

IHC2018-Symposium 15

Ornamental Horticulture: Colour Your World

ORAL PRESENTATIONS

SESSION I: Plant Physiology, Propagation and Production

OS 1-1:

EFFECT OF PLANT GROWTH REGULATORS ON FLOWER DEVELOPMENT AND QUALITY OF FIVE *Cyclamen persicum* HYBRIDS

Mostafa Qrunfleh^{1*}, Zuha Alshakhaly²

¹Department of Horticulture Plant Protection, Faculty of Agriculture, The University of Jordan, Amman, Jordan

²The University of Jordan, Amman, Jordan

*mostafaq@ju.edu.jo

A two year experiment on five F-1 hybrids of *Cyclamen persicum* Mill., grown in pots, were performed to study effect of foliar sprays of several bioregulators on flower development when most of flower scapes were about 1 to 2 cm long. Results of the first year showed that Gibberellic Acid (GA₃) (25, 2x25, 50, 2x50, and 100 ppm) and Promalin (0.75, 1.0, and 1.25 ml/L) significantly hastened flower development and increased peduncles length over the control. In addition, GA₃ (2x50m, 50, 2x50, and 100 ppm) brought excessive elongation of peduncles; and the low concentrations of Promalin (0.25 and 0.5 ml/L) were ineffective in hastening flower development. Moreover, Benzyladenine (BA) (25, 50, 2x50, and 100 ppm) was ineffective in hastening flower development and in increasing peduncles length, while Ethrel (0.4, 1.0, 1.5, 2.0, and 2.5 ml/L) delayed flower development, deformed flowers, and enhanced leaf senescence. In the second year, GA₃ (5, 10, 25, and 50 ppm; and Promalin (1.5, 2.0, and 3.0 ml/L) significantly hastened flower development, increased peduncles length, and increased number of flowers to open at bloom. In addition, Promalin (0.5 ml/L) significantly hastened flower development but was ineffective in bringing long peduncles and in increasing number of flowers to open at bloom.

Keywords: cyclamen, GA₃, promalin, benzyladenine, ethrel

OS 1-2:

VEGETATIVE PROPAGATION OF *Echeveria gibbiflora* var. Helena, THROUGH THE GENERATION OF VEGETATIVE SHOOTS IN FLORAL STEMS

Edith Salomé-Castañeda*, Nicolás Alvarez-Acevedo

21 Sur 1103, Colonia Santiago, Puebla, 72410, Mexico

*edith_salom@yahoo.com.mx

The *Echeveria* genus offers a great diversity of shapes, sizes and colors in its leaves and flowers, which gives it desirable aesthetic characteristics in ornamental horticulture. In addition, this genus offers agronomic characteristics which favor its production, such as adaptation to environments with little water availability and efficiency in the use of it, as well as ease of propagation. There are several methods of vegetative propagation applicable to this genus, for example, propagation in vitro, production of plants through leaf or shoots production in the floral stem of the plant. It has been observed that in some species, the pruning of the floral stem before the blooming of the flowers, favors the generation of shoots that can be used to rapidly multiply plants of commercial interest. The objective of the present study was to analyze the production of shoots from flower stems, in *Echeveria gibbiflora* var. Helena. Cultivar that includes plants of big size, its rosette reaches 50 cm in diameter and its floral stems can measure more than 1.5 meters in height (under cultivation). Four treatments were established and evaluated. The pruning of the flower stems was evaluated and the effect of the pruning of rosette leaves and the pruning of the bracts of the floral stem in the production of shoots were analyzed. In the results it was observed that keeping the leaves of the rosette while removing the bracts in the flower stem, favors the production of a greater number of shoots.

Keywords: vegetative propagation, Crassulaceae, vegetative shoots, floral stem



OS 1-3:

EFFECTS OF LIGHT QUALITIES ON GROWTH, DEVELOPMENT AND PHOTOSYNTHETIC CAPACITY OF PETUNIA (*Petunia* spp.)

Sasan Aliniaiefard^{1*}, Amir Arjmandi², Mehdi Seif², Tao Li³, Oksana Lastochkina⁴

¹Department of Horticulture, College of Aburaihan, University of Tehran, Imam Reza Blvd., 3391653755 Pakdasht, Tehran, Iran

²University of Tehran, Tehran, Iran

³Chinese Academy of Agricultural Science, Beijing, China

⁴Bashkir Scientific Research Institute, Ufa, Russian Federation

*aliniaiefard@ut.ac.ir

Light quality is an important factor for plant growth and development. Using different colors of light is becoming popular in the green spaces of the cities. However, it is still not clear how light spectrum influence growth, development and physiology of plants in green spaces. In this study, the effect of different light spectra, including white (400-700nm), blue (430-470 nm), red (635-665 nm) and a combination of red and blue (R:B =70:30) lights were used for growing petunia (*Petunia* spp.) plants. Red light significantly increased number of flowers, flower diameter, shoot fresh weight, leaf thickness, water content and root dry weight. However, root fresh and dry weight was significantly increased by blue light. Combination of red and blue light caused significant increase in maximum quantum yield of photosystem II (Fv/Fm) and performance index per absorbed light (PIABS), in comparison with other light treatments. The lowest values for Fv/Fm and PIABS were observed in monochromatic red and blue lights. In concluded, although red light negatively influenced photosynthetic electron transport system, it had a positive effect on petunia vegetative and reproductive characteristics.

Keywords: light spectrum, electron transport chain, petunia, ornamental plants

OS 1-4:

VEGETATIVE PROPAGATION METHODS FOR CROCUS SPECIES AT WESTERN ANATOLIA

Gülden Haspolat^{1*}, Mustafa Ercan Özzambak²

¹Aegean Agricultural Research Institute PK9, 35661 Menemen, İzmir

²Aegean University, Faculty of Agriculture, Department of Horticulture, Bornova, İzmir

*gulden.haspolat@tarim.gov.tr

Crocus is the genus which has the richest taxa among the geophytes in Turkey flora. Vegetative propagation studies were carried out on some Crocus taxa spreading at western Anatolia such as *Crocus olivieri* ssp. balansae, *Crocus chrysanthus*, *Crocus baytopiorum*, *Crocus pallasii* ssp. pallasii. The taxa were picked up around the regions where they spread and their species were identified. The methods of vegetative propagation such as basal cut (BC), cutting corm from top to middle (CTM) and cutting corm from bottom to middle (CBM) had been applied to the dormant corms of the taxa. The effects of these methods on young corms and mother corms were studied for two years. After the treatments the rate of consisting mother corms and young corms, their diameters and weight, flowering rate of plants, loss rate of corms and the number of corms per plant were determined. For the first year the number of corms per plant were had the highest value (1.53) at *C. olivieri* ssp. balansae using both treatments of BC and CTM. For the second year the highest value 4.38 corm/plant for *C. pallasii* ssp. pallasii at the treatment of CTM. For *C. chrysanthus* the number of corms per plant was observed at the treatment of CTM and the value was 2.1 corm/plant. At *C. baytopiorum* 1.6 corm/plant in control group and in all vegetative propagation methods at *C. olivieri* ssp. balansae had the same value was 1.5 corm/plant. Vegetative bulb propagation methods were used for the first time on some Crocus taxa and the respond was positive. The best treatments were cutting from top to middle and basal cut.

Keywords: *Crocus* sp., geophyte, propagation, endemic



OS 1-5:

QUANTIFICATION OF THE EFFECT OF CUT-ROSE CANOPY ARCHITECTURE ON MICROCLIMATE

Leo F. M. Marcelis¹, **Arian van Westreenen^{2*}**, Ningyi Zhang², Jochem B. Ever², Niels P. R. Anten²

¹Wageningen University, Horticulture & Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands

²Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands

*arian.vanwestreenen@wur.nl

In greenhouses, overall greenhouse climate is usually optimized for high yields. However, the microclimate can show strong gradients from top to bottom of the canopy, which can have a big effect on plant growth and disease development. This sensitivity of microclimate to canopy position implies that any variation in canopy architecture strongly alters the microclimate. Therefore, in this study we quantified the effect of canopy architecture on the microclimate in cut-roses. In a cut-rose greenhouse experiment (Wageningen, NL) different stem densities were realized. These different stem densities resulted in quite distinct canopy architectures. E.g. the dense canopy had much thinner and shorter stems. Furthermore, leaf area per stem was smaller. To quantify the microclimate in these different densities, we measured (net) radiation, (leaf) temperature, relative humidity (RH) and air movement at several places in the greenhouse and the canopy with a measurement interval of 1s. The results show that the microclimate is influenced by canopy architecture. In this talk, we will present the relations between greenhouse climate and the microclimate and how this is influenced by canopy architecture. Furthermore, we will show the relevance of taking into account the differences between different climates inside the greenhouse for plant development.

Keywords: canopy climate; cut-roses; crop architecture; greenhouse climate

OS 1-6:

PROPAGATION OF SACRED LOTUS (*Nelumbo nucifera* Gaertn.) BY STOLON CUTTING WITH ACTIVE BUD AND DIFFERENT NODE NUMBER

Panupon Hongpakdee^{1*}, Cattleya Samranyat², SORAYA Ruamrungsri³

¹Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002, Thailand

²Department of Plant Science Agricultural Resources, Faculty of Agriculture, Khon Kaen University, 123 Mitrapap Rd, Ni Muang District, Khon Kaen 40002, Thailand

³Department of Plant and Soil Science, Faculty of Agriculture, Chiang Mai University, Chiangmai 52000, Thailand

*panupon@kku.ac.th

Sacred lotus is one of valuable economic cut flower in Thailand and Asian countries. The grower usually propagated by cutting stolon segment, since this technique allowed the cloning to supply uniform planting stock. They however consider that only longer stolon cutting with many nodes and active buds would suitable as material. To clarify this vegetative propagation technique, the study of nodes number in propagated stolon affected on plant growth and flowering in 'Sattrabutra' *Sacred lotus* was conducted in completely randomized design experiment with 3 stolon cutting type as treatments: stolon cutting with 1, 2 and 3 nodes, respectively. All active stolons were planted in each 1.20m diameter and 1.0m height of circular concrete pot, filled with 1/3 clay soil and 2/3 tap water of pot height level under the natural condition (May to August, 2016). It was found that increase node number in stolon cutting material gave the parallel increase in total leaves number of early 6 weeks after planting (WAP). None of propagated stolon cutting treatment affected total leaf area, new internode length, flower stalk length and flower length at 3 months after planting. Nevertheless, planting sacred lotus with single node stolon cutting gave the lowest new stolon length, flower number, percentage of flowering and delay more 2-3 weeks of flowering. Triple nodes of propagated stolon cutting gave the best result in plant dry weight components (flower, pod, new stolon and fibrous root).

Keywords: vegetative propagation, flowering lotus, rhizome straps, stem cutting



KEYNOTE 1

LED APPLICATIONS IN GREENHOUSE AND INDOOR PRODUCTION OF SPECIALTY CROPS

Erik Runkle*, Qingwu Meng, Yujin Park

1066 Bogue Street, Michigan State University, East Lansing, MI 48824, United States of America *runkleer@msu.edu

Arrays of light-emitting diodes (LEDs) are increasingly being used in controlled environments to deliver supplemental, photoperiodic, and sole-source lighting to horticultural crops. Compared to conventional light fixtures such as high-pressure sodium or fluorescent lamps, LEDs emitting different bands of radiation can be combined to create light spectra that elicit specific plant responses, such as regulation of extension growth and flowering. LED applications in horticulture can be divided into three major categories: 1) low-intensity lighting to regulate photoperiodic and photomorphogenic responses; 2) supplemental (photosynthetic) lighting in greenhouses to increase growth and yields; and 3) sole-source lighting to consistently produce crops indoors, conceivably with value-added attributes. Potential advantages of LED lighting include greater efficacy at converting electricity into photosynthetic photons; selection and manipulation of the light spectrum to elicit specific plant responses; less emission of radiant heat; more focused lighting, resulting in less loss to non-target areas; instant on/off and dimming capabilities; and greater longevity. The primary barrier to commercial implementation of LED lighting in horticulture continues to be return on investment, which is situational. This paper presents a science-based, practical summary of LED applications in the production of specialty crops grown in controlled environments, especially on vegetable and floriculture crops.

Keywords: controlled environments; flowering; light-emitting diodes; lighting; plant growth

OS 1-7:

PROPAGATION OF *Begonia scapigera* Hook. f OUTSIDE ITS NATURAL HABITAT IN THE RAINFOREST ZONE OF NIGERIA

Olufunmilayo Adesin^{1*}, Julius Fagbayide²

¹4 Cheif Adele Close Off Uyo Street , Extension Rumuomasi, Rivers Port Harcourt, Nigeria

²Department of Agronomy, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria

*yemifunmiadesina@yahoo.co.uk

Begonia scapigera Hook. f, one of the endangered species of the family Begoniaceae was propagated under two simulated environments outside its natural habitat. The experiment was conducted at the nursery unit of the Department of forest Resources Management, University of Ibadan, Nigeria. A total of 70 plants comprising of 30 seedlings and 40 adult rhizomes and leaves were randomly collected from rock surface at Erin-Ijesa site in May 2013. Five propagule types viz; rhizome with and without leaf petioles, seedlings, whole leaf and leaves cut into wedges with portion of main veins were planted in 3 types of soils. The soils used were loamy sand collected around the mountain base at Erin-Ijesa; sandy loam soil from the Teaching and Research farm, University of Ibadan and washed river sand. A 2 x 3 x 5 factorial experiment laid out in a completely randomized design replicated 3 times was setup giving 15 treatments combinations. It was duplicated to accommodate planting inside and outside the humidity chamber. Data collected were Time of sprout Emergence (TSE), number of leaves (NL), leaf area (LA) and rhizome length (RL) and were subjected to ANOVA at $p \leq 0.05$. Propagules established inside the humidity chamber sprouted earlier and performed significantly better in NL, LA and RL. Propagules established inside the chamber had 95.6% sprouting while only 37.8% of those established outside the chamber were able to sprout. *B. scapigera* will perform better under a cool, humid environment with bright but indirect light.

Keywords: *Begonia scapigera*, endangered species, propagule types, environment



OS 1-8:

EFFECT OF LEAF SIZE AND IBA ON ROOTING AND ROOT QUALITY OF JAPANESE PRIVET, ROCK COTONEASTER AND ORNAMENTAL POMEGRANATE MINI CUTTINGS

Hüseyin Çelik¹, Şeyda Çakır¹, Damla Çelik¹, **Bahadır Altun**^{2*}

¹Ondokuz Mayıs University, Faculty of Agriculture, Horticulture Department, 55000 55 Samsun, Turkey

²Ahi Evran University, Faculty of Agriculture, Horticulture Department, 40100 40 Kirsehir, Turkey

*bahaltun@gmail.com

This study was conducted to investigate the effect of leaf size (half and full leaf) and indole-3-butyric acid (IBA) (0, 500, 1000 and 2000 ppm) doses on rooting and root quality of privet (*Ligustrum japonicum* L.), rock cotoneaster (*Cotoneaster horizontalis* var. *perpusillus*) and ornamental pomegranate (*Punica granatum* L. "Nana") leafy mini cuttings taken from the first half of July. Experiments were designed as 3 repetitions according to the random blocks design separately for each species and 15 cuttings were used in each replication. The mini cuttings were planted in foamy cell trays (3x3x5 cm) filled with sterile peat moss and placed on rooting benches with bottom heating (22°C) in a glasshouse with 60% shading and misting. For Japanese privet, full leafy mini cuttings with 500, 1000 and 2000 ppm IBA gave the highest rooting rate (93.33%) while full leaf and 1000 ppm IBA for ornamental pomegranate (97.78%) and 0 and 2000 ppm IBA for rock cotoneaster (66.67%) has the highest rooting rate. However, the highest rooting degree calculated over 1-9 scale observed as 3.38, 4.63 and 7.00 of Japanese privet mini cuttings (full leaf with 2000 ppm IBA), ornamental pomegranate mini cuttings (half leaf with 2000 ppm IBA) and rock cotoneaster mini cuttings (half leaf with 0 ppm IBA), respectively.

Keywords: *Ligustrum japonicum*, *Punica granatum*, *Cotoneaster horizontalis*, leaf size, IBA, rooting

OS 1-9:

PLANT-MICROBIAL INTERACTIONS AS A WAY OF INCREASING THE EFFICIENCY OF *Spiraea cantoniensis* Lour. GROWING IN AN INDUSTRIAL NURSERY

Yury Plugatar^{1*}, Nikolai Klimenko², Olga Klimenko²

¹Nikita Botanical Gardens-NSC, 298648 Yalta, Russian Federation

²Nikitsky Descent, 52, Nikita, 298648 Crimea Yalta, Russian Federation

*plugatar.y@mail.ru

Cultivation of seedlings and cuttings requires the application of high doses of mineral fertilizers. This often leads to environmental pollution. One of the ways to increase the efficiency of growing, provided that the environment is preserved and soil fertility is improved, is the use of microbial preparations (MP). MP are created on the basis of active strains of microorganisms possessing useful properties. They affect the plants in a complex way: improving nutrition through nitrogen fixation and phosphate mobilization, stimulating growth, protecting against pathogens. The use of such preparations in ornamental nursery is limited. Our study included MP: Phosphoenterine (PMB) – *Enterobacter nimipressuralis*-32-3, phosphate mobilizer, growth stimulator; Azotobacterine (AB) – (*Azotobacter chroococcum* 10702) –nitrogen fixator, bioprotector, growth stimulator; Complex of microbial preparations (CMP), a mixture of AB+PMB+Biopoliticide (*Bacillus polymyxa* P) – antagonist of pathogenic microbiota, phosphate mobilizer in lignified cuttings *S. cantoniensis*. A three-year study showed that their use increased the survival of lignified cuttings, improved their growth, promoted the formation of lateral shoots, increased the output of standard seedlings by 46%. The low rhizogenesis of cuttings of *S. cantoniensis* during cultivation in an open ground nursery is caused by a lack of atmospheric moisture in April. The use of AB during of *S. cantoniensis* cuttings growing in the nursery led to increasing in the content of N-NO₃ and mobile K₂O in the soil, N and K₂O in leaves, but decreased the content of mobile P₂O₅ and humus in the soil, as well as the total P₂O₅ in the leaves. The use of AB for the cultivation of biennial cuttings of *S. cantoniensis* with the introduction of starting phosphorus doses (P20-30) during the planting, the maintenance of optimum soil moisture in April-May, as well as the introduction of organic matter in the steamed field for better bacterial development and an increase in humus content.

Keywords: Ornamental nursery, microbial preparations, planting, soil properties



OS 1-10:

THE EFFECTS OF PLANTING TIME AND BULB SIZE ON QUANTITATIVE PROPERTIES OF *Narcissus tazetta*

Ömer Sari^{1*}, Fisun Çelikel²

¹Agricultural Research Institute, of the Black Sea, Samsun, Turkey

²Ondokuz Mayıs University, Faculty of Agriculture, Department of Horticulture, Atakum, Samsun, Turkey

*omer.sari@tarim.gov.tr

The effects of planting time and bulb size on the quantitative characteristics of *Narcissus tazetta* flowers were investigated, which was probably one of the first study on quantitative analysis of bulbous flowers. *Narcissus tazetta* bulbs were removed from natural habitat in August, divided into three sizes (12.1-14 cm, 10.1-12 cm and 8.1-10 cm) according to the circumference and planted at 3 different times (September, October and November). Stem weight ratio, leaf weight ratio, leaf area ratio, specific leaf area, leaf thickness were determined as quantitative measurements. Leaf area was measured by planimeter. Dry weights of plant samples were determined and plant growth parameters were calculated according to the models adapted to the bulbous plants. According to the results, planting time significantly effected the leaf thickness, leaf weight ratio and stem weight ratio. The differences among the bulb sizes were not statistically significant on quantitative measurements. Planting time and bulb size did not affect the leaf area ratio and specific leaf area. The results showed that plant growth parameters can be used in modeling studies on bulbous flowers.

Keywords: *Narcissus tazetta*, quantitative analyses, bulb size, planting time

OS 1-11:

USING OF PHYTOMONITORING DATA FOR ECO-PHYSIOLOGICAL EVALUATION OF THE ENVIRONMENTAL FACTORS LIMITING DEVELOPMENT OF ORNAMENTAL PLANTS

Andrey Pashtetskiy*, Yury Plugatar, Oleg Ilitsky, Svetlana Korsakova

Nikita Botanical Gardens - NSC, Nikita, 298648 Yalta, Russian Federation

*pashteckiy@gmail.com

The aim of this study is the evaluation of the ecophysiological reaction of evergreen ornamental plants on progressive soil drought and estimation of the optimal and threshold values of environmental factors limiting growing of plants. Continuous automatic recording of CO₂/H₂O gas exchange of intact leaves, plant growth and water balance of young plants of *Nerium oleander* L., *Laurus nobilis* L. and *Aucuba japonica* variegata Thunb. was performed using PTM-48A Photosynthesis Monitor and PM-11z Phytomonitor. We found the genotypic characteristics of evergreen ornamental plants in supporting optimal water balance. Optimal light and temperature conditions were established for the intensive growth of *N.oleander*: leaf temperature from 23 to 36.5°C, light regime: full sunlight in the range Photosynthetically active radiation (PAR) 850-1600 µmol/(m²·s), and soil moisture 45-75% field capacity (FC). For *L.nobilis*: leaf temperature from 24 to 32°C, light regime: full sunlight, part-shade or shade in the range PAR 350-1650 µmol/(m²·s), when soil moisture 45-75% FC. For *A.japonica* variegata: leaf temperature from 15 to 26°C, light regime: part-shade or shade in the range 300-1250 µmol/(m²·s) (15-60% of full light,) when soil moisture 70-90% FC. With increasing levels of irradiance above 1300 µmol m⁻²s⁻¹, photoinhibition impairs light acclimation and can cause photodestruction of the photosynthetic apparatus of *A.japonica* variegata that must be considered in the cultivation of this species. One of the specific adaptation reaction for *N.oleander* to long-term extreme drought conditions in case of complex influence of water stress, high levels of irradiance and overheating accelerated senescence and defoliation not only in old, but also in young leaves, resulting in the loss of ornamental value. Those data may be effectively used both for plant research and for commercial crop growing. This study was funded by a research grant № 14-50-00079 of the Russian Science Foundation.

Keywords: *Nerium oleander* L., *Nerium oleander* L., *Laurus nobilis* L., *Aucuba japonica* variegata Thunb., water relations, photosynthesis, drought tolerance, environmental factors



OS 1-12:

RHIZOME CHARACTERISTIC AND ESSENTIAL OIL YIELD OF *Etlingera elatior* CLUMPS IN DIFFERENT ENVIRONMENTS

Paula G Pinheiro de Araujo¹, Ana Cecília Ribeiro de Castro², Vivian Loges¹, **Stella Aurea C Gomes da Silva**^{*}

¹Floriculture Laboratory, Agronomy Department, Federal Rural University of Pernambuco, Dom Manoel of Medeiros Avenue, 52171-900 Recife-Pernambuco, Brazil

²Embrapa Agroindústria Tropical, Cnpq, Dra Sara Mesquita Street, 2270, Planalto do Pici, 60511-100 Ceará - Fortaleza, Brazil

^{*}stella.agron@yahoo.com.br

Etlingera elatior, popularly known as torch ginger, is a multifunctional crop that has been used for culinary, medicinal, antibacterial agent and as ornamental plant for landscape and cut flower purpose. It is a herbaceous, perennial, rhizomatous plant and form large clumps. The rhizome is utilized for asexual propagation and from essential oil extracts. The aim of this study was to determine the rhizome characteristics of torch ginger clumps in two different field conditions. Seven *E. elatior* genotypes from the IAC collection were cultivated in Paulista-PE at the Forest Zone (07°56'73" S, 34°54'67" W, 100 m a.s.l., tropical climate, 24 – 28° average temperatures and 1897 mm average annual rainfall) and Pacajus-CE at Coastal with Semi-Arid Zone (4°11'07" S; 38°30'07" W an altitude of 70 m a.s.l., tropical climate, 26 - 28° average temperature and 1020 mm average annual rainfall). After 28 months of planting, the clumps were removed and photographed. Characteristics from the rhizome, ramets and oil yield rediment were analyses. Was possible observed the “Y” system of the rhizome distribution in the clumps cultivates in Paulista, nevertheless was not possible observe this in Pacajus thus the high number of rhizomes. The genotypes cultivated in Paulista presented differences only to the rhizomes diameter (DRi) and ramets length (CRa). In Pacajús, no differences were observed for the characteristics evaluated to the genotypes. Comparing the environments, all values were higher in Paulista, except to CRa for the genotype IAC 2. The genotypes IAC 3 and IAC 26 presented higher try biomass of rhizomes per clump (BSRiT) in both environments, and due to the higher content of essential oils in Pacajus (0.08 and 0.09%, respectively), these presented higher yield. It was possible to observe that the environments conditions interfere in the rhizomes characteristics of *E. elatior* clumps.

Keywords: ginger torch, genotypes, production

OS 1-13:

FLOWERING INHIBITION BY INTERMITTENT HIGH TEMPERATURE CONDITIONS IN *PHALAENOPSIS* ORCHIDS

Hyo Beom Lee^{*}, Seong Kwang An, Ki Sun Kim

Gwanak-ro 1, Gwanak-gu, 200-3104, CALS, Seoul National University, 08826 Seoul, Korea (Republic of)

^{*}hyobumi1003@snu.ac.kr

Phalaenopsis plants have a qualitative response in vernalization effect for flower induction, and temperature below 25°C is normally required to induce the flowering initiation of these plants. We hypothesized that 1) the spiking or subsequent development of flower-stalks can be inhibited by the insufficient period of vernalization temperature and 2) intermittent high temperature during vernalization inhibits the flower induction. We conducted a series of experiments to determine the required period of vernalization temperature for inducing the flowering initiation and to verify the flowering inhibition by intermittent high temperature in *Phalaenopsis* plants. Although the required period differed among cultivars, it was approximately six to eight weeks at 20°C for 100% spiking. Plants exposed to four weeks of this temperature also showed over 50% spiking, but further flower-stalk elongation was inhibited by the following high temperature conditions higher than 28°C. When one week of the intermittent high temperature treatment was delivered every one or two weeks of vernalization, the percentage of plants with visible inflorescence which is a flower-stalk longer than 0.5 cm decreased by the treatments. Also, flowering-induced plants under the intermittent temperature conditions showed the lower number of flower-stalks and longer days to visible inflorescence than flowering-induced plants under no intermittent temperature conditions. Especially, because these plants showed more new leaf numbers, it is assumed that the reproductive growth is inhibited by the intermittent high temperature. From these results, we could conclude that *Phalaenopsis* plants require the sufficient period of vernalization temperature for the flowering process, i.e. flower induction and flower-stalk development, and intermittent high temperature can



inhibit the flower induction in *Phalaenopsis* orchids. In addition, these results also suggest that an energy-saving strategy can be used to inhibit flowering by reducing heating requirement with intermittent high temperature.

Keywords: flower induction, intermittent high temperature, orchids, *Phalaenopsis*, vernalization, visible inflorescence

OS 1-14:

PERFORMANCE OF DIFFERENT DAFFODIL VARIETIES IN IZMIR ECOLOGICAL CONDITIONS

Ali Salman^{1*}, Emrah Zeybekoğlu², Şevket Alp³, Mustafa Ercan Özzambak²

¹Bayındır vocational high school, Ege University, Izmir, Turkey

²Department of Horticulture, Agriculture Faculty, Ege University, Izmir, Turkey

³Department of Landscape Architecture, Van Yüzüncü Yıl University, Van, Turkey

*salmanali51@hotmail.com

Commercial narcissus cultivation in Turkey is relied on with a double flowered variety of *Narcissus tazetta* L. ("Karaburun"), mostly in west and south regions, having Mediterranean climate. Large flowered varieties, which are commonly called daffodils and have been bred for cooler countries like Holland and England, are not widespread. There is just a small commercial cultivation with *Narcissus pseudonarcissus* L. varieties around İstanbul. The aim of this study was to investigate the performance of different daffodil group varieties in İzmir/Bayındır, where have a warm climate like most other narcissus cultivation areas in Turkey and involve new crops for these regions. The study was carried out in the farm of Bayındır Vocational High School of Ege University with 22 daffodil varieties. Sprouting time, blooming time, blooming period, flower stem length and diameter were some of the characters were investigated in the trial. Durations from planting to first sprouting and blooming were 16-37 and 70-96 days. Stem length changed in the range 20-47 cm. As a result it was determined that most of the varieties could performed their characters in this region.

Keywords: Narcissus, Anatolia, phenology, daffodil, adaptation

OS 1-15:

Sedum mexicanum 'Gold Mound' EXHIBIT BETTER ADAPTIVE CHARACTERS IN CONTRAST TO AND *S. spurium* 'Coccineum' WHEN SUBJUGATED TO SUSTAINED WATERLOGGING STRESS

Li Dong, Jie Zhang^{*}, Dejie Yin, Shuyin Fan, Xiaopeng Li, Fan Wu

Beijing Forestry University, 35 Qinghua Donglu, Haidian District, Beijing, China

*619871021@qq.com

Waterlogging is becoming a critical threat to plants growth and landscape visual effect. A comparative study was performed to investigate the morphological and physiological differences between *S. mexicanum* 'Gold Mound' and *S. spurium* 'Coccineum' plants in response to simulated waterlogging. The experimental design was completely randomized with two water conditions (control and waterlogging) combined with five evaluation times (0, 7, 14, 21 and 28-days waterlogging conditions). After 4 weeks of waterlogging, *S. mexicanum* 'Gold Mound' showed better response towards waterlogging in comparison to *S. spurium* 'Coccineum'. The stress induced wilting, leaf chlorosis and abscission in both cultivars, but symptoms were more apparent and occurred earlier in *S. spurium* 'Coccineum'. Although, both of two text accessions showed outgrowth of adventitious roots to assist waterlogging tolerance, the survival rate of *S. spurium* 'Coccineum' was just only 30% which was lower than that of *S. mexicanum* 'Gold Mound' (86%). Waterlogging affected negatively plant growth vigor, aboveground biomass and root biomass and significantly decreased the relative water content of leaves compared to controls and the reduction of them was less pronounced in *S. mexicanum* 'Gold Mound'. In addition, chlorophyll content, soluble protein and antioxidative enzyme activities were comparatively more salient in *S. mexicanum* 'Gold Mound' during this hypoxia treatment and *S. mexicanum* 'Gold Mound' showed a lower content of MDA throughout the duration of waterlogging. It was indicated that *S. mexicanum* 'Gold Mound' is relatively waterlogging-tolerant depend on a combination of morphological, physiological metabolic and biochemical adaptations.

Keywords: waterlogging, sedum, stress response, osmotic, regulation, antioxidant enzymes



OS 1-16:

IN VITRO MUTATIONS IN CHRYSANTHEMUM

Gülden Haspolat^{1*}, Ümran Şenel¹, Burak Kunter², Kadriye Yaprak Kantoğlu², Nüket Günçag², Mustafa Ercan Özzambak³

¹Aegean Agricultural Research Institute PK9, Aegean Agricultural Research Institute PK9, 35661 Menemen, İzmir, Turkey

²Turkish Atomic Energy Authority, SANAEM, Atom Caddesi No 27, Saray, 06983 Kazan Ankara, Turkey

³Aegean University, Faculty of Agriculture, Department of Horticulture, Bornova, izmir, Turkey

*gulden.haspolat@tarim.gov.tr

Mutation breeding is one of the most useful methods in ornamental plant breeding. Chrysanthemum is the genus that has the richest mutant varieties in ornamental plants. In this study white “Bacardi” variety was used. The objective of this study was creating variation by gamma irradiation and improving traits by mutation breeding. In order to determine Effective Mutation Dose (EMD-LD50), in vitro cuttings were irradiated with gamma (60Co) source at 7 different doses which are 0, 5, 10, 15, 20, 25 and 30 Gy (Gray). Each dose contained 150 buds in 30 young plants. After irradiation all plants were subcultured. At 60 days of regeneration shoot and root lengths were measured. The EMD was calculated by linear regression and founded 20 Gy comparing control shoot length to irradiated groups. For creating main population, 3000 in vitro plantlets were irradiated with EMD. In vitro subcultures were continued till M1V4 period. Some changes were observed at leaves and flowers of the plants. The following parameters were measured: variable flower diameter, flowering time, length of internodes, differentiation on ray and disc flowers’ width, plant length, chimeric leaves, chlorophyll changes on leaves, flower number per bunch, cluster flowering and petal differentiation. The changes of the petals were; pink color, pink strips, small formation, anatomic changes and several numbers (22-55) of the petals. Approximately 3% of useful mutant lines were selected from the population.

Keywords: chrysanthemum, in vitro mutation, effective mutation dose (EMD-LD50)

OS 1-17:

CHARACTERISTICS OF DIANTHUS CULTIVARS STARTING ANTHOCYANIN ACCUMULATION IN THE PETALS AFTER ANTHESIS

Hayato Morimoto^{*}, Kento Umakoshi, Hiroaki Sugihara, Takako Narumi-Kawasaki, Takejiro Takamura, Seiichi Fukai

Kagawa University, Faculty of Agriculture, Miki, Kagawa 761-0795, Japan

*morimoto1877@gmail.com

Many cyanic flowering plants start accumulating anthocyanin in the petals before anthesis, and a whole of petals are completely colored at anthesis. Some of Dianthus cultivars changes flower color from white to cyanic color after anthesis due to delayed accumulation of anthocyanins. Such phenomenon has been also observed in other plants. However, the mechanism of flower color change after anthesis in delayed-petal-coloring (DPC) Dianthus cultivars remains unclear. To elucidate the mechanism of the delay of petal coloration, we used two DPC Dianthus cultivars ‘Color Magician’ (*Dianthus barbatus* L. × *chinensis*) and ‘Hatsu-koi’ (*D. hybrida*) and other three non-DPC Dianthus cultivars “Telstar series” (*D. chinensis* × *D. barbatus*), ‘Orange Minami’ (*D. caryophyllus*) and ‘Mini Tiara Pink’ (*D. caryophyllus*) whose petals show coloration before anthesis. The petal color change and the accumulation of anthocyanins in the petals were investigated through developments of flower buds. Before anthesis, petal color of the DPC cultivars was yellowish white by naked eye, and little or no amount of anthocyanin was detected by HPLC. When petals of the DPC cultivars opened horizontally, the accumulation of anthocyanin had started, and then the highest accumulation rate of anthocyanin was observed during three to five days after anthesis. On the other hand, the non-DPC cultivars showed visible coloration of petals by the accumulation of anthocyanins before anthesis. The composition of anthocyanin did not change during petal coloration in all tested cultivars regardless of early or late coloring. The results suggest that a cue for anthocyanin biosynthesis, independent of light and temperature, exists in DPC Dianthus cultivars. To understand the regulation mechanism of the delayed pigmentation, the gene expression analysis of flavonoid biosynthesis-related genes is in progress.

Keywords: dianthus cultivar, petal color change, flavonoid biosynthesis



OS 1-18:

THE EFFECTS OF DIFFERENT GA₃ APPLICATIONS ON EARLY FLOWERING AND STEM ELONGATION OF DAFFODIL (*Narcissus tazetta*)

Deniz Hazar

Akdeniz University, Agricultural Faculty, Agricultural Faculty, Department of Horticulture, Antalya, Turkey
dhazar@akdeniz.edu.tr

Flower stem length has great importance in the pricing in the cut flower sector. In addition, earlier flowering also positively affects flower prices. The daffodils only bloom at a certain time. And sometimes the shortness of the flower stem can be a problem. The study was conducted to evaluate the effect of various concentrations of GA₃ (giberellic acid) on stem elongation, number of branches, leaves, flowers per plant, days to flowering, blooming period, flower size and flower fresh weight. The experiment had two different applications consisting five concentrations of GA₃ at 0, 50, 100, 250 and 500 mg L⁻¹. Bulbs were plunged for two hours in the first application and in the second application the leaves of daffodil were sprayed with the different concentration of GA₃.

Keywords: Giberellic acid, *Narcissus tazetta*, early flowering, stem elongation

OS 1-19:

ISOLATION AND EXPRESSION ANALYSIS OF FLAVONOID BIOSYNTHESIS GENES FROM PINK FLOWER PETALS OF LISIANTHUS (*Eustoma grandiflorum*)

Daiki Mizuta^{1*}, Ryoichi Yano², Eri Imamura³, Tatsuya Kikuchi³, Naoya Fukuda², Mitsuru Douzono⁴

¹Nihon University, 1866 Kameino, Fujisawa 252-0880, Japan

²University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8572, Japan

³Kumamoto, Prefectural Agricultural Research Center, 3801 Sakae, Koshi 861-1113, Japan

⁴Institute of Vegetable, and Floriculture Science, NARO, 2-1 Fujimoto, Tsukuba 305-0852, Japan

*mizuta.daiki@nihon-u.ac.jp

Lisianthus (*Eustoma grandiflorum*) is one of the main cut flower species in Japan. Pink lisianthus flowers are more popular than purple, red, or yellow flowers. Certain environmental conditions, for example, high temperature, can lead to color-dulling of the corolla, and this lowers the market value of the flowers. In this study, to obtain basic information about the molecular mechanism of pink flower coloration in lisianthus, we isolated flavonoid biosynthetic genes from pink lisianthus flowers and analyzed their expression patterns. Total RNA was extracted from petals of the lisianthus cultivar 'Granada pink' at the beginning of the coloration stage and subjected to next-generation sequencing. We obtained a total of 26 gigabases of sequence data (209 M reads). Then, 229,947 contigs with an average sequence length of 866 bases were obtained by de novo assembly. After querying these contigs to Arabidopsis thaliana genetic databases, we got 36,031 contigs with information about homologous genes and putative gene functions. And we found contigs showing homology to eight important flavonoid biosynthetic genes in Arabidopsis: phenylalanine ammonia lyase (PAL), cinnamate 4-hydroxylase (C4H), chalcone synthase (CHI), flavanone 3-hydroxylase, dihydroflavonol 4-reductase (DFR), anthocyanidin synthase (ANS), and flavonol synthase. Using real-time RT-PCR analyses, we evaluated the transcript levels of five of the eight flavonoid biosynthetic genes in the pink flowers at each developmental stage. Genes such as DFR and ANS, which function in the downstream part of the flavonoid biosynthetic pathway, were highly expressed at the pigmentation initiation and post-flowering stages, whereas those upstream in the flavonoid biosynthetic pathway such as PAL, C4H, and CHI were expressed in flowers at all stages, including the stages when pigment accumulation did not occur. These results demonstrate the relationship between corolla pigmentation and the expression of certain genes, especially those downstream in the flavonoid biosynthetic pathway.

Keywords: flavonoid biosynthetic gene, gene expression, lisianthus, next-generation sequencing, pink color flower

OS 1-20:

Short presentations on selected posters (5 min.)



SESSION II: Breeding and Molecular Genetics

KEYNOTE 1

COMPREHENSIVE APPROACH AND MOLECULAR TOOLS FOR BREEDING AND PRODUCTION OF ORNAMENTAL CROPS

Silan Dai^{*}, He Huang, Yan Hong, Xiaohui Wen, Chaofeng Ma, Bohan Zhang, Chenfei Lu

Beijing Forestry University, China Beijing, China

[*silandai@sina.com](mailto:silandai@sina.com)

The most fantastic feature of ornamental plants is their unique characters, which often differ from those of the native plants. Ornamentals attract people by their special beauty for a long time. As a kind of crops, ornamentals need not only one special “good” trait, but complex traits to form ornamental quality. Moreover, multiple genes may be involved in one trait. This is a challenge for plant breeding experts in this field. Breeding approaches consist of traditional (such as introducing, selection and cross-breeding) and modern techniques (such as gene mutation and gene transformation). Modern molecular biological techniques provide new approaches to deal with such complicated situation in ornamentals. As more and more plant genomic sequencing are completed, it is possible to understand the mechanisms of special traits, such as flower color, shape and fragrance, flowering time, plant architecture, hardiness and drought tolerance, resistance to diseases and pests, and so on. A lot of great results have been achieved in the past ten years. Molecular breeding techniques not only allow to transform foreign genes (both over-expression and inhibit the expression of target gene in transgenic plants), but also gene editing, such as CRISPER/Cas9. This makes possible to modify multiple genes and to improve ornamental traits in a short time. Therefore, the creation of brand new ornamental crops by using these tools in a comprehensive way is possible. Bioinformatics can help us to integrate more breeding information in both traditional and modern approaches. Such kind of efforts not only benefit flower industry, but also help to understand the evolution of plant traits and to enforce the basic research of plant biology.

Keywords: ornamental crops, ornamental traits, genetics and breeding, molecular tools, bioinformatics

OS 2-1:

OVEREXPRESSION LiDXR AND LiTPS GENES OF LILY (*Lilium* ‘Siberia’) ENHANCE MONOTERPENES IN TOBACCO FLOWER

Tengxun Zhang^{*}, Ming Sun, Qixiang Zhang

Beijing Forestry University, No35, Qinghua East Road, Haidian District, Beijing, China

[*zhangtengxun@163.com](mailto:zhangtengxun@163.com)

Lilium, the famous and significant cut flowers, emit amount of volatile organic compounds, which mainly consisted of monoterpenes such as myrcene, (E)- β -ocimene, linalool. In the course of breeding, some *Lilium* hybrids have lost their floral scent while others produce high concentration volatile compounds. To improve this situation and cultivate new *Lilium* varieties with middle-amount flower fragrance attracting people's attention, we should demonstrate the molecular mechanism of monoterpene production in *Lilium*. In this study, we cloned two potential vital genes in MEP pathway, 1-deoxy-D-xylulose-5-phosphate reductoisomerase (up-stream gene, named LiDXR) and monoterpene synthase (down-stream gene, named LiTPS), from strong-flavor Oriental *Lilium* ‘Siberia’ using a homology-based PCR strategy. Gene expression showed that LiDXR and LiTPS transcript levels were consistent with the emission and accumulation of monoterpenes during floral development, indicating these two genes probably played key roles in monoterpene synthesis. Subcellular location demonstrated that LiDXR and LiTPS enzymes catalyzed substrates on chloroplasts of *Nicotiana benthamiana*, consistent with the MEP pathway located in the plastid. Their stable expression in transgenic tobacco suggested that flowers of LiDXR and LiTPS transgenic lines substantially accumulated more linalool compared to wild type lines. Surprisingly, new monoterpenes, like β -myrcene, (E)- β -ocimene, and (Z)- β -ocimene, were identified in LiTPS transgenic lines. Meanwhile, green fluorescent protein were observed on chloroplasts in leaves and plastids in petals of transgenic tobacco, indicating that these two genes played roles in the floral volatiles synthesis in transgenic plants. These results show that LiDXR and LiTPS could contribute to monoterpenes biosynthesis in *Lilium* ‘Siberia’.

Keywords: *lilium*, floral scent, monoterpenes biosynthesis, LiDXR, LiTPS, functional analysis



OS 2-2:

BREEDING FOR DWARF, WINTER-HARDY *Iris domestica*, BLACKBERRY LILY (IRIDACEAE)

Neil O. Anderson

University of Minnesota, Department of Horticulture, 1970 Folwell Avenue, St. Paul, MN 55108, United States of America

ander044@umn.edu

Iris domestica (= *Belamcanda chinensis*) is an ornamental native to China and Japan. At seed set, the capsules open and display rows of large black seeds; the entire dehiscent capsule has the appearance of a blackberry. The species is drought tolerant (once established), flowers through the summer season, is highly self-compatible and, as a result, has become an invasive species escaped from cultivation throughout most of the southern United States and elsewhere around the globe. Despite its spread, it remains a unique ornamental with a spacious inflorescence useful for cut flower production since plants often reach 1m in height. Conversely, if dwarf types could be bred and selected their potential as a potted flowering plant would be useful for interior and exterior containers and landscapes. The purpose of this research was to analyze phenotypic diversity of seedling populations for seed germination, plant habit (dwarf vs. cut flower types), reduced vegetative phase (early flowering), and the occurrence of semi- to double-flowered mutants. A total of 72 crosses were made from 15 winter-hardy (USDA Z4) parental selections, resulting in N=1627 seedlings for evaluation. There were 13.5±2.6 leaves/plant on the primary stem beneath the inflorescence. Mean stem height was 50.9±9.9 cm whilst the inflorescence height averaged 34.3±9.8 cm. Two seedlings had the shortest stem heights of 11.8 and 15.9 cm whereas the tallest seedling was 87.5 cm; the shortest inflorescence heights were 5.9 cm and 6.9 cm to the tallest of 84.2 cm. Visible bud dates ranged from 19-38 wks after sowing while flowering dates occurred 21-38 wks after sowing. There were 160 (9.8%) non-flowering seedlings. Flower petal coloration ranged from the classic orange with red spots, to pure reds, yellows, creamy white, pink, and purple; color patterns included picotee, etc. Several crosses were homozygous for flower color. At least one seedling had semi-double flowers and could serve as a source for sterility in this crop.

Keywords: seed germination, visible bud date, flowering, flower color, dwarfness

OS 2-3:

GENETIC VARIABILITY STUDIES IN BIRD OF PARADISE (*Strelitzia reginae* L.)

Basavarajappa Ramappa^{1*}, Nayana GP², Jagadeesha RC³, Shantappa Tirakannavar⁴

¹University of Horticultural Sciences, Bagalkot, Karnataka, 587104, India

²PPMC, UHS Bagalkot, Bagalkot, Karnataka, 587104, India

³Dept of Crop Improvement Biotechnology, College of Horticulture, UHS, Bagalkot, Karnataka, 587104, India

⁴College of Horticulture, SIRSI, SIRSI, Karnataka, 587104, India

*basavarajappa.hr@uhsbagalkot.edu.in

Forty cultivars of Bird of Paradise were studied for genetic variability. The parameters leaf width and flower length had low estimate of Genotypic Coefficient of Variation (GCV) (9.67 & 4.87) and Phenotypic (PCV) (11.99 & 9.37) respectively, indicating low genetic variability in germplasm stock studied. Moderate estimates of GCV & PCV were recorded for plant height (15.46 & 15.89), leaf length (16.24 & 19.10), stalk length 16.38 & 23.24), stem girth (14.77 & 21.52), suggesting the traits are more sensitive to environmental effects and their expression depends more on non-genetical factors. The PCV and GCV were recorded high for number of leaves (25.37 & 26.13), number of bracts (21.40 & 28.19), number of flowers per clump (20.57 & 28.64) indicating the existence of wide range of genetic variability. The narrow difference between the GCV and PCV were recorded for all characters, indicating the lesser influence of the environment in the expression of these traits and presence of strong inherent association. High heritability estimates were observed for plant height (94.77), leaf length (72.32), number of leaves (94.29) and leaf width (65.01) indicating the predominance of additive gene component. The number of flowers per plant exhibited highly significant and positive association with plant height and number of leaves, suggesting the possibility of indirect selection of this trait. The quality traits can be improved through the selection of these characters i.e., stalk length, stem girth and number of bracts. The highest inter cluster distance was observed between cluster III and IX (193.01) and the lowest between cluster VIII and X (19.70). The highest intracluster distance was observed in cluster II (18.13) and lowest in cluster VII (11.05). So, by intercrossing the divergent genotypes, i.e., with maximum intercluster distance, we can utilize hidden variability and produce good recombinations in advancing generations.



Keywords: bird of paradise, genetic variability, GCV, PCV

OS 2-4:

QUANTITATIVE CLASSIFICATION OF THE MORPHOLOGICAL TRAITS OF RAY FLORETS IN LARGE-FLOWERED CHRYSANTHEMUM (*Chrysanthemum × morifolium* Ramat.)

Xuebin Song*, Kang Gao, Guangxun Fan, Xiaogang Zhao, Zhilan Liu, Silan Dai

Beijing Forestry University, Beijing, China

*xuebinsong@sina.cn

The large-flowered Chinese chrysanthemum is one of the most complicated ornamental plants. The identification and classification of such complicated cultivars requires a specific system. The diversity of the capitula is mainly determined by multiple shapes of ray florets. However, the existing classification systems for ray floret types are incomplete and unsystematic. In this study, 299 ray florets from 151 large-flowered chrysanthemum varieties in China and 12 related traits of ray florets were selected for quantitative classification. First, as one of the most important index of ray floret shape, the corolla tube merged degree (CTMD) was defined as the corolla tube length/ray floret length (CTL/RFL). Combined with probability grading method and linear regression analysis, the corolla tube merged degree was divided into 3 groups, flat, spoon and tubular, of which the CTL/RFL ranged from 0 to 0.2, 0.2 to 0.6 and 0.6 to 1.0, respectively. Second, Q-mode cluster analysis indicated that the each groups could be further categorized into 3 types (straight, curve and peculiar), based on other important variation of ray floret. Finally, the ray floret was classified into 9 types, including flat-straight, flat-curve, flat-peculiar, spoon-straight, spoon-curve, spoon-peculiar, tubular-straight, tubular-curve, and tubular-peculiar. Such ray floret classification system is helpful for the classification of capitulum shape and is great significance for identification, breeding and international communication of chrysanthemum cultivars.

Keywords: chrysanthemum, ray floret, corolla tube merged degree, quantitative classification

OS 2-5:

CHRYSANTHEMUM ALTERATION BY CONSTITUTIVE EXPRESSION OF ASTERACEAE AGAMOUS-LIKE MADS-BOX GENES

Tatiana Mitiouchkina^{1*}, Olga Shulga², Sergey Dolgov³

¹Branch of Institute of Bioorganic Chemistry, Science av.6, 142290 Moscow region Pushchino, Nikita Botanical Gardens, Crimea, Russian Federation

²ARRIAB, Moscow, Timiryazevskaya, 42, Russian Federation

³BIBCH, Pushchino, Science av.6, Russian Federation

*mitiouchkina@rambler.ru

Novel flower shape induction remains actual goal for chrysanthemum biotechnology. Genes encoding MADS-box transcription factors have attracted particular attention because they are the key regulators of plant morphogenesis. Among them are the genes of the AGAMOUS (AG) group, which specify stamen and carpel development, the repression of genes responsible for perianth development, and the floral meristem determinacy. So, plant biotechnology offers an opportunity to develop new “unusual” flower form by changing florets organs identity. Previously, we have identified AGAMOUS-like genes from Chrysanthemum (CDM37) and Helianthus (HAM45 and HAM59). The influence of the constitutive expression of the CDM37, HAM59 and HAM45 genes on the morphology of transgenic tobacco plants is expressed mainly via the stamen shortening and the change in the corolla size, shape, oversized nectaries and, sometimes, identity. Plants 35S::HAM45 and 35S::CDM37 demonstrated more severe changes of flower morphology: the perianth has acquired the characteristics of reproductive organs, whereas pistil, stamens did not differ from the control; at the upper lobes petals have structures similar to anthers. Some 35S::CDM37 plants had a functioning nectary at the base of each sepal, whereas the upper part of sepal was partially replaced with style- and stigma-like tissues. In the late flowers of 35S::CDM37, corollas were transformed into five staminoid petals. At the same time, ectopic expression of the HAM59 in transgenic sunflower produce a double-flower phenotype of the disk florets. Thus, though the proteins are very similar, the changes of the transgenic plant morphology caused by their expression significantly differ. In this work, we tested the possibility of Chrysanthemum flower shape alteration by constitutive expression of the CDM37, HAM59 and HAM45 genes. Totally 19 independently regenerated plants carrying



integrated transgenes were produced by the Agrobacterium-mediated transformation of leaf disks. Results of the comparative analysis of transgenic and control plants will be presented.

Keywords: chrysanthemum, MADS-box genes, transgenic plants, flower shape

OS 2-6:

DNA METHYLATION ANALYSIS OF THE CAPITULUM AND THE TWO TYPES OF FLORETS DURING CAPITULUM DEVELOPMENT IN *Chrysanthemum lavandulifolium*

Fan Zhang*, Shuai Qi, Silan Dai

Beijing Forestry University, Beijing, China

*silandai@sina.com

C. × morifolium Ramat. has a complex flower head shape formed by ray floret and disc floret on the capitulum. At present, the development mechanism of the two types of florets in Compositae has not yet been resolved. In this study, *C. lavandulifolium* ($2x=2n=18$) was used as the material, and the relative DNA methylation levels of the capitulum and two types of florets at different flowering stages were tested and analyzed by the MSAP (Methylation Sensitive Amplified Polymorphism). The results suggested that the total DNA methylation level of capitulum in *C. lavandulifolium* showed a trend of increasing and then decreasing with the process of flower development. And the total DNA methylation level of capitulum at the second flowering stage was the highest (79.13%). However, the total DNA methylation of the two types of florets showed a trend of decreasing and then increasing at the 4~7 flowering stage. And, the total DNA methylation levels of ray florets (73.49%) and disc florets (65.39%) were the lowest at stage 6. Simultaneously, a total of 3768 methylation sites were detected and 320 locus of them was difference in two types of florets during the 4~7 flowering stage. In addition, there was a correlation between the relative genes expression levels and the relative DNA methylation levels in two types of florets. This study proved that there were some differences in DNA methylation levels and patterns between the two types of florets on the capitulum in *C. lavandulifolium*, and it may be one of the reasons that led to the difference of the two types of florets.

Keywords: *C. lavandulifolium*, DNA methylation, flower development

OS 2-7:

VARIATION IN THE KARYOTYPE AND DNA CONTENT OF WILD VARIETIES OF *Narcissus tazetta* L. (AMARYLLIDACEAE) IN TURKEY

Şevket Alp^{1*}, Mine Koçyiğit², Emrah Zeybekoğlu³, Ali Salman⁴, Mustafa Ercan Özzambak³

¹Department of Landscape Architecture, Van Yüzüncü Yıl University, Van, Turkey

²Department of Pharmaceutical Botany, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

³Department of Horticulture, Agriculture Faculty, Ege University, Izmir, Turkey

⁴Bayındır vocational high school, Ege University, Izmir, Turkey

*alpsevket@gmail.com

The genus *Narcissus* L. is one of the smallest genera in the family Amaryllidaceae in Turkey. It is taxonomically difficult genus, due to highly polymorphy in the wild populations. The taxonomy is also confused by the effects of long-established cultivation, hybridisation and selection followed by escape and naturalisation. The genus *Narcissus* includes 60 hybrids of 142 taxa in the world. In Turkey, *Narcissus* is represented by 2 native and 2 hybrids species, the others are recorded as naturalised species. *Narcissus tazetta* L. is one of the natural daffodil species grown in Anatolia. It has had a growing interest as an ornamental plant because of the fragrant flowers, and traditionally it has been grown in gardens. The cytological variability of *N. tazetta* was studied in the different regions of the world, but is absent for the Turkish specimens. In this study, the karyotype and DNA content data of *N. tazetta* in Turkey have been examined. Wild variants of double and single accessions of *N. tazetta* in Turkey have been estimated separately. Relative variations in chromosome length and mean centromeric asymmetry of the species have been revealed. Somatic chromosome numbers of single *Narcissus* varieties have been determined as $2n=2x=20$ and double *Narcissus* varieties have been determined as $2n=3x=30$. It has been revealed that 2C nuclear DNA content is ranging between 33.02 and 31.01 pg in the single variants, and 48.02 and 44.02 pg in double variants.



Keywords: *Narcissus tazetta*, Amaryllidaceae, karyology, DNA content, Turkey

OS 2-8:

Lathyrus belinensis* FROM TURKEY CARRIES A MILDEW RESISTANCE ALLELE THAT CAN BE INTROGRESSED INTO *Lathyrus odoratus

Russell Poulter*, George Taiaroa

University of Otago, PO Box 56, 9054 Dunedin, New Zealand

*russell.poulter@otago.ac.nz

Lathyrus belinensis is an endangered, yellow flowered, *Lathyrus* from Turkey. The species can be crossed, with difficulty, to the sweet pea, *Lathyrus odoratus* L. *belinensis* is fully resistant to powdery mildew (*Erysiphe*), whereas *L. odoratus* is very sensitive. Analysis of the F2 plants from the cross suggests that resistance is due to a single, dominant, locus. Introgression against *L. odoratus* for ten generations yielded plants indistinguishable from *L. odoratus*, except for being fully resistant to powdery mildew. Molecular analysis of the transcriptomes of *L. belinensis*, *L. odoratus* and the introgressed hybrid was performed. The transcriptome describes the complete set of genes expressed in a cell, with modern high-throughput sequencing (RNA-seq) being both cost effective and sensitive to mRNAs expressed even at low levels. Preliminary analysis showed sufficient Single Nucleotide Polymorphisms (SNPs) between the parental plants to determine the origins of transcripts from the hybrid. Analysis of the transcriptomes demonstrated that there is a single block of genetic material derived from *L. belinensis* in the introgressed hybrid. This block of *L. belinensis* genetic material corresponds to 51Mb to 51.5Mb on chromosome 4 of *Medicago truncatula*. This region contains a number of R-genes in *Medicago*. Fine structure mapping of hybrid plants is being used to more precisely define the resistance locus. Interestingly, the plants homozygous for the resistance allele have hairless seed pods, resembling *L. belinensis*. This recessive character is presumably very closely linked to mildew resistance and is of use in performing genetic mapping. *L. belinensis* has yellow flowers, a colour missing from varieties of *L. odoratus*. Attempts are being made to transfer this yellow coloration to *L. odoratus*.

Keywords: *Lathyrus belinensis*, *Lathyrus odoratus*, powdery mildew resistance, transcriptomics, *Erysiphe*

OS 2-9:

RESEARCH PROGRESS ON RESOURCES AND BREEDING OF *Prunus mume*

Qixiang Zhang

National Engineering Research Center for Floriculture, Beijing Forestry University, 100083 Beijing, China

*zhangqxbjfu@163.com

Prunus mume (mei) originated in the Hengduan Mountains region in China, was domesticated as an important ornamental and fruit plant more than 3,000 years ago. Through long-term selection and breeding, mei has been domesticated to produce about 350 varieties in 15 distinct regions stretching 20 provinces, some of which exist in more than 200 year trees (known as ancient mei). It is observed that there are 75 ancient mei identified in six southwestern and southeastern provinces. *Prunus mume*, as ornamental plant and fruit, is one of the first genomes among *Prunus* subfamilies of Rosaceae been sequenced. *Prunus mume* contains a 280 M genome by combining 101-fold next-generation sequencing and optical mapping data and anchors 83.9% of scaffolds to eight chromosomes with genetic map constructed by restriction-site-associated DNA sequencing. Finally, 31,390 protein-coding genes were annotated 11.3 Gb of RNA-Seq data from five major tissues: bud, fruit, leaf, root and stem. Furthermore, the genetic architecture of floral traits in mei and its domestication history were investigated by sampling and resequencing a total of 351 samples including 348 individual mei accessions at an average sequencing depth of 19.3×. Deep sequencing data (~70.1-fold coverage) from eight mei trees from different populations and three other *Prunus* species were used to establish the pan-genome of *P. mume* and *Prunus* genus. Through a genome-wide association study (GWAS), we identified significant quantitative traits locus (QTLs) and genomic regions where several genes, such as MYB108, are positively associated with traits with extensive attention. We further sequenced transcriptomes of flowers with diverse traits to validate the QTLs by biased expression of candidate genes between transcriptomes. As an ornamental woody plant, mei has proven itself to be an important fuel for studying the evolution and diversification of genus *Prunus*.

Keywords: *Prunus mume*, genome, resequencing, QTLs, floral traits



OS 2-10:

TRANSCRIPTOME ANALYSIS OF *Opisthopappus taihangensis* PROVIDES NEW INSIGHT INTO THE MECHANISM OF DROUGHT RESISTANCE

Qixiang Zhang^{1*}, Yongjuan Yang², Xuejun Shi², Jian Zhong², Ming Sun²

¹National Engineering Research Center for, Floriculture/Beijing Forestry University, 100083 Beijing, China

²No.35 Tsinghua East Road Haidian District, Beijing, China

*zhangqxjfu@163.com

Chrysanthemum is one of the most important commercial flowers in the world, however drought resistance limits its production, quality and distribution seriously. *Opisthopappus taihangensis* has excellent drought resistance, which only survives on the Taihang Mountains in China. However, little is known about the genomic information of the drought resistance mechanism in *O. taihangensis*. Thus, in this study, six cDNA libraries constructed from mRNA of control and drought stressed seedlings' roots with triplicates were sequenced by Illumina technology. In total, 400098198 raw data and 389037422 clean data were assembled into 73589 transcripts and 33511 unigenes, of which 14134 (42.18% of the total) and 22513 (67.18% of the total) were aligned in Swiss-Prot and Nr protein, respectively. A total of 4991 significantly different expressed genes (p-value) of *Opisthopappus taihangensis* drought-responsive genes can be classified into two groups: the first group is mainly comprised of enzymes in the biosynthesis, of various osmo-protectants (P5CS, PDH), late-embryogenesis-abundant (LEA) proteins, aquaporin (PIP, TIP, NIP, SIP) and detoxification enzymes (SOD, POD, CAT, APX, GPX); the second group mainly includes transcription factors (NAC, MYB, WRKY, DREB, ERF), protein kinases (CDPK, MAPK), and enzymes involved in the phosphoinositide metabolism (PPK, PDPK). Expression of DEGs in drought responsive pathways includes plant signaling transduction (MAPK signaling pathway, calcium signaling pathway, chemokine signaling pathway), phenylalanine metabolism, starch and sucrose metabolism, plant-pathogen interaction, oxidative phosphorylation and so on. Our studies provide novel insight into mechanisms of drought stress in *O. taihangensis* and find a valuable germplasm resource for Chrysanthemum breeding to improve its drought resistance.

Keywords: Chrysanthemum, transcriptome, drought resistance, breeding

SESSION III: Flowers in Culture and New Crops

KEYNOTE 1

WILD FLOWERS IN TURKEY GENETIC RESOURCES AND POSSIBLE USE

Fatma Neriman Özhatay

Bahariye Caddesi Kuzukestanesi Sokak, Huzur Apt. No 79 , Bahariye Kadiköy, 34 Istanbul, Turkey

*nozhatay@istanbul.edu.tr

Turkey is located on a large peninsula with a land surface of 779 452 km², bordering on three seas and extending both into Europe and Asia. Floristically, Turkey is one of the richest countries in the Western Palearctic Region. The vascular flora (flowering plants and ferns) of Turkey comprises about 10 000 species, with a high percentage of endemic taxa (34 %). A considerable number of taxa new to the country's flora or new to science, have been described in the result of taxonomic or floristic studies in recent decades. Diversity of vascular plants of the country has been documented in the Flora of Turkey and the East Aegean Islands published in nine volumes. After publication of this monumental work, many new taxa (either to science or to the Turkish flora) added. Identification of these additional taxa has necessitated the subsequent publication of supplementary volumes (vol. 10 and vl.11) to the Flora of Turkey. The flora of Turkey continues to provide new information after publication of vol. 11. In the period up to 2017, 1526 taxa were added, including 1121 taxa new to plant science and 405 taxa new to the Turkish flora. Geophyte flora is particularly rich in genera and species with app. 1200 taxa of which 500 endemics. They are characteristic of different habitats, soil and climatic conditions, and can offer exciting opportunities for innovation in the floricultural industry. In this paper the data of wild geophytic species with a focus on the distribution Information regarding the attributes of each species was obtained from a number of published sources, including flora and plant checklists. Ecological vision: harmony between natural resources and commercial production have been discussed.

Keywords:



OS 3-1:

HEDONIC TESTS IN THE ORNAMENTAL HORTICULTURAL PLANT SECTOR TO PREDICT NEW CULTIVARS PERFORMANCE

Ronan Symoneaux^{1*}, Gilles Galopin², Alain Ferre³

¹Ecole Supérieure d'Agricultures, 55, rue Rabelais, 49000 Angers, France

²AGROCAMPUS OUEST, 2, rue le Notre, 49000 ANGERS, France

³arexhor, 1 Rue des Magnolias, 49130 Les Ponts-de-Cé, France

*r.symoneaux@groupe-esa.com

In the sector of ornamental plants, innovations are generally developed and launched without integrating the consumers' insights during the development of concepts and products. In food, cosmetics, automobile sectors, consumer sciences are used regularly to better understand the perceptions of the consumers and to predict their behaviour. This knowledge can be a way of progress to improve the success of plants' innovations and the performance of products in garden center. Two studies were led within the framework of the project Evalinnov to estimate the interest of these approaches. A methodological development was necessary for adapting hedonic tests to the specificities of the horticultural products. Concrete examples will be presented on new cultivars of *viola*, *viola cornuta* and *begonias*. New varieties were presented to two groups of 200 consumers. In each group, 100 consumers evaluated products without information concerning products and 100 others evaluated products with commercial information. Intention to purchase and perceptions of innovations was recorded in order to evaluate the visual performance of the new cultivars and to observe the weight of information on purchase intention. Results give interesting outputs about drivers of acceptability for the cultivars tested (colour, number and type of flowers, density...). The information "New Cultivar" seemed to have a huge impact on intention of purchase compared to other types of communication. Methodological limits will be discussed concerning the integration of the variability of plants and the context of evaluation.

Keywords: consumer, marketing, new ornamental plant

OS 3-2:

GARDENS, WHERE WORDS RESHAPE MEANINGS: A LITERARY PERSPECTIVE OF HORTICULTURE

Jia Wang^{1*}, Sagheer Ahmad², Cunquan Yuan², Tangren Cheng², Qixiang Zhang²

¹Beijing Forestry University, Qinghua East Road 35#, 100083 Haidian District, Beijing, China

²No.35 Tsinghua East Road Haidian District, Beijing, 100083, China

*wangjia8248@163.com

It is a long held dogma that contact with nature (landscape, vegetation and water) ameliorates anxieties and fetch general healthcare benefits. Throughout its life, an individual enmeshes within a dynamic confliction of the natural and artificial environment, social life and consciousness. Within this confliction, the well-being rests on the availability of a perfect environment offering peace of mind and happiness. Nerve-shaken and tired people find wilderness, mountains, forests and meadows as fountains of mental peace and happy life. Thus, mental exhaustion drives a thrust to contact with nature to nourish our physical and physiological needs, and comfort. Naturalized spaces and gardens present a powerful symbolic platform for best manipulations in literature. In addition to nourishing exhausted minds, company of plants do offer nice selection of words for poets and literary men. Gardens as rhythmical manifestation of nature serve the best source of linking literature with the horticulture and this can be the best topic to study so that the upcoming generations can be connected with plants in order to secure the fading love for nature in this materialistic world. Therefore, we can hypothesize that a sophisticated use of word either in literature or in poetry is imperfect unless accompanied by nature.

Keywords: literary horticulture, poetry, words, gardens, mental peace



OS 3-3:

CRABAPPLE IN CHINA, PAST, PRESENT AND FUTURE

Ling Guo*, Jian Quan, Ying Cao, Boyang Liu

Beijing Botanical Garden, Sleeping Buddha Temple Road, Beijing 100093, China

[*lingguo27@hotmail.com](mailto:lingguo27@hotmail.com)

Crabapples are the most ornamental of small trees in the temperate zone, and symbolize everything good in Chinese painting, poetry, and the garden arts. The history, development of new cultivars, studies and applications in landscape design and architecture in the past 30 years in China is described. The work of the International Cultivar Registration Authority for *Malus* Mill. (excluding *M. x domestica*) since 2014 is also reported in this paper.

Keywords: crabapple; cultivar; international cultivar registration

OS 3-4:

DEVELOPMENT OF ORNAMENTAL *Cannabis sativa* L. VARIETIES

Salvatore Casano

Phytoplant Research S.L., Parq.Cient.Tec.Córdoba-Rabanales 21, c.Astrón.C.Payne-Ed.Centauro B-1, 14014 Córdoba, Spain

s.casano@phytoplant.es

The distinctness easily detected by using a variegated foliage as morphological marker could be an impulse to the commercialization of ornamental *Cannabis sativa* L. varieties. During the last years various chimera have been detected and, while most of them are still in process of selection, the company in April 2017 has obtained from the Community Plant Variety Office (CPVO) the provisional protection of plant breeder' rights for the dioecious female variety Divina (CPVO file number: 2017/0149) characterized by a stable variegated foliage of the vegetatively propagated derived plants. Divina variety has a distinctive "mottled yellow & green leaf" phenotype from the variety Pilar where the mutated type chimera was detected and isolated from a mutated donor plant growing in greenhouse. Both varieties are showing the same genotype when DNA fingerprinting is performed by using 15 SSRs molecular markers. Additionally, by using a molecular marker for THCA/CBDA synthases it was confirmed that only the alleles for CBDA synthase can be detected in both varieties, as it is also confirmed by using gas chromatography that both varieties have a cannabidiol (CBD) chemotype. Microscope observations of "yellow" portions of stalks, leaves and inflorescence bracts confirm the presence of bulbous, sessile- and capitate-stalked trichomes. Divina cuttings are more prone to fungal disease during in vivo rooting stage than Pilar cuttings, however satisfactory percentages of true to type rooted cuttings can be achieved by adopting good propagation practices. A protocol for all the stages of in vitro micropropagation is already established at our laboratories. When considering the sexual propagation of the variety, all the F1-hybrid offspring obtained by crossing a dioecious "green leaf" male plant with a Divina plant shown a "green leaf" phenotype.

Keywords: cannabis, divina, ornamental, variegated, chimera



IHC2018-Symposium 15 **Ornamental Horticulture: Colour Your World** **POSTER PRESENTATIONS**

P1:

RESPONSE OF LISIANTHUS (*Eustoma grandiflorum* [Raf.] Shinn) TO APPLICATIONS OF GROWTH REGULATORS

Ana Maria Castillo-Gonzalez^{1*}, Luis Alonso Valdez-Aguilar², Edilberto Avitia-Garcia¹

¹Universidad Autonoma Chapingo, Departamento de Fitotecnia, Instituto de Horticultura, Chapingo, Mexico 56230, Mexico

²Universidad Autonoma Agraria Antonio Narro, Departamento de Horticultura, Saltillo, Coahuila, 25315, Mexico

*anasofiacasg@hotmail.com

Lisianthus is an ornamental crop, very attractive due to large array of flower colors and long vase life. The use of growth regulators, such as gibberellic acid (GA₃) and benzylaminopurine (BAP), in lisianthus is very scarce, as there are only few reports indicating that gibberellins promote bolting of rosetted plants. The objective of this work was to determine the response of lisianthus to foliar applications of GA₃ and BAP. Plants of lisianthus cv. ABC Misty Blue were transplanted into black polyethylene bags of 7 L; the substrate was red tezontle (volcanic rock) 2 to 3 mm in diameter. Irrigation was performed on a daily basis with 300 mL of nutrient solution. The treatments were: 6 mg L⁻¹ of GA₃, 6 mg L⁻¹ of BAP, 6 mg L⁻¹ of GA₃ + 6 mg L⁻¹ of BAP, 10 mg L⁻¹ of GA₃, and control (water). Three foliar applications were performed at 7, 9 and 11 weeks after transplanting. The experiment was set in a completely randomized design with eight replicates per treatment. The results showed that the plants sprayed with GA₃ had similar height to that of control plants. Plants sprayed with BAP and GA₃ + BAP exhibited a 21% to 26% decrease in height, but stem was thicker, and also showed a 300% to 450% increase in the number of stems per plant, respectively. BAP and GA₃ + BAP also promoted a higher growth rate (>500%) and reduced dropping. Plants sprayed with GA₃ + BAP presented lower nitrogen and phosphorus concentration compared to that of plants with other treatments. The applications of GA₃ and BAP at the tested concentration did not affect the biomass of the plants or the number of flower buds. The applications of GA₃ + BAP promoted favorable characteristics in lisianthus for pot plant.

Keywords: *Eustoma grandiflorum*, nutrient concentration, vegetative growth, gibberellins, cytokines

P2:

EFFECTS OF EARTHWORM CASTINGS AND PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPRS) TREATMENTS ON THE PLANT GROWTH AND DEVELOPMENT PARAMETERS IN GLADIOUS (*Gladiolus grandiflorus* L.)

Atila Dursun^{1*}, Fazilet Parlakova Karagöz¹, Recep Kotan², Raziye Kul¹, Nasibe Tekiner²

¹Ataturk University, Faculty Of Agriculture, Department Of Horticulture, Erzurum, Turkey

²Ataturk University, Faculty Of Agriculture, Department Of Plant Protection, Erzurum, Turkey

*atilladursun@atauni.edu.tr

The use of environmental and sustainable ornamental flower production practices with renewable resources has drawn worldwide interest. One of these renewable resources is earthworm castings (vermicompost) due to uniform and odorless material, containing good physical structure, mineral and trace elements, plant growth regulating substances. Earthworm castings also help microbial agents function effectively in soil. In this study, a total of six treatments [A: PGPRs including *Bacillus subtilis* RK-1901, *Bacillus megaterium* RK-1902 and *Pseudomonas fluorescens* RK-1903 strains, B: Not autoclaved earthworm castings, C: Autoclaved earthworm castings, D: Not autoclaved earthworm castings + PGPRs, E: Autoclaved earthworm castings + PGPRs, F: Control (untreated bacteria and earthworm castings)] were tested for their effects on the plant growth and development parameters in gladiolus (*Gladiolus grandiflorus* L. "Red Beauty"). Corms were planted 15 cm intervals during the third week of April in 2017. Sixteen corms were planted in each treatment and these plants in pots were arranged according to completely randomized design with four replicates. All the treatments were applied one times to soil at three leaf stage. Plant height, length and width of leaf, number of leaves per plant,



number and length of branches per plant and yield attributes included number of flowers per plant, diameter of flowers, color of leaf and flower fresh and dry weight of flowers were determined and analyzed. Results indicated that the PGPRs (A), autoclaved earthworm castings (C) and autoclaved earthworm castings + PGPR (E) treatments exhibited overall better performance as compared to other treatments for number of leaves per plant, number of florets per spike, stem diameter, spike length, fresh and dry weight of flowers.

Keywords: Gladiolus (*Gladiolus grandiflorus* L.), vermicompost, earthworm castings, PGPR, flower development

P3:

IDENTIFICATION AND RELATIONSHIP OF OLD JAPANESE HYDRANGEA CULTIVARS IN EUROPE BY MORPHOLOGICAL AND NUCLEAR SSR ANALYSIS

Hirokazu Yamamoto*, Sho Yamamoto, Muneaki Ogawa, Takahiro Yoshida, Koudai Totuka, Takashi Handa

1-1-1 Higashi-Mita, Tama-ku, Kawasaki-shi, Japan

*cf170222@meiji.ac.jp

Hydrangea (hortensia) is one of the important ornamental plants as garden trees and pot plants. Old Japanese cultivars have been introduced from Japan to Europe since 18th century. However it has not yet been confirmed whether these old cultivars imported to Europe are identical with old cultivars existing in Japan. In this study, we investigated morphological and molecular analysis of 20 Japanese old cultivars in European production (France, Belgium), using nine sets of nuclear SSR markers, for their identification and relationship. Six old cultivars had the same genotypes between Europe and Japan by morphology and SSR analysis. However other old cultivars didn't show identical SSR profiles and some cultivars were classified in the different clusters between Europe and Japan by NJ cluster analysis. For example, 'Benigaku' shows similar morphological traits in Europe and Japan. However, SSR analysis exhibited the different genotype between Japan and France. SSR analysis also supports the record that 'Sekka-yae-Ajisai' was a bud mutation of 'Nigra'. These results revealed the complex history of introduction and distribution of old Japanese cultivars into Europe since 18th century.

Keywords: microsatellite, old cultivars, synonym

P4:

ORIGIN OF THE *Rhododendron kaempferi* RELATED SPECIES AND VARIETIES ESTIMATED BY SSR ANALYSIS

Sho Yamamoto^{1*}, Takumi Nakamura¹, Kazuki Koiwai¹, Miki Miyano¹, Emiko Iizuka¹, Asako Nakayama¹, Yuji Kurashige², Nobuo Kobayashi³, Takashi Handa¹

¹1-1-1, Higashi-mita, Tama-ku, kawasaki 214-0033, Japan

²186 Kanazu, Akiha-ku 956-0845, Japan

³1060, Nishikawatsu-cho, Matsue 690-8504, Japan

*sho.cactus@gmail.com

More than 30 native evergreen azalea species has been recognized in Japan, and in which many cultivars have been produced since Edo era (1603-1867). *Rhododendron kaempferi* Planch. is classified as subsection Tsutsusi and widely distributed in mountains and suburban forests throughout Japan. There are several native species and varieties close related to *R. kaempferi*. Our previous study revealed that origin of *R. transiens* and *R. hanceanense* are considered as interspecific hybrids of *R. kaempferi* and other evergreen azalea species and cultivars by using microsatellite (SSR) markers. Recently, we also applied SSR analysis to other *R. kaempferi* related species and variety such as *R. komiyamae* and *R. kaempferi* var. *mikawanum*. Assignment tests with canonical discriminant analysis showed that *R. komiyamae* and *R. kaempferi* var. *mikawanum* were assigned in *R. kaempferi* and not related to other evergreen azalea species, which means they were originated from *R. kaempferi* and not hybridized with other azalea species. Our study suggest that there are three models of establishment of *R. kaempferi* related species and varieties: (1) natural mutation, (2) interspecific hybridization between wild species, and (3) hybridization between wild species and cultivars.

Keywords: azalea, genetic diversity, speciation, taxonomy



P5:

INHERITANCE OF COROLLA LOBE COLOR IN *Pentas lanceolata*

Der-Ming Yeh*, Cheng-Ying Hung

Dept Horticulture & Landscape Architecture, No. 1 Sec 4 Roosevelt Rd, Taipei 106, Chinese Taipei

*dmyeh@ntu.edu.tw

Pentas lanceolata (Forsk.) Delf. has showy and long-lasting flowers and is widely used for potted plants or landscape in sub- or tropical areas. Many cultivars exhibit rose, purple, or pink corolla lobe, while the information on the inheritance of these corolla lobe colors is presently limited. In this study, 'Graffiti Rose' (rose), 'Butterfly Deep Pink' (rose), and 'Graffiti Violet' (purple) were self- and cross-pollinated. The corolla lobe color of progenies was investigated when the entire inflorescences were almost full. Progenies from selfing 'Graffiti Rose' and reciprocal crossing 'Graffiti Rose' and 'Butterfly Deep Pink' all fit a 3 rose : 1 pink segregation ratio. Progenies from selfing 'Graffiti Violet' fit a 3 purple : 1 pink segregation ratio. Progenies from reciprocal crossing 'Graffiti Rose' and 'Graffiti Violet', 'Butterfly Deep Pink' and 'Graffiti Violet' all fit a 2 rose:1 purple:1 pink corolla lobe segregation ratio. We proposed locus as R and V for rose and purple corolla lobe, respectively. The dominance order of corolla lobe color is rose > purple > pink, while R_₋V/R__{vv} resulted in rose corolla lobe, rrV_₋ in purple corolla lobe, and rrvv in pink corolla lobe.

Keywords:

P6:

INHERITANCE OF EYE ZONE COLOR IN *Catharanthus roseus*

Der-Ming Yeh*, Yu-Tang Tsai

Dept Horticulture & Landscape Architecture, No. 1 Sec 4 Roosevelt Rd, Taipei 106, Chinese Taipei

*dmyeh@ntu.edu.tw

Periwinkle [*Catharanthus roseus* (L.) G. Don] has long-lasting flowering periods under warm climate with many flower color variations. Flowers with various colors in corolla and eye zone are more attractive. Cultivars with eye zone in red, purple, or orange have recently been released on the markets, while information on the inheritance of the eye zone color is presently limited. Three cultivars with red eye ('Nirvana Cascade Pink Splash', 'Cora Cascade Strawberry' and 'Mediterranean White Broadeye') and two cultivars with purple eye ('Ray' and 'Summer Mikan') were self- and cross-pollinated. F1 and F2 progenies were produced. Results showed that progenies from self-pollination of cultivars with red eye were all red eye. Progenies from self-pollination of 'Ray' fit a 3 purple eye: 1 orange eye segregation ratio, while those from selfed 'Summer Mikan' all exhibited purple eye. F1 progenies between red and purple eye were all red eye. F2 progenies from 'Ray' × 'Nirvana Cascade Pink Splash' fit a 9 red eye: 3 purple eye: 4 orange eye segregation ratio ($\chi^2=3.56$, $P=0.17$). The dominance order of the eye color is red > purple > orange. We proposed two loci Hf2 and Mt that determine color in the eye zone. Hf2_Mt_₋ resulted in red eye, Hf2_mtmt in purple eye, and hf2hf2Mt_₋/hf2hf2mtmt in orange eye.

Keywords:



P7:

POLLEN GERMINATION AND INHERITANCE OF FLOWER FORM IN SINNINGIA

Der-Ming Yeh*, Pei-Wen Kan

Dept Horticulture & Landscape Architecture, No. 1 Sec 4 Roosevelt Rd, Taipei 106, Chinese Taipei

*dmyeh@ntu.edu.tw

Double flower may increase the horticultural value of ornamental plants. Gloxinia [*Sinningia speciosa* (Lodd.) Hiern] flowers could be categorized as single-flower (one petal whorl), semi-doubled flower (two petal whorls), and double-flower (three petal whorls). Semi-double flowered 'Brocade' have three types of anthers: normal stamen, petaloid filament, and staminoide. Pollen from these respective of anthers of 'Brocade Purple/white bicolor' was inoculated onto the BK media with 10% sucrose for 2 h in dark. Results showed that pollen in anthers from normal and petaloid filament stamen germinated, but not for those from staminoide. Self-pollinated single-flowered cultivars produced all single-flowered progeny. Cross-pollinated semi-doubled flowered and single flowered cultivars fit a 1 single: 1 semi-double segregation. Self- and cross-pollinated semi-double flowered cultivars progeny from segregated 1 single: 2 semi-doubled:1 double ratio. Results indicated that double-flowered form was governed by a dominant allele. Dominant homozygous shows double-flower, heterozygous shows semi-doubled flower, recessive homozygous shows single-flower.

Keywords:

P8:

SELECTION OF EARLY FLOWERING AND SELF COMPATIBLE GENOTYPE IN *Chrysanthemum seticuspe* var. Boreale

Sayaka Nishitsuji*, Saori Tada, Takako Narumi, Seiichi Fukai

Kagawa University, Faculty of Agriculture, Ikenobe 2393, Miki-cho, Kagawa 761-0795, Japan

*sayaka.sora.0930@gmail.com

In chrysanthemum, genetic analysis is difficult because of sporophytic self incompatibility (SI) and polyploidy. Diploid wild chrysanthemum, *Chrysanthemum seticuspe* var. Boreale is expected to be a model plant in genus Chrysanthemum. In this study line Sarusawa, showing SI and early flowering, and line AEV2, showing self compatible (SC), late flowering and albinos in selfing progeny, were crossed to establish early flowering and SC genotype of *C. seticuspe* var. Boreale. Eleven F₁ lines were obtained from the cross of Sarusawa and AEV2. F₁ lines tended to bloom earlier than AEV2 under nature day length, and all showed SI. To obtain progenies having SC, F₁ progenies were full-sib matched with mixed pollens. Four of eleven F₁ lines produced albino seedling. Sixty three of progenies (F₂) were selected from the other F₁ lines which showed no albino production and early flowering. Forty eight of sixty three F₂ progenies showed SI and others had SC. The segregation ratio of SI:SC were assumed 3:1 and the SC was attributed to a recessive gene. Four of fifteen F₂ lines having SC produced albino by selfing, and the segregation ratio of albino:non-albino was assumed 1:3, suggesting the albino was also attributed to a recessive gene. Almost F₂ progenies bloomed earlier than AEV2. The earliest F₂ progeny having SC and no albino production bloomed 14 days earlier than AEV2. The early flowering SCC. *seticuspe*. var boreale could be useful for genomic research.

Keywords: *Chrysanthemum seticuspe* var. Boreale, self compatibility, early flowering



P9:

PETAL COLOR CHARACTERISTIC OF CARNATION CULTIVARS 'MINITIARA SERIES' BRED BY BUD MUTATION

Hiroaki Sugihara*, Hayato Morimoto, Takako Narumi-Kawasaki, Takejiro Takamura, Seiichi Fukai

Kagawa University, Faculty of Agriculture, Miki, Kagawa 761-0795, Japan

*hs.monotremata@gmail.com

Cut spray carnation cultivars "MINITIARA series" have a unique narrow sword-shaped petals with various colors, and were bred from pinkish-flowered 'MINITIARA PINK (MP)' or pinkish creamy-flowered 'MINITIARA CREAM (MC)' through bud mutation. The bud mutation of MP has produced 4 cultivars; deep pinkish-flowered 'MINITIARA CORAL PINK (CP)', orange-flowered 'MINITIARA SUNNY (MS)', pale pinkish-flowered 'MINITIARA BABY PINK (BP)' and white-flowered 'MINITIARA MILK WHITE (MW)'. Another cultivar, yellow flowered 'MINITIARA STAR YELLOW (SY)', was bred from MS through the bud mutation. The color values of L*, a* and b* of each cultivar were determined by use of color meter. The petals of CP indicated that larger a* value than those of MP, whereas the b* value was not so different. The petals of MS showed larger a* and b* values than those of MP. The petals of BP and MW showed remarkably smaller a* value and slightly larger b* value than those of MP. The petals of SY indicated remarkably smaller a* value and larger b* value than those of MS. 'MINITIARA LILAC (ML)' having pale purplish flowers, a cultivar derived from MC, showed remarkably larger a* value and smaller b* value in the petals than MC. Main flower pigments of each cultivar were determined by using HPLC. The main pigments of petals in these 6 cultivars derived from MP were pelargonidin-type anthocyanins and chalcononaringenin 2'-glucoside (Ch2'G). MC and ML contained cyanidin-type anthocyanin and Ch2'G in the petals. Anthocyanin and Ch2'G contents in the petals varied depending on the cultivars suggesting that the petal color variations of "MINITIARA series" determined by ratio of the anthocyanin and Ch2'G.

Keywords: cut spray carnation, bud mutation, flavonoid biosynthesis

P10:

CHANGES IN CARBOHYDRATE CONTENT IN PETAL PARTS OF INCURVED MALFORMED FLOWERS OF FRAGRANT CUT ROSE VARIETY 'Yves Piaget'

Rei Kaneeda*, Takashi Handa

School of Agriculture, Meiji University, Kawasaki, Japan

*ef1012867@gmail.com

Rosa × hybrida 'Yves Piaget' is a fragrant cut rose variety that sometimes bears malformed flowers known as 'incurved flowering'. This 'incurved flowering' is characterized by adaxial curving of the petals, which decreases emission of volatile compounds. However, 'incurved flowering' mechanism is not clear. In this study, we compared fresh weight, and levels of carbohydrates in petal parts and leaf of both normal and malformed flowers. The flowers were harvested at three different flowering stages: stage 1: tight bud, stage 2: mature bud, stage 3: five opened petals. Five outer petals were removed from the flowers and they were cut into pieces at less than 1cm, using edge and inner section of the petals. Their fresh weight and growth rate was measured and calculated. The five outer petals were used to analyse carbohydrate content with HPLC. Fresh weight was increased at stage 2 in all parts of both normal and malformed flowers, and the growth rate in malformed flowers were higher than normal flower. However, at stage 3, growth rate of the petal edges of malformed flower decreased. The fructose content of the edge of malformed flower petals was lower than those of normal flowers at stage 2 and 3. On the other hand, the inner parts of the petals showed no difference of carbohydrate contents between normal and malformed flowers at all stages. These results suggest that fructose level in edge of malformed flower petals decreased osmotic pressure that enabled water flow into the petal cells. As a result, water could not flow into the immature cells at the edges of the petals and caused the adaxial curving of the petals in malformed flower.

Keywords: petal growth, soluble carbohydrate, fructose



P11:

EFFECT OF QUALITY, QUALITY SHIFTING, AND POSITIONING OF NIGHT INTERRUPTION LIGHT ON MORPHOGENESIS, FLOWERING, AND PHOTOPERIODIC GENE EXPRESSIONS IN *Petunia hybrida* Hort. 'Easy Wave Pink'

Yoo Gyeong Park^{1*}, Hai Kyoung Jeong², Byoung Ryong Jeong¹

¹Institute of Agriculture Life Science, Gyeongsang National University, 52828 Jinju, Korea (Republic of)

²Division of Applied Life Science BK21 Plus, Gyeongsang National University, 52828 Jinju, Korea (Republic of)

*iuyiuy09@naver.com

Effect of quality, quality shifting, and positioning of night interruption light (NIL, 10 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPF) on morphogenesis, flowering, and photoperiodic gene expressions was investigated in petunia 'Easy Wave Pink' (qualitative long day plant, LDP). Plants were grown in a closed-type plant factory under an intensity of 180 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ photosynthetic photon flux (PPF) provided by white (W) light emitting diodes (LEDs) under either long day (LD, 16 h light/8 h dark), short day (SD, 10 h light/14 h dark), or SD with 4 h NI. In expt. 1, NIL was provided by blue (NI-B), green (NI-G), red (NI-R), far-red (NI-Fr), or white (NI-W) LEDs. Shoot length was the greatest in NI-Fr. Flowering was observed in LD, NI-G, NI-Fr, and NI-W. The phyA, phyB, and cry1 were highly expressed in NI-G, NI-B, and NI-R, suggesting that morphogenesis, flowering, and transcriptional factors were highly affected by quality of NIL. In expt. 2, with LD and SD as the control, NIL quality (B, R, Fr and W) was shifted after 2 h, and they were designated as NI-BR (i.e. from blue to red), NI-RB, NI-RFr, NI-FrR, NI-BFr, NI-FrB, NI-WB, NI-BW, NI-FrW, NI-WFr, NI-RW, and NI-WR. Shoot length was the greatest in NI-RFr. Plants flowered in LD, NI-BR, NI-RB, NI-RFr, NI-WB, NI-BW, NI-RW, and NI-WR. While the second NIL affected both, the first NIL did not affect neither morphogenesis nor flowering. In expt. 3, NI-B, NI-R, NI-Fr, or NI-W was given to shoot tip (ST), youngest mature leaf (YL), or old leaf (OL). Shoot length was the greatest in NI-Fr given onto any position. Leaf growth was affected by NIL given to ST. Flowering occurred in NI-R onto YL and NI-W onto OL. The NI-R or NI-W onto YL or OL could potentially be used as a tool for the flowering control during SD seasons.

Keywords: anthesis, blue LED, cryptochrome, lighting position, light quality, photomorphogenesis, photoreceptor, phytochrome

P12:

ANTHOCYANIN CONTENT IN LEAVES OF ORNAMENTAL POT PLANTS MODIFIED BY LED LIGHT SPECTRA

Ellen De Keyser¹, Emmy Dhooghe¹, Annelies Christiaens², Marie-Christine Van Labeke³, Johan Van Huylenbroeck^{4*}

¹Caritasstraat 39, 9090 Melle, Belgium

²Schaessestraat 18, 9070 Destelbergen, Belgium

³Coupure links 653, 9000 Gent, Belgium

⁴ILVO- Plant Sciences Unit, Applied genetics & breeding, Caritasstraat 39, 9090 Melle, Belgium

*johan.vanhuylenbroeck@ilvo.vlaanderen.be

Light stimulates the production of anthocyanins in leaves. Assimilation light is needed in the production of red colored foliage plants during the winter period in order to obtain a commercially attractive product. Here we tested whether this can be achieved by growing those plants for a few weeks in a growth chamber under specific LED light spectra. The experiment was conducted on 3 species: *Hypoestes* or polka dot plant (both red and pink), *Guzmania lingulata* 'Theresa' with yellow and red bracts and *Cryptanthus carnosus*. Different combinations of blue and red light with a total PAR of 100 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ were applied and control treatments were given with and without HPS lamps in the greenhouse. In *Guzmania*, a minimal amount (20% was the minimal value in our experiment) of blue light is compulsory to induce the anthocyanin production in the bracts. If only red light is used, the bracts remain yellow and this is not wanted by the consumer. Similar for *Hypoestes* a combination of red and blue light is required; when only red LEDs are used leaves become curly and plants are unattractive. On *Cryptanthus* also the combination of red and blue light is sufficient to obtain intensive leaf coloring. Addition of extra far-red had no added value. In all cases, the use of LED was an improvement for the anthocyanin content when compared to plants grown without supplementary light. We demonstrated that for all



3 species a period of 5 weeks under specific light spectra can be a good way to produce attractive coloured plants during the winter.

Keywords: LED light, blue light, red light, pigments

P13:

ORNAMENTAL PLANT POTENTIAL OF SOME ERICACEAE SPECIES IN TURKEY

Bahadır Altun^{1*}, Ezgi Ekici²

¹Ahi Evran University, Agriculture Faculty, Horticulture Department, 40100 40 Kirsehir, Turkey

²Ahi Evran University, Agriculture Faculty, Agricultural Biotechnology, 40100 40 Kirsehir, Turkey

*bahaltun@gmail.com

The species of Ericaceae family, natural flora elements of rural landscape, have become an indispensable element in urban landscape planning, in the world with the different colors and structures of flowers and leaves. Depending upon the species, their flowers are single or the form of spikes, in quite different colors and tones. Leaves with autumn colouring of foliage or evergreen species, large entire or dentate; sometimes needle-shaped, hairy or hairless. In this presentation, it was aimed to give some information on the morphological characteristics, natural distribution areas and possible usage in landscape planning of the species of natural Ericaceae genera, such as Andromeda, Rhododendron, Epigaea, Rhododendron, Calluna, Arbutus, and Clerodendrum exotic plant for Turkey. These genera have not been used in the urban landscape planning in Turkey because of the various reasons such as unrecognition, reproduction and breeding techniques etc.

Keywords: Ericaceae, morphology, distribution areas, landscape planning

P14:

EFFECT OF NIL QUALITY AND INTENSITY ON MORPHOGENESIS AND FLOWERING OF CHRYSANTHEMUM AND KALANCHOE

Hai Kyoung Jeong^{1*}, Dong Il Kang¹, Hao Wei¹, Yoo Gyeong Park², Chen Liu¹, Luc The Thi¹, Byoung Ryong Jeong²

¹Division of Applied Life Science BK21 Plus, Gyeongsang National University, Jinju 52828, Korea (Republic of)

²Institute of Agriculture Life Science, Gyeongsang National University, Jinju 52828, Korea (Republic of)

*jhksmile@naver.com

Chrysanthemum and kalanchoe are qualitative short day plants that will not produce flowers when the day length is greater than a critical value which is cultivar-dependent. Flowering is effectively inhibited when the required long night phase is interrupted by a short period of exposure to night interruption light (NIL). The effect of NIL quality and intensity on morphogenesis and flowering of three cultivars of *Chrysanthemum morifolium*, 'Pearl Egg', 'Golden Egg' and 'Gaya Yellow', and two cultivars of *Kalanchoe blossfeldiana*, 'K15-16' and 'K15-9-6', were examined. Plants were grown in a close-type plant factory under a light intensity of 250 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ photosynthetic photon flux density (PPFD) provided by white LEDs in an either long day (LD, 16 h light/8 h dark), short day (SD, 8 h light/16 h dark), or SD with a 4 h night interruption (SD + NI). The NI was provided by either 10, 20, 30 or 40 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPFD with either blue (NI-B), red (NI-R), white (NI-W), or blue+white (NI-BW) LEDs. In the case of chrysanthemum, flowering induction was only observed in the treatments of SD and SD interrupted with 10 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PPFD blue light (NI-B10) in all cultivars. In the case of kalanchoe, flowering was consistently observed under SD treatments in both cultivars. In conclusions, the results suggest that morphogenesis and flowering of these plants were affected by quality and intensity of NIL, implicating potential usefulness as a practical technique for pot plants production in closed plant factory systems.

Keywords: flowering control, photoperiodic plant, night interruption, light intensity, light quality



P15:

AN ANALYSIS TO THE SELF-CONGRUITY OF FLOWERS FOR FLOWER GIVER'S PERSONALITY TRAITS IN ROMANTIC GIFT GIVING

Li-Chun Huang

National Taiwan University, No.1, Sec.4, Roosevelt Rd, 10617 Taipei, Chinese Taipei

[*lihuang@ntu.edu.tw](mailto:lihuang@ntu.edu.tw)

Romantic gift giving has become an important sector for the retail of flowers. As gifts are the extension of giver's self, whether the gift can identify the personal characteristics of givers becomes critical for consumers to decide whether to buy flowers as gifts. Based on the theory of self-congruity, consumers tend to buy the products that are consistent with their personal traits, so the comprehension of the self-congruity of flowers with consumers' personality can help the florists in designing their products in a style fitting to consumers' personality, which is beneficial for increasing consumers' purchase intentions. This study was aimed to identify the perceived personality traits of flower givers in romantic gift giving, as well as the self-congruity of flowers with flower givers' personality. The statistical results of factor analysis with the data grounded from 384 valid questionnaires indicated that the personality of flower givers were portrayed from seven dimensions, including elegance, sincerity, richness, extroversion, romanticism, home-life styled, and language skills. The statistical results of t-test also indicated that the consumers who revealed high involvement in romantic relationship were more likely to perceive flowers as consistent to their true self, but less likely to their ideal self or social self, compared with the consumers who were less involved in romantic relationship. Self-esteem also influenced consumers' perception regarding the consistency between the image of flowers and individuals' personality. Consumers with high self-esteem were more likely to image flowers as consistent to their true self, instead of their ideal self or social self, compared with the consumers with low self-esteem. The study results clarify the metaphor of flowers that consumers used to identity their personal traits in the different roles of self, benefiting the florists to design their products more fitting to the demand of flower givers for romantic gift giving.

Keywords: flowers, symbolic consumption, factor analysis, t-test, personal traits

P16:

COLLECTION OF GENUS *Magnolia* L. IN THE ARBORETUM OF THE NIKITA BOTANICAL GARDENS

Yury Plugatar*, Vladimir Gerasimchuk, Vladimir Koba, Vladimir Papelbu

Nikita Botanical Gardens-NSC, 298648 Yalta, Russian Federation

[*plugatar.y@mail.ru](mailto:plugatar.y@mail.ru)

The Arboretum of the Nikita Botanical Gardens (NBG) is located in the central part of the Southern Coast of Crimea and encompasses four parks with the total area of 40 ha. Over more than 200-years history of its development, NBG has contributed significantly to the introduction of woody and frutescent plants, many of which became later widely used in landscaping and greening of the populated areas in the south of Russia. Such ornamental plants include certain species of magnolias. The genus *Magnolia* L. comprises 270 taxons of evergreen, foliage plants and bushes growing predominantly in the subtropical areas of Central and East Asia and at the east of North America. According to its climatic conditions, the observation area belongs to dry subtropics. The average annual temperature in the area of the parks' location amounts to +12,5°C. The average annual precipitation in this region is 589 mm, its majority falls in autumn and winter. The parks have brown soils on the carbonate lower subsoils (limestones). The plants grow mainly on immature and shallow soils with low humus content that, coupled with the long drought season (May-September) and a high value of the radiative dryness index of (2,0), characterize rather stringent conditions for growth and development of magnolias at the Arboretum of the NBG. Since 1813, the introductions tests in the Arboretum of the NBG was conducted with 9 species of genus *Magnolia* L. In the first plantings the following species were represented: *Magnolia acuminata* L. – 1814-1850, *Magnolia glauca* L. – 1813-1910, *Magnolia tripetala* L. – 1817-1900, *Magnolia denudata* Desf. – 1842-1990, *Magnolia macrophylla* Michx. – 1840-1900. Currently 12 taxons of the genus *Magnolia* L. grow at the Arboretum of the NBG: *Magnolia grandiflora* L., *Magnolia grandiflora* var. *hartwissiana* Zabel., *Magnolia grandiflora* 'Exmouth', *Magnolia grandiflora* 'Ferruginea', *Magnolia grandiflora* 'Rotundifolia', *Magnolia kobus* DC., *Magnolia kobus* var. *borealis* Sarg., *Magnolia kobus* var. *loebneri* (Kache) Spongberg, *Magnolia kobus* var. *loebneri* 'Merrill', *Magnolia liliiflora* 'Nigra', *Magnolia* × *soulangeana* Soul.-Bod., *Magnolia* ×



soulangeana 'Alexandrina'. Acknowledgements: This study was funded by a research grant № 14-50-00079 of the Russian Science Foundation.

Keywords: genus *Magnolia* L., the Arboretum of the NBG, introduction, bioecological peculiarities, adaptation potential, gene pool collection

P17:

CHROMOSOME DOUBLING OF TORENIA INTERSPECIFIC HYBRIDS BY USE OF EFFICIENT ADVENTITIOUS SHOOT REGENERATION IN VITRO

Seiichi Fukai^{1*}, Takako Narumi-Kawasaki¹, Tanapoom Laojunta²

¹Faculty of Agriculture, Kagawa University, Miki-cho, Kida-gun, Kagawa 761-0795, Japan

²Ikenobe 2393, Miki-cho 761-0795, Japan

*fukai@ag.kagawa-u.ac.jp

Torenia is a popular summer bedding plant. Commercial *torenia* cultivars derived from interspecific cross have been increased. Interspecific hybrids often show male sterility, which is a limit for further use in a breeding program. Chromosome doubling is a way to restored pollen fertility. To develop efficient adventitious shoot regeneration protocol leaf explants treated with or without scarification were cultured on MS medium with or without BA. Result showed that explants with scarification cultured on MS medium supplemented with 2 mg/l BA showed best regeneration with 21.7 shoots per leaf explant. Then polyploidy induction was tested by the combination of the efficient regeneration and colchicine treatment in *Torenia fournieri*. 1500 mg/l colchicine treatment showed best result with 20 % tetraploid induction. Twenty days of colchicine treatment produced 42.4 % tetraploid induction. Leaf explants of some male sterile interspecific hybrids were treated with colchicine. The tetraploid induction frequency varied from 10 to 84.6 % depending on hybrids. All tetraploid *torenia* hybrids produced fertile pollen. The pollen germination also varied from 13.2 to 65.4 % depending on hybrids. The tetraploid *torenia* had bigger flower and leaf compared with diploid.

Keywords: interspecific cross, pollen germination, diploid, tetraploid, scarification

P18:

A STUDY ON GROWING TECHNIQUES OF NATIVE *Narcissus tazetta*

Ömer Sari^{1*}, Fisun Çelikel²

¹Agricultural Research Institute, of the Black Sea, Samsun, Turkey

²Ondokuz Mayıs University, Faculty of Agriculture, Department of Horticulture, Atakum, Samsun, Turkey

*omer.sari@tarim.gov.tr

The effect of planting time (September, October and November) and the size of flower bulbs (12.1-14 cm, 10.1-12 cm and 8.1-10 cm) on flower quality and flowering period of *Narcissus tazetta* naturally grown in Ordu on Black Sea region, were investigated. Tepal width, tepal length, corona diameter, corona length, perianth tube length, flower size, flower stem length, flower stem diameter, the pedicel length, ovary length, the number of flowers per stem, flower diameter, number of leaves, leaf width, leaf length, vase life, yield and flowering period were determined. The best quality of flowers, as well as the highest flowering rate, were obtained from the flower bulbs with a circumference of 12-14 cm. The smaller bulbs with a circumference of 10-12 cm produced only a few florets, whereas the smallest ones did not produce any florets. Therefore, it is suggested that the minimum circumference of the bulbs should be at least 12 -14 cm for cut flower production of *Narcissus tazetta*. September was the best planting time for *Narcissus tazetta* cut flower production as to the flower quality and harvest period. The flowering period was extended to about 3 months (15 January - 11 April) by planting the bulbs at 3 different times.

Keywords: *Narcissus tazetta*, bulb size, cultivation, flowering period, flower quality, planting time



P19:

HOW TO MANIPULATE HYDRANGAEA (*Hydrangea macrophylla*) COLOR?

Elçin Gözde Ergür^{*1}, Tuğba Kılıç², Soner Kazaz¹, Burak Aslansoy³, Ezgi Doğan⁴

¹Department of Horticulture, Faculty of Agriculture, Ankara University, Turkey

²Department of Horticulture, Faculty of Agriculture, Bozok University, 66200 Yozgat, Turkey

³Plant Biodiversity, Geophyte Research and, Training Center Directorate, 34820 Istanbul, Turkey

⁴Department of Horticulture, Faculty of Agriculture, Bingöl University, 12000 Bingöl, Turkey

[*gozde_gop@hotmail.com](mailto:gozde_gop@hotmail.com)

Recently, Hydrangea which has common usage as cut flower, pot plants and garden plants, has been gradually increasing in both popularity and production in the world. The colour of hydrangea (*Hydrangea macrophylla*)'s sepals (except white colour) varies from blue to purple and red depending on soil pH, sucrose content, metal content, temperature and light. The main factor in colour change is the pH value of the growth medium. It is possible to see different colours in the flowers which are located on the different stems of the same plant, depending on the pH value of the growth medium and the addition of Aluminium (Al). When the pH value of the growth medium is in between 4.5 and 5.0, the intake ability of Al increases and the colour of the sepals becomes blue. In case of pH value at 6.5, the intake of Al become restricted and the sepals are turned into pink and red colour; but in neutral conditions, the sepals are purple colour. The anthocyanins has a distinct role on the colour change of hydrangeas. In the structure of these compounds, as the number of -OH group (hydroxyl) increases, the blue colour increases; but as the number of OCH₃ group (methoxylated hydroxyl) increases, the redness increases. Al is not only promotes the anthocyanin pigment to turn into blue colour, but also protects intracellular pH from possible changes and ensures that the colour remains constant. Anthocyanin, delphinidin 3-glucoside and co-pigments have an effect on blueness in hydrangeas. Al binds the pigments and 3-caffeoyl and 3-p-coumaroylquinic acids which are co-pigments in the sepals, and this Al/pigment/co-pigment complex provides the colours conversion of sepals from pink to blue. In this study, it is given information about manipulation of flower colour and factors which is affecting flower colour in hydrangeas.

Keywords: Hydrangea, color, sepal, anthocyanin, manipulating, pH, aluminium

P20:

BIOLOGICAL CONTROL IN CUT FLOWERS

Ezgi Doğan^{1*}, Soner Kazaz², Emin Kaplan³, Tuğba Kılıç⁴, Elçin Gözde Ergür², Burak Aslansoy⁵

¹Bingöl University, Faculty of Agriculture, Department of Horticulture, 12000 Bingöl, Turkey

²Ankara University, Faculty of Agriculture, Department of Horticulture, Diskapi - Ankara, Turkey

³Bingöl University, Faculty of Agriculture, Department of Plant Protection, 12000 Bingöl, Turkey

⁴Bozok University, Faculty of Agriculture, Department of Horticulture, 66200 Yozgat, Turkey

⁵Plant Biodiversity, Geophyte Research and, Training Center Directorate, 34820 Istanbul, Turkey

[*ezgidgn23@gmail.com](mailto:ezgidgn23@gmail.com)

While globalization has spread economic, political and social relations among countries, international competition has increased. These competition has also increased the use of pesticides in order to enhance productivity and quality, and now it poses a threat to the environment and human health. While the yield and quality of cut flowers foreground satisfaction of producer, it comes into foreground visual quality in terms of consumer satisfaction. Both yield and visual quality are exposed to the threats by many harmful organisms (red spider mites, thrips, white fly, mealybug, leaf beetle, fly leaf gallery, etc.) and as a result, economic losses are experienced. In cut flowers, the problems of development of tolerance or resistance to pests and chemical residues, led to the efforts to reduce the use of insecticides against pests and to develop the alternative methods. Biological control is the leading alternative. The most common natural enemies of cut flower pests such as parasite, parasitoid and predator are insects, mites, bacteria, fungi and nematodes. Cut flowers are produced in many countries such as Kenya, Ecuador, Ethiopia, Italy, Spain and Israel, especially in the Netherlands and Colombia, which is the world leader in cut flower production. In the production of many cut flower species, especially cut roses and chrysanthemums, biological control method against pests is applied in these countries and it is expected that this method will become more widespread in the future. This study generally focuses on the insects and mites used in biological control of cut flower pests and includes the principles of biological



control, its advantages, important issues related to it and studies on biological control suggested and used against cut flower pests.

Keywords: cut flower, biological control, pests, useful insects

P21:

EFFECTS OF BULB PRECOOLING TREATMENTS ON POT DAFFODIL GROWING

Emrah Zeybekoglu^{1*}, Şevket Alp², Ali Salman³, Mustafa Ercan Özzambak¹

¹Ege University, Faculty of Agriculture, Horticulture Department, 35100 Izmir Bornova, Turkey

²Department of Landscape Architecture, Van University, Van, Turkey

³Bayındır Vocational High School, Ege University, Faculty of Agriculture, 35100 Izmir Bayındır, Turkey

*zeybekoglu@gmail.com

While cut narcissus is a popular ornamental crop in Turkey, almost there is no pot narcissi usage. In this study, to offer a useful knowledge, which may be useful the spread of pot narcissi cultivation, it is aimed to determine the suitable cultivars for pot cultivation and investigate the effects of some pre-cooling treatments on growth and blooming time-ratio and flower size. 13-14 sized bulbs of 8 different daffodil cultivars and pots 10 cm in diameter (at the top) were used. Peat-perlite mix (1:1) was used as growing media. Plant growth was carried out in greenhouse conditions. Before planting three different preparation treatments were applied: (1) Storage at 17-20 °C for 10 weeks (10.7.2015 – 10.9.2015), afterwards at 9 °C for 8 weeks; (2) Storage in the ordinary storage conditions (under the porch) 10 weeks afterwards at 9 °C for 8 weeks; (3) Storage in ordinary storage conditions for 18 weeks (control). Bulbs were planted in the pots at 25-28. 10. 2015. Flower stem length, total length, leaf length, first flowering time, flowering period were affected by the treatments. Treatment 1 gave the most favorable results. At treatment 1 flowering was 7,6 day earlier than control and quality properties were better. Duch master, Strong Gold, Ice Folies, Golden Harvest, Prof Einstein were determined as suitable cultivars for pot planting.

Keywords: preparation daffodil, pot

P22:

RESPONSE OF THE TROPICAL CLIMBING WOODY *Ipomoea purpurea* TO FERTILIZATION

Armando Tavares^{1*}, Karina Silva², Mauricio Lamano³

¹Instituto de Botânica, Rua da Paz, 2150 apto. 22, 04713-002 São Paulo, Brazil

²Av. Miguel stefano, 3687, São Paulo, Brazil

³R. Dante Batiston, 87, São Paulo, Brazil

*atavares2005@yahoo.com.br

Ipomoea purpurea is a tropical climbing woody with beautiful foliage on stems that interlace in substrates and rods exhibiting an ornamental arrangement. The objective of this study was to analyze the growth and biomass accumulation of plants of *I. purpurea* fertilized with different concentrations of commercial solution of nitrogen, phosphorus and potassium (NPK). Plants of *I. purpurea* were weekly irrigated with 100 ml of commercial solutions NPK (10-15-15) prepared as follows: 0 g L⁻¹, 0.25 g L⁻¹, 0.50 g L⁻¹; 1.00 g L⁻¹ or 1.50 g L⁻¹ for one month. The Biometric and accumulation of aboveground biomass evaluations were performed on the end of the experiment. The results showed that the stem height showed significant differences between treatments 0 and 0.25 g L⁻¹ NPK. Older leaves were grew more than new ones, showing statistical differences between treatments. The biomass showed that the stem had the highest average values of biomass accumulation compared to leaves. The ratio leaf/stem was higher on 1 g L⁻¹ NPK, with the most ornamental quality. We concluded that the solution 1 g L⁻¹ NPK was effective in promoting growth and enhance the ornamental characteristics in this species.

Keywords: biometrics, Convolvulaceae, NPK, ornamental potential



P23:

CUTTING AGE AFFECTS WATER DEMAND OF UNROOTED CUTTINGS PRIOR TO ROOT INITIATION

Peter Alem¹, James Faust^{2*}

¹E-143 Poole Agriculture Bldg, Clemson SC 29634, United States of America

²D136 PA Bldg, Clemson, SC 29634-0375, United States of America

*jfaust@clemson.edu

Commercial propagators reduce the frequency of mist provided to unrooted poinsettia (*Euphorbia pulcherrima*) cuttings on a daily basis during the first week in propagation prior to root initiation. This suggests that water regulation by the cuttings changes as the cuttings recover from being severed from the stock plant. The objective of this experimentation was to quantify the water flux of unrooted cuttings during the first week in propagation. In the first experiment, cuttings of four ages (1, 3, 5 and 7 days in propagation) were removed from their water source and placed into dark or light environments. Time to wilt was recorded. In the dark, the time to wilt increased as cutting age increased. For example, it took 75, 135, 230 and 325 minutes to wilt for cuttings that had previously been in propagation for 1, 3, 5, or 7 days, respectively. In the light ($275 \mu\text{mol.m}^{-2}\text{s}^{-1}$), the cuttings wilted much faster, e.g., after 26, 36, 48 and 62 minutes for 1, 3, 5, or 7 day old cuttings, respectively; however, the trend was similar. The amount of water loss per cutting at the point of wilting was not affected by cuttings. Thus, water regulation markedly improved with time in propagation regardless of the light environment. In a second experiment, water uptake was recorded on 1, 3, 5, or 7 day old cuttings placed into vials of water. The rate of water uptake decreased with cutting age. For example, Day 1 cuttings used 0.24 ml.h^{-1} , while Day 7 cuttings used only 0.14 ml.h^{-1} . These results suggest that water regulation of unrooted cuttings increases during propagation before root initiation. Possible mechanisms for water regulation of unrooted cuttings and the ramifications on mist control strategies for commercial propagators will be discussed.

Keywords: *Euphorbia pulcherrima*, evapotranspiration, poinsettia, stock plant

P24:

GAS EXCHANGE OF POINSETTIA LEAVES FROM THE STOCK PLANT THROUGH THE PROPAGATION ENVIRONMENT

Peter Alem¹, James Faust^{2*}

¹E-143 Poole Agriculture Bldg, Clemson SC 29634, United States of America

²D136 PA Bldg, Clemson, SC 29634-0375, United States of America

*jfaust@clemson.edu

Gas exchange measurements (photosynthesis, stomatal conductance and transpiration) were measured on poinsettia (*Euphorbia pulcherrima*) leaves under ambient conditions on the stock plant prior to cutting removal and then on those same leaves after the cuttings were harvested from the stock plant, placed in a simulated postharvest environment for 3 days, and grown on a propagation bench for 28 days. The results demonstrate a dramatic reduction in photosynthesis on leaves on unrooted cuttings (Days 1-7) in propagation compared to the stock plant. As cuttings begin to develop roots, photosynthesis and transpiration rates continue to increase, regaining the normal level of photosynthetic capacity and stomatal functioning typical of a mature stock plant. In a second study, light response curves were generated for leaves on stock plants and through 28 days in propagation. These results showed that unrooted cuttings that were 1 to 7 days in propagation had very low photosynthetic rates while photosynthesis increased significantly by Day 21 when the plants had significant root growth. By Day 28, the cuttings were well rooted and the photosynthetic capacity of leaves had returned to levels similar to those of the stock plants. Chlorophyll fluorescence measurements (Fv/Fm) did not significantly change on leaves from the stock plant through the propagation cycle. These results document the changes in gas exchange that occur to leaves as they progress from the stock plant to unrooted cuttings and then to rooted cuttings.

Keywords: *Euphorbia pulcherrima*, photosynthesis, stomatal conductance, transpiration



P25:

THE SELECTION OF A SEED BEARING VARIETY OF THE PERENNIAL, *Cosmos atrosanguineus* (HOOK.) VOSS

Russell Poulter¹, Margi Butler^{2*}

¹University of Otago, Dunedin, New Zealand

²University of Otago, Department of Biochemistry, Dunedin, New Zealand

*margi.butler@otago.ac.nz

The southern highlands of Mexico were once home to a wild 'dahlia', a perennial cosmos, *Cosmos atrosanguineus*. It reaches 60cm with dark stems and narrow leaves and has tuberous roots. The flowers are deep blood red to dark brown with a scent very like chocolate. Shortly after its discovery, the species was described, with a coloured illustration, by William Hooker in Curtis' Botanical Magazine (1861). The species was introduced to cultivation in Europe and was widely acclaimed (it won a Royal Horticultural Society Award of Merit in 1938). In the meantime, the species was believed to have become extinct in the wild (Hind & Fay, 2003). The plant was initially maintained in cultivation either by seed or vegetatively (cuttings or division of tubers). Over time, the seed forming character was lost. This loss was unfortunate since in Europe, North America and other temperate climates the tubers are at risk from frosts if left in the open ground during winter. It is also expensive to reproduce the plant vegetatively. Between 1990 and 1995, we selected from rare seeds, plants that closely resembled the early illustrations. This seed, under the name 'Pinot Noir', was submitted for Plant Variety Rights protection in New Zealand and Europe. It was granted in 1997. This fertile seed-raised cultivar has been maintained for more than 20 years creating a population of *C. atrosanguineus* that breeds true from seed and retains genetic diversity (Rice 2017). *C. atrosanguineus* has recently been discovered in the wild: "...it turns out that *C. atrosanguineus* is not extinct and that there are records of the plant from 1986 through to the recent collections of Aarón Rodríguez and his team" (Rice 2017). *C. atrosanguineus* Pinot Noir has been the source of multiple new selections, such as Dark Secret ('3013/01'), Eclipse ('Hamcoec') and Spellbound ('Hamcosp').

Keywords: *Cosmos atrosanguineus*, chocolate scented, perennial, seed

P26:

THE ADAPTATION OF ALIEN ORNAMENTAL HERBACEOUS PERENNIALS' BENEFITS AND RISKS

Inese Naburga-Jermakova*, Lauma Strazdina

Kandavas street 2, LV-1083 Riga, Latvia;

*bitc.les@inbox.lv

During the last 25 years, the diversity of plants for ornamental horticulture in Latvia has grown rapidly. Most of the taxa are alien species and cultivars. The success in gardening depends on the adaptation of plants to the local conditions. At the same time, too good adaptation of alien taxa may cause a risk to wild local flora and landscape as well. The aim of our study was to evaluate the adaptation of ornamental herbaceous perennials to the agroclimatic conditions in Latvia and the Botanical Garden of the University of Latvia in particular. 335 taxa from 182 genera were studied at the Botanical Garden, and it reaches 58% of herbaceous perennials stock in local markets and nurseries. The adaptation rate of taxa was determined depending on several features fixed during phenological observations such as overwintering, resistance against diseases and pests, reproduction etc. Plants were classified according to adaptation rate in four groups: bad, medium, good and very good adapted. The results showed that 33% of alien taxa were good adapted and 37% of taxa were ranked in the middle adaptation group, followed by very good (7%) and bad (2%) adapted species. All of the plants that showed good adaptation excel in a high generative and/or vegetative self-reproduction. Some of them have the potential for naturalization or invasiveness. Besides the alien taxa, nursery-stock catalogs offer 61 species that are native in Latvia's flora and 31 escaped cultivated species.

Keywords: adaptation rate, ornamental herbaceous perennials, escaped cultivated species



P27:

MOLECULAR CHARACTERISTICS AND EVOLUTION OF NRDNA ITS AND CPDNA PETB/PETD SEQUENCE IN *Lilium Pumilum* REDOUTÉ ON SOUTHEASTERN OF QINGHAI-TIBET PLATEAU

Dr. Nan Tang*, Fujuan Jiang, Daocheng Tang

The key laboratory of landscape plants, Plateau Flower Research Center, Qinghai University, Xining, 810016, China

*natasha_tn@hotmail.com

Lilium pumilum Redouté belongs to Liliaceae genus *Lilium* Sect. *Sinomartagon*. *L. pumilum* distribute widely in China, Korea, Mongolia, Russia and et al. On Qinghai-Tibet Plateau, there are *L. pumilum*, *L. lancifolium* and *L. davidii*, in which *L. pumilum* is the only wild species. *L. pumilum* grows on sunny slope of dry grassland, forest edge and ravine in the forest. Due to the special climate and rich plant resources, Qinghai-Tibet plateau is considered to be a hot spot region to study biodiversity. This study selected 25 *L. pumilum* populations (217 individuals) as material, using genome DNA as template, nrDNA ITS and cpDNA sequences were amplified, purified and sequenced. Primary phylogeography analysis was performed to provide basis for protection and utilization of wild resources and for genebank construction. By sequence alignment, it was known that length of nrDNA ITS sequence was 696bp, of which 4 variable sites with a percentage of 0.72% were found. The G+C content of ITS sequence was 60.4% and 7 haplotypes were observed. The length of cpDNA petB/petD sequence was 616bp, of which only 1 variable site was found (0.16%). The G+C content of the sequence was 34.6% and 2 haplotypes were found. The petB/petD region of *L. pumilum* was more conserved and evolved slower than ITS sequence. Therefore, cpDNA sequence was not quite suitable for phylogeographic related study due to lack of effective variable site. Although the number of effective variable site provided by nrDNA ITS sequence was not so many, it is possible to estimate whether the populations experienced expansion. So, nrDNA ITS could be used for phylogeographic related study. AMOVA analysis showed that genetic diversity of *L. pumilum* was rich, and genetic variation mainly existed within populations. Gene flow between populations was high ($N_m > 1$), which means the number of immigration was large. However, $NST > GST$ ($P > 0.01$) showed that there was no significant phylogeographic structure of genetic variation in *L. pumilum* in Qinghai-Tibet plateau.

Keywords: *Lilium pumilum*, Qinghai-Tibet plateau, molecular evolution, ITS, cpDNA

P28:

THE EFFECT OF CALCIUM ON ION CONTENTS IN DIFFERENT ORGANS AND ABSORPTION OF K^+ AND Na^+ OF ROOT TIP IN *Mesembryanthemum crystallinum* UNDER NaCl STRESS

Pingsheng Leng*, Guanglu Li, Zenghui Hu,

Beijing University of Agriculture, Beijing, 102206, China

*bualengpingsheng@163.com

Mesembryanthemum crystallinum is of high salt resistance, but the role of calcium in the regulation of ionic absorption and balance is little known. In this study, the seedlings of *M. crystallinum* were used as plant materials. After treatment with NaCl, NaCl+CaCl₂, NaCl+LaCl₃, using ICP-OES the contents of Na⁺, K⁺, Ca₂⁺, Mg₂⁺ in leaves, stems, and roots were measured, and the values of K⁺/Na⁺, Ca₂⁺/Na⁺, Mg₂⁺/Na⁺ were also calculated to explore the role of calcium in maintaining ion balance of *M. crystallinum* in response to NaCl stress. Moreover the fluxes of Na⁺ and K⁺ was determined by non-invasive micro-test technique (NMT). The results showed that after NaCl treatment, the Na⁺ contents in three parts increased, the contents of K⁺, Ca₂⁺, Mg₂⁺ decreased, and the ratios of ion contents also dropped significantly. Addition of CaCl₂ reduced the Na⁺ contents, and raised the contents of K⁺, Ca₂⁺, Mg₂⁺, then lead to the increased ratios of ion contents. And LaCl₃ treatment resulted in the opposite change in ion contents and ratios. After treatment with NaCl for 24h, the significant effluxes of Na⁺ and K⁺ on the root tip were found, which indicated that *M. crystallinum* was in a state of ionic imbalance. After addition of CaCl₂, the Na⁺ efflux rate increased obviously, and the K⁺ efflux rate was inhibited. On the contrary, LaCl₃ reduced the Na⁺ efflux rate, and accelerated K⁺ efflux. So in *M. crystallinum* under salt stress, calcium contributed to promoting Na⁺ efflux and preventing K⁺ efflux in root tip, and furthermore resulted in the lower Na⁺ contents in three parts. Thus, calcium plays an important role in maintainment and regulation of ionic balance of *M. crystallinum* exposed to salt stress.

Keywords:



P29:

ACOUSTICAL DIAGNOSIS OF SHAFT-WOOD PHYTO-PATHOGENIC DAMAGE OF *Sequoiadendron giganteum* (LINDL.) BUCCHOLZ

Vladimir Gerasimchuk^{1*}, Yury Plugatar², Vladimir Koba², Mr. Vladimir Papelbu²

¹The Nikita Botanical Gardens, Yalta, Crimea, Nikita, 298648, Russian Federation

²The republic of the Crimea, Yalta, Russian Federation

*gerasimchuk_vova@mail.ru

Nowadays the oldest trees of the first introduction years are in the parks of the Crimea from Foros to Alushta. *Sequoiadendron giganteum* (Lindl.) J.Buchholz cultivation practice in the region shows its successful adaptation to the local conditions. *S. giganteum* endures summer high temperatures and periodical droughts, small frosts, phyto- and entomology pests'- resistant. To improve on breeding composition of forests, to increase their productivity, to step up water conservative and soil-protecting plants' role *S. giganteum* was widely used in the Crimea while creating forest cultivars. The external signs of vital functions' decrease defined the necessity of the complex investigation to appraise the reasons of plants' condition deterioration. At the first stage of work the supersonic tomography method was used because it allows to analyze the destructive changes in the shaft-wood tissues of the depressed trees. The supersonic acoustic tomography complex "Arbotom®" (model ABT05-S) includes the system of impulse location monitors and the computer block for a digital processing of the results of measurements. "Arbotom®" is used for analysis of a shaft-wood tissues' structure. The investigation results allowed to show up the role of some edaphic factors in their affection on a vital condition and the level of destructive processes while shaft tissue damaging of *S. giganteum* in the conditions of the Southern Coast of the Crimea. It was pinned up that soil consolidation and hydro-morphication equally make for a phyto-pathogenic damage of plants. While soil consolidation negative acting the shaft-wood damage is located in an underneath of a shaft. In the conditions of enlarged hydro-morphication a tissue degradation runs less intensively, the destructive processes more active spread in a vertical section of a shaft. The use of a supersonic tomography method gives wide possibilities to diagnose a shaft-wood phyto-pathogenic damage.

Keywords: *Sequoiadendron giganteum* (Lindl.) Buccholz., supersonic tomography, diagnosis, phyto-pathogenic damage, a vital condition

P30:

FLOWERING RESPONSE CATEGORIZATION OF KOREAN NATIVE PLANTS *Veronica rotunda* AND *Lysimachia mauritiana*

Seong Kwang An^{*}, Nam Hyun Im, So Hyun Im, Hyo Beom Lee, Ki Sun Kim

¹Gwanak-ro, Seoul National University, 08826 Seoul Gwanak-gu, Korea (Republic of)

*ahnsungkwang@snu.ac.kr

To determine the flowering requirements of Korean native plants *Veronica rotunda* and *Lysimachia mauritiana* plants were grown under 9-hour photoperiods at 22°C until those have at least five leaves, then the plants were stored at 5°C for 0, 3, 6, 9, or 12 weeks. After cold treatment, the plants were forced under 5 different photoperiod treatments (9, 12, 14, 16, and 24 hours) and night interruption (NI: 9-hour day with a 4-hour between 2200 and 0200HR) with white LEDs in case of *Veronica*. Percentage of plants flowering, days to flowering and plant growth were evaluated. *Veronica* plants without cold treatment flowered regardless of the photoperiods. Flowering rates of *Veronica* plants were 85.7, 92.8, 100, 92.8, 100, or 90% under 9-, 12-, 14-, 16-, 24-hour photoperiod or NI, respectively. However, *Lysimachia* plants without cold treatment remained vegetative growth state under all of the photoperiods. *Lysimachia* plants flowered when exposed to cold treatments before forcing treatment under > 16-hour photoperiods and flowering percentages were 37.5 and 33.3% with 3 weeks, 83.3 and 81.8% with 6 weeks, and 100 and 100% with > 9 weeks of cold treatments, respectively. These results implicated that flowering responses of *Veronica rotunda* and *Lysimachia mauritiana* can be categorized as day-neutral plant and obligate long-day plant, respectively. Also, vernalization before a critical long-day treatment is necessary for flowering in *Lysimachia mauritiana*.

Keywords:



P31:

RECURRENT IRRADIATION WITH COBALT GAMMA RAYS (^{60}Co) ON SEEDS OF AMARYLLIS (*Hippeastrum hybridum*)

Ma. de Jesús Juárez Hernández*, Jesus Alberto Romualdo Atlahua, Luis Fernando Contreras Cruz, Jese Merced Mejia Muñoz, Eduardo Valdez Velarde

Universidad Autónoma de Chapingo, Km 38.5 Carretera Mexico - Texcoco, 56263 Chapingo, Mexico

*juarezhma@yahoo.com.mx

In this study the objective was to evaluate the effect of different doses of irradiation with cobalt 60 on seeds of *Hippeastrum hybridum*. Seeds were seeded in a different mixture of substrates in order to study the germination, growth and development of the seedlings in the first phenological stages. Previously the seeds were selected in large and medium size, were irradiated at different doses: 0 (control), 25, 50, 75 and 100 Gy. Seeds were seeded in three mixtures of substrates in a ratio 1: 1 containing one of them Leaf soil + Peat moss, another Leaf soil + Perlite and the last Peat moss + Perlite, putting 15 seeds per container. There were 30 treatments obtained from the five irradiation doses, three mixtures of substrates and two sizes of seed. The variables evaluated were: germinated seedlings and seedling height. The substrate mixture Leaf soil + Peat moss recorded the highest mean values in seedling height (9.7 cm) and the germination (10.7 seedlings) and were significantly different of the rest of the substrates with $\alpha \leq 0.05$, according to the test of Tukey. Seeds exposed to 25 Gy showed the highest germination (11.08 seedlings), while the control seedlings (0 Gy) obtained the highest mean values in height (10.07 cm); the doses of 75 and 100 Gy recorded the lowest values in both variables. Regarding seed size, there were no significant differences in seedlings height, however, large seeds showed a significant difference in the germination (10.8 seedling). In the leaf soil substrate + Peat moss at 50 Gy and in the substrate Peat moss + Perlite at 50 Gy, there were albino seedlings, which showed a slow growth and only survived during 60 days after germination.

Keywords: mutation, substrates, germination, seedlings

P32:

STUDY OF HUMIC ACID AND HONEY BEE IN THE PRODUCTION OF TULIPA (*Tulipa gesneriana* L.)

Ma. de Jesús Juárez Hernández*, Ittai Queren Lara Cruz, José Merced Mejia Muñoz, Jesús Axayácatl Cuevas Sánchez, Amando Espinoza Flores

Universidad Autónoma de Chapingo, Km 38,5 Carretera Mexico - Texcoco, 56230 Chapingo, Mexico

*juarezhma@yahoo.com.mx

Tulip is one of the most important ornamental bulb crops in the world, which is why its production in organic agricultural systems with low environmental impact is considered important as an alternative for Mexican producers to diversify or increase the production of ornamentals. Some organic products with beneficial effects are humic acid and honey bee. With this approach, the effect of both products on the cv. World's Favorite, in 6" pots, with a substrate composed of leaf soil, volcanic lava (tepojal named) and perlite in a 60:20:20 ratio was experimentally evaluated. Using the completely random design, with factorial treatment arrangement 42, consisting of humic acid with four levels: 0, 1.5, 3.0 and 4.5 ml L⁻¹ (diluted in irrigation water) and foliar fertilization with honey bee, also with four concentrations: 0, 1, 2 and 3%. Tukey's means test showed significant differences ($\alpha \leq 0.05$) with application to the substrate of humic acid on number of leaves, with 3.0 ml L⁻¹ and length of floral peduncle with 1.5 ml L⁻¹. The fertilization with 1% honey bee had significant effects on plant height, with 2% dose, in length, leaf width and floral bud length. Beneficial effects derived from the application of both products were found, with respect to which, it is recommended to experiment more thoroughly.

Keywords: substrate, organic agriculture, fertilization



P33:

THE EXPRESSION PATTERN OF INFLORESCENCE ARCHITECTURE RELATED GENES DURING *Chrysanthemum lavandulifolium* CAPITULUM MORPHOGENESIS

Xiaohui Wen*, Shuai Qi, Liwen Yang, Yan Hong, Xiaoyun Wu, Silan Dai

Beijing Forestry University, China, China

*wenxiaohui@126.com

Chrysanthemums (*Chrysanthemum* × *morifolium* Ramat.), the most beautiful flowers among ornamental plants, possess unique capitula with various flower types. However, little is known on their inflorescence morphogenesis due to the complicated flower types, hindering the flower type-oriented modification in practical breeding and production. Although previous studies showed that inflorescence architecture related genes (homologs of PIN1, ARF5 and LFY) are important regulators for inflorescence development in higher plants, the mechanism underlying the capitulum morphogenesis is still unclear. In the present study, we observed capitulum morphogenesis by using micro-technology and recorded the corresponding external morphological changes in *C. lavandulifolium*, a wild diploid species, close to cultivated chrysanthemums. The expression patterns of inflorescence architecture related genes were detected by Real-time PCR at key stages of capitulum morphogenesis, as well as in different organs of capitulum. The results showed that (1) the initial and middle stages of floret primordia differentiation were vital for the orientation of disc and ray florets; ray florets initiated later than the outermost disc florets, which broken the acropetal initiation of organ primordia on capitulum; (2) the early generation of floret corolla primordia, at which disc and ray florets fused with actinomorphic and zygomorphic corolla, respectively, was the key differentiation stage; (3) CIARF5 and DFL were expressed significantly at the initial stage of floret primordia, and markedly expressed in the corolla of ray florets; during the initial stage of corolla primordia, CIPIN1c was highly expressed in capitulum. Our results indicated that CIARF5 and DFL might be responsible for the orientation and differentiation of disc and ray florets, and CIPIN1c might participate in the establishment of corolla polarity. Studies on the capitulum morphogenesis of *C. lavandulifolium* not only bring insights into capitulum morphogenesis, but also lay foundation for the flower type-oriented modification in cultivated chrysanthemums.

Keywords: inflorescence; morphogenesis; capitulum; disc and ray florets; gene expression

P34:

MOLECULAR CLONING AND EXPRESSION ANALYSIS OF WRKY FAMILY GENES ASSOCIATED WITH SALT TOLERANCE OF *Crossostephium chinensis* BASED ON TRANSCRIPTOME SEQUENCING ANALYSIS

Tengxun Zhang*, Ming Sun, Qixiang Zhang, Shuangji Lin,

Beijing Forestry University, Beijing, China

*zhangtengxun@163.com

The utilization of Landscape plant has been decreasing, for serious soil salinization. *Crossostephium chinensis* is an excellent salt tolerant germplasm cultivated along the southeast coast of China. However, there are only a few reports on the mechanism of salt tolerance in this species. In this study, we initially screened 8 candidate WRKY genes that responded to salt stress and expressed significantly differential based on transcriptome data of *C. chinensis* under normal conditions and salt stress. Transcripts levels of these 8 genes were verified through real-time quantitative PCR, showing that expression profiles of 6 WRKY genes were consistent with the transcriptome sequencing. To analyse the function in salt tolerance process, we isolated the open reading frame sequences of these six genes from *C. chinensis*. Among these, the amino acid sequence of three candidate genes contained conserved WRKY domain in N-terminal and zinc finger domain in C-terminal, which were specific in WRKY family. According to homology with WRKY genes from *Arabidopsis*, three genes were designated CcWRKY3, CcWRKY70 and CcWRKY17. Based on the number and type of conserved domains, CcWRKY3 containing two typical WRKY domains grouped into cluster I on which role III and CcWRKY70 containing one typical WRKY domain belonged to cluster II, both of which biological and abiotic stress response of plants. Meanwhile, phylogenetic analysis showed that CcWRKY70 and CcWRKY17 grouped together with WRKY genes from chrysanthemum or other close species, involving in salt stress response according to the reports. We suggested that CcWRKY70 and CcWRKY17 might play important



roles in the process of response to salt stress, providing potentially useful information for future research into the possible roles of WRKY genes in mechanism of salt tolerance.

Keywords: *Crossostephium chinensis*, salt stress, salt tolerance mechanism, WRKY gene

P35:

CHARACTERIZATION OF APOMIXIS-LIKE 2X PLANTS FOUND AMONG TRIPLOID PROGENY POPULATION OBTAINED FROM THE 2X-2X CROSSES USING UNREDUCED GAMETE PRODUCER AS FEMALE PARENTS BY SPECIES SPECIFIC DNA MARKER IN CYMBIDIUM

Juntaro Kato^{1*}, Fuma Mise¹, Daisuke Suzuki¹, Kazuyuki Doi²

¹Dep. Sci. Educ., Aichi U. Educ., 1 Hirosawa, Igaya, kariya, Aichi 448-8542, Japan

²Grad. Sch. Bioagr. Sci., Nagoya Univ., Togo-cyo 4700151, Japan

*jkato@aecc.aichi-edu.ac.jp

Unexpected ploidy level progenies are often found among progenies of crossing. Previous our study revealed that triploid progenies were obtained dominantly from the 2x-2x crosses when diploid cultivars included one genome of *Cymbidium floribundum* were used as a parent. So, these diploid cultivars with one genome of *C. floribundum* had been estimated unreduced gamete producer. However, when diploid cultivars with one genome of *C. floribundum* were used as the female parent, not only triploid progenies (more than 90%) but ones of different ploidy level progenies were also found from 2x-2x crosses. Their ploidy levels were estimated to diploid, pentaploid or hexaploid by flow cytometric analysis. Especially, origin of these diploid plants was considered two possibility; a) derived from apomixis, and b) derived from fertilization between reduced egg and reduced pollen. To confirm these possibility, species specific DNA marker were produced by next generation sequencer Miseq (Illumina). When two apomixis-like plants obtained from the 2x-2xcrosses between *C. Sarah Jean Ice cascade* and *C. eburneum* and between *C. Sarah Jean Ice cascade* and *C. lowianum* using 21 *C. floribundum* specific DNA markers, all DNA markers were detected from both apomixis-like plants. These results indicated that these two apomixis-like plants might be formed via apomeiosis.

Keywords:

P36:

DIFFERENCES OF OVULE DEVELOPMENT AND FERTILIZATION TIME AMONG SEVERAL SPECIES IN ORCHID

Misato Kameyama^{1*}, Arisa Nakano¹, Shohei Toyota², Daisuke Suzuki², Asami Iwata², Juntaro Kato²

¹Grad. Sch. Sci. Educ., Aichi U. Educ., 1,hirosawa, Igaya, Kariya 4488542, Japan

²Dep. Sci. Educ., Aichi U. Educ., Kariya 448-8542, Japan

*s217m075@aecc.aichi-edu.ac.jp

In many orchid species, a long time up to 10 months after pollination is required to produce mature seeds. In order to reduce this period, immature seed culture technique, which used ovaries harvested approximately 6 months after pollination, had been developed. Our previous research revealed that the mature seeds can be produced in vitro by the direct ovary culture at fertilization phase in *Cymbidium*. To use this technique for the other orchids, information of fertilization phase and ovule developing phase of each species is required. In the present research, these phases were investigated in several orchid species. Ovules of *Cymbidium eburneum* were not be observed in the ovary at flowering time, but developing ovules could be observed 4 weeks after pollination and early fertilization occurred 6 weeks after pollination. *Phalaenopsis amabilis*, *Phalaenopsis* cultivar and some *Cymbidium* species show similar type of development. However, ovules of *Cymbidium* 'Miss Muffet' developed ovuli during flowering time. In *Bletilla striata*, *Habenaria radiata*, semi-developed ovuli were observed, and mature seeds of these species could be obtained earlier than in species or cultivars that required long period between pollination and seed maturation. Although haploid parthenogenesis plants were induced by the stigma NAA treatment in *Bletilla brigantes*, induction of parthenogenesis plants in *Cymbidium* and *Phalaenopsis* by stigma NAA treatment are difficult. Differences of ovule development initiation might indicate that type of ovary without ovules might be more difficult to produce parthenogenesis plants by stigma NAA treatment because more steps, e.g. initiate to ovules, might be required via parthenogenesis process.



Keywords: cymbidium, phalaenopsis, bletilla, habenaria, direct ovary culture, ovule development

P37:

PRODUCTION OF PARTHENOGENETIC PLANTS OBTAINED FROM THE INTERGENERIC CROSSES BETWEEN HABENARIA RADIATA AND DISA CULTIVARS

Arisa Nakano^{1*}, Mai Mitoma², Akira Kanno², Syoichi Ichihashi¹, Juntaro Kato¹

¹Grad. Sch. Sci. Educ., Aichi U. Educ., 1, hirosawa, Igaya, Kariya, 448-8542, Aichi, Japan

²Grad. Sch. Life Sci., Tohoku U., Sendai 980-8577, Japan

*s217m079@aecc.aichi-edu.ac.jp

Parthenogenetic *Habenaria radiata* plants were obtained from the intergeneric crosses between *H. radiata* using as female parent and two *Disa* cultivars using as male parents. Flower shape of *H. radiata* looks like flying egret and it is one of the famous orchid in Japan. This species flowers at August and this species has powder pollen. Genus *Disa* originated from South Africa. While *H. radiata* is only white flower color, *Disa* cultivars, which have various flower colors, are one of the candidates to introduce flower colors to *H. radiata*. Intergeneric crosses between *H. radiata* and two *Disa* cultivars were performed and immature seeds, which were obtained 4 or 5 weeks after pollination, were cultured on the Hyponex medium in vitro. Although seeds obtained from self-pollination were initiated to germinate 1 week after seed culture and to form plant via protocorm formation 1 month after seed culture, germination timing of immature seeds obtained from intergeneric crossing, were initiated 7 weeks after seed culture and developed the first leaf 12 weeks after seed culture. Small plants were obtained 5 months after seed culture. No differences of growing speeds between plants obtained from self-pollination and ones obtained from intergeneric crosses were observed. When flow-cytometric analysis was conducted among plants obtained from intergeneric crossing to confirm their hybrid nature, all the plants analyzed did not show this trait. Because longer periods were needed in seedling obtained from intergeneric crosses than in ones obtained from self-pollination, some of unknown factor, ex. *Disa* chromosome elimination, were considered in the delay growing of seedlings obtained from intergeneric crosses.

Keywords: *disa* cultivar, flow cytometry, *Habenaria radiata*, in vitro seeding, parthenogenesis

P38:

THE CONTROL BY PACLOBUTRAZOL OF STEM ELONGATION IN *Allium ampeloprasum* L.

Deniz Hazar^{*}, Ozaz Hafiz Mohammed

Akdeniz University, Agricultural Faculty, Department of Horticulture, Antalya, Turkey

*dhazar@akdeniz.edu.tr

Allium ampeloprasum is one of 164 *Allium* species that growing naturally in Turkey. This species is highly suitable for use as cut flower, landscape and pot plants. The flower stem of *A. ampeloprasum* is too long to be used as a landscape plant and pot plant, and has a length of up to 130 cm. This study was conducted to determine the effect of paclobutrazol in reducing the stem elongation of *A. ampeloprasum*. Three different doses of paclobutrazol (2.5, 5 and 10 mg·L⁻¹) were applied in two ways; bulb dipping and spraying on the leaves. All applications were compared with the control.

Keywords: *Allium ampeloprasum*, paclobutrazol, dipping, spraying, stem elongation



P39:

(Not Completed Registration)

PH AND ITS RELATIONSHIP WITH FLOWER COLOR OF LISIANTHUS (*Eustoma grandiflorum*)

Sweetia Ramirez^{1*}, Rosa Isela Montoya-Chavez², Joel Pineda-Pineda¹, Mateo Vargas-Hernandez¹

¹Universidad Autonoma Chapingo, km. 38.5 carretera Mexico-Textcoco, Textcoco, Mexico, 56230, Mexico

²Instituto de Horticultura, Universidad Autonoma Chapingo, km.38.5 Carretera Mexico-Textcoco, 56230, Mexico

*sweetia.ramirez@gmail.com

Currently the flower industry is growing and facing a demand with constant changes, which is a challenge to the adaptability of producers. So in this sense research is necessary in order to understand and manage key aspects like the nutrition. The goal of this research was to evaluate the relationship between the pH of the nutrient solution and the flower colour in lisianthus (*Eustoma grandiflorum* L.). Four treatments were applied with different levels of pH (4, 5, 6 and 7) and two treatments with pH 6 plus additional Fe or Al, using the Steiner universal nutrient solution in all of them. The treatments were arranged as a completely randomized design. The plants were established in polyethylene bags with perlite substrate, fertigation and greenhouse conditions. The level of pH 7 showed a remarkable trend toward smaller flower diameter, number of petals, brightness in color, concentration of nitrogen and phosphorus, as well as reduced vase life. On the other hand, the treatments with pH 4 and 5 had a trend toward greater flower stem diameter and greater anthocyanins, phosphorus and nitrogen concentration, tint and color of flower vase life.

Keywords: acidity, aluminum, iron, anthocyanins

P40:

(Not Completed Registration)

SSR ANALYSIS OF GENETIC RELATIONSHIP AND CLASSIFICATION IN CHRYSANTHEMUM GERMPLASM COLLECTION

Conglin Huang^{*}, Chang Luo, Dongliang Chen, Xi Cheng, Hua Liu

Beijing agro-biotechnology research center, Beijing, China

*conglinh@126.com

Chrysanthemum (*Chrysanthemum morifolium*) is one of the most popular ornamentals throughout the world, has approximately 1600 years of cultivation history in China. In this study, 10 simple sequence repeat (SSR) markers were used to identify a collection of 88 chrysanthemum and its related genera accessions. In total, 42 effective alleles across 88 accessions were detected; 3118 bands were obtained by PCR amplification, including 2630 polymorphic bands. The similarity coefficient ranged from 0.5322 to 0.8750. Cluster analysis based on UPGMA illustrated that the wild species and large-flower cultivars were first divided into two clusters, then the large-flower cultivars formed five distinct group according to petal type, indicating that petal type can be a classification criterion. In the wild species cluster, *C. vestitum* and *C. zawadaskii* grouped with *A. trilobata*, suggest that the Ajanía genera was closely related to the Chrysanthemum genera. 'Hang-baiju', 'Gong-ju' and 'Chu-ju' were grouped together, and 'Bo-ju', *O. longilobus* and *C. mongolicum* form another branch, shows a correlation with geographic region of origin. Population structure analysis was subsequently performed with K values ranging from 2 to 10, and the most likely estimate for the population structure is five subpopulations, which is nearly consistent with the clustering results. Principle component analysis was further performed to verify the classification results. The results showed that these SSR markers are very powerful for studying genetic relationships and will be useful tools in the identification and classification of chrysanthemum.

Keywords: chinese traditional chrysanthemum, ssr markers, polymorphism, genetic relationship, classification



P41:

(Not Completed Registration)

PREFERENCES OF ROSES AMONG RESIDENTS AND THEIR CONTRIBUTION TO URBAN LANDSCAPE WITHIN THE BUILT-UP AREAS OF BEIJING, CHINA

Wanmei Jin^{1*}, Hua Wang²

¹Institute of Forestry and Pomology, Beijing Acad. Agri. and Forestry Sciences, 12, Ruiwangfen, Xiangshan, Haidian Distr., 100093, China

²12 Ruiwangfen Xiangshan Haidian District, Beijing, China

*jwm0809@163.com

Rose is one of the most important cut flowers, and forms part of the urban landscape, contributing to many ecological functions. To increase sales and choose the proper types of roses for urban planning, there is growing interest in understanding residents' differences in their rose preferences, the distribution and features of rose, as well as the linkage between them. The present study focuses on well-known ornamental roses, specifically on how they should be designed to promote a potential for market and on urban planning. To determine the rose preferences of residents in Beijing, we analyzed answers to a questionnaire that required the residents to choose their preferences on color, growth type, and function. To address the distribution and features of roses in Beijing, we surveyed 546 sites covering different types of urban green spaces within the built-up areas. The survey shows that roses significantly intervened in the ecological functions of urban green space. They exhibited high resistance to the influence of environment stress, and differ in their performance in the built-up areas of Beijing. They also varied in carotenoid and anthocyanin content. There is predictable relationship between pigments content and color. In terms of residents' main expectations for rose, the predominant expectation was color, and emphasizing the ecological outcomes. In preference for the color of rose, the predominant color was red. Our results indicate that the preference for the color of roses among residents was consistent with the predominant color of roses planting in Beijing. A question how to integrate such civic-led interventions into urban planning as well as market, still remains open.

Keywords: rose; residents' preference; urban planning; flower color; ecosystem function

P42:

(Not Completed Registration)

MORPHO-ANATOMY OF FRUIT, SEED AND LEAF OF *Galeandra stylломisantha* (vell.) Hoehne

Paulo Adller Alves de Araújo,¹ Alan Pena de Sousa², Milton Renan Cabral da Costa², Patrick Patrick de Castro Cantuár², Fernando Galvão Rabelo², Breno Silva^{3*}

¹Av. Das Amazonas, Goiabal, Av. Das Amazonas, 68906018 Macapá-Amapa, Brazil

²Av. Presidente Vargas 650, Macapá, Brazil

³Avenue Aurora F. da Costa, Number 2126., Macapá Novo Buritizal Square-68904-282, Brazil

*silvabms@hotmail.com.br

The purpose of this study was to morphoanatomically describe the fruit, seeds and leaf of *Galeandra stylломisantha* (vell.) Hoehne. For the morphoanatomical description, the evaluations were examined by optical and electron microscopy scanning. The description was based on specialized bibliographies. The fruits of *G. stylломisantha* are capsules, longitudinal crevices, stomata at the level of the epidermis, simple and hyaline trichome from the base to the apex, persistent floral perianth and with 6 cyclic valves (3 external minor valves and 3 internal larger valves), oblong, with a base and apex acute, slightly bright, beige to brown at maturity and axillary placentation (internal larger valves), measuring about 2.82 cm, 0.54 cm, 0.51 cm and 0.09 g in length, width, thickness and dry mass, respectively. The seeds are elliptic, base and apex acute, rough, glabrous, from orange to red, bright, untegmentated, with circular homochrome hilum, open or close, and discrete micropyle, with undifferentiated elliptical embryo. The leaves of *G. stylломisantha* are simple, sessile, alternate-distichous, parallel, smooth, glabrous and linear veins, entire margin and amphistomatic.

Keywords: orchidaceae, seed technology, plant morphology



P43:

(Not Completed Registration)

DAHLIA PETALS (*Dahlia* spp.) WITH EDIBLE PURPOSES

Maria Teresa Martinez Damián

Universidad Autonoma Chapingo, Km 38.5 Carretera Mexico-Texcoco, Texcoco, 56230, Mexico

*teremd13@gmail.com

The aim of this study was to evaluate the effect of ray florets of dahlia (*Dahlia* spp.) on postharvest quality for edible purposes. Ray florets of five different varieties of dahlias were placed in clamshell containers, and kept at 4 °C and room temperature (22°C). A completely factorial randomized 2x5 design, with three replications, was performed. Weight loss (%), total soluble solids (TSS), titratable acidity (TA), respiration rate (TR) and ethylene production (PE) were analyzed. Also a sensory evaluation using the five-point hedonic scale was conducted, evaluating the attributes of taste, palatable texture, visual appearance and rotting. The results indicated that at lower temperature, the physical, chemical and sensory characteristics of the ray florets of dahlia were kept for 14 days, compared to those kept at 22 °C, where the quality of florets was lost after the day 3 of storage. At 4 °C the yellow variety presented the lowest weight loss, TSS, TR and PE. The yellow and white varieties showed the highest values of brightness, chroma and hue angle. Finally, in the sensory evaluation, the red, cherry and white varieties showed good texture and good flavor, in all varieties there were no signs of rot during the storage period.

Keywords: quality, postharvest, edible flowers

P44:

(Not Completed Registration)

COMPARATIVE PROFILING OF FLAVONOIDS FROM RAY FLOWERS OF SIX *Centaurea cyanus* CULTIVARS

Chengyan Deng*, Yan Hong, Yiliu Luo, Mengling Li, Yuting Liu, Silan Dai

Beijing Forestry University, China

*dcinya@sina.com

Blue flowers enjoy great popularity for their dreamlike colors that most ornamental plants lack. After years of breeding, *Centaurea cyanus* has not only capitula with pure blue color, but also cultivars with other vivid colors, which makes them an ideal material to investigate the mechanisms of blue flower color development. In the present study, flavonoid profiles of ray flowers from six cornflower cultivars (*Centaurea cyanus* 'Dwarf Tom Pouce white/blue/pink/red' and 'Tall Double Ball mauve/black') were determined by use of ultra-performance liquid chromatography coupled to photodiode array and tandem mass spectrometry. Totally, there were ten anthocyanins, six flavones and two flavonols isolated and putatively identified. Along with three known compounds cyanidin-3-O-(6"-O-succinyl-glucoside)-5-O-glucoside[A1], pelargonidin-3-O-(6"-O-succinyl-glucoside)-5-O-glucoside[A2] and apigenin-4'-O-(6-O-malonyl-glucoside)-7-O-glucuronide[F1], four cyanidin(cyanidin-3-O-glucoside-5-O-glucoside[A3], cyanidin-3-O-malonyl-glucoside-5-O-glucoside[A4], cyanidin-3-O-malonyl-glucoside-5-O-malonyl-glucoside[A5], cyanidin-3-O-succinyl-glucoside-5-O-malonyl-glucoside[A6]) , four pelargonidin(pelargonidin-3-O-malonyl-glucoside-5-O-glucoside[A7], pelargonidin-3-O-malonyl-glucoside-5-O-glucoside[A8], pelargonidin-3-O-malonyl-glucoside-5-O-malonyl-glucoside[A9] and pelargonidin-3-O-malonyl-glucoside-5-O-succinyl-glucoside[A10]), three apigenin(apigenin-4'-O-glucoside-7-O-glucuronide[F2], apigenin-4'-O-(malonyl-galactoside)-7-O-glucuronide[F3], apigenin-7-O-glucuronide[F4]), two luteolin(luteolin-3-O-glucoside-5-O-glucoside[F5], luteolin-3-O-succinyl-glucoside[F6]) and two kaempferol derivatives(kaempferol-3-O-glucoside[F7], kaempferol-3-O-malonyl-glucoside[F8]) were identified in cornflower for the first time. The accumulation of flavonoids in cornflower were widely acylated with aliphatic acids and showed significant cultivar specificity. Except white ray flowers without anthocyanins, blue(A1), mauve(A1, A3-4) and black(A1, A3-6) ray flowers contained cyanidin derivatives, while pink(A2) and red(A2, A7-10) ones had different pelargonidin derivatives. The flavone and flavonols were widely existing among six cultivars. Moreover, the quantitative analysis showed that the total anthocyanin content was most abundant in the black ray flowers (61.0±10.9 mg/g, dry weight), which was seven and ten times higher than blue and mauve ray flowers. The ratios of total flavone and flavonol content to total anthocyanin content were 1.6, 3.7 and 0.4 in blue, mauve and black ray flowers, respectively. The above results suggested cyanidin, apigenin and



their comparative content were necessarily involved in blue flower color formation of cornflower. This study will provide chemical basis for further molecular mechanism research of flower color development.

Keywords: *Centaurea cyanus*, flavonoids, flower color

P45:

(Not Completed Registration)

GAMMA RAY INDUCED FOLIAGE VARIEGATION AND ANATOMICAL ABERRATIONS IN CHRYSANTHEMUM (*Dendranthema grandiflora* R) cv Maghi

Deepa H Dwivedi*, Anurag Bajpay

Department of Horticulture, School of Agriculture Sciences and Tech., Babasaheb Bhimrao Ambedkar University, Rae Bareilly Road Lucknow, Uttar Pradesh, 226025, India

*deepahansraj@gmail.com

In the present study rooted cuttings of chrysanthemum (*Dendranthema grandiflora* R) cv. Maghi, were subjected to gamma radiation 0, 1, 1.5, 2, 2.5, 3, 3.5, 4 and 4.5 kR with the objective of developing novel variegated mutants as well as variation in flower color etc. The experiment was laid out in Randomized Block Design with nine treatments which were replicated three times. The quantitative and qualitative characters studied and revealed variegation in foliage and also in color and shape of flowers in plants treated with 1 and 1.5kR gamma radiation over control. Maximum number of variegated plants (6), number of branches (31), diameter of flower (3.60 cm.) and size of stomata (length of Guard cell 30 micron, width 17 micron, length of pore 26 micron and width of pore 7 micron) was recorded for the lower radiation doses (1 and 1.5 kR). Higher radiation doses of 3 to 4.5 kR were ineffective since they adversely affected the plant performance in terms of its survival, vegetative as well as flower growth. Chimeric plants were produced which could be multiplied for obtaining mutants in pure form.

Keywords: chrysanthemum, maghi, gamma radiation, chimera scanning electron microscope

P46:

(Not Completed Registration)

INCIDENCE AND DISTRIBUTION OF VIRUSES IN DAHLIA (*Dahlia variabilis*) IN SEVERAL STATES IN THE USA

Cristian Olaya, Afhsa Tabassum, Lindani Moyo, Ying Zhai, Madhu Kappagantu, Hira Kamal, Hanu Pappu*

Department of Plant Pathology, Washington State University, Pullman WA 99164, United States of America

*hrp@wsu.edu

Dahlia (*Dahlia variabilis*) is an important ornamental plant in the US and several other countries in the world. In the USA, there are dozens of dahlia societies with active participation from dahlia enthusiasts, home gardeners, commercial suppliers that include small and large-scale operations. Dahlia propagating material is exchanged and traded widely. Viruses continue to be both a qualitative and quantitative issue in dahlias and research on developing rapid and sensitive virus detection methods and production of virus-free material are research priorities for the dahlia industry. A survey followed by testing of dahlia plants over the last three years was carried out on samples collected from eastern, midwestern and western states in the USA. Leaf samples from more than 2,000 plants were tested for several viruses that included Cucumber mosaic virus, Dahlia mosaic virus, Impatiens necrotic spot virus, Tobacco streak virus, and Tomato spotted wilt virus. Overall, incidence of viruses ranged from less than 1% to over 40% depending on the region/state. The most prevalent viruses were Tobacco streak virus followed by Impatiens necrotic spot virus. Cucumber mosaic virus was least common. As expected, asymptomatic infections were prevalent, which underscores the need for testing instead of solely relying on symptoms. Efforts to reduce virus infection should include thrips vector management, removal of infected plants, starting with virus tested material. Additionally, tissue-culture based production of virus-free material should offer clean planting material.

Keywords: dahlia, *Dahlia variabilis*, viruses, virus detection, tobacco streak virus, tomato spotted wilt virus, impatiens necrotic spot virus



P47:

(Not Completed Registration)

LIFE-HISTORY AND BIOLOGICAL CHARACTERISTICS OF *LYCORIS* HERB

Dong Zhang*, Yi-ping Xia, Ziming Ren, Xue-si Lyu

NongShengHuanA128, Zhejiang University, Nong Sheng Huan Building A128, 866 Yuhangtang Road, Hangzhou, Zhejiang Province, 310000, China

*zhangdong8732@126.com

According to the literature and 10 years of observations, the biological and life-history characteristics of *Lycoris* Herb. (Amaryllidaceae) is described here. The genus *Lycoris* is composed of about 30 species and originated in the warm areas of Eastern Asia, such as China, Japan, Korea, Myanmar, Vietnam and Nepal. *Lycoris* is also called 'Summer tulip', 'Surprise lily', or 'Magic lily'. Several species of *Lycoris* are used as traditional groundcover and landscape plants in Eastern Asia. In the wild, *Lycoris* is usually distributed in sheltered moist slopes along streams in the mountains, edges of forests, paddy fields, and margins of plantations. *Lycoris* species vary in flower colors from purple, red, orange, to yellow and white in nature. The plants of *Lycoris* have ornamental value because of their special flowers and attractive foliage. *Lycoris* species can be used as cut flowers and potting plants. The flowers of *Lycoris* start blooming from July to October, and the leaves grow from September to May. The leaves of *Lycoris radiata* and *Lycoris aurea* emerge in late autumn, but only for a 6 month period from late October to April, just before the deciduous trees expand their foliage leaves and cast shade as a result of the closed upper canopy layer. However, all leaves of *Lycoris* will thoroughly decay during May to June, when the upper canopy foliage layer of the deciduous forests has completely expanded. Flowering occurs during August to October, but only flowers without leaves appear above ground. The seasonal growth pattern of this species is unique, and similar to those found in Mediterranean geophytes. The seeds of *Lycoris* are often difficult to germinate in the wild. And the seedlings take more than 6 years to reach flowering size. Fortunately, these plants can be produced by clonally propagation.

Keywords: *lycoris*, ornamental plants, Amaryllidaceae, life-history, biological characteristics

P48:

(Not Completed Registration)

THE EFFECT OF THE PLANT GROWTH REGULATOR, PACLOBUTRAZOL, ON THE GROWTH AND FLOWERING POTENTIAL OF THE FLOWERING POTTED PLANT, *Felicia aethiopica*

Gerhard Griesel*, Dean Berry, Charles Laubscher

Cape Peninsula University of Technology, P. O. Box 1906, Bellville 7535, South Africa

*grieselg@cput.ac.za

The *Felicia* genus (Asteraceae) is composed of either annual, perennial shrublets, or herbs and is indigenous to Africa, and specifically the South-Western Cape in South Africa. The *Felicia* species, in general, produce daisy flowers in various colours. *Felicia aethiopica* (Wild Aster) produces bright blue and yellow flower heads all year around with maximum flowering during spring. It is a densely leafy shrublet, growing between 0.5 m to 1 m tall. Its potential for a flowering potted plant is due to its suitability to be grown in containers and its extended flowering period. However, the plant is naturally too tall for pot plant production. South Africa is known for its rich flora, yet the pot plant industry have overlooked its diverse flora due to some of the morphological characteristics, which make the plants commercially unviable. The aim of this study was therefore to evaluate the use of paclobutrazol as a possible technique for promoting *F. aethiopica* as a flowering potted plant. The plants were tested with five different concentrations (control, 800, 1000, 1250 and 1500 ppm) applied as a foliar spray. All the specimens were cut back to a height of 10 cm before the first application of paclobutrazol was applied. The second application was applied 3 weeks later. The 800-ppm concentration produced shorter plants than the control. Although there were significant differences in plant width in week 8 and 10, the paclobutrazol had no effect on reducing plant width in relation to the control. The paclobutrazol showed a positive effect on lateral branching and flower bud development towards the end of the experiment.

Keywords: *Felicia aethiopica*, chlormequat (2-chlorethyl) trimethylammonium chloride, parts per million, potted plants, plant height, plant growth regulators and paclobutrazol



P49:

(Not Completed Registration)

EFFECTS OF 85% DAMINOZIDE, ON THE HYDROPONIC CULTIVATION OF *Barleria obtusa*, TO IMPROVE PLANT COMPACTNESS FOR COMMERCIAL VALUE AS A BEDDING PLANT

Johan Van Rooyen^{*}, Charles Laubscher, Shain Butt

CPUT, Corner of Keizersgracht and Tennant Street, Zonnebloem, PO Box 652, 8000 Cape Town, South Africa

*vanrooyenjo@cpud.ac.za

Barleria obtusa is a fast growing, evergreen multi stemmed perennial covered with a mass of violet flowers in the autumn period. *B. obtusa* occurs naturally in the Eastern and Northern provinces of South Africa. The unique flowering time makes *B. obtusa* desirable as a bedding plant, however the plants vigorous growth reduces its commercial value. A test was conducted to determine if the growth of *B. obtusa* could be reduced and if the reduced growth would improve its commercial value as a bedding plant. Rooted cuttings of *B. obtusa* were planted into a hydroponic natural flow full system. B-Nine® WSG (active ingredient of 85% daminozide), a plant growth regulator foliar spray was applied 3 weeks after plants acclimatised to greenhouse conditions and had sufficient new growth. Plants cultivated in the hydroponic natural flow full system were treated with daminozide, at concentrations of 2, 6, 10, 16 g/L active ingredient (a.i.) per treatment on a weekly basis for 4 weeks, while the control remained untreated. Plant height during increased concentrations showed a significance difference between the control and treated plants. The control produced the most number of shoots, as compared to the treated plants. However, the best results, obtained at week 8, was the treatment with 6 g/L (a.i.). Compactness was measured using total surface area of the plants per pot and treatments with 2, 6, 10, 16 g/L (a.i.) were significantly different than the control. Total wet and dry weights of plants treated with the growth retardant were significantly affected as compared to the control. With the results obtained, 6 g/L (a.i.) showed significant results as to improve the commercial value of *B. obtusa* as a bedding plant.

Keywords: *Barleria obtusa*, bedding plant, ornamental horticulture, hydroponic, natural flow technique, plant growth retardant

P50:

(Not Completed Registration)

EVALUATING THE EFFICACY OF COMMON SUBSTRATES AND BENEFICIAL MICRO-ORGANISMS ON ALLAMANDA

Vivek Govindasamy^{1*}, Anisha Rajbhandari²

¹Block 17, 09-208, Lorong 7 Toa Payoh, 310017 Singapore Singapore, Singapore

²1E Cluny Road, 259601 Singapore Singapore, Singapore

*vivegam2005@gmail.com

Relative growth of *Allamanda cathartica* L. was studied in four different substrates (that are common in Singapore): A: 100% cocopeat, B: 1:1 of cocopeat & perlite, C: 3:2:1 of loamy soil, compost & sand, D: 1:1 of cocopeat & compost, with (T1) and without (T0) the presence of beneficial soil micro-organisms (BSMO). The BSMO inoculum consisted of 1:1:1 of *Azospirillum lipoferum*: Phospho bacteria: *Frateruria aurentia*. Phospho bacteria consists of *Bacillus megaterium* var. phosphaticum, *B. subtilis*, and *Pseudomonas striata*. Comparative studies between different substrates and between T1 and T0 for each of the substrates were made separately. Following 6 months after planting, comparatively there was an increase in plant height (PT), internodal distance (ID), number of branches (NOB), number of flowers (NOF), and chlorophyll content (CHL) in substrate D. Similar results were obtained following 12 months after planting. Among T1 and T0, T1 showed increased PT, ID, NOB, NOF, and CHL in all four substrates. Microbial isolation and counting at 12th month after planting proved the presence of higher concentration of BSMO in T1 than T0. All parameters were analyzed, and thus effective in predicting the efficacy of the substrates and BSMO application. Understanding the efficacy of different substrates and BSMO application could be utilized to improve the quality of urban landscape through an organic and sustainable approach. Comparative studies on different substrates widen the options for skyrise greenery planting, where space, weight, and logistics are the major constraints.

Keywords: common substrates, allamanda, beneficial microorganisms, cocopeat, perlite, azospirillum, bacillus



P51:

(Not Completed Registration)

INTEGRATED NUTRITIONAL MANAGEMENT IN *Lilium hybrids* cv. Nashville

Rita Seet^{1*}, Sashikala Beura², Prem N Jagadev³

¹College of Agriculture, Orissa University of Agriculture Technolo, Bhubaneswar, 751003, India

²Director, BTCC, Bermunda, Bhubaneswar, 751003, India

³Dean of Research, Orissa University of Agriculture and Tech, Bhubaneswar, 751003, India

*seetrita@gmail.com

Lilium one of the important floriculture crops grown for its marvellous cut flowers, stands as fourth most popular crop in global floriculture industry. An experiment entitled “Integrated Nutritional Management in *Lilium Hybrids* cv.Nashville” was carried out under poly shade net structure of RKVY project at Biotechnology-Tissue Culture Centre, Bhubaneswar, in 2016-17, with objectives to study the impact of different combinations of organic manure, bio fertilizers and foliar nutrient solution on vegetative, floral and post harvest characteristics of the variety. The experiment was conducted with 16 treatments and 4 replications following Randomized Block Design. The treatments consisted RDF @ N:P:K @ 3 : 8.5 : 2.25 g/plant, soil application of Vermicompost, Azotobacter and PSB each @ 2g /plant, foliar application of MS Macro @ 100 ml/l, MS Micro @ 10ml/l and MS Vitamins @ 1ml/l in different combinations. The result revealed that application of RDF, Vermicompost, Azotobacter, MS Macro, MS Micro and Vitamins recorded maximum plant height (95.88cm), number of leaves/plant (92.31). Application of RDF, Vermicompost, Azotobacter, PSB, MS Macro, MS Micro and Vitamins advanced the days for flower opening (47.37days), number of flowers/plant (4.37), whereas application of RDF, Azotobacter, PSB, MS Macro, MS Micro and Vitamins enhanced bloom life of whole spike by (17.59 days). Application of RDF, Vermicompost, Azotobacter, PSB, MS Macro, MS Micro and Vitamins enhanced the number of effective roots (17.05), bulb weight (65.72g) and bulb circumference (17.71cm). Adopting this cultural practice under 1000 area in poly shade net house, the total expenditure, income and net profit will be Rs. 60,30,200, Rs. 1,18,80,000 and Rs. 58,49,800 respectively with B:C ratio 1:97.

Keywords: INM, biofertilizers, organic manure, foliar spray, vegetative, flower, postharvest

P52:

(Not Completed Registration)

ARBUSCULAR MYCORRHIZA APPLICATION WITH THE VARIATION OF WATER FREQUENCIES ON NUTRIENT UPTAKE AND GROWTH PARAMETERS OF *Perlargonium reniforme* Curtis

Charles Laubscher*, Patricia Ingarfield, Learnmore Kambizi

Cape Peninsula University of Technology, PO Box 1906, 7535 Bellville, South Africa

*laubscher@cput.ac.za

Mycorrhiza inoculation is known to be beneficial for nutrient uptake in providing a symbiotic association with plant roots. Similarly, watering quantities can affect plant growth parameters. The combination and availability of both can enhance plant quality for commercial purposes. *Pelargonium reniforme* Curtis. is an indigenous herbaceous groundcover from the Western Cape region of South Africa. This species is drought resistant and offers great economic potential as a colourful ornamental plant. This study aimed to measure the effects of different watering frequencies with and without the addition of arbuscular mycorrhiza on plant growth, leaf chlorophyll and nutrient uptake of *P. reniforme*. Plants were grown in a drip culture system over a period of 15 weeks with a total of ten treatments applied to ten replicates. Irrigation was supplied at 320 ml at five different watering frequencies varying from once a day to every twenty-four days. Five treatments were inoculated with 30 g of arbuscular mycorrhiza and repeated without arbuscular mycorrhiza. Results of the water frequency showed statistical significance in all variables except the wet root weight. A significant difference was observed in the mycorrhiza inoculation in the total wet weight. Results on measurements of C, K, Mg, N and P were all significant in the watering frequency treatments without mycorrhiza. There was also a higher interaction between the watering frequency with and without mycorrhiza in the availability of Mg. Total dry weight and chlorophyll readings were obtained in the highest watering frequency for *P. reniforme*. The addition of arbuscular mycorrhiza generally increased growth parameters, photosynthesis and water assimilation in the species.



Keywords: arbuscular mycorrhiza, irrigation, plant growth, water deficit, water stress

P53:

(Not Completed Registration)

EFFECTS OF AN ORGANIC SEAWEED GROWTH REGULATOR TO ENHANCE ROOT GROWTH PARAMETERS IN POT-CULTURED *Erica verticillata* Bergius ERICACEAE IN DEVELOPING A PRODUCTION SCHEDULE TO SUPPORT FUTURE REINTRODUCTIONS INTO THE WILD

Trevor Adams¹, Charles Laubscher², Felix Nchu², Carolyn Wilmot^{2*}

¹Cape research Centre, South African National Parks, P.O. Box 216, 7947 Cape Town Steenberg, South Africa

²Cape Peninsula University of Technology, P.O. Box 1906, Bellville, Cape Town, 7535, South Africa

*wilmot@telkomsa.net

Erica verticillata Bergius. (Ericaceae) is a South African indigenous species which is classified as extinct in the wild. Current cultivation practices have focused on reintroducing the coastal fynbos shrub into its original habitat. The use of organic seaweed growth regulators on indigenous fynbos species is unknown. The 18 week study tested two different formulations of a commercial organic seaweed growth regulator at varied concentrations on root growth parameters of potted *Erica* plants. Ten replicates of plant growth regulator treatments were used. Treatments of 0 (control), 50, 100, 200, 300 ml liquid active ingredient (a.i.) per plant group and ¼, ½, 1 and 2 solid disks per plant were applied to rooted cuttings of ± 3 cm in height. The study aimed to develop a production schedule for growing pot-cultured *E. verticillata*. Plants treated with the highest liquid treatment of 300 ml a.i., ¼ disk and the control treatment induced the highest wet weights. Liquid concentrations of 50, 100, 200 ml a.i. and ¼, 1 and 2 disks were all similar in increasing dry root weight. Post-harvest root lengths of plants treated with 50 ml a.i. and 2 disks were sufficiently longer than the control. Liquid treatments had better results on the root length. It is recommended that an application of 50 ml liquid a.i. or 2 disks per plant of organic seaweed growth regulator be used in successfully growing pot-grown *E. verticillata*. This will enhance cultivation protocols of other indigenous fynbos species with similar growing requirements suitable for container growing. The production of *E. verticillata* will support the effective re-establishment and conservation in the wild.

Keywords: extinct species, organic seaweed, plant growth regulator, indigenous fynbos, potted plant

P54:

(Not Completed Registration)

DESCRIPTION OF PITAHAYA (*Hylocereus* spp) IN MEXICO

Claudio Perez*, Eduardo Campos

Dpto de Fitotecnia, Universidad Autonoma Chapingo, Carretera Mexico-Texcoco Km 38.5, Texcoco, Estado de Mexico

*clarpem@gmail.com

A specimen collected in the northern area corresponded to the characteristics of *H. ocampensis*. Further collections from the Sierra Costera presented some characteristics of flower and fruit similar to the species *H. purpusii*, but could not be established within these species, because they presented characteristics of stem, areoles, thorns, and some characteristics of flowers and fruit specific of pitahaya from warm sub-humid area. Further analysis is required to establish this group as a part of *H. purpusii* or as a different species or sub-species close to this. The appearance of the fruits of thirteen collections present productive potential feature for human consumption. A specimen is not edible because it presented fruits of bitter taste.

Keywords: fruits, cactaceae, botanical description, floral biology, forest



P55:

(Not Completed Registration)

EFFECT OF SOIL COOLING ON GROWTH AND FLOWERING OF *Hippeastrum* spp

Soraya Ruamrungsri^{1*}, Chaiartid Inkham², Issarush Kajornrungsilp³, Ruamjuan Kijkar⁴, Kanokwan Panjama¹, Panupon Hongpakdee¹

¹Department of Plant Science and Soil Science, Faculty of Agriculture, Chiang Mai University, 50200 Chiang Mai, Thailand

²Science and Technology Research Institute, Chiang Mai University, Chiang Mai, Thailand

³PTT LNG Company Limited, Bangkok, Thailand

⁴H.M.The Kings Initiative Centre for Flower, and Fruit Propagation, Chiang Mai, Thailand

*soraya.r@cmu.ac.th

Soil temperature affects plant growth and development. Different responses of root to soil temperature depend on plant species. Thus, in an attempt to improve growth and flowering of *Hippeastrum* 'Apple Blossom', the effect of soil cooling on root growth and flowering was investigated. *Hippeastrum* bulbs were harvested and continuously grown in planting-beds by using expanded clay as growing media. The growing methods were conducted with three treatments of soil cooling treatments i.e., T1) no cooling (control treatment; average temperature = 25°C) T2) soil cooling at 13°C (using cool water (13°C) circulated through the pipes installed on the beds) for 90 days and T3) soil cooling at 13°C throughout the experiment. The results showed that at 203 days after planting (DAP), plant growth in term of plant height, plant width and leaves length in control treatment (no cooling) was lower than the others. Roots length, total roots fresh and dry weight and leaves dry weight were increased when plant grown by soil cooling at 13°C for throughout the experiment (T3). However, the number of leaves per plant and leaves fresh weight were not different among treatments. At flowering stage (160 DAP), the results showed that stalk length of plant grown with soil cooling by T1 and T2 gave the greater results than no-cooling treatment. In addition, bulbs quality, photosynthetic rate, stomatal resistance, the content of nitrogen, phosphorus and potassium in plants were discussed on this study.

Keywords: root-zone cooling, cool water circulated, roots temperature, amaryllis

P56:

(Not Completed Registration)

FREEZING-TOLERANCE AND PHYSIOLOGICAL DIFFERENCES BETWEEN *Rosa beggeriana* AND *Rosa fortuneana* DURING THE OVERWINTERING

Shuhua Yang*, Qiang Liu, Ruidong Jia, Xin Zhao, Hong Ge

Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, No.12, Zhongguancun South Street, Haidian, 100081 Beijing, China

*yangshuhua@caas.cn

To study the dynamic changes of freezing tolerance and its physiological basis of leaves and annual shoots of *R. beggeriana* and *R. fortuneana*, the cold hardiness was estimated by the semi-lethal temperature (LT₅₀), which was assessed by electrolyte leakage rate with Logistic equation, the accumulation of saccharides substances in stems was observed by periodic acid-shiff (PAS) staining and the content of relative water (RWC), malondialdehyde (MDA), soluble sugars, proline, ABA and activity of SOD, POD and CAT were measured. Results showed that the freezing tolerance of leaves were similar, but, shoots of *R. beggeriana* exhibited stronger cold hardiness than *R. fortuneana*. Compared with *R. fortuneana*, *R. beggeriana* accumulated more photosynthetic products at the beginning of cold acclimation, which transported to shoots and stored as starch under the regulation of increased ABA content before defoliation and hydrolyzed as soluble sugars at the midwinter to sustain osmotic balance, and dependent on higher activity of SOD to maintain redox balance, while, the higher content of proline and POD activity observed in shoots of *R. fortuneana* could not sustain the osmotic and redox balance, which lead to more membrane lipid peroxidation damage and weaker hardiness, eventually.

Keywords: *Rosa beggeriana*, *Rosa fortuneana*, freezing tolerance, physiology, overwintering



P57:

(Not Completed Registration)

EFFECTS OF SOWING DEPTH AND GROWTH MEDIUM ON EMERGENCE AND GROWTH OF GOLDEN PALM (*Chrysalidocarpus lutescens*) SEEDLINGS

Musibau Olosunde*, Matthew Ojo Oluwafemi, Aminat O. Fayomi

Federal University of Agriculture, Department of Horticulture, PMB 2240, 110001 Ogun Abeokuta, Nigeria

*olatundeolosunde@yahoo.com

Golden Palm (*Chrysalidocarpus lutescens*) is an important slow growing bushy ornamental palm, widely used for air purification, indoor and outdoor ornamental purposes. Experiment to determine the effects of different sowing depths (2, 4, 6 and 8 cm) and growth media (topsoil, rice husk and sawdust) on emergence and growth of *C. lutescens* seedlings was conducted at the Horticultural Nursery of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria in 2012 and validated in 2014. The treatments were arranged in Completely Randomized Design and replicated four times. Data collected on seedling emergence, plant height, number of leaves, number of roots, root length, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight were subjected to analysis of variance (ANOVA). The study revealed that sowing depth significantly influenced seed germination and seedling emergence (%). Highest percentage of seedling emergence in fewer days was observed in seeds sown at 2 cm depth. Effect of different growth media on days to seedling emergence, root and shoot growth was significant ($p \leq 0.05$). Topsoil medium supported seedling emergence and growth than rice husk or sawdust. It was concluded that producers could improve seedling emergence and growth of *C. lutescens* by sowing at 2 cm depth in topsoil medium.

Keywords: ornamental palm, germination, planting depth, seedling establishment, environmental beautification

P58:

(Not Completed Registration)

DETERMINATION OF ANTIOXIDANTS AND PIGMENT CONTENT IN FIVE AFRICAN MARIGOLD (*Tagetes erecta* L.) CULTIVARS

Jayoti Majumder^{1*}, Sellam Perinban², Anirban Dutta²

¹Department of Floriculture and Landscape Archit, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, India

²ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi, 110012, India

*jayotisarkar1@gmail.com

Apart from ornamental purposes, African marigold (*Tagetes erecta* L.) is also widely consumed as edible flower. In India, different provinces grow various cultivars. To know the best suitable cultivar for nutraceutical values among them, the present study is aimed to forecast the antioxidant and phytochemical components of five African marigold cultivars viz. Pusa Narangi Gaiinda, Seracole, Inca Orange, Crakerjack Orange and Sunshine Orange, which are grown under north Indian condition. As per the yield is concerned, cultivar Pusa Narangi Gaiinda recorded highest yield (66.97 flowers/plant) followed by Seracole (51.72 flowers/plant). The colorimetric comparison for visual colour analysis showed that, the L* value was highest (62.75) in the cultivar Crackerjack Orange whereas, the a* value was superior (13.27) in Pusa Narangi Gaiinda. Antioxidant activity assays were performed by the Ferric ion Reducing Antioxidant Power (FRAP) and the cultivar Pusa Narangi Gaiinda was found with highest (0.84 mmol of trolox/g) amount of it. The lutein content was estimated by HPLC. Here also the cultivar Pusa Narangi Gaiinda showed highest lutein (3.83 mg of LT/g) followed by Seracole (2.89 mg of LT/g). The total phenol content was found to be highest in cultivar Pusa Narangi Gaiinda i.e., 1.08 mg of GA/g. Besides that, vitamin C content was also found to be higher in the variety Pusa Narangi Gaiinda (105.29 mg/100g) followed by the Seracole (90.96 mg/100g respectively). Therefore, it was found out that among five cultivars grown in North India of *Tagetes erecta* L., Pusa Narangi Gaiinda is best suitable variety for pigment and phytochemical production.

Keywords: *Tagetes erecta*; FRAP, lutein, vitamin C, HPLC



P59:

(Not Completed Registration)

EFFECT OF PUTRESCINE AND DIFFERENT MEDIA ON VEGETATIVE GROWTH, FLORET AND SOME BIOCHEMICAL PARAMETERS OF GLADIOLUS UNDER SOILLESS CONDITIONS

Ali Tehranifar^{1*}, Ali Jabbar²

¹Ferdowsi University of Mashhad, Faculty of Agri., Dept. of Horticulture, PO Box 91775-1163, Mashhad, Iran

²Ferdowsi University of Mashhad, Mashhad, Iran

*tehranifar2009@yahoo.com

This experiment was conducted to evaluate the effect of putrescine (50 and 100 ppm) and coco peat: perlite medium with three ratios (v/v) (1:1, 3:1 and 1:3) on vegetative growth, florets and biochemical parameters of gladiolus cv. 'Strong' under soilless conditions in 2016. Data indicated that most criteria of vegetative growth expressed as plant height, leaf number and leaf area, floret parameters as floret number, floret fresh weight and floret dry weight, and biochemical parameters as chlorophyll (a), chlorophyll (b) and total chlorophyll significantly increased by putrescine 100 ppm with (118.28 cm, 10.53, 72.11 cm², 15.69, 10.64 g, 5.42 g, 3.12 mg/g, 1.60 mg/g and 4.72 mg/g) respectively. In terms of media, the same traits (113.46 cm, 10.50, 47.18 cm², 16.75, 10.57 g, 5.35 g, 3.15 mg/g, 1.71 mg/g and 4.87 mg/g) respectively, significantly increased by the coco peat: perlite medium with ratio (1:3). Interaction between putrescine and media in term of plant height, leaf area and floret number was significant (124.33 cm, 493.67 cm² and 18.32) respectively, by putrescine 100 ppm and coco peat: perlite medium with ratio (1:3).

Keywords: gladiolus, putrescine, soilless, coco peat, perlite

P60:

(Not Completed Registration)

REGENERATION, RESISTANCE TO KANAMYCIN AND TRANSIENT GENE EXPRESSION OF SOME LILIUM VARIETIES TO TRANSFORM F3'5'H GENE

Parisa Koobaz^{1*}, Maliheh Fallahpour², Alireza Ghanbari³, Pejman Azadi², Esmail Chamani³

¹Agricultural Biotechnology Research Inst., ABRII, Tehran, Iran

²Karaj, Iran

³Ardebil, Iran

*koobaz@abrii.ac.ir

Flower color is one of the most attractive features of ornamental plants, which has a major value in the flowering market. Usually in any of the plants, a limited amount of anthocyanin accumulates, resulting in a limited number of colors based on the expression of a specific set of genes. In this way, the range of colors in many ornamental plants is limited by genetic background and genetic modification (GM) is the only effective way to overcome this limitation. In order to GM production, ten commercial different colors of liliu cultivars were selected to find appropriate ones. For this purpose, the regeneration ability of the explants under in vitro conditions and their resistance to kanamycin antibiotics as a selectable marker was investigated. Then, three different cassettes that carrying the F3'5'H gene were separately examined to gene transient expression. The results showed that the maximum number of bulblets was observed with 0.05 and 0.5 mg/l BAP and NAA. Also the highest amount of callosity was found on MS medium containing 1 mg/l picloram. Moreover, the regeneration of the explants was stopped after two months when they were put in 200 mg/l kanamycin. This experiment further highlights that transient transgene expression derived from Agro-infection into the abdominal surface of the liliu petals. Due to the change in the color of the flower after a few days, two oriental lilies were introduced as the suitable host for gene transfer and stable expression. Further studies can be used to measure the concentration and expression level of anthocyanin compounds related to flower color and attempt to the stable gene transfer methods.

Keywords: gene transfer, in vitro bulblet regeneration, kanamycin, liliu



P61:

(Not Completed Registration)

MOLECULAR EVALUATION OF GENETIC DIVERSITY AND POPULATION STRUCTURE IN WILD AND CULTIVATED TULIPS (*Tulipa* L.) BY EST-SSR MARKERS

Morteza Khosh-Khu

Department of Horticultural Science, College of Agriculture, Shiraz University, Shiraz, Iran

*mkhoshkhui@yahoo.com

Tulips (*Tulipa* L.) ranked as the third most important cut flowers at the flower auctions. Analysis of molecular variability of tulips is of great importance in conservation and parental lines selection in breeding programs. Of the 70 genic microsatellites, 15 highly polymorphic and reproducible markers were used to assess the genetic diversity, structure, and relationships among 280 individuals of 36 wild and cultivated tulip accessions from two countries: Iran and the Netherlands. The mean values of Gene Diversity (GD) and Polymorphism Information Content (PIC) were 0.69 and 0.66, respectively which indicated the high discriminatory power of markers. The calculated genetic diversity parameters were found to be the highest in wild *T. systola* Stapf (Derak region). Bayesian model-based STRUCTURE analysis detected five gene pools for 36 germplasms which corresponded with morphological observations and traditional classifications. Based on Analysis of Molecular Variance (AMOVA), to conserve wild genetic resources in some geographical locations, sampling should be performed from distant locations to achieve high diversity. The UPGMA clustering and Principal Component Analysis (PCA) plot indicated that among wild tulips, *T. systola* and *T. micheliana* Hoog exhibited the closest relationships with cultivated tulips. It is widely believed that the wild progenitors which have contributed to develop *T. gesneriana* cultivars have originated from a collection of tulips in Istanbul, Turkey. On the other hand, it is assumed that wild tulips from Iran may have been brought into Turkey during the Seljuk and especially Ottoman periods. As a consequence, it can be assumed that wild tulips from Iran, Turkey, and perhaps other Middle East countries played a role in the origin of *T. gesneriana*. In conclusion, combining tulip germplasms between Iran and the Netherlands would be possible to broaden the genetic base of cultivated tulips to overcome some disadvantages in these cultivars, especially susceptibility to plant pathogens.

Keywords: conservation implications, genic microsatellites, ornamental geophyte, population genetics

P62:

(Not Completed Registration)

MORPHO-PHYSIOLOGICAL RESPONSE OF *Vinca rosea* AT DIFFERENT FIELD CAPACITY LEVELS

Noman Ahmad¹, Adnan Younis¹, Ghulam Mustafa², Muhammad Kashif Mukhtar¹, **Muhammad Amin^{2*}**

¹Institute of Horticultural Sciences, University of Agriculture, 38040 Punjab Faisalabad, Pakistan

²Department of Horticulture, Muhammad Nawaz, Shareef University of Agriculture, 60000 Punjab Multan, Pakistan

*aminuaf42@yahoo.com

Vinca rosea is an annual bedding flowering plant, which is planted in urban landscape in the world. Acquaintance of comparative drought resistance is important for selecting *Vinca rosea* in landscape that persists during drought stress circumstances. A pot experiment was conducted to evaluate the morphological and physiological response of two *Vinca rosea* cultivars (cv. Pacifica and cv. Titanic) under different field capacity conditions. The potted plants of both cultivars were subjected to different field capacity levels (40, 60, 80 and 100%). The experiment was laid out under Completely Randomized Design (CRD) with two factors (drought levels, cultivar) factorial arrangement and four replications. Highly significant interaction among field capacity and cultivars was ascertained for leaf area, root length, transpiration rate, stomatal conductance and water use efficiency. Moreover, the plant height, root fresh weight, root-shoot ratio for fresh weight were significantly affected in response to different field capacity levels. Overall, cv. Pacifica showed more resistance to drought stress conditions than cv. Titanic. The field capacity level of 60-80% was found suitable for both cultivars.

Keywords: drought, plant growth, water deficiency, climate change

