было отмечено, что активные морфогенетические процессы происходили при низких концентрациях регуляторов роста, тогда как при повышенных наблюдались витрификация тканей регенерантов и затрудненность корнеобразования. В процессе адвентивного побегообразования формировались кластеры растений, состоящие в среднем из 7–8 розеточных побегов (максимальное количество – 17). Для высадки регенерантов из кластеров побегов изолировали растения, имеющие придаточные корни. Растения, не имеющие корней, высаживались на среду ½ MS с добавлением 0,3 мг/л ИМК. Таким образом, впервые показано, что внесение в индукционную среду цитокинина ТДЗ способствует инициации морфогенных каллусов, а в среду для дифференциации – массовому образованию адвентивных побегов. Низкие концентрации регуляторов роста на всех этапах эмбриокультуры позволяют получать жизнеспособные растения - регенеранты путем непрямого органогенеза у трех редких видов подрода *Iris*.

## ИСПОЛЬЗОВАНИЕ СТОЛОНОВ В БИОТЕХНОЛОГИИ КАРТОФЕЛЯ

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Культивирование столонов картофеля *invitro* открывает новые возможности для изучения физиологии клубнеобразования и поиска новых биотехнологических приемов, увеличивающих индексы урожая, а также позволяющих раскрыть механизмы гормональной и углеводной регуляции роста и развития растений.

Показана возможность использования культуры столонов *in vitro* для регуляции клубнеобразования картофеля. Обнаружено отсутствие сезонной зависимости клубнеобразования у пробирочных растений, индуцируемых из столонов. Отмечено изменение морфологии побегов при увеличении концентрации сахарозы и гормонов.

Для повышения адаптационной способности растения выращивали *in vivo* на различных субстратах: почва, песок, почва-песок (1:1), почва – навоз (1:1), навоз. Коэффициент приживаемости растений увеличивался до 90-93% в полевых условиях.

Испытывались различные среды культивирования столонов, содержащие разные концентрации агара. Обычная среда содержит 0,7% агара и среда содержимого 0,3% агара-жидкая среда, которая была использована нами в сравнительных экспериментах. Как показывают полученные нами результаты, регенерация столонов в жидкой среде имеет высокую морфогенетическую потенцию, чем выращивание их в твёрдой среде *in vitro*. Наиболее активное каллусообразование наблюдается при использовании в системе *in vitro* фолиевой кислоты, НУК, глутамина. В этих условиях процент каллусообразования составляет более 50%, с побегами 90%. В других исследованных средах образование каллусов и побегов было значительно ниже. Добавление в среду культивирования столонов 2,4Д в низких концентрациях (0,1 мг/л) значительно увеличивало образование каллусов (до 78%), но сильно снижало образование побегов. В этих условиях выращивания столонов процент каллусов с побегами составлял 40%, т.е. был в два раза ниже, чем в среде без 2,4Д.

Столовые растения картофеля *in vitro* не отличались по морфогенетическим параметрам и по микроклубнеобразования.

Особых различий по морфологическим признакам столовых и меристемных регенерантов не обнаружено. Количество междуузлий пробирочных растений-регенерантов в 25-дневном возрасте в среднем составляет 5шт./растение. Особых различий также не обнаружено по общей площади листьев, сырой массе растений и времени инициации клубнеобразования.

Полученные данные свидетельствуют об идентичности столовых и меристемных регенерантов *in vitro*, что имеет существенное значение для использования столовых культур в биотехнологии оздоровления растений картофеля, как альтернативные меристемной культуре системы.

Существенное различие обнаружено по количеству морфологически измененных регенерантов при культивировании апикальных меристем и столонов.

## ПОЛУЧЕНИЕ ТРАНСГЕННЫХ РАСТЕНИЙ, ЭКСПРЕССИРУЮЩИХ ГЕН ТРАНСКРИПЦИОННОГО ФАКТОРА AtCBF3

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Экспрессия гена транскрипционного фактора *AtCBF3* происходит в ответ на действие низких температур. Белковый продукт экспрессии приводит к активации генов многих стрессовых белков.

Рекомбинантный ген *AtCBF3* был амплифицирован и клонирован под контролем различных регуляторных элементов. Полученные ДНК-конструкции содержали следующие кассеты экспрессии:

- 1) {35S-промотор-[5'НТП PVY-(*AtCBF3*)-3'ТMV]-nos-терминатор};
- 2) {35S-промотор-[ «ARC x 3»-(*AtCBF3*)-3'ТMV]-nos-терминатор};

где 35S-промотор - промотор транскрипции 35S РНК вируса мозаики цветной капусты; 5'НТП PVY - 5'-нетранслируемая последовательность геномной РНК Y-вируса картофеля; «ARC x 3» - 3 копии искусственного трансляционного энхансера, вставленного в 5'НТП; (*AtCBF3*) - белок-кодирующая последовательность гена *AtCBF3* из *Arabidopsis thaliana*; 3'ТMV - 3'-нетранслируемая последовательность геномной РНК вируса табачной мозаики; nos-терминатор - терминатор транскрипции гена нопалинсинтазы *Agrobacterium tumefaciens*.

Эти экспрессионные кассеты переклонировали в состав бинарного агробактериального вектора pCAMBIA 2300 и провели трансформацию растений табака *Nicotiana tabacum* сорта Samsun NN и рапса *Brassica napus* сортов «Крис» и «Гедемин». В результате стабильной трансформации и последующей селекции получены трансгенные линии.

Для изучения действия низких температур все трансгенные растения помещали в условия следующего температурного режима: 3 ч при температуре +5 °C, 3 ч при температуре -3 °C, 18 ч при температуре +5 °C. С помощью ОТ-ПЦР проведен анализ *AtCBF3*-транскриптов в препаратах тотальных РНК, выделенных до и после действия холодового стресса и отобраны следующие три группы растений-трансформантов табака и рапса: (1) растения, у которых отсутствовали *AtCBF3*-транскрипты как до, так и после холодового стресса; (2) растения, у которых количество транскриптов было неизменным в обоих случаях; (3) растения, показавшие увеличение количества *AtCBF3*-транскриптов после действия холодового стресса.

В ходе дальнейших испытаний несколько трансгенных растений табака показали устойчивость к действию более низких температур (16-18 ч при +4 °C, 3 ч при -10 °C), и все холодаустойчивые растения относились ко второй и третьей группам по содержанию *AtCBF3*-транскриптов.

## РАСТЕНИЯ КАРТОФЕЛЯ, ЭКСПРЕССИРУЮЩИЕ ТРАНСГЕН *HvNhX2*, ДЕМОНСТРИРУЮТ ПОВЫШЕННУЮ СОЛЕУСТОЙЧИВОСТЬ ПРИ КУЛЬТИВАЦИИ В ПОЧВЕ

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Методом обратной транскрипции и последующей ПЦР была амплифицирована последовательность кДНК гена *HvNhX2*, кодирующего вакуолярного  $\text{Na}^+/\text{H}^+$ -антиспортера ячменя. Данная последовательность была клонирована в агробактериальную плазмиду pCambia 2300 под контроль промотора и терминатора транскрипции вируса мозаики цветной капусты. Методом ко-культивации с агробактериями, несущими полученную плазмиду, было получено пять трансгенных линий картофеля сорта «Тамаша». В тотальном растворимом белке полученных растений белок HvNHX2 не детектировался (использовались специфичные поликлональные антитела). По стандартной методике в градиенте сахарозы (45%-25%-15%) была выделена микросомальная фракция, обогащённая фрагментами тонопласта; в этой фракции искомый белок детектировался, но неравномерно для разных трансгенных линий – максимальное количество было отмечено у линий H202 и H203.

У всех пяти трансгенных линий и у контрольных исходных растений в условиях *in vitro* были получены микро-клубни, высаженные в почву, содержащую 100 mM NaCl (соответствует 0,59% засоления). Проросшие растения культивировались в тепличных условиях при 22°C, 70% относительной влажности и 16-ти часовом световом дне. На 160-й день эксперимента уровень гибели контрольных растений достиг 51%, а трансгенных растений – от 50% до 90%, за исключением линии H202, для которой уровень гибели составил 31%. На момент 100%-ой гибели контрольных растений (220-й день эксперимента) и фактически всех растений прочих трансгенных линий, уровень смертности растений линии H202 составлял 69%.

У растений линии H202, культивировавшихся в присутствии 100 mM NaCl, были собраны клубни (средняя масса клубней ~ 13 г), у растений других трансгенных линий и контрольных растений клубни не сформировались. Полученные клубни линии H202 и клубни контрольных растений были высажены в почву, содержащую 150 mM NaCl (соответствует 0,88% засоления). Проросшие растения культивировались в условиях, описанных выше. Спустя семь месяцев с момента посадки клубней, все контрольные растения погибли, трансгенные растения линии H202 погибли на месяц позже. У растений линии H202, культивировавшихся в присутствии 150 mM NaCl, были собраны клубни (средняя масса клубней ~ 6 г), у контрольных растений клубни не были сформированы.

Таким образом, можно заключить, что полученная нами линия трансгенного картофеля H202, экспрессирующая трансген *HvNhX2*, демонстрирует повышенную солеустойчивость при культивировании на сильнозасоленной почве в сравнении с контрольными растениями.

**ПОЛУЧЕНИЕ ТРАНСГЕННЫХ РАСТЕНИЙ ТОМАТА,  
ЭКСПРЕССИРУЮЩИХ ГЕНЫ ТРАНСКРИПЦИОННЫХ  
ФАКТОРОВ ПЕТУНИИ ЕОВІ И ЕОВІІ**

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Аромат плода представляет собой смесь молекул различных летучих веществ, которые синтезируются во время созревания плода, и является неотъемлемым признаком качества и спелости плода. Летучие органические вещества, образующие композицию аромата томата, являются продуктами различных метаболических путей растения, а их синтез обусловлен огромным пулом ферментов, в силу чего запах становится сложным объектом для изучения и модификации. Современные методы генетической трансформации позволяют создавать такие экспрессионные кассеты, которые будут инициировать каскадную транскрипцию целого пула генов в определенную стадию онтогенеза.

Целью нашей работы стало получение растений томата с измененным ароматом плодов и повышенной, таким образом, привлекательностью для потребителей. Для генетической трансформации томатов нами были выбраны гены транскрипционных факторов EOBI и EOBIІ (Emission Of Benzenoids) недавно обнаруженные в петунии и охарактеризованные группой ученых под руководством профессора Вайнштейна А. Было показано, что EOBIІ напрямую влияет на уровень транскрипции некоторых генов, кодирующих ферменты фенилпропаноидного пути биосинтеза летучих органических соединений, а также генов шикиматного пути. Благодаря скординированному влиянию на биосинтез летучих соединений цветков и при этом отсутствию влияния на продукцию антоцианов, высказано предположение о центральной регуляторной роли генов транскрипционных факторов EOBI на биосинтез фенилпропаноидных летучих соединений (Spitzer-Rimon и др., 2010).

Для работы было создано две векторные конструкции, содержащих кодирующую область гена EOBI/EOBIІ, под контролем плодоспецифичного промотора E8, который обеспечивает высокий уровень экспрессии и обладает жесткой тканевой специфичностью. Также подобрано 5 различных по своим характеристикам сортов томатов, среди которых черри, желтоплодные и розовые томаты, а также томаты с повышенным содержанием никотина.

На данный момент мы имеем более чем по 10 линий каждого сорта с каждой из конструкций, вставка целевого гена подтверждена методом ПЦР-анализа. Линии были проанализированы с помощью ПЦР-анализа, сопряженного с обратной транскрипцией, показавшего экспрессию гена на уровне РНК. Методом газовой хроматографии и масс-спектрометрии удалось выявить изменение содержания некоторых веществ ряда фенилпропаноидов в плодах трансгенных растений томата.

Таким образом, полученные результаты демонстрируют эффективность выбранного нами подхода к модификации аромата плодов томата, что позволяет предложить использовать такую стратегию и в дальнейшем.

1. Spitzer-Rimon B., Marhevka E., Barkai O., Marton I., Edelbaum O., Masci, T., Prathapani N., Shklarman E., Ovadis M. and Vainstein A. EOBIІ, a gene encoding a flower-specific regulator of phenylpropanoid volatiles' biosynthesis in petunia // Plant Cell. – 2010. – V. 22. – P. 1961-1976.

## ЭКСПРЕССИЯ ГЕНА ТРАНСКРИПЦИОННОГО ФАКТОРА AtDREB2A *IN VITRO* И *IN PLANTA*

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Транскрипционный фактор DREB2A контролирует экспрессию индуцибельных генов в условиях засухи и требует посттрансляционных модификаций для своей активации.

Мы амплифицировали два ДНК-фрагмента: один содержащий полную кодирующую последовательность белка AtDREB2A из *Arabidopsis thaliana* (natAtDREB2A), другой –конститтивно активную форму этого же белка ( $\Delta$ AtDREB2A) с делецией размером в 30 аминокислотных остатков в центральном районе (с 135 по 165 положение). Оба ДНК-фрагмента были «помечены» на 3'-конце последовательностью, которая кодирует шесть гистидинов, и были клонированы в состав вектора pET11d под контроль промотора T7. Индукция экспрессии белков была выполнена в клетках *E. coli* штамма BL21(DE3)pLysS при трех температурных режимах ( $30^{\circ}\text{C}$ ,  $37^{\circ}\text{C}$  и  $42^{\circ}\text{C}$ ) в присутствие различных концентраций IPTG (1-7 мМ). Экспрессия обоих вариантов белков не зависела от концентрации индуктора. Белковые продукты различались по подвижности в SDS-ПААГ (около 50 кДа и около 40 кДа, соответственно). Если синтез белка natAtDREB2A не зависел от температурного режима, то максимальный выход белка  $\Delta$ AtDREB2A наблюдался только в условиях стрессовых температур  $37^{\circ}\text{C}$  и  $42^{\circ}\text{C}$ . Оба белка были выделены и очищены с помощью Ni-аффинной хроматографии.

Далее оба варианта ДНК-фрагментов были клонированы под контроль следующих регуляторных элементов: конститтивного промотора 35S CaMV или индуцибельного промотора rd29A, двух различных вариантов 5'-нетранслируемых последовательностей (синтетического энхансера 3xARC или 5'-НТП Y-BK), 3'-НТП ВТМ и nos-терминатора, а полученные рекомбинантные кассеты были переклонированы в состав вектора pCAMBIA2300. Проведена растительная трансформация созданными нами вариантами рекомбинантных кассет и получены трансгенные растения картофеля.

Несколько трансгенных растений показали явную устойчивость к условиям искусственно созданной засухи (среда с 300 мМ маннитола). Используя метод qRT-PCR, мы проанализировали уровень экспрессии  $\Delta$ AtDREB2A или natAtDREB2A в трансгенных линиях и определили количество копий трансгена.

## РАСШИРЕНИЕ СПЕКТРА ГЕНЕТИЧЕСКОЙ ИЗМЕНЧИВОСТИ ПШЕНИЦЫ НА ОСНОВЕ ТЕХНОЛОГИИ ДЛИТЕЛЬНОЙ РЕГЕНЕРАЦИИ РАСТЕНИЙ IN VITRO

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Из-за важного продовольственного и экспортного значения пшеницы, настороженного отношения общественности к генетически модифицированным объектамиспользование методов генетической инженерии для улучшения этой культуры в Казахстане ограничено. В связи с этим, одним из дополнительных биотехнологических инструментов повышения генетического разнообразия отечественной пшеницы считается изменчивость, накапливаемая клетками в процессе культивирования *in vitro* и передающаяся полученным из них растениям-регенерантам (Larkin, Scowcroft, 1981; Сидоров, 1990). Нами разработана генотип-независимая клеточная технология длительной регенерации растений, которая позволяет преодолеть различия между сортами и линиями пшеницы в способности к регенерации растений *in vitro*. Это позволяет получать растения-регенеранты у любых коммерчески важных сортов и перспективных линий по заказу селекционеров. Ранее методы клеточной и генетической инженерии реализовывались с использованием генотипов, обладающих высокой регенерационной способностью, но не всегда коммерчески ценных.

В настоящее время данная технология используется нами для изучения изменчивости *in vitro*. В результате, выявлено расширение спектра и размаха генетической изменчивости сомаклональных линий по количественным (высота растений, длина главного колоса, число зерен в колосе, масса зерен с колоса) и качественным признакам (окраска зерен, размер, окраска и форма колосковых чешуй, остистость). Обнаружение краснозерных форм, форм с антоциановой окраской ушка, остистых форм и скороспелых форм свидетельствует о расширении спектра генетической изменчивости сомаклональных линий по сравнению с исходными генотипами. О расширении размаха изменчивости количественных признаков можно судить на примере сомаклональных линий с. Отан. Так, среднее значение высоты растений у линий R3 с. Отан варьирует от 50,2 до 85,1 см, тогда как у контрольного сорта Отан оно равно 85,2 см. Размах варьирования признака «высота растений» у линий с. Отан существенно расширяется до 42,0 см по сравнению с исходным сортом (9,4 см), преимущественно, за счет нижней границы значения показателя: появляются короткостебельные и карликовые формы. Необходимо отметить, что характер изменений признаков у полученных нами сомаклональных линий находится в существенной зависимости от исходного генотипа и значительно отличается у разных сортов и гибридов, что согласуется с литературными данными.

В целом, общей тенденцией для всех сортов было появление сомаклональных линий с крупным и озерненным колосом, с изменением окраски зерна, формы и окраски колосковых чешуй. Перспектива – использование технологии длительной регенерации в гаплоидии для получения гаметоклональных вариантов с улучшенными признаками.

Работа выполнена в рамках проектов программы РНТП МОН РК (2001-2005 гг.).

## ИНДУКЦИЯ МОРФОГЕНЕЗА И АГРОБАКТЕРИАЛЬНАЯ ТРАНСФОРМАЦИЯ *Wolffia arrhiza*

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Создание вакцин на основе трансгенных растений можно считать революционным направлением современной вакцинологии. Эти вакцины обладают такими преимуществами по сравнению с бактериальными и дрожжевыми системами, как отсутствие общих с человеком и животными патогенов и высокий уровень экспрессии гетерологичных белков.

Растения семейства *Lemnaceae*, в частности *Lemna minor* и *Spirodela oligorhiza*, применяются в качестве продуцентов рекомбинантных белков ( $\alpha$ -интерферон, плазмин, микроплазмоген, моноклональные антитела) при культивировании в факторостатных условиях в рамках поверхностных ферментационных систем.

Еще более перспективным объектом для биофарминга является вольфия бескорневая (*Wolffia arrhiza*), принадлежащая к семейству *Lemnaceae*. Основной отличительной особенностью данной культуры является отсутствие корневой системы, что предполагает возможность её глубинного культивирования в биореакторе. Однако, несмотря на возросший интерес к растениям семейства *Lemnaceae* как экспрессионной платформе для биофарминга и активную работу в этом направлении, в настоящий момент нет ни одного сообщения о стабильной трансформации растений рода *Wolffia*.

Одним из основных методов получения трансгенных растений является агробактериальная трансформация. Однако, вне зависимости от способа трансформации, прежде всего необходимо наличие надежной и высокоэффективной системы регенерации целых растений в условиях *in vitro*. Нами разработана двухэтапная методика индукции каллусогенеза вольфии с использованием среды Шенка-Хильдебрандта (SH), содержащей глюкозу, маннитол и сорбитол в различных концентрациях. На первом этапе индуцируют кластерные структуры в присутствии 2,4-Д и ВА в течение 16 недель. На втором этапе протяжении 4 недель в среде для индукции каллусогенеза ВА заменяют на PCL. Полученный каллус можно длительно поддерживать в культуре *in vitro* при относительно низкой концентрации PCL или регенерировать целые растения вольфии путем переноса его на среду SH, не содержащую гормонов.

В экспериментах по трансформации было задействовано 3 штамма агробактерии: AGL0, CBE21 и EHA105. В качестве векторных конструкций использовали pCamGFP и pVec035, содержащие селективный ген *hptII*, и pBINmGFP5ER, содержащую ген *nptII*. В качестве репортера конструкции содержат гены *gfp* и *gus*.

В ходе проведения экспериментов установлено, что наиболее эффективный трансгеноз и селекция трансгенных линий происходит в присутствии гигромицина в концентрации 5 мг/л. Отмечено, что для успешной трансформации необходимо присутствие 2,4-Д совместно с ВА в среде для культивирования эксплантов в течение 15 дней. В результате проведенных исследований получены 4 трансгенные линии вольфии.

Все полученные линии были подвергнуты анализу на предмет экспрессии репортерных белков. По результатам GUS-окрашивания все линии с интеграцией конструкции pVec035 экспрессировали фермент  $\beta$ -глюкуронидазу.

**ПРИМЕНЕНИЕ БИОТЕХНОЛОГИЧЕСКИХ И МОЛЕКУЛЯРНО-ГЕНЕТИЧЕСКИХ МЕТОДОВ ВСЕЛЕКЦИИ ПШЕНИЦЫ *TRITICUM AESTIVUM***

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Для оптимизации методов ПЦР анализа - генотипирования сортов селекции КазНИИЗиР (Женис, Эритроспермум, Алмакен) нами был проведен ПЦР анализ HMWглютенинов (M.Ahmad, 2000). Полимеразная цепная реакция (ПЦР) - экспериментальный метод молекулярной биологии, позволяющий добиться многократного увеличения (амплификации) малых концентраций определенных фрагментов нуклеиновой кислоты (ДНК) в биологическом материале (пробе). ПЦР анализ проводили при 94<sup>0</sup>С для 5 минут по следующему режиму для 45 циклов: 1) Денатурация: 94<sup>0</sup>С - 1 минута, 2) Отжиг праймера: 63<sup>0</sup> С-1 минута, 3) Элонгация: 72<sup>0</sup>С - 1 минута. Полученный ПЦР - продукт охлаждали до 4<sup>0</sup>С. Хранить в морозильнике при - 20<sup>0</sup>С. Качество ДНК определяли в 2% агарозном геле с добавлением 2мкл этидиума бромида в течение 1 часа (Маниатис, 1984).

Для выделения ДНК из растений использовали СТАВ- метод. Хлебопекарно-качествоексаплоидных пшениц является сложным признаком. Количество и состав белка может влиять на реологические свойства теста. Высокомолекулярный глютенин кодируется комплексом локусов Glu-1, на длинном плечегруппы-1 гомеологичной хромосомы A, B и D геномов. В своей работе мы использовали STS маркеры ДНК в качестве инструмента определения различий сортов пшеницы по хлебопекарным качествам. Эти маркеры являются очень важными при отборе пшеницы для хлебопечения качества. Диапазон длин полученных фрагментов ДНК при использовании четырех праймеров составлял от 250 до 2500 п.н. Количество выявляемых ДНК-фрагментов зависит от генотипа. Для наших селекционных материалов КазНИИЗиР при амплификации праймерами HMWP1+HMWP2 и HMWP3+HMWP4 показало, максимальное количество полос. Это может свидетельствовать об относительном разнообразии генетических данных селекционных материалов всех генотипов. Для генотипов пшеницы КазНИИЗиР использовали маркеры, позволяющие их идентифицировать хлебопекарные качества яровой пшеницы. Молекулярно-генетический анализ дает возможность выявить специфические геномные маркеры, которые могут использоваться для селекции. Целенаправленное использование специфических праймеров позволит исследователям сократить затраты труда и средств, необходимые для анализа образцов. В будущем селекция, основанная на молекулярных маркерах, может значительно увеличить эффективность селекции сельскохозяйственных культур. Все изучаемые нами сорта являются 1Dx5-1Dx10 типами.

## ОТДАЛЕННАЯ ГИБРИДИЗАЦИЯ И ЭКСПЕРИМЕНТАЛЬНАЯ ГАПЛОИДИЯ В СЕЛЕКЦИИ ОЗИМОГО ТРИТИКАЛЕ

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Повышение цитологической и экологической стабильности синтетической культуры тритикале (*X Triticosecale* Wittmack) является актуальной задачей практической селекции, в решении которой важную роль играют биотехнологические методы. Новые дигаплоидные сорта зерновых культур, в первую очередь ячменя и риса, получившие широкое распространение в Европе и США, характеризуются высокой конкурентоспособностью на продовольственном рынке и отвечают требованиям биобезопасности. Сорта тритикале, обладая высоким потенциалом продуктивности и хорошей питательной ценностью, нередко не соответствуют требованиям однородности, отличимости и стабильности, предъявляемым к современным сортам.

Для стабилизации генома озимого гексаплоидного тритикале ( $2n=42$ , AABBRR) и получения широкого спектра константных дигаплоидных рекомбинантов мы использовали отдаленную гибридизацию и гаплоидию. По схеме двухтестерного топкросса проводили реципрокные скрещивания между перспективными образцами тритикале и видами пшеницы *T. spelta* L. ( $2n=42$ , AABBDD) и *T. turgidum* L. ( $2n=28$ , AABB) — источниками генов, определяющими высокое качество зерна и устойчивость к абиотическим факторам и болезням. Для преодоления постгамной несовместимости и повышения сохранности гибридных зародышей использовали эмбриокультуру *in vitro*; для получения фертильного потомства — полипloidию. Оценка эффективности родительских компонентов по завязываемости показала, что пшеницу предпочтительней использовать в качестве материнских форм. Однако, анализ созданных тритикально-пшеничных гибридов  $F_{1-6}$  по элементам продуктивности и качеству зерна показал, что наиболее успешным, с точки зрения конкуренции в селекционном процессе, оказалось потомство комбинаций *Triticale*  $\times$  *T. turgidum*.

Также мы использовали *Hordeum bulbosum* L., кукурузу, сорго веничное, суданскую траву и сорго-суданковые гибриды в качестве гаплопродюсеров с целью гомозиготизации геномов внутривидовых гибридов озимого тритикале. Для повышения завязываемости и степени дифференциации зародышей соцветия гаплоидизируемой формы обрабатывали до и после цветения растворами биологически активных соединений цитокининового и ауксинового ряда, в которые добавляли незаменимые лимитирующие аминокислоты лизин, аргинин и треонин. К эффективным гаплопродюсерам для озимого тритикале можно отнести *Hordeum bulbosum*, сорго и суданскую траву. Полученные дигаплоиды после размножения семян включали в селекционный процесс, в ходе которого тестировали полученный материал по показателям хозяйственной ценности. Выделившийся сортообразец Жемчуг, созданный нами на генетической базе озимого тритикале с использованием сорго веничного Венскор, в 2012 г. был передан в Государственную инспекцию по испытанию и охране сортов растений Республики Беларусь.

## MORPHOLOGICAL HETEROGENEITY AND METHAMORPHOSIS IN COTTON TISSUE CULTURE

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The development and implementation of the genetic transformation technology for cotton improvement is constrained by the significant dependence of morphogenesis *in vitro* from genotype. Transgenic plants with valuable features obtained previously in the world were produced from high regenerable genotypes which were not always commercially important. In this regard, one of the important tasks of cotton biotechnology is to overcome the genotype dependence of plant regeneration process *in vitro* and elaboration of recipient systems for the genetic transformation of commercially important varieties.

One of the productive approaches to solve this problem is to identify the common to different genotypes laws of morphogenesis *in vitro* and development on this basis the universal plant regeneration systems for different genotypes. The aim of this study was to clarify the features of morphological heterogeneity and metamorphosis of callus tissue for identification of the common for different genotypes of morphogenetically perspective types.

Eight Kazakh cotton local varieties have been used as an object of investigation: Maktaaral-4003 Maktaaral-4005, Maktaaral-4006 Maktaaral-4007, Maktaaral-4011, Maktaaral-4019, Pahtaral-3044, Turkestan. Cotyledons, hypocotyls of sterile seedlings were used as the explants for callus induction. In primary culture of all genotypes three types of callus were identified: I - grayish white morphogenic; II - white matted non-morphogenic; III - brown non-morphogenic callus. Grayish-white callus type (I type) was selected as universal for all eight genotypes, as well as good growing and most stable in morphology during subcultivation on the original callus induction media. Transfer of grayish-white callus (I type) on the nutrient modified media lead to the metamorphosis with the arising of three callus types: grayish-white morphogenic callus (IV type) and two types of friable embryogenic calli - translucent yellow (V type) and matted white (VI type). Also compact green embryogenic callus was obtained (VII type) in modified media. Comparative histological study of three types of embryogenic calli showed, that V and VI callus types consist of 3-, 4-, 8- celled proembryos and globules, and tissue type VII – contain globules.

Embryogenic suspension cultures of cotton consisting of 3-, 4-, 8- celled proembryos and globules have been initiated from friable embryogenic calli of V and VI types. All three types of embryogenic callus (V, VI, VII) retain their morphology after long-term subcultivation (8-10 passages).

Thus, as a result of the study of morphological heterogeneity and metamorphosis of primary calli grayish-white type of callus has been revealed as universal for different genotypes and morphogenetically stable during subcultivation, as well as capable for the induction of embryogenic tissues for all genotypes.

This work performed under the project of STP MES RK 01.01.08.03.R1 (2006 – 2008).

## МОРФОЛОГИЧЕСКАЯ ГЕТЕРОГЕННОСТЬ И МЕТАМОРФОЗ В КУЛЬТУРЕ ТКАНЕЙ ХЛОПЧАТНИКА

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Разработка и внедрение технологии генетической трансформации для улучшения хлопчатника сдерживается существенной зависимостью процессов морфогенеза *in vitro* от генотипа. Трансгенные растения с ценными признаками, полученные в мире, в основном, инициированы из генотипов с высокой регенерационной способностью, не всегда коммерчески важных. В связи с этим, одними из важных задач биотехнологии хлопчатника являются преодоление генотипической зависимости процесса регенерации растений *in vitro* и разработка реципиентных систем для генетической трансформации коммерческих сортов.

Одним из продуктивных подходов для решения этих задач является выявление общих для различных генотипов закономерностей морфогенеза *in vitro* и разработка на этой основе универсальных для различных генотипов систем регенерации растений. Целью данного исследования служило выяснение особенностей морфологической гетерогенности и метаморфоза каллусных тканей для идентификации универсальных для различных генотипов морфогенетически перспективных типов тканей.

Объектами исследования служили восемь отечественных сортов хлопчатника: Мактаарал-4003, Мактаарал-4005, Мактарал-4006, Мактаарал-4007, Мактаарал-4011, Мактаарал-4019, Пахтарал-3044, Туркестан. В качестве эксплантов использовали семядоли и гипокотили стерильных проростков. В первичной культуре у всех изученных генотипов идентифицировали три типа каллусных тканей: I – серовато-белый морфогенный; II – белый матовый неморфогенный; III – бурый неморфогенный каллус.

В процессе субкультивирования был отобран универсальный для всех восьми генотипов серовато-белый тип каллуса (I тип), как хорошо растущий и наиболее стабильный по морфологии при субкультивировании на исходной среде. При пересадке серовато-белых каллусов (I тип) на модифицированные питательные среды наблюдали метаморфоз с образованием трех типов каллусов: серовато-белого морфогенного каллуса (IV тип) и двух типов рыхлых эмбриогенных каллусов – полупрозрачного желтоватого (V тип) и матового белого (VI тип). Также получен зеленый плотный эмбриогенный каллус (VII тип). Сравнительное гистологическое изучение строения трех типов эмбриогенных каллусов показало, что в V и VI типах каллусов эмбриоиды находятся на стадии 3-х, 4-х, 8-ми клеточных проэмбрио и глобулы, а в VII типе тканей – на стадии глобулы.

Из рыхлых эмбриогенных каллусов V и VI типов была получена эмбриогенная суспензионная культура хлопчатника, состоящая из 3-х, 4-х, 8-ми клеточных проэмбрио и глобул. Все три типа эмбриогенных каллусов (V, VI, VII) сохраняли свою морфологию при многократном субкультивировании (8-10 пассажей).

Таким образом, в результате изучения морфологической гетерогенности и метаморфоза первичных каллусов выявлен универсальный для различных генотипов и морфогенетически стабильный при субкультивировании серовато-белый тип каллуса, из которого для всех генотипов можно индуцировать эмбриогенные ткани.

Работа выполнена в рамках проекта НТП МОН РК 01.01.08.03.Р1 (2006-2008 гг.).

## *Спонсоры, партнеры*

# VELD

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ТОО Научно-производственная фирма "VELD" основано в 1994 года и занимается поставкой лабораторного оборудования и расходных материалов в различные лаборатории на территории Республики Казахстан, Киргизии, Узбекистан. Спецификой работы нашей фирмы является большие товарные запасы (лабораторного оборудования, химических реагентов, лабораторной посуды, тест-систем и других товаров, необходимых для полноценной работы лаборатории), находящиеся на складе в г. Алматы. Это позволяет нам в короткие сроки обеспечить любую лабораторию всем необходимым для работы. Мы поставляем также лабораторное оборудование и расходные материалы под заказ. Являясь дистрибутором крупнейших мировых производителей, мы имеем возможность поставки до 250000 наименований лабораторного оборудования и расходных материалов.

Наша фирма является дистрибутером таких известных мировых производителей как **Eppendorf AG, Thermo Fisher Scientific, Partec GmbH, Binder GmbH, Esco Micro Pte, Vilber Lourmat, Telstar, SLEE medical, AppliChem GmbH, Amresco, MilliporeMerck** и других.

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Мы имеем достаточный штат сервисных инженеров, в количестве 9 человек, прошедших обучение на заводах-производителях оборудования и специализированных по собственным направлениям. Кроме этого, мы привлекаем сервисные службы заводов производителей. При поставке оборудования, мы обеспечиваем установку оборудования, обучение специалистов работе на оборудование. Сервисные инженеры осуществляют гарантийный и послегарантийный ремонт и сервисное обслуживание всего поставленного оборудования.

Одним из главных направлений фирмы является продвижение наукоемких технологий в Республике Казахстан. Специалисты фирмы осуществляют постоянный скрининг новых технологий, регулярно посещая международные выставки. После реализации новых методов и методик в приборе и программном продукте наши специалисты проходят подготовку в фирмах, наладивших производство, и начинают продвижение новых технологий на территории Казахстана. Осуществляются постоянные связи с ведущими научными и практическими лабораториями Казахстана.

Фирма имеет разносторонне профессионально обученный штат (имеющий медицинское, химическое, биологическое, техническое, математическое, инженерное, финансовое образование).

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## *Спонсоры, партнеры*



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Модель Mastercycler nexus X2

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- Спектральный диапазон, нм – 200 – 830;  
• источник излучения – ксеноновая лампа;  
• дискретность, нм – 1;  
• ширина спектральной щели, нм – не более 4

### **Методы**

- > Определение концентрации нуклеиновых кислот
- > Определение содержания белков
- > ОП 600
- > Линейная/нелинейная графическая интерполяция
- > Проверка качества проб, сканирование(1 или несколько длин волн)
- > Выбор длины волны
- > Спецметоды молекулярной биологии
- > Расширенный/комплексный анализ кривых

### **Преимущества**

- > запись спектра длин волн
- > измерение экстинкции при одной или нескольких длинах волн
- > наличие справки для описания и объяснения последовательности шагов
- > наличие встроенных программ обработки результатов:
  - факторный анализ
  - анализ серий
  - двух волновой метод анализа вычитанием и разделением
- > измерение концентраций веществ, посредством метода стандартных серий (включая линейную, нелинейную регрессии и линейную интерполяцию)

Продукцию компании Eppendorf Вы можете приобрести у официального дистрибутера – фирмы ТОО Научно-производственная фирма «VELD».

### **Контакты ТОО НПФ VELD:**

050004, Республика Казахстан,  
г. Алматы, ул. Сейфуллина, 410  
тел 8-727-2952270, 952269  
E-mail: info@veld.kz

## *Спонсоры, партнеры*



**ТОО «Юмгискор Холдинг»**  
 010000, г. Астана, ул. Сары-Арка 15,  
 БЦ «Іскер», 14 этаж  
**Тел/факс:** 8 /7172/ 901 389, 901 289  
[info@yumgiskor.kz](mailto:info@yumgiskor.kz)

Юмгискор Холдинг – компания, стабильно работающая и динамично развивающаяся на рынке лабораторного оборудования Республики Казахстан.

Начиная свою деятельность с 2006 года, компания фокусировалась на представлении принципиально новых решений в оборудовании и расходных материалах для обеспечения задач клинических лабораторий. За 8 лет работы компания завоевала доверие более чем 350 клиентов на медицинском рынке с помощью своих партнеров из списка мировых лидеров-производителей медицинского лабораторного оборудования (BeckmanCoulter – США, OlympusCorporation – Япония, Randox – Великобритания, NihonKoden – Япония, Masimo – США и многие другие).

С 2012 года компания активно начала развивать линейку научного оборудования как с помощью существующих партнеров – BeckmanCoulter, Randox, Olympus, так и с привлечением новых партнеров – Bio-Rad, Jeol, Jeitech, Systec, Slee, Esco. За период менее, чем полтора года, к началу 2014 года компания заслужила доверие и обеспечила поставку оборудования таких крупнейших научно-исследовательских учреждений, как АО «Назарбаев Университет», Национальный Центр Биотехнологии, Евразийский Национальный университет им. Гумилева, Казахский Агротехнический университет им. С.Сейфуллина, НИИ Биологии и биотехнологии растений, Казахский Национальный университет им. Аль-Фараби, Медицинский Университет Астана и многих других.

В своей линейке научного оборудования компания стремится учитывать пожелания клиента от узкоспециализированных задач до комплексного оснащения научно-исследовательских лабораторий. Неотъемлемым преимуществом компании является также наличие собственного сервис-центра в г. Астана с возможностью выезда инженеров по всему Казахстану.

### **Список партнеров и продукции в научном направлении**

<p><b>ГЕРМАНИЯ</b></p>	<ul style="list-style-type: none"> <li>- вертикальные автоклавы</li> <li>- горизонтальные настольные автоклавы</li> <li>- горизонтальные напольные автоклавы</li> <li>- проходные автоклавы</li> <li>- средоварки</li> <li>- устройства для разливки сред в чашечки Петри</li> </ul>
<p><b>ЮЖНАЯ КОРЕЯ</b></p>	<ul style="list-style-type: none"> <li>- водяные бани и циркуляторы</li> <li>- осушители/сухожаровые шкафы</li> <li>- вытяжные шкафы</li> <li>- лабораторная мебель</li> <li>- инкубаторы</li> <li>- печи</li> <li>- насосы</li> <li>- циркуляционные охладители</li> <li>- лабораторные холодильники и морозилки</li> <li>- шейкеры</li> <li>- нагреватели</li> </ul>

## Спонсоры, партнеры

	<ul style="list-style-type: none"> <li>- мешалки/мешалки с подогревом</li> <li>- вортекс-миксеры</li> <li>- температурные камеры</li> <li>- климатические камеры</li> </ul>
 <b>ДАНИЯ</b>	<ul style="list-style-type: none"> <li>- одноканальные пипетки</li> <li>- многоканальные пипетки</li> <li>- электронные пипетки</li> <li>- стеклеры</li> <li>- дозаторы-пипетторы</li> <li>- авторазливочные станции</li> <li>- вощеры для микропланшет</li> </ul>
 <b>ИТАЛИЯ</b>	<ul style="list-style-type: none"> <li>- боксы биологической безопасности</li> <li>- боксы для работы с токсичными материалами</li> <li>- ламинарные шкафы</li> <li>- вытяжные шкафы</li> <li>- реагенты для культур клеток</li> <li>- оборудование и реагенты для ПЦР (наука)</li> <li>- СО2 инкубаторы</li> <li>- настольные шейкеры</li> <li>- термомиксеры</li> <li>- холодильные установки</li> <li>- водяные бани</li> </ul> <p>Реагентика:</p> <ul style="list-style-type: none"> <li>- агро-пищевая промышленность</li> <li>- цитогенетика</li> <li>- оборудование для выделения ДНК/РНК</li> <li>- ветеринарная диагностика</li> </ul>
 <b>США</b>	<ul style="list-style-type: none"> <li>- ДНК амплификаторы/ПЦР реал-тайм</li> <li>- проточная цитометрия (сортер)</li> <li>- системы электрофореза и блоттинга</li> <li>- системы визуализации</li> <li>- счетчики клеток</li> <li>- хроматография</li> <li>- анализ взаимодействия протеинов</li> <li>- научная реагентика</li> </ul>
 <b>ЯПОНИЯ</b>	<ul style="list-style-type: none"> <li>- сканирующие электронные микроскопы</li> <li>- трансмиссионные электронные микроскопы</li> <li>- масс-спектрометры</li> </ul>
 <b>США</b>	<ul style="list-style-type: none"> <li>- масс-спектрометрия</li> <li>- инфра-красная спектрометрия</li> <li>- рентгеновская дифракция и элементный анализ</li> <li>- магнитный резонанс</li> <li>- атомно-силовая микроскопия</li> </ul>
 <b>ФРАНЦИЯ</b>	<p>Оборудование для микробиологии:</p> <ul style="list-style-type: none"> <li>- стерильные мешочки для образцов</li> <li>- гравиметрические системы заливки</li> <li>- блендеры/гомогенизаторы</li> <li>- системы автоматического разбавления</li> <li>- системы разливки препарата в чашечки Петри</li> </ul>

## *Спонсоры, партнеры*

	<ul style="list-style-type: none"> <li>- счетчики колоний</li> </ul>
 <b>ESCO</b> <small>WORLD CLASS. WORLDWIDE.</small>  <b>СИНГАПУР</b>	<ul style="list-style-type: none"> <li>- Боксы безопасности 1-2-3 класса</li> <li>- Ламинарные шкафы</li> <li>- CO2 инкубаторы</li> </ul>
 <b>BIOHIT HealthCare</b> <small>Innovating for Health</small>  <b>ФИНЛЯНДИЯ</b>	<p>Диагностические наборы:</p> <ul style="list-style-type: none"> <li>- гастропанель для крининга рака ЖКТ (Pepsinogen I ELISA, Pepsinogen II ELISA, Gastrin 17 ELISA, Helicobacter pylori IgG)</li> </ul>
  <b>США</b>	<ul style="list-style-type: none"> <li>- проточная цитометрия (проточные цитофлуориметры/сортеры клеток)</li> <li>- центрифуги (от микро до ультра)</li> <li>- спектрофотометры</li> <li>- анализаторы (биохимия/иммунохимия/гематология)</li> <li>- автоматические станции разлива</li> <li>- счетчики клеток</li> <li>- научная реагентика</li> </ul>
  <b>ЯПОНИЯ</b>	<ul style="list-style-type: none"> <li>- исследовательские прямые микроскопы</li> <li>- исследовательские инвертированные микроскопы</li> <li>- исследовательские стерео-микроскопы</li> <li>- лазерные конфокальные сканирующие микроскопы</li> <li>- сканирующие системы виртуальных слайдов</li> <li>- микроскопы для материаловедения</li> </ul>
 <b>ГЕРМАНИЯ</b>	<ul style="list-style-type: none"> <li>- микротомы</li> <li>- криостаты</li> <li>- станции заливки парафином</li> <li>- автоматические станции окрашивания</li> </ul>

## Спонсоры, партнеры



## Готовые решения для Вашей лаборатории

### Что мы делаем

Компания "Zalma LTD" (Цалма Лтд.) - это внедрение передовых лабораторных технологий, подготовка и реализация системных решений для генетических лабораторий:

- комплексно оснащаем лаборатории сложным специализированным и общелабораторным оборудованием, лабораторной мебелью, посудой, аксессуарами и расходными материалами;
- оказываем методическую и сервисную, гарантийную и послегарантийную поддержку;
- обучаем персонал лаборатории, как на базе заказчика, так и на базе производителя оборудования;
- регулярно проводим семинары и профильные тренинги, предоставляем информационную поддержку;
- предоставляем помощь в проведении проектирования;

Сотрудники нашего сервисного и технического отдела проходят регулярное обучение на тренингах компаний-производителей; и готовы оказать помощь и содействие при возникающих вопросах и трудностях.

### Наши партнеры

Наши основные поставщики Life Technologies Corporation (Applied Biosystems, Invitrogen, Molecular probes) ведущие зарубежные производители лабораторного молекулярно-генетического оборудования и материалов.



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## КОНТАКТЫ

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## ФЛУОРЕСЦЕНТНАЯ МИКРОСКОПИЯ

### Системы EVOS для визуализации клеток



**Совмещение всех аспектов цифровых инвертированных флуоресцентных микроскопов** без потери функций и эффективности анализа (рутинный и высокоспециализированный анализ от клеточных культур до комплексного белкового анализа и мультифлуоресценции);

**Hard-coated фильтры** позволяют получать изображения высокого разрешения, даже от слабо флуоресцирующих объектов;

**Новая конфигурация Light Cube** (включает источник флуоресценции LED и фильтры на выбор) сокращает путь света, обеспечивая лучшую детекцию флуоресцентного сигнала;

**Стоимость систем EVOS® существенно ниже стоимости аналоговых по функциональности флуоресцентных микроскопов**, что обусловлено несопоставимой долгосрочностью службы источника флуоресценции LED, а также оптимальной комплектацией объективов и фильтров для работы;

**Простота в использовании и комплексное программное обеспечение** для анализа и автоматизации процесса (фокусировка, запоминание расположения образца, смена объективов, переход между фильтрами и др.).

#### Сравнение систем EVOS и флуоресцентных микроскопов

ПАРАМЕТР	ФЛУОРЕСЦЕНТНЫЕ СИСТЕМЫ EVOS®	ФЛУОРЕСЦЕНТНЫЕ МИКРОСКОПЫ
Источник флюоресценции	Запатентованный высокоеффективный экологически безопасный светодиод LED (срок службы свыше 50000 часов, около 17 лет)	Ртутная лампа (срок службы около 300 часов), галогеновый осветитель (срок службы около 1500 часов)
Контроль срока службы источника флюоресценции и соблюдение режимов нагрев/охлаждение	Не требуется	Требуется
«Темная комната» для работы	Не требуется	Требуется
Фотобледки	Регулируемая интенсивность LED минимизирует фотобледки. Избыток красителя не вызывает проблем	Фотобледки – типичная проблема, возникающая в случае добавления флуоресцентного красителя в избытке
Комплектация	Оптимальный набор объективов или набор объективов по выбору пользователя	В 85 % исследований используется только 20x объектив! Количество объективов определяет высокую стоимость флуоресцентного микроскопа
Анализ изображения	Возможность проведения сравнительного количественного анализа изображений (в том числе полученных в разные дни) без сложной калибровки, необходимой для микроскопов с ртутными лампами	Не возможен

АФ ТОО "Zalma Ltd." (Цалма Лтд.)  
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**Фылыми – Өндірістік фирмасы «Медилэнд»  
Научно – производственная фирма «Медилэнд»**

*Юридический адрес: 050061, г. Алматы, ул. Ташкентская 417А;*

*Почтовый адрес: 050061, г. Алматы, пр. Райымбека 417А*

*Тел.: 8 (727) 222-00-55 (многоканальный);*

*Факс: 8 (727) 222-00-56;*

*E-mail: mail@mediland.kz*

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ТОО «НПФ Медилэнд» является частной казахстанской компанией с дислокацией в г. Алматы. Компания организована в 1993 году и имеет специализацию в области поставок сложной медицинской и лабораторной техники, а также расходных материалов для приборов клинической и функциональной диагностики и последующее их сервисное обслуживание.

Являясь официальным дистрибутором на территории Казахстана таких ведущих мировых производителей, как «Sigma» (Германия), «Systec» (Германия), «Memmert» (Германия), «Heidolph» (Германия), «GFL» (Германия), «Brand» (Германия), «Kern» (Германия), «Bandelin» (Германия), «Siemens» (Германия), «Nabertherm» (Германия), «Martin Christ» (Германия), «Sartorius» (Германия), «Arctiko» (Дания), «Kojaire» (Финляндия), и многих других, мы занимаемся поставкой в РК медицинского и лабораторного оборудования для оснащения медицинских и научных лабораторий, расходных лабораторных материалов и хим. реагентов. Все специалисты компании регулярно проходят обучение и повышают свою квалификацию на заводах компаний-производителей и имеют соответствующие сертификаты.

Мы имеем постоянно действующий склад расходных материалов и реагентов для предлагаемого нами лабораторного оборудования. С 1996 г. наша компания успешно участвует в тендерах по закупке медицинского, лабораторного оборудования и расходных материалов. Мы обеспечиваем бесплатное сервисное обслуживание в пределах гарантийного срока и последующее постгарантийное обслуживание на поставленное нами оборудование, обучение специалистов организаций-заказчиков методикам работы на приборах и консультационную поддержку по поставляемому нами оборудованию в различных областях применения. Кроме того, нами создана разветвленная сеть дилеров по всему Казахстану, своевременно реализующих поставляемую нами продукцию. В настоящее время штат компании составляет более 70 сотрудников, из них 3 кандидаты биологических наук, 10 магистров, 5 специалистов по продукции, имеющих медицинское, фармацевтическое, биологическое, химическое высшее образование, 9 сервис-инженеров. С 2000 года объем продаж вырос в 8 раз и составил в 2007 году более 1,7 миллиарда тенге.

## **Спонсоры, партнеры**

В числе наших клиентов крупнейшие медицинские и научные центры Республики: Медицинский Центр Управления делами Президента РК, Научный центр хирургии им. А. Н. Сызганова, НИИ Урологии им. Джарбусынова, НИИ Кардиологии и внутренних болезней, Центральный военный клинический госпиталь, Научный Центр Акушерства, Гинекологии и Перинатологии, Республиканский НИИ Проблем Туберкулеза, НИИ Кожно-венерологических заболеваний, Институт глазных болезней, Институт Молекулярной Биологии и Биохимии АН-МН РК, Институт Общей Генетики и Цитологии РК, Республиканская СЭС, Республиканский Центр СПИД, Республиканский Центр Крови, Научный Центр Противоинфекционных препаратов, Научный Центр Педиатрии и Детской Хирургии, НИИ Травматологии и Ортопедии и многие другие. Нами оснащены лаборатории Областного Диагностического Центра в г.Павлодаре, лаборатории строящихся объектов Медицинского Кластера в г.Астана. В текущем году мы завершили проекты оснащения «под ключ» бактериологической лаборатории Медицинского Центра Управления делами Президента РК и лаборатории Научного Центра Животноводства и Ветеринарии.

В качестве консультанта ТОО «НПФ Медилэнд» привлекалось к разработке государственной Программы «Здоровье народа», участвует в техническом обеспечении программ «Предупреждение заболеваний, передаваемых половым путем» и «Туберкулез».

Мы видим своей целью внедрение инновационных технологий в области медицины и исследовательского оборудования, предоставляя в распоряжение наших клиентов последние технические разработки наряду с приборами, уже зарекомендовавшими себя и проверенными обширной практикой пользователей. Учитывая все возрастающий интерес и большое прогрессивное значение исследований стволовых клеток и пуповинной крови, мы представляем полное аппаратное обеспечение для работы лабораторий на этапах получения пробы, выделения, типирования и стандартизации образцов в соответствии с международными требованиями, а также их долгосрочного хранения.

Мы осуществляем консультирование нашего клиента от этапа выбора оборудования с максимальным учетом его целей, задач и запросов, до послепродажной информационной поддержки в виде:

- организации и проведения учебных семинаров и научно-практических конференций;
- поддержке участия пользователей, в международных программах фирм-производителей предлагаемого нами оборудования;
- оказания консультативно-методической и практической помощи пользователям оборудования;
- регулярного информирования о новинках в методиках, технологиях и оборудовании для проведения учеными научно-исследовательских работ.

И во время и после истечения гарантийного срока эксплуатации предлагаемых нами приборов сертифицированные специалисты нашей сервисной службы сделают всё возможное для того, чтобы наши заказчики могли работать на поставленном нами оборудовании с максимальной эффективностью.

Нашей сервисной службой осуществляются консультации по телефону или оперативный выезд специалиста для срочного выявления и устранения неисправности приборов, а также гарантийное и послегарантийное обслуживание поставленного нами оборудования по договору с заказчиком.

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