

B.Sc. (Hons.) Agriculture

Optional course

**SST 451 Seed Entrepreneurship skill development
and management (1+1)**

Lecture 1 Current status of national and global seed industry and future perspectives

SEED is the most important input component for productive agriculture. In the significant advances that India made in agriculture in the last four decades, the role of the seed sector has been substantial. The expansion of seed industry has occurred in parallel with growth in agricultural productivity. Given the fact that sustained growth to cope with increasing demand would depend more and more on the pace of development and adoption of innovative technologies, the seed would continue to be a vital component for decades to come. The organized seed industry of the country is just forty years old. Yet, its growth has been phenomenal. India is one of the few countries where the seed sector is already reasonably advanced¹. **The private seed industry is no more confined to just production and marketing of seed. It has as well acquired technological strength to cater to the varietal needs of tomorrow.** Contribution of seed market share by **Public sector market share is 30% to the private companies which is 70%.**

SEED INDUSTRY DEVELOPMENT IN INDIA

1928	:	Royal Commission on Agriculture Report submitted, citing that facilities for increasing the supply of breeder seed were inadequate, and that varietal purity of seeds was not maintained.
1957	:	All-India Coordinated Maize improvement Project began.
1960	:	Similar projects on sorghum and pearl millet began. Training in seed technology started.
1961	:	Four maize hybrids released.
1963	:	National Seeds Cooperation (NSC) established
1964	:	First sorghum hybrid released
1965	:	First pearl millet hybrid released. 250 tonnes of dwarf wheat seed imported from CIMMYT, Mexico
1966	:	Seeds Act passed
1963-69	:	Certified seed production increased from 360 ha to 35,000 ha.
1968	:	Seed review team report submitted
1969	:	Tarai Development Corporation (TSC) established with World Bank assistance primarily to produce certified wheat seed. Concept of compact area development for seed production initiated.
1971	:	National Commission on Agriculture submitted its report. Government decided to reorganize seed production in India. The Indian Society of Seed Technology (ISST) was born.
1972	:	ISST organized first All-India Seed seminar. (Five more have since been held.)
1975	:	Project Report on National Seeds Program (NSP) submitted

1981	:	First workshop on seed technology under NSP was held. Certified seed production increased from 137,000 tonnes in 1974/75 to about 350,000 in tonnes in 1980/81. 1983: Seeds (control) order enacted
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Policy Initiatives in Seed Sector: The following policy initiatives have been taken by the Government of India in seed sector:-

- Enactment of the Seeds Act, 1966
- Seed Review Team-SRT (1968)
- National Commission on Agriculture's Seed Group (1972)
- Launching of the World Bank aided National Seeds Programme (1975-85) in three phases leading to the creation of State Seeds Corporations, State Seed Certification Agencies, State Seed Testing Laboratories, Breeder Seed Programmes *etc*
- Seed Control Order (1983)
- Creation of the Technology Mission on Oilseeds & Pulses (TMOP) in 1986 now called The Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM).
- Seed Transport Subsidy Scheme (1987)
- New Policy on Seed Development (1988)
- Seed Bank Scheme (2000)
- National Seeds Policy (2002)
- The Seeds Bill (2004)
- Formulation of National Seed Plan (2005)
- National Food Security Mission (2007)
- RashtriyaKrishiVikasYojna (2007)

Global Seed Industry

- ❖ The global seed market is projected to be valued at \$85,237.6 million by 2018 and is growing with a CAGR of 12.1% from 2013 to 2018.
- ❖ The size of the global seeds market was derived by forecasting techniques based on segments of the entire market, **such as seed types, share of biotech trait seeds, area under crop cultivation, and trade between various geographical regions.**
- ❖ The global seed market is segmented into oilseed, grain seed, fruit and vegetable and others.
- ❖ North America is the largest seeds market in the world, in terms of revenue, and is projected to grow rapidly.
- ❖ Latin America is the fastest growing market for seed. **China, Brazil, and India are also important countries for this market, adopting new technologies to grow faster.**
- ❖ **Globally, India is projected to be the fastest growing market during the period under consideration for the scope of this report.** The grain seeds market held maximum share in 2012 and is estimated to grow at a CAGR of 11.9% from 2013 to 2018.
- ❖ **For grain seed, corn covers the largest market share followed by soybean under the crop segment which shared 70.4% of the total grain seed market in 2012, growing with the fastest CAGR of 12.5%.**
- ❖ Grain seed dominated for seed with trait market in 2012, growing with a CAGR of 10.5%.
- ❖ **In 2012, maximum traits were developed in corn crop; approximately 52.5% of total seeds with trait.**
- ❖ **Herbicide tolerant trait is the most applied trait under the seed with trait market followed by insect resistant trait.** It held 42.2% share in 2012 and is growing with the fastest CAGR of 16.5% from 2013 to 2018.
- ❖ **The key driving factors for seeds market are - continually growing world population, increasing advanced agricultural technologies, decreasing per capita land availability, and high return on investment.**
- ❖ **Demand for hybrid seed is increasing globally as these biotech trait seeds provide benefits like helping the crop sustain extreme climatic conditions.**

- ❖ The seeds market was \$44,122.2 million in 2012 and is projected to reach \$85,237.6 million by 2018, growing at a CAGR of 12.1% from 2013 to 2018.
- ❖ **The global market was dominated by some major companies such as Monsanto (U.S.), DuPont (U.S.), Syngenta (Switzerland), and Bayer (Germany).**

Present status of seed industry

The profile of seeds in India has changed over the years. Earlier, it was the seeds saved from the previous crop that was used in Indian agriculture. Now it is the most advanced seeds that are developed by seed companies that dominate the farmers' fields. The phenomenon has roots in the changing dynamics of agriculture, not only in India but also world wide. The spectre of changing climate, the danger of depleting resources and the threat of burgeoning population has diminished the productivity of agriculture. Stagnant yields and yield loss have become quite persistent. Adding to the chaos, India has its own share of problems –lower penetration of technology, shrinking land holdings, marginal farmers, lack of mechanization, shortage of labour to name among a few. A study titled 'Labour in Indian Agriculture: A growing challenge' conducted by industry lobby group Federation of Indian Chambers of Commerce and Industry (Ficci) and audit and consulting firm KPMG reveals that the size of the agricultural workforce in India reduced by 30.57 million between 2004-05 and 2011- 12 and the share of agricultural workforce in the total workforce reduced from 56.7% to 48.8% during this period. The way out suggested by the study was mechanization of farms, promoting seed technology that reduces labour requirements, and increasing use of herbicides.

Apparently seeds have come to dictate the course of agriculture and it is high time India seizes the opportunity and invests in good seeds. India's Seed Sector India has a vibrant seed market. Over the years, the seed industry has evolved side by side with the Indian agriculture. From the practice of saving seeds from the previous crop, Indian farmers have come a long way and has become avid users of 'factory manufactured seeds'. The growth of seed industry can be considered parallel to the growth of India's agri production.

Today, the Indian seed industry is the fifth largest seed market in the world, accounting for 4.4% of global seed market after the U.S. (27%), China (20%), France (8%) and Brazil (6%). In terms of global trade, India is almost self-sufficient in flower, fruits and vegetables and field crops seeds. According to Ken Research's report, "India Seed Industry Outlook to FY'2018 - Rapid Hybridization in Vegetables, Corn and Rice to Impel Growth", the hybrid seed market has grown at a stupendous CAGR of 36.1 per cent over the period FY'2007- FY'2013. The contribution of varietal seeds to the overall commercial seed market in India has witnessed a steep decline from 72 per cent in FY'2007 to 36.8 per cent in FY'2013. The Indian seed market is majorly contributed by non-vegetable seeds such as corn, cotton, paddy, wheat, sorghum, sunflower and millets. In FY'2013, the non-vegetable seeds accounted for 82.2 per cent of the overall seed market in India. Non-vegetable seed market in India is largely concentrated in cotton, contributing the largest share of 40.8 per cent. Overall, paddy, maize and vegetables are expected to drive the growth of Indian hybrid seed industry in the next five years. It is expected that better rice hybrids will be

developed to give a yield advantage of at least 3-4 tonnes per hectare over the research varieties. With the arrival of newer forms of seed varieties, the traditional open pollinated varieties have taken a back seat.

In 2010, they valued at 0.19 billion USD which was around 12 per cent of total market value. The open pollinated seeds which are saved over years for their desirable traits has a varying Seed Replacement Rate (SRR) of 20-80 per cent. **Only government agencies and few small regional players are involved in their multiplication and distribution. Hybrid seeds, on the hand, now occupy the highest share in terms of total market value.** In fact, this is a promising sector for the private players as this section of seed needs **cent per cent SRR.** Syngenta, Dupont, Mahyco, J K seeds, Bioseed, Rasi and Bayer are some of the players in this business. The most controversial category of seeds is the one which are genetically modified and more commonly referred to as GM seeds. This category of seeds were seen capturing a good share of markets with heavy investments in R&D. Unfortunately, the unsteady policy measures and wavering government stand has dampened the spirits of this sector. Monsanto, Dupont, Syngenta, Rasi and Pioneer are some of the companies working on this line of seeds. Despite the strong statistics in support of the commercial seed sector, Indian seed market is strongly dominated by the farm saved seeds. Tradition of saving seeds, economic feasibility and ease of using the saved seeds have still now made them the most favoured category of seed varieties among the Indian farmers. **Around 75 per cent of seed used in the country falls in this category.**

Public sector has a strong representation in the country's seed market. This includes 99 ICAR research institutes, 65 agricultural Universities (SAUs & DUs), 15 State Seed Corporation (SSC), National Seed Corporation (NSC) and State Farms Corporation of India (SFCI). Seeds are a critical and basic input for enhancing agricultural production and productivity in different agro-climatic regions. **Indian seed programme largely adheres to the limited generation system for seed multiplication. Indian seed programme includes the participation of Central and State governments, Indian Council of Agricultural (ICAR), State Agricultural Universities (SAU) system, Public sector, cooperative sector and private sector institutions. Seed sector in India consists of two national level corporations i.e. National Seeds Corporation (NSC) and State Farms Corporation of India (SFCI), 15 State Seed Corporations (SSCs) and about 100 major seed companies. For quality control and certification, there are 22 State Seed Certification Agencies (SSCAs) and 105 state Seed Testing Laboratories (SSTLs).** The private sector has started to play a significant role in the production and distribution of seeds. The private sector is represented by 500 small & medium players and 50 large national & Multinational players. Among the strong contenders for growth, hybrid seed sector is stealing the show. The Indian hybrid seed market, with over 300 companies, has been growing at 15-20 per cent annually **over the past several years and is projected to reach around Rs 18,000 crore by 2018. About 10 domestic and multinational companies control over 80 per cent of the market.**

Future Outlook of Indian Seed Industry

The seed industry of the country is going to align with the changing food consumption scenario of the country. There has been a decline in the proportion of expenditure on food items in last three decades. The change has occurred in both urban and rural areas. Between

1990 and 2010, consumption of cereals and pulses has decreased considerably while consumption of fruits and vegetables has almost doubled. The future seed market of the country is expected to witness more adoption of hybrid seeds. The country is going to witness an increase in the cultivation of vegetables and fruits, driven by the growth and development of the food processing sector along with changing consumption habit of the people. **The export sector is also set to witness growth. One of the most important developments in the future will be the increased demand for quality vegetable and fruit products, because of the increased consumer awareness and increase in disposable income of the population.** As a result of this, trend of protected cultivation will increase in India. The current seed industry might also need to develop new products in order to attune with the greater mechanization of agriculture sector in India in the near future, vastly due to labor challenges. **One more expected change that the seed industry is going to witness is in the form of an increased demand for fruits and vegetable varieties with higher nutritional values. Life style related health problems are increasing in the country with diseases like obesity, diabetes, malnutrition etc. on the rise and hence people are becoming more health conscious which will propel the use of fruits and vegetables with more nutritional values.**

Seed plan - supply chain management - significance of seed replacement rate (SRR) - formal and informal seed sector

Seed planning:

Success of seed production depends upon prior planning of production of different classes of seeds. In order to supply quality seed to farmers, generation system of seed multiplication has to be followed. Therefore, seed planning should be done 3 years ahead of the year of supply in order to produce sufficient quantity of breeder seed, foundation seed and certified seed.

Basic information's needed for planning for seed production for different classes of seeds in varieties and hybrids are as follows.

- ❖ Quantity of seeds required (area x seed rate)
- ❖ Area to be covered (quantity of seeds required / seed yield)
- ❖ Seed multiplication ratio
- ❖ Extend of reduction in yield
- ❖ Processing losses
- ❖ Fruit yield in case of vegetables
- ❖ Seed recovery (%)

The basic formula used in planning

Seed requirement = Area x seed rate

Area required to produce the required seed = $\frac{\text{Seed requirement}}{\text{Seed yield}}$

Problem 1 : Calculate the foundation seed area needed to produce 1,00,000 kg of certified seeds of rice var. ADT 43 if the seed rate per ha is 40 kg and seed multiplication ratio is 1:80.

Given

Quantity of certified seed required : 1, 00,000 kg
Seed rate per ha : 40 kg
Seed multiplication ratio : 1:80

Seed yield

Seed produced from one ha : Seed rate x seed multiplication ratio
: 40 x 80
Seed yield : 3200 kg

Certified seed

Certified seed area required to produce : 1, 00,000 kg
: Seed required / seed productivity
: $\frac{1, 00,000}{3200}$
: 31.25 ha
Foundation seed needed to sow 31.25 ha : Area x seed rate
: 31.25 ha x 40 kg/ha
: 1250 kg
Foundation seed area needed to produce 1250 Kg at the same seed multiplication ratio
: $\frac{1250}{3200}$
: 0.39 ha

Problem 2: Calculate the breeder seed area required to cover 10000 ha with certified seeds of bajra if the seed replacement rate (SRR) is 10% ; seed multiplication ratio (SMR) is 1:200 and seed rate is 4 kg/ha.

Given

- 1.Area required to cover 10000 ha
- 2.Seed replacement rate (SRR) is 10%
- 3.Seed multiplication ratio (SMR) is 1:200
- 4.Seed rate is 4 kg/ha.

Calculate seed yield

Seed multiplication ratio : 1:200

Certified seed produced based on 1:200 SMR : Seed rate / ha x SMR
: 4 x 200

Seed yield : 800 kg/ha

Calculate Actual area to be covered

Area proposed to cover under certified seeds of bajra : 10000 ha

Seed replacement rate given : 10%

Actual area to be covered : Total area under the crop x SRR
: 10000 x $\frac{10}{100}$

Area to be covered certified seed : 1000 ha

Certified seed:

Area to be covered with certified seed of bajra : 1000 ha

Quantity of certified seed needed to cover 1000 ha : Area X seed rate
: 1000 ha x 4 kg/ha

Area is required for produce 4000 kg of C.S : 4000kg
: Seed required / Seed yield
: $\frac{4000}{800}$
: 5 ha

Foundation seed:

Quantity of foundation seed require to cover 5 ha : Area X seed rate
: 5 ha x 4 kg/ha
: 20 kg

Area is required for produce 20kg of F.S : Seed required / Seed yield
: $\frac{20}{800}$
: 0.025 ha

Breeder seed:

Quantity of Breeder seed require to cover 0.025 ha : Area X seed rate
: 0.025 ha x 4 kg/ha

Area is required for produce 0.1 kg B.S : 0.1 kg
: Seed required / Seed yield
: $\frac{0.1}{800}$
: 0.00125 ha

Seed supply chain management

SEED SUPPLY SYSTEM IN TAMILNADU

The seed supply system involves scientific rising of seed crops, rigorous roguing, constant vigil **to maintain field standards of seed crop, stage specific inspections, timely harvest, processing and seed testing / certification and labeling.** The ‘Generation System of Seed Multiplication’ is followed to produce the quality seeds. The flow chart depicting the steps in crop improvement and seed multiplication is provided in Figure 1.

The seeds supplied to the farmers of Tamil Nadu are either Public or Private varieties. **The Public varieties are the varieties bred by Public institutions like Tamil Nadu Agricultural University or State Agricultural Universities of neighboring states like Karnataka, Andhra Pradesh etc., or central varieties released by the Indian Council of Agricultural Research.** The private varieties are the ones released by the **big seed companies which have their own Research and Development wing.** The seeds of **Public varieties are multiplied and supplied to the farmers by the Department of Agriculture, Tamil Nadu Agricultural University and the interested seed companies.** Irrespective of the agency that multiplies and supplies the seed, the indent for the breeder seeds from which further multiplication has to be made with the Tamil Nadu Agricultural University one year in advance. The seed multiplication procedure and the quality control procedure followed for each class of seed is described below. The agencies involved and existing interface in the seed supply system of Tamil Nadu is depicted in Figure 3.

a) Public Varieties

For public varieties and hybrids, Tamil Nadu Agricultural University helps to meet breeder seeds of released varieties. Department of Agriculture, private seed companies or co-operatives that wish to obtain breeder seed should submit the indent to the University one year in advance. The indents are made once in a year; University then apportions the requests among its research stations. Ideally the breeder seed production of a variety should be managed by the respective scientists in the seed production centres.

Figure 1. Step – wise flow chart on crop improvement and seed multiplication

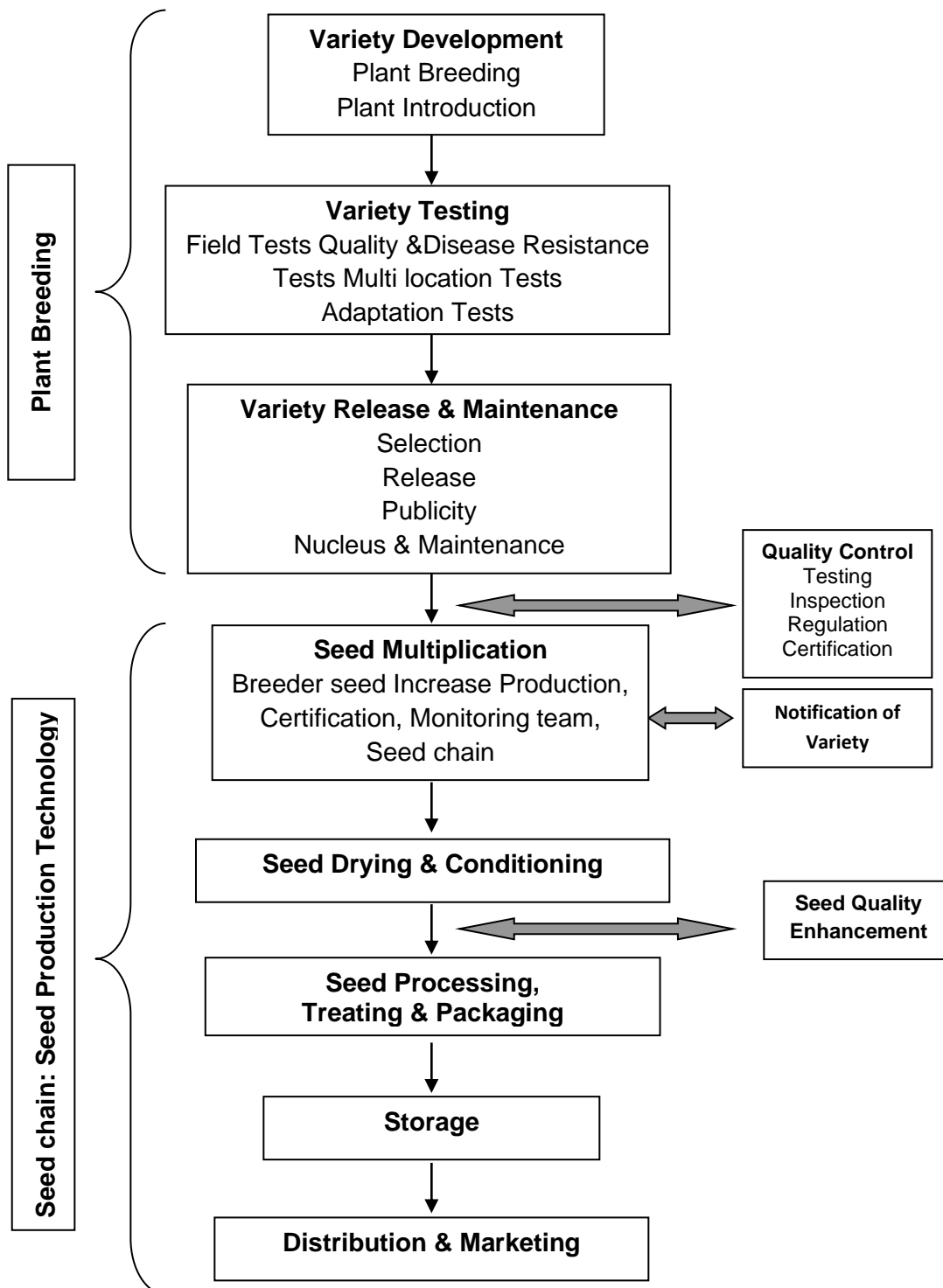
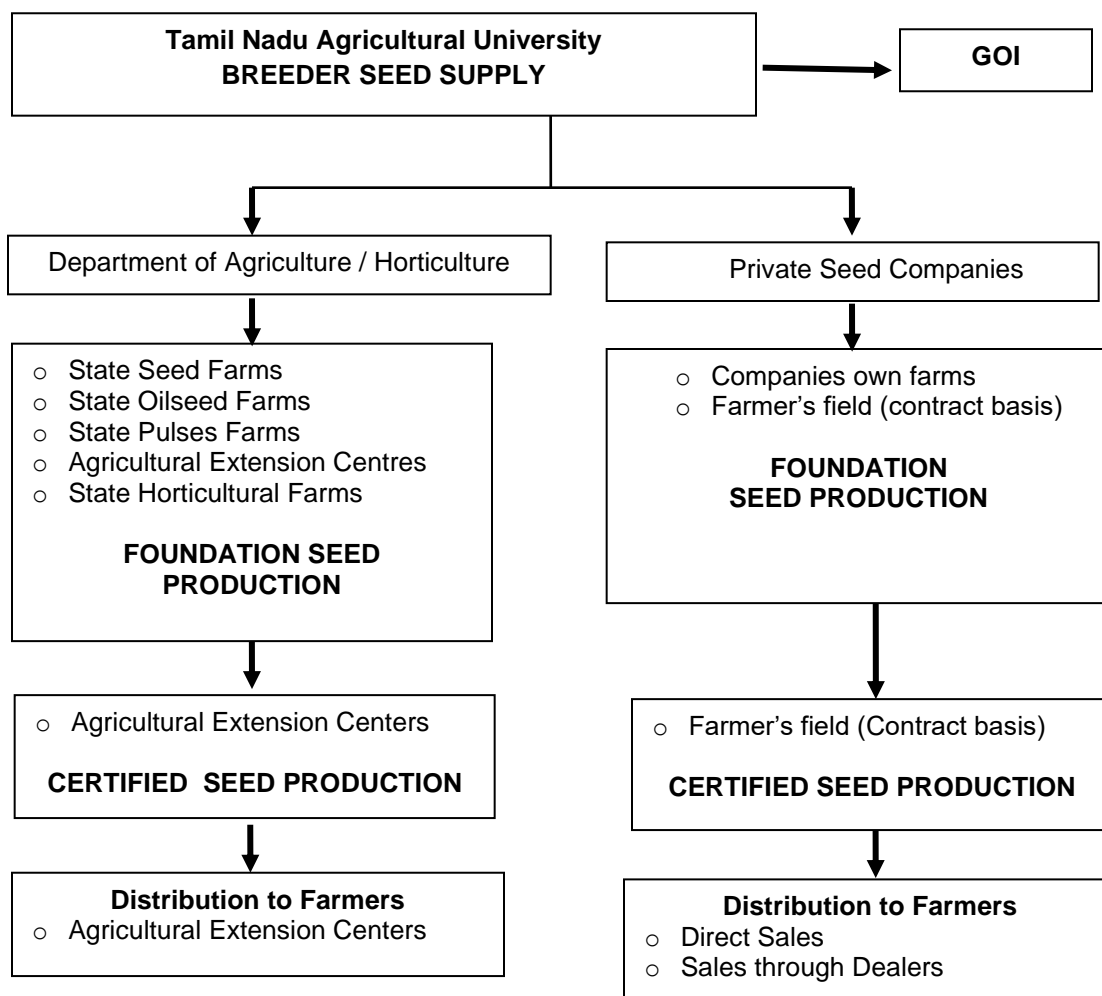


Figure 2. Seed Supply System for Public / notified Varieties in Tamil Nadu



It takes approximately three years from the time of indent until the resulting commercial seed is ready for the market, since seed multiplication chain includes foundation and certified seed production. So seed producers need to plan their indents for breeder seed carefully and need to know which varieties are likely to be in demand. The scientist in charge of Breeder Seed Production is responsible for the quality of the breeder seed, however a monitoring committee which includes the members from Department of Seed Certification and SAU will monitor the seed field and check the field standards. **The seeds will be sent to a Notified Seed Testing Laboratory at Tamil Nadu Agricultural University, Coimbatore for testing the purity and germination standards. Simultaneously, Grow Out Test will be conducted for genetic purity.**

The State Department of Agriculture, private companies and co-operatives receiving breeder seed, multiply it to produce foundation seed, which is the second stage in the seed chain. The Department of Agriculture organize foundation seed production in State

Seed Farms, State Oilseed Farms, State Pulses Farms, State Horticultural Farms and Agricultural Extension Centers. All the private companies organize seed multiplication in the companies own farms or through contract seed growers. Company staff may contact the farmers directly but they often work through the organizers with contracts in villages, who take responsibility for identifying and supervising the growers. **Seeds are subjected to seed certification process by registering with the Department of Seed Certification.**

From the foundation seeds, the Department of Agriculture produces certified seeds through Agricultural Extension Centers. Private companies and co-operatives produce certified or truthfully labeled seed through contract farming, which forms the third stage in the seed chain. Many seed companies have their own seed conditioning facilities or they can rent the facilities. Certified seeds produced by Department of Agriculture are certified through Department of Seed Certification. The third chain produced by the seed companies may be certified or Truthfully Labeled (TFL) seeds.

b) Private Hybrids and Varieties

The company produces its own breeder, foundation and truthfully labeled seeds by entering into contract with the seed growers. At all stages of seed multiplication, the company maintains the seed quality standards at field level with their own staff followed by seed testing in their own laboratory and seeds sold as Truthfully Labeled seeds.

Certified seeds of new varieties may be eligible for a subsidy from the State Government and this is an incentive for certification. However, some times the seed companies choose to forgo certification and sell Truthfully Labelled seed since the time required for post harvest operations and testing after the seed crop is harvested seems to be inconvenient for the seed producers for ensuring timely marketing. In addition, there are some varieties (particularly newer ones) that have been released but not Notified and these are not eligible for certification as per the Seed Act (1966).

SEED SUPPLY CHAIN DYNAMICS

The Lacuna

In Tamil Nadu the gap between requirements (demand) and production of quality (supply) seeds remain consistently high for many of the crops *i.e.*, 76 percent for agricultural crops and 50 per cent for horticultural crops. During the last decade, the share of government sector in seed production has come down heavily whereas the share of private sector has steadily increased. The need of the hour is to increase the participation of the Public Sector in catering to the seed needs of the farmers. A competitive Public Sector Organization / Agency are a must to guard unwarranted exploitation of farmers by private seed companies in the name of quality seeds. **A vibrant Public Sector Organization / Agency is necessary to safeguard the interests of the marginal and resource poor farmers who cannot afford to purchase high cost seeds offered by the Private Sector.** Deterred by the high cost of private company seeds, **marginal and resource poor farmers may shun away from high yielding varieties/hybrids leading to lower agricultural production.** Thus, to bring social and economic development to farmers of all strata, it is important to nurture a efficient and effective Public Sector in seed supply system.

At present, the valuable breeder seeds supplied from the Tamil Nadu Agricultural University and ICAR Institutes are not fully utilized to produce the expected certified seeds as per Seed Plan to achieve the targeted SRR. Further, low Seed Multiplication Ratio is realized in the public and private sector, due to unknown reasons leading to consumption of more quantities of breeder seeds. Therefore, public and private sector have adopted the practices of placing indents for breeder seeds in higher magnitude than what is actually required. This situation not only increases the expenditure of seed production agencies on the purchase of excess breeder seeds but also causes stress on Tamil Nadu Agricultural University and ICAR Institutions to spend excessively on financial and human resources for breeder seed production.

As per the seed supply system in the State, the Department of Agriculture of State Government places the indent for the breeder seeds with Tamil Nadu Agricultural University and on procuring the breeder seeds from the University, further multiplication into foundation and certified seeds is carried out by the Department of Agriculture at the State Seed Farms,

State Oilseeds Farms, State Pulses Farms and in farmers field through Agricultural Extension Centers.

Although the breeder seeds are supplied as per the indent by the University, the public and private sectors have not followed the *Seed Multiplication Chain* intensively to achieve the expected certified seed production.

This is due to the operational constraints experienced in both public and private sector seed production agencies. The Tamil Nadu Agricultural University and Directorate of Seed Certification is engaged in offering number of trainings to the Agricultural Officers in the field of seed production. However, one of the major constraints experienced in the public sector is discontinuous engagement of trained staff in seed production activities. Similarly in private sector, except in very few seed companies, trained manpower is not available for seed production.

Discontinuation of the ‘Seed Multiplication Chain’ by supplying the foundation seeds as commercial seeds, instead of forwarding it to certified seed production.

1. Usage of excessive seed rate while sowing the breeder seed for foundation seed production resulting in lower than expected area of foundation seed production.
2. Poor management of seed production plots, improper agronomic practices resulting poor yield *i.e.*, less than expected foundation seed and certified seed.

The above lacunae have to be addressed with conviction to assure that each breeder seed supplied by Tamil Nadu Agricultural University is multiplied in to foundation and certified seed so as to meet the entire seed demand of the State.

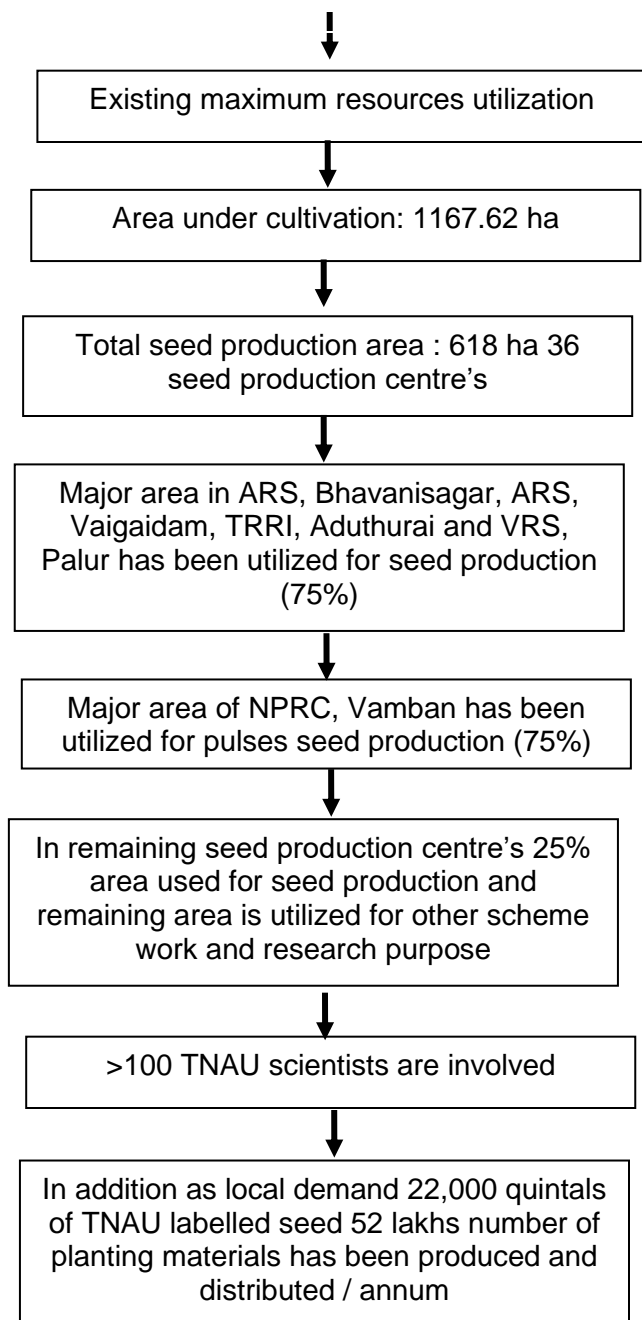
The State Seed Producing Agency (DoA) should function with the following objectives.

1. To monitor the production of foundation seeds effectively in State Seed Farm.
2. To look after the production, procurement and distribution of quality seeds through contract seed production.
3. To ensure timely supply of quality seeds of improved varieties both during normal as well as off seasons.
4. To accelerate the spread of high yielding hybrids and varieties.

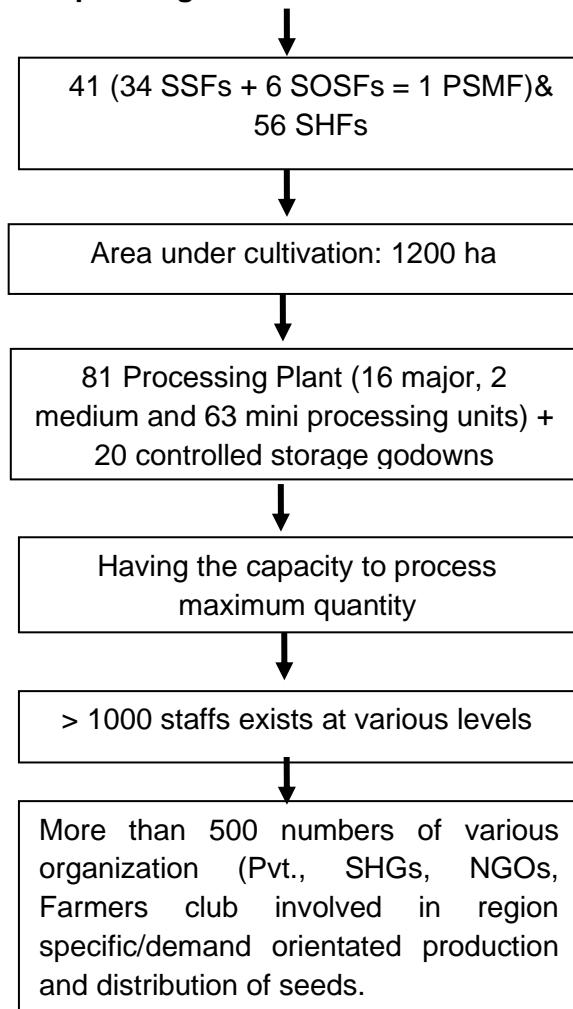
5. To co-ordinate with other State Seed Corporations and National Seed Corporations for seed production and distribution.
6. To develop the Human Resource in Seed Production by offering trainings to NGO's, private entrepreneurs and farmers.
7. To educate the farmers on the benefits of usage of quality seeds
8. To achieve the increased Seed Replacement Rate.

Infrastructure facilities and other support available for seed production

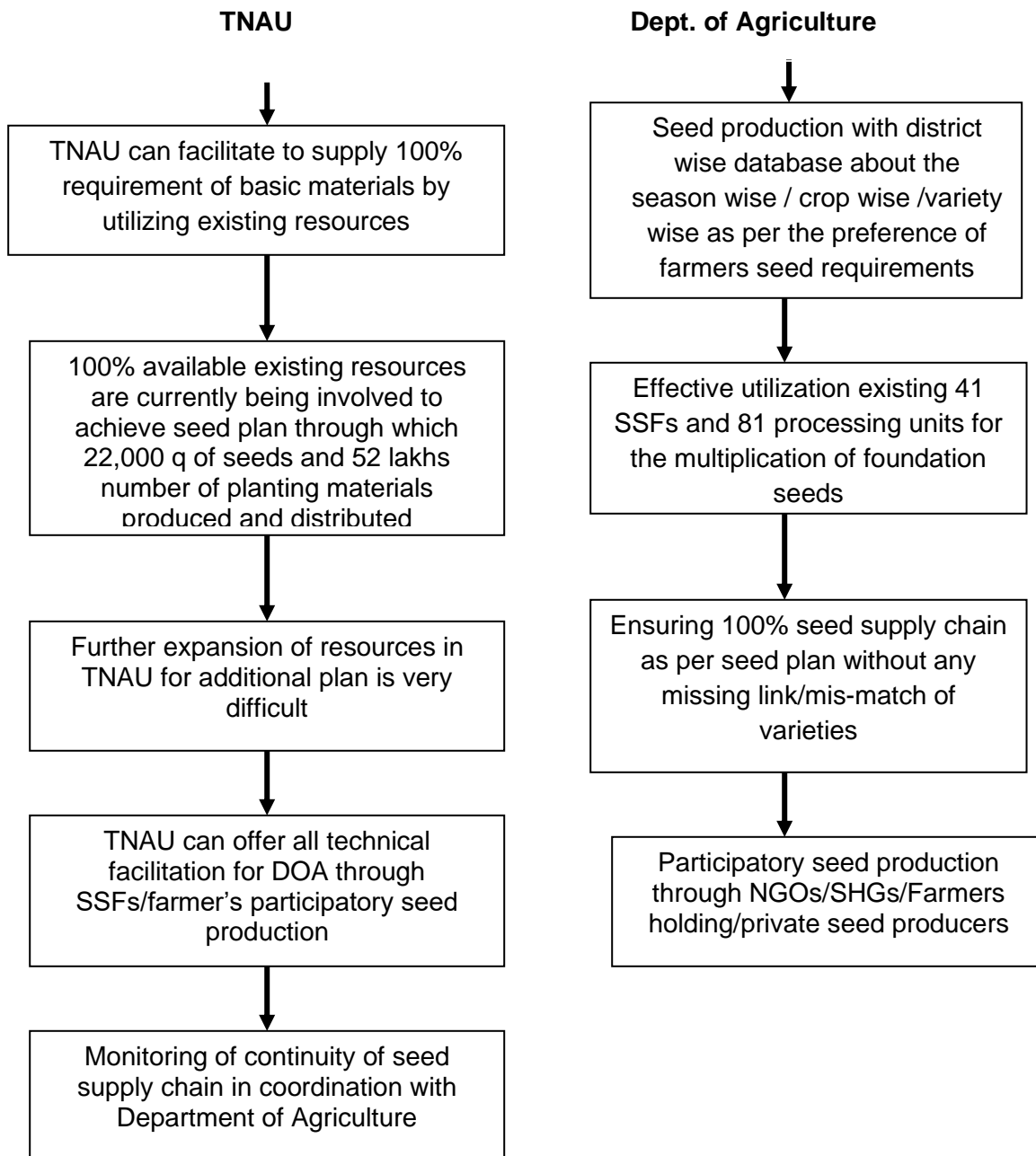
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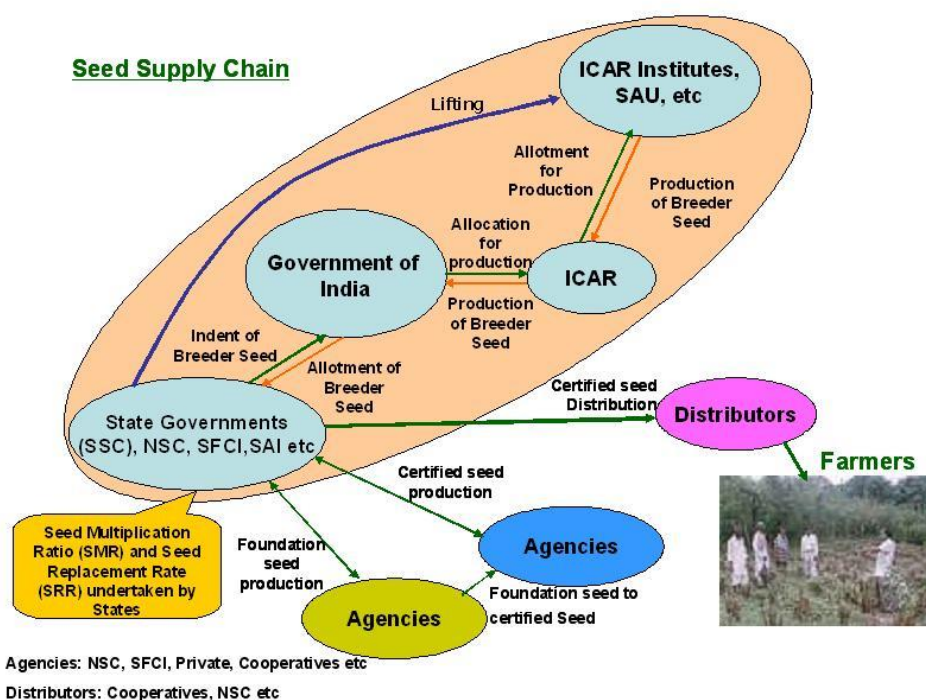


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To achieve effective seed plan – seed supply chain system





Seed Replacement Rate (SRR)

Definition

Seed Replacement Rate is the percentage of area sown out of total area of crop planted in the season by using certified/quality seeds other than the farm saved seed.

Seed Replacement Rates for Agricultural crops in Tamil Nadu (2008)

Sl.No.	Crop	State SRR
1.	Paddy	67.00
2.	Maize Variety & Hybrid	70.00
3.	Sorgum Variety & Hybrid	11.00
4.	Cumbu Variety & Hybrid	91.00
5.	Bengalgram	5.00
6.	Blackgram	42.00
7.	Greengram	21.00
8.	Redgram	6.00
9.	Groundnut	6.07
10.	Sunflower variety	13.00
11.	Cotton	100.00

Source: www.seednet.gov.in

The low replacement rate in groundnut indicates that farmers used the crop retained for seed purpose or obtained it from fellow farmers. However these seeds need not be of poor quality. The lateral exchange of seeds among the farmers may also help in diffusing new varieties faster. The low SRR adopted by government should be increased as proposed shown in table for proper diffusion of varieties / hybrids from seed production centres.

At public sector level, the NSC, SFC and State Seed Corporations are producing quality seeds and distributing to the farming community. The quality seeds produced in government owned seed farms and farmers holdings under seed farm agreement condition are being distributed through Agricultural Extension Centres to the farming community. The seed multiplication programme is handled by the Agricultural and Horticultural Departments in their State Seed Farms. There are certain practical difficulties in the production of quality seeds in government owned farms by the Agriculture and Horticulture departments, which are now responsible for non-availability of adequate quantities of seed materials to the farmers.

However, in practice seed is replaced less often especially, in case of open pollinated crops. As a consequence, seed replacement rates are lower than recommended for different crop varieties. Seed replacement rate for different crop during different year for country

Continuous usage of farm saved seeds will lead to varietal deterioration and concomitant yield reduction. Replacement of farm saved seeds with certified seeds is mandatory to minimise varietal deterioration and maintain yield potential of a particular variety. Therefore, it is mandatory to “renew” the farm saved seeds with certified seeds based on the pollination behaviour of the crop.

The suggested ‘seed renewal period’ is

- i) Once **in Four years** for Self pollinated varieties
- ii) Once in **three years** for Cross pollinated varieties
- iii) **Every year** for Hybrids

SEED TRADE - ROLE OF INTERNATIONAL AGENCIES IN CROSS BORDER TRADING (UPOV, OECD, ISTA, IPPC, AOSA, AOSCA)

International seed movement

The following organizations are involved in international seed movement.,

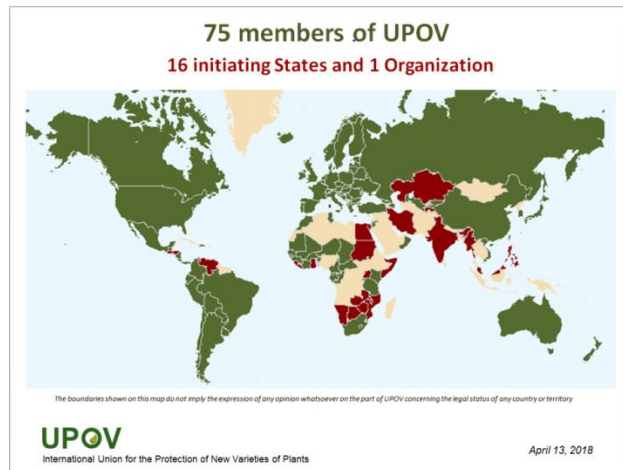
1. International Union for the Protection of New Varieties of Plants (UPOV)
2. The Organization for Economic Co-operation and Development (OECD)
3. International Seed Testing Association (ISTA)
4. International Plant Protection Convention (IPPC)
5. The **Association of Official Seed Analysts (AOSA)**
6. The Association of Official Seed Certifying Agencies (**AOSCA**)

1. International Union for the Protection of New Varieties of Plants (UPOV)

The International Union for the Protection of New Varieties of Plants (UPOV) is an intergovernmental organization based in Geneva, Switzerland. UPOV was established in 1961 by the International Convention for the Protection of New Varieties of Plants (the "UPOV Convention").

The mission of UPOV is to provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.

The UPOV Convention provides the basis for members to encourage plant breeding by granting breeders of new plant varieties an intellectual property right: the breeder's right.



1. The International Union for the Protection of New Varieties of Plants (UPOV) seeks to provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.

2. UPOV now has 75 members, almost one third of whom are developing countries. They have experienced the beneficial effects with regard to productivity, competitiveness and overall economic development. The plant variety protection system established on the UPOV Convention meets the requirements of Article 27.3(b) of the TRIPS Agreement.

3. The UPOV Convention provides an effective sui generis system of plant variety protection at national level and, through international harmonization, at the international level. Under the UPOV Convention, all breeders in all members of UPOV enjoy the same level of protection. Enhancing international harmonization is an indispensable tool for the protection of new plant varieties, for international trade and for the transfer of technology. Should a country introduce a system not compatible with the internationally harmonized system based on the UPOV Convention, this might result in barriers to trade and the transfer of technology. Breeders of UPOV members would be hesitant to release their varieties in such a country. This means that farmers in that country would lose the possibility of benefiting from the use of the best varieties. International harmonization in the protection of new varieties of plants is essential. The introduction of a system which differs significantly from the harmonized approach based on the UPOV Convention will raise questions with regard to the implementation of the TRIPS Agreement.

4. The UPOV Convention requires the use of a given variety denomination whenever seed of protected varieties is traded for reasons of market transparency. The importance of this requirement is such that it extends beyond the period of protection of the variety. Reducing the level of protection, by allowing selling of seeds without using a/the commercial denomination would create confusion and breeders would lose the possibility of recovering their investment in sustainable breeding programs.

5. It should be emphasized that the practices of farmers, in relation to the existing varieties and land races which are not protected, will not be affected in any way by the introduction of the

UPOV system of plant variety protection. The UPOV system is designed to encourage the development of new varieties of plants for the benefit of society – which can only be achieved by providing benefits for both breeders and farmers. Thus, the UPOV system includes certain exemptions for the benefit of farmers. Farmers are allowed to use protected varieties for private and non-commercial purposes, including subsistence farming. Protected varieties can be used for experimental purposes and for breeding other varieties. In addition, farmers may be permitted to use “farm-saved seed” of protected varieties (the use of the product of the harvest, which they have obtained by planting propagating material of protected varieties on their own farms, for propagating purposes). Such permission would, however, be within certain constraints designed to ensure that the incentive for breeders to develop new varieties is not undermined. Almost all UPOV members have developed adequate solutions. It should also be remembered that, under the UPOV system, farmers can develop and protect their own new varieties.

6. It should be noted that under the UPOV system, a breeder, for example a public breeding station, decides the conditions under which he authorizes the exploitation of his protected variety. He may, for instance, allow the farmer to exchange or sell seeds to neighbors. In many developing countries, public research institutes play a very important role in the breeding of staple food crops. These institutes would be free to authorize their protected varieties to be distributed from farmer to farmer, but, equally, not to allow propagation of their varieties by commercial enterprises.

7. The lack of adequate protection for new plant varieties in developing countries will result in a failure to provide a key incentive for potential investment and undertakings to develop agriculture. Consequently, developing countries would lose an opportunity to develop their national agriculture and enhance their overall economic development in agriculture, horticulture and forestry.

8. Concerning the relationship between the Convention on Biological Diversity and the TRIPS Agreement, UPOV submitted its position to the Council for TRIPS at its session in June 2002, as document IP/C/W/347add.3 dated June 11, 2002. In that document UPOV expressed the view that the Convention of Biological Diversity and relevant international instruments dealing with intellectual property rights, including the UPOV Convention, should be mutually supportive in respect of access to genetic resources and benefit sharing.

9. As for the disclosure of origin of genetic resources, UPOV is not opposed to the disclosure, per se, of countries of origin or geographical origin of genetic resources in any way that will facilitate the examination of whether a variety qualifies for protection. It should be recalled, however, that under the UPOV Convention, protection shall be granted where the variety is new, distinct, uniform and stable. Further or different conditions for protection are excluded. Therefore, disclosure of origin of genetic resources should not be regarded as an additional condition of protection.

10. UPOV recognizes the importance of capacity building and UPOV's capacity building activities cover more than 90 countries in Africa, Asia, the Pacific, in Latin America/Caribbean and in countries in transition to a market economy.

The Organization for Economic Co-operation and Development (OECD)

- **History:** established in 1961
- **Headquarters:** Paris, France
- **Membership:** 36 countries
- India is also member in OECD
- Inter-governmental Organization

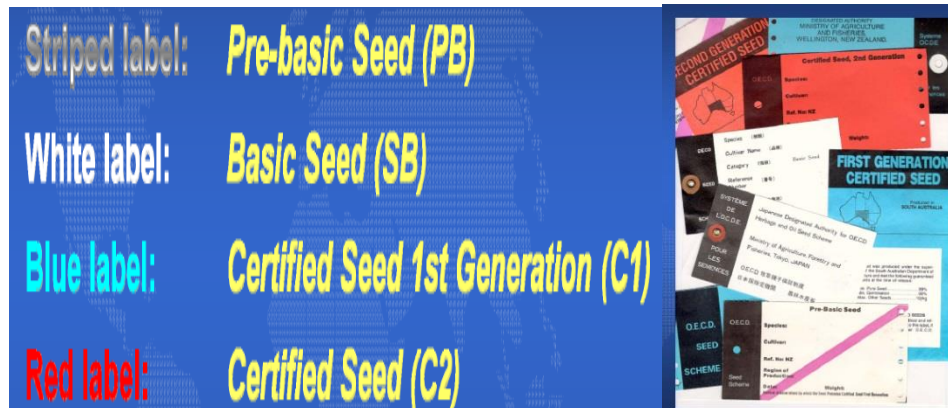
The Organization for Economic Co-operation and Development (OECD) **Seed Certification Schemes** is a global framework for the varietal certification of internationally-traded seed. The OECD schemes have made a substantial contribution to growth in the global seed trade, especially with respect to **field crops**. The United States, China, France and Brazil are the **largest seed markets in terms of value**. OECD **varietal certification standards are developed by an expert committee** consisting of the National Designated Authorities (NDA), researchers, industry and farmer representatives, as well as representatives of other international organizations. The certification standards are based on two key criteria: **varietal identity and varietal purity**.

The OECD Seed Certification Schemes

OECD seed schemes provide an international framework for the certification of seed to facilitate the growth in international trade of seed by reducing technical barriers. The schemes were established in **1958** to encourage the use of “quality-guaranteed” seed in participating countries. There are now 59 participating countries and as of 2016 the scheme covers **seven groups of species**:

- Grass and legume seed
- Cereal seed
- Crucifer and other oil or fiber species seed
- Maize and sorghum seed
- Sugar beet and fodder beet seed
- Seed of subterranean clover and similar species
- Vegetable seed.

The Maize and Sorghum Seed Scheme is the largest of the seven. The schemes facilitate **imports and exports of seed** by the removal of technical barriers using labels recognized globally which, in effect, act as a “**passport**” for the seed traded.



The OECD provides rules and guidelines for the whole certification process. The schemes are designed to verify varietal identity and establish varietal purity, and do not deal with other seed quality issues (e.g. physical and physiological seed quality). However, they are normally used in tandem with ISTA seed lot certificates, which carry the results of seed quality tests.

OECD seed schemes are based on the following principles:

- Only varieties officially recognized as distinct and of acceptable value are included in the variety list. The names and breeder of varieties eligible for multiplication are listed.
- Three categories of seed are recognized: pre-basic, basic and certified.
- Certified seed must be directly related to authentic basic seed of the variety.
- Control plot tests are conducted in association with the crop inspection to help confirm varietal identity and purity and to ascertain whether the schemes are operating satisfactorily.
- Variety descriptions are required and a reference sample of the variety must be used for a living description.
- There is a maximum seed lot size. The size of a seed lot depends on the size of the seed of the species involved.

The procedure for joining an OECD seed scheme entails the following steps:

- Sending of official letter to the OECD secretariat.
- Provision of basic documentation explaining seed certification procedures in the country.
- Fulfilment all OECD technical requirements (e.g. establishment of variety list, implementation of pre- and post-control tests for ≥ 3 years prior to application).
- Payment of all fees related to the evaluation mission.
- Admittance or rejection on basis of evaluation report.
- Final approval (if admitted) by consensus at the OECD Seed Schemes Annual Meeting, the OECD Committee for Agriculture and the OECD Council.

International Seed Testing Association (ISTA)

- **History: established in 1924**
 - **Headquarters: Zurich, Switzerland**
 - **Membership: 225 Member Laboratories, 35 Personal Members and 63 Associate Members**
- ISTA- International seed testing Association **1924.(TNPSC,1999)**
 - The headquarters of ISTA is located in - **Zurich, Switzerland.**
 - The book published by ISTA is –**International Rules for seed testing**
 - The journal published by ISTA is – **Seed Science and Technology** (TNPSC,2018)
 - **International seed analysis certificate** issued by ISTA
 - **The seed testing rules were adopted by ISTA in -1931.**

Functions:

- To ensuring the uniformity in seed testing methods
- For global seed trade issue the international certificates
- Sampling and testing have been carried out in the same country – **orange seed lot certificate**
- Sampling and testing have been carried out in the different country –**green seed lot certificate**
- Seed sample not drawn by ISTA representative but seed sample tested in ISTA accredited laboratories – **Blue seed lot certificate**

4. International Plant Protection Convention (IPPC)

About IPPC

Type	agricultural; environmental
Signed	6 December 1951
Location	<u>Rome, Italy</u>
Effective	3 April 1952
Condition	three ratifications
Signatories	29
Parties	183
Depository	Director-General of the <u>Food and Agriculture Organization</u>

The **International Plant Protection Convention (IPPC)** is a 1951 multilateral treaty overseen by the Food and Agriculture Organization that aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products. The Convention extends beyond the protection of cultivated plants to the protection of natural flora and plant products. It also takes into consideration both direct and indirect damage by pests, so it includes weeds.

The Convention created a governing body consisting of each party, known as the **Commission on Phytosanitary Measures**, which oversees the implementation of the Convention. As of August 2017, the Convention has 183 parties, which includes 180 United Nations member states, the Cook Islands, Niue, and the European Union. The Convention is recognized by the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) as the only international standard setting body for plant health.

While the IPPC's primary focus is on plants and plant products moving in international trade, the Convention also covers research materials, biological control organisms, germplasm banks, containment facilities, food aid, emergency aid and anything else that can act as a vector for the spread of plant pests – for example, containers, packaging materials, soil, vehicles, vessels and machinery.

The IPPC was created by member countries of the Food and Agriculture Organization of the United Nations. The IPPC places emphasis on three core areas: international standard setting, information exchange and capacity development for the

implementation of the IPPC and associated international phytosanitary standards. The Secretariat of the IPPC is housed at FAO headquarters in Rome, Italy, and is responsible for the coordination of core activities under the IPPC work program.

In recent years the Commission of Phytosanitary Measures of the IPPC has developed a strategic framework with the objectives of:

- Protecting sustainable agriculture and enhancing global food security through the prevention of pest spread;
- Protecting the environment, forests and biodiversity from plant pests;
- Facilitating economic and trade development through the promotion of harmonized scientifically based phytosanitary measures, and;
- Developing phytosanitary capacity for members to accomplish the preceding three objectives.

By focusing the Convention's efforts on these objectives, the Commission on Phytosanitary Measures of the IPPC intends to:

- Protect farmers from economically devastating pest and disease outbreaks.
- Protect the environment from the loss of species diversity.
- Protect ecosystems from the loss of viability and function as a result of pest invasions.
- Protect industries and consumers from the costs of pest control or eradication.
- Facilitate trade through International Standards that regulate the safe movements of plants and plant products.
- Protect livelihoods and food security by preventing the entry and spread of new pests of plants into a country.

The Association of Official Seed Analysts (AOSA)

AOSA was formed in 1908 in response to initial attempts by individual states to develop seed laws. Initial priorities included, as was defined in the constitution, an attempt to seek uniformity and accuracy in methods, results, and reports. Objectives include efforts to perfect and make publicly known, through publication, uniform rules for seed testing, to establish the AOSA Rules for Testing Seeds which are generally adopted by most states as the rules for testing seeds in their respective states, and to ensure that testing procedures are standardized between analysts and between laboratories.

The Association of Official Seed Certifying Agencies (AOSCA)

AOSCA seed schemes AOSCA was originally established in 1919 as the International Crop Improvement Association. Its membership includes seed certifying agencies across the

United States, as well as agencies in Canada, Argentina, Brazil, Chile, Australia, New Zealand and South Africa.

AOSCA functions:

- Sets out the minimum standards for seed purity and seed identity;
- Cooperates with the OECD and international organizations involved in the development of standards, regulations, procedures, and policies to expedite movement of seed and encourage international commerce in improved varieties; has no concept of a seed lot size; recommends minimum standards for seed quality for the different classes of certified seed; and
- Recognizes four categories of seed: breeder, foundation, registered and certified seed.

AOSCA seed labels

- White – foundation and breeder
- Purple – registered
- Light blue – certified

Varietal registration - Seed legislation and regulatory frame works (Seeds Act and Rules, Seed Control Order 1983 and amendments - PPV&FRA 2001)

Variety Registration Procedures:

Each variety has to pass through 3 phases of evaluation. Breeders contribute their best entries on the basis of evaluation carried out in their local programmes for testing in the Initial Yield Evaluation Trial (IET) or Preliminary Yield Trial (PYT). These trials are organized in selected number of Places in each zone. Simultaneously, these entries are supplied to Pathologists to study their reaction to important diseases. Entries qualifying from yield, disease and quality point of view in IET/PYT are tested in the Uniform Regional Trials (URT). These trials are also called Advanced Varietal Trials (AVT) or Coordinated Varietal Trials (CVT). These trials are organized at a very large number of locations in each zone and the plot size is larger than that in IET. During the tests, reaction to various diseases, pests and quality traits are also studied. Entries found suitable in the second phase are again evaluated in the URT and simultaneously supplied to Pathologists, Entomologists, Nematologists, Agronomists and Quality Evaluation Groups to study the entries comprehensively for factors which are important from the point of view of their own discipline. Actual measurements are also made on other parameters. Agronomy group evaluates these entries for their adaptability to varied range of agronomic variables such as sowing dates, levels of fertilizers and number of irrigations etc.

These are occasionally studied for their reaction to important herbicides. These tests are followed by a critical discussion in a crop workshop. A Special Committee of multi disciplinary scientists is constituted at the workshop to consider the proposals for identification of the varieties for release. Varieties evolved by the SAUs and Government Research Institutes are tested within the concerned States at limited locations. Central Seed Committee (CSC) pointed out in 1982 that varieties of State importance might also be tested in the concerned All India Crop Improvement Project. All the States are now submitting their samples for the coordinated trials though some have reservations of this decision. Concept of simultaneous testing of State varieties in the coordinated trials needs to be welcomed by the State Governments and their Research Institutes all over the country. Simultaneous testing of all State varieties along with the Central Varieties provides exposure to the State varieties to a wide range of environments. This will help to identify the varieties which are highly prone to diseases and pests and release of which may cause problems in some other States.

Identification of superior genotypes by Plant Breeder can benefit the public only if it is offered for commercial multiplication. It is therefore, necessary to maintain a system where quantities of promising genotype are made available for commercial production. This process is referred to as release of the varieties. The purpose of release system is to introduce

newly evolved varieties to the public for general cultivation in the regions in which it is suitable. It serves as a guideline in the choice of varieties for cultivation in any region. The practice of official release of varieties started in October, 1964 with the formation of the Central Variety Release Committee (CVRC) at the Central level and State Variety Release Committee (SARC) at State level. CVRC functioned up to November, 1969 when its functions were taken over by the CSC established Seeds Act, 1966. The CSC constituted a Central Sub-committee on Crop Standards, Notification and Release of Varieties (CSC on CS, N&RV). The sub-committee discharges the functions of release and notification of varieties at Central level, while State Seed Sub-Committees (SSSCs) discharge similar function at State level. CSC and its Sub-committee have due representation for all the agencies involved in seed research, production and quality control namely State Governments, SCAs, SAUs, ICAR Institutes, Seed producing agency in public and private sector and seed farmers.

RELEASE AND NOTIFICATION OF CROP VARIETIES

Procedure for Notification of Variety

Steps:

1. Evaluation
2. Identification
3. Release and Notification

Evaluation

Consists of various trials and tests to determine its superiority over the best existing variety in yield, agronomic traits and its suitability for consumption

Identification

Outstanding cultures are identified for release as new varieties at the Annual workshops of the coordinated projects on the respective crops. Proposals for the identification of cultures may be prepared by the respective breeder in a prescribed format.

Proposals should consist of information on the results of the various centres of AICRP for at least two years, pest and disease reactions and quality parameters. The proposals will be examined by an Identification committee. The criteria for identification as variety may vary from one crop to the other. Culture after consideration called as Identified variety

Release and Notification

After identification, the variety is to be tested for at least one year for disease and quality tests. The breeder should submit a proposal for release as a new variety for approval by the Central Sub-Committee on Crop Standards, Notification and release of varieties. After a variety has been released for a zone by the Central Sub-Committee, the Director, HYV,

Ministry of Agriculture and Irrigation, GOI notifies the concerned authorities of the states within that zone for seed multiplication and distribution of variety. This is known as notification of variety.

Release of a variety by a State Variety Release Committee

The breeder concerned should submit Variety Release Proposal (12 copies) in the prescribed format to the Director of Research, TNAU, Coimbatore. They will initially scrutinize the proposals. After scrutinization, it will be examined by State Variety Release Committee consists of the following members

S.No.	Officials	Position
1	Secretary to Government of Tamil Nadu, Agrl. Department	Chairman
2	Vice-Chancellor, TNAU, Coimbatore	Member
3	Director of Agriculture	Member
4	Chief Engineer (Agrl.Engg.)	Member
5	Director of Seed Certification, Coimbatore	Member
6	Professor and Head, Dept. of SS&T, TNAU, Coimbatore	Member
7	Joint Director of Horticulture	Member
8	Dean, Faculty of Agriculture, Annamalai University, Chidambaram	Member
Non-official members		
1	Leading farmers – 2 Nos.	
2	President, Tamil Nadu Seed Association, Coimbatore	

The official release of the new varieties will be made by the Hon'ble Minister for Agriculture in Farmers' Day celebration

Notification

The breeder concerned should submit 70 copies of the notification proposal in the proforma to the State Seed Sub-Committee for onward transmission to Central Sub-Committee. Deposition of seed material to Gene Bank, NBPGR, New Delhi is a pre requisite. The State Seed Sub-Committee is to be constituted by the Central Committee, Ministry of Agriculture, GOI, New Delhi which consists of the following members

S.No.	Officials	Position
1	Secretary to Government of Tamil Nadu, Agrl. Department	Chairman
2	Director of Agriculture	Member
3	Director, CPBG, TNAU, Coimbatore	Member
4	Director of Seed Certification, Cbe	Member
5	Addl. Director of Agriculture (Input)	Member
6	Seed Testing Officer, Cbe.	Member

7	Regl. Manager, NSC, Ambattur	Member
8	Director, SFC, Chengam	Member
9	E.I.D. Parry Ltd., Chennai	Member
10	TUCAS, Coimbatore	Member
11	Leading Farmers – 2 Nos.	Member
12	Secretary, TN Seed Assn. Cbe.	Member
13	JDA, (SSF), DA, Chennai	Co-convener
14	Deputy Commissioner (QC), New Delhi	Co-convener

Seed Quality Regulation

The seed quality regulation is the responsibility of the Government and Seed Certification Agency. Public sector has adopted a facilitating role and enforces regulations to deal with unscrupulous firms or dealers supplying spurious seed. The seed quality control is brought about by three functions *viz.*, i) Seed Certification ii) Seed Testing and iii) Seed Law Enforcement.

This lecture covers

1. Seeds Act, 1966
2. Seeds Rules, 1968
3. SEEDS (CONTROL) ORDER 1983
4. SEEDS (CONTROL) AMENDMENT ORDER, 2006.
5. PPV&FRA 2001

THE SEEDS ACT, 1966
(ACT NO. 54 OF 1966)

[29th December, 1966]

An Act to provide for regulating the quality of certain seeds for sale, and for matters connected therewith

BE it enacted by Parliament in the Seventeenth Year of the Republic of India as follows:-

Short title, extent and commencement

1. (1) This Act may be called the Seeds Act, 1966.
- (2) It extends to the whole of India.
- (3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint, and different dates may be appointed for different provisions of this Act, and for different States or for different areas thereof.

Definitions

2. In this Act, unless the context otherwise requires,
 - (1) “Agriculture” includes horticulture;
 - (2) “Central Seed Laboratory” means the Central Seed Laboratory established or declared as such under sub-section (1) of section 4;
 - (3) “Certification agency” means the certification agency established
 - (4) “Committee” means the Central Seed Committee constituted under sub-section (1) of Section 3;
 - (5) “Container” means a box, bottle, casket, tin, barrel, case, receptacle, sack, bag, wrapper or other thing in which any article or thing is placed or packed;
 - (6) “Export” means taking out of India to a place outside India;
 - (7) “Import” means bringing into India from a place outside India;
 - (8) “Kind” means one or more related species or sub-species of crop plants each individually or collectively known by one common name such as cabbage, maize, paddy and wheat;
 - (9) “notified kind or variety” , in relation to any seed, means any kind or variety thereof notified under Section 5;
 - (10) “Prescribed” means prescribed by rules made under this act;
 - (11) “seed” means any of the following classes of seeds used for sowing or planting-
 - (i) seeds of food crops including edible oil seeds and seeds of fruits and vegetables;
 - (ii) cotton seeds;

- (iii) seeds of cattle fodder; and includes seedlings, and tubers, bulbs, rhizomes, roots, cuttings, all types of grafts and other vegetatively propagated material, of food crops or cattle fodder;
- (12) “Seed Analyst” means a Seed Analyst appointed under section 12;
- (13) “Seed Inspector” means a Seed Inspector appointed under section 13;
- (14) “State Government”, in relation to a Union territory, means the administrator thereof;
- (15) “State Seed Laboratory”, in relation to any State, means the State Seed Laboratory established or declared as such under sub-section (2) of section 4 for that State; and
- (16) “variety” means a sub-division of a kind identifiable by growth, yield, plant, fruit, seed, or other characteristic.

Central Seed Committee

3. (1) The Central Government shall, as soon as may be after the commencement of this Act, constitute a Committee called the Central Seed Committee to advise the Central Government and the State Governments on matters arising out of the administration of this Act and to carry out the other functions assigned to it by or under this Act.

(2) The Committee shall consist of the following members, namely:-

- (i) a Chairman to be nominated by the Central Government;
- (ii) eight persons to be nominated by the Central Government to represent such interests that Government thinks fit, of whom not less than two persons shall be representatives of growers of seed;
- (iii) one person to be nominated by the Government of each of the States.

(3) The members of the Committee shall, unless their seats become vacant earlier by resignation, death or otherwise, be entitled to hold office for two years and shall be eligible for renomination.

(4) The Committee may, subject to the previous approval of the Central Government, make bye-laws fixing the quorum and regulating its own procedure and the conduct of all business to be transacted by it.

(5) The Committee may appoint one or more sub-committees, consisting wholly of members of the Committee or wholly of other persons or partly of members of the Committee and partly of other persons, as it thinks fit, for the purpose of discharging such of its functions as may be delegated to such sub-committee or sub-committees by the Committee.

(6) The functions of the Committee or any sub-committee thereof may be exercised notwithstanding any vacancy therein.

(7) The Central Government shall appoint a person to be the secretary of the Committee and shall provide the Committee with such clerical and other staff as the Central Government considers necessary.

Central Seed Laboratory and State Seed Laboratory

4. (1) The Central Government may, by notification in the Official Gazette, establish a Central Seed Laboratory or declare any seed laboratory as the Central Seed Laboratory to carry out the functions entrusted to the Central Seed Laboratory by or under this Act.

(2) The State Government may, by notification in the Official Gazette, establish one or more State Seed Laboratories or declare any seed laboratory as a State Seed Laboratory where analysis of seeds of any notified kind or variety shall be carried out by Seed Analysts under this Act in the prescribed manner.

Power to notify kinds or varieties of seeds

5. If the Central Government, after consultation with the committee, is of opinion that it is necessary or expedient to regulate the quality of seed of any kind or variety to be sold for purposes of agriculture, it may, by notification in the Official Gazette, declare such kind or variety to be a notified kind or variety for the purposes of the Act and different kinds or varieties may be notified for different States or for different areas thereof.

Power to specify minimum limits of germination and purity, etc.

6. The Central Government may, after consultation of the Committee and by notification in the Official Gazette, specify –

(a) the minimum limits of germination and purity with respect to any seed of any notified kind or variety:

(b) the mark or label to indicate that such seed conforms to the minimum limits of germination and purity specified under clause (a) and the particulars which marks or label may contain.

Regulation of sale of seeds of notified kinds or varieties

7. No person shall, himself or by any other person on his behalf, carry on the business of selling, keeping for sale, offering to sell, bartering or otherwise supplying any seed of any notified kind or variety, unless-

(a) such seed is identifiable as to its kind or variety;

(b) such seed conforms to the minimum limits of germination and purity specified under clause (a) of section 6;

(c) the container of such seed bears in the prescribed manner, the mark or label containing the correct particulars thereof, specified under clause (b) of section 6; and

(d) he complies with such other requirements as may be prescribed.

Certification agency

8. The State Government or the Central Government in consultation with the State Government may, by notification in the Official Gazette, establish a certification agency for the State to carry out the functions entrusted to the certification agency by or under this Act.

Grant of certificate by certification agency

9. (1) Any person selling, keeping for sale, offering to sell, bartering or otherwise supplying any seed of any notified kind or variety may, if he desires to have such seed certified by the certification agency, apply to the certification agency for the grant of a certificate for the purpose.

(2) Every application under sub-section (1) shall be made in such form, shall contain such particulars and shall be accompanied by such fees as may be prescribed.

(3) On receipt of any such application for the grant of a certificate, the certification agency may, after such enquiry as it thinks fit and after satisfying itself that the seed to which the application relates conforms to the minimum limits of germination and purity specified for that seed under clause (a) of section 6, grant a certificate in such form and on such conditions as may be prescribed.

Revocation of certificate

10. If the certification agency is satisfied, either on a reference made to it in this behalf or otherwise, that-

(a) the certificate granted by it under section 9 has been obtained by misrepresentation as to an essential fact; or

(b) the holder of the certificate has, without reasonable cause, failed to comply with the conditions subject to which the certificate has been granted or has contravened any of the provisions of this Act or the rules made thereunder; then, without prejudice to any other penalty to which the holder of the certificate may be liable under this Act, the certification agency may, after giving the holder of the certificate an opportunity of showing cause, revoke the certificate.

Appeal

11. (1) Any person aggrieved by a decision of a certification agency under section 9 or section 10, may, within thirty days from the date on which the decision is communicated to him and on **payment of such fees as may be prescribed, prefer an appeal to such authority as may be specified by the State Government in this behalf:** Provided that the appellate authority may

entertain an appeal after the expiry of the said period of thirty days if it is satisfied that the appellate was prevented by sufficient cause from filing the appeal in time.

(2) On receipt of an appeal under sub-section (1), the appellate authority shall, after giving the appellant an opportunity of being heard, dispose of the appeal as expeditiously as possible.

(3) Every order of the appellate authority under this section shall be final.

Seed Analysts

12. The State Government may, by notification in the Official Gazette, appoint such persons as it thinks fit, having the prescribed qualifications, to be Seed Analysts and **define the areas within which they shall exercise jurisdiction.**

Seed Inspectors

13. (1) The State Government may, by notification in the Official Gazette, appoint such persons as it thinks fit, having the prescribed qualifications, to be **Seed Inspectors and define the areas within which they shall exercise jurisdiction.**

(2) Every Seed Inspector shall be deemed to be a public servant within the **meaning of section 21 of the Indian Penal Code (45 of 1860) and** shall be officially subordinate to such authority as the State Government may specify in this behalf.

Powers of Seed Inspector

14. (1) The Seed Inspector may-

(a) take samples of any seed of any notified kind or variety from-

(i) any person selling such seed; or

(ii) any person who is in the course of conveying, delivering or preparing to deliver such seed to a purchaser or a consignee; or

(iii) a purchaser or a consignee after delivery of such seed to him;

(b) send such sample for analysis to the Seed Analyst **for the area within which such sample has been taken;**

(c) enter and search at all reasonable times, with such assistance, if any, as he considers necessary, any place in which he has reason to believe that an offence under this Act has been or is being committed and order in writing the person in possession of any seed in respect of which the offence has been or is being committed, not to dispose of any stock of such seed for a specific period not exceeding thirty days or, unless the alleged offence is such that the defect may be removed by the possessor of the seed, seize the stock of such seed;

(d) **examine any record, register, document or any other material object** found in any place mentioned in clause (c) and seize the same if he has reason to believe that it may furnish evidence of the commission of an offence punishable under this Act; and

(e) exercise such other powers as may be necessary for carrying out the purposes of this Act or any rule made thereunder.

(2) Where any sample of any seed of any notified kind or variety is taken under clause (a) of sub-section (1), **its cost, calculated at the rate at which such seed is usually sold to the public, shall be paid on demand to the person from whom it is taken.**

(3) The power conferred by this section includes **power to break-open any container** in which any seed of any notified kind or variety may be contained or to break-open the door of any premises where any such seed **may be kept for sale**: Provided that the power to break-open the door shall be exercised only after the owner or any other person in occupation of the premises, if he is present therein, refuses to open the door on being called upon to do so.

(4) Where the Seed Inspector takes any action under clause (a) of sub-section (1), he shall, as far as possible, call **not less than two persons to be present at the time when such action is taken and take their signatures on a memorandum to be prepared in the prescribed form and manner.**

(5) The provisions of the Code of Criminal Procedure, 1898 (5 of 1898), shall, so far as may be, apply to any search or seizure under this section as they apply to any search or seizure made under the authority of a warrant issued under section 98 of the said Code.

Procedure to be followed by Seed Inspectors

15. (1) Whenever a Seed Inspector intends to take sample of any seed of any notified kind or variety for analysis, he shall-

(a) give notice in writing, then and there, of such intention to the person from whom he intends to take sample;

(b) except in special cases provided by rules made under this Act, take three representative samples in the prescribed manner and mark and seal or fasten up each sample in such manner as its nature permits.

(2) When samples of any seed of any notified kind or variety are taken under sub-section (1), the Seed Inspector shall-

(a) deliver one sample to the person from whom it has been taken;

(b) send in the prescribed manner another sample for analysis to the Seed Analyst for the area within which such sample has been taken; and

(c) retain the remaining sample in the prescribed manner for production in case any legal proceedings are taken or for analysis by the Central Seed Laboratory under sub-section (2) of section 16, as the case may be.

(3) If the person from whom the samples have been taken refuses to accept one of the samples, the Seed Inspector shall send intimation to the Seed Analyst of such refusal and thereupon the Seed Analyst receiving the sample for analysis shall divide it into two parts and shall seal or fasten up one of those parts and shall cause it, either upon receipt of the sample or when he delivers his report, to be delivered to the Seed Inspector who shall retain it for production in case legal proceedings are taken.

(4) Where a Seed Inspector takes any action under clause (c) of sub-section (1) of section 14:

(a) he shall use all despatch in ascertaining whether or not the seed contravenes any of the provisions of section 7 and if it is ascertained that the seed does not so contravene, forthwith revoke the order passed under the said clause or, as the case may be, take such action as may be necessary for the return of the stock of the seed seized;

(b) if he seizes the stock of the seed, he shall, as soon as may be, inform a magistrate and take his orders as to the custody thereof;

(c) without prejudice to the institution of any prosecution, if the alleged offence is such that the defect may be removed by the possessor of the seed, he shall, on being satisfied that the defect has been so removed, forthwith revoke the order passed under the said clause.

(5) Where as Seed Inspector seizes any record, register, document or any other material object under clause (d) of sub-section (1) of section 14, he shall, as soon as may be, inform a magistrate and take his orders as to the custody thereof.

Report of Seed Analyst

16. (1) The Seed Analyst shall, as soon as may be after the receipt of the sample under sub-section (2) of section 15, analyse the sample at the State Seed Laboratory and deliver, in such form as may be prescribed, one copy of the report of the result of the analysis to the Seed Inspector and another copy thereof to the person from whom the sample has been taken.

(2) After the institution of a prosecution under this Act, the accused vendor or the complainant may, on payment of the prescribed fee, make an application to the court for sending any of the samples mentioned in clause

(a) or clause (c) of sub-section (2) of section 15 to the Central Seed Laboratory for its report and on receipt of the application, the court shall first ascertain that the mark and the seal or fastening as provided in clause

(b) of sub-section (1) of section 15 are intact and may then despatch the sample under its own seal to the Central Seed Laboratory which shall thereupon send its report to the court in the prescribed form within one month from the date of receipt of the sample, specifying the result of the analysis.

(3) The report sent by the Central Seed Laboratory under sub-section (2) shall supersede the report given by the Seed Analyst under sub-section (1).

(4) Where the report sent by the Central Seed Laboratory under sub-section (2) is produced in any proceedings under Section 19, it shall not be necessary in such proceedings to produce any sample or part thereof taken for analysis.

Restriction on export and import of seeds of notified kinds or varieties

17. No person shall, for the purpose of sowing or planting by any person (including himself), export or import or cause to be exported or imported any seed of any notified kind or variety, unless-

(a) it conforms to the minimum limits of germination and purity specified for that seed under clause (a) of section 6; and

(b) its container bears, in the prescribed manner, the mark or label with the correct particulars thereof specified for that seed under clause (b) of section 6.

Recognition of seed certification agencies of foreign countries

18. The Central Govt. may, on the recommendation of the Committee and by notification in the Official Gazette, recognise any seed certification agency established in any foreign country, for the purposes of this Act.

Penalty

19. If any person-

(a) contravenes any provision of this Act or any rule made thereunder; or

(b) prevents a Seed Inspector from taking sample under this Act; or

(c) prevents a Seed Inspector from exercising any other power conferred on him by or under this Act; he shall, on conviction, be punishable-

(i) for the first offence with fine which may extend to five hundred rupees, and

(ii) in the event of such person having been previously convicted of an offence under this section, with imprisonment for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

Forfeiture of property

20. When any person has been convicted under this Act for the contravention of any of the provisions of this Act or the rules made thereunder, the seed in respect of which the contravention has been committed may be forfeited to the Government.

Offences by companies

21. (1) Where an offence under this Act has been committed by a company, every person who at the time the offence was committed was in charge of, and was responsible to the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment under this Act if he proves that the offence was committed without his knowledge and that he exercised all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly. *Explanation.*— For the purpose of this section,–

(a) “company” means any body corporate and includes a firm or other association of individuals; and

(b) “director”, in relation to a firm, means a partner in the firm.

Protection of action taken in good faith

22. No suit, prosecution or other legal proceeding shall lie against the Government or any officer of the Government for anything which is in good faith done or intended to be done under this Act.

Power to give directions

23. The Central Government may give such directions to any State Government as may appear to the Central Government to be necessary for carrying into execution in the State any of the provisions of this Act or of any rule made thereunder.

Exemption

24. Nothing in this Act shall apply to any seed of any notified kind or variety grown by a person and sold or delivered by him on his own premises direct to another person for being used by that person for the purpose of sowing or planting.

Power to make rules

25. (1) The Central Government may, by notification in the Official Gazette, make rules to carry out the purpose of this Act.

(2) In particular and without prejudice to the generality of the fore-going power, such rules may provide, for-

(a) the functions of the Committee and the travelling and daily allowances payable to members of the Committee and members of any subcommittee appointed under sub-section (5) of section 3;

(b) the functions of the Central Seed Laboratory;

(c) the functions of a certification agency;

(d) the manner of marking or labelling the container of seed of any notified kind or variety under clause (c) of Section 7 and under clause

(b) of section 17;

(e) the requirements which may be complied with by a person carrying on the business referred to in section 7;

(f) the form of application for the grant of a certificate under section 9, the particulars it may contain, the fees which should accompany it, the form of the certificate and the conditions subject to which the certificate may be granted;

(g) the form and manner in which and the fee on payment of which an appeal may be preferred under section 11 and the procedure to be followed by the appellate authority in disposing of the appeal;

(h) the qualifications and duties of Seed Analysts and Seed Inspectors;

(i) the manner in which samples may be taken by the Seed Inspector, the procedure for sending such samples to the Seed Analyst or the Central Seed Laboratory and the manner of analysing such samples;

(j) the form of report of the result of the analysis under sub-section (1) or sub-section (2) of section 16 and the fees payable in respect of such report under the said sub-section (2);

(k) the records to be maintained by a person carrying on the business referred to in section 7 and the particulars which such records shall contain; and

(l) any other matter which is to be or may be prescribed.

(3) Every rule made under this Act shall be laid as soon as may be after it is made, before each House of Parliament while it is in session for a total period of thirty days which may be comprised in one session or in two successive sessions, and if, before the expiry of the session in which it is so laid or the session immediately following, both Houses agree in making any modification in the rule or both Houses agree that the rule should not be made, that rule shall, thereafter have effect only in such modified form or be of no effect, as the case may be; so however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

The salient features of the Seeds Act (1966)

The major legislative measures involved under the Act are Seeds rules framed in 1968, Seeds (Control) order, formulated in 1983 after including seeds as an essential commodity. A total of **twenty five sections** have been mentioned in the act and they are:

1. Enacted by Parliament for the whole of India to regulate seeds
2. Seeds of food crops, oil crops, cotton seeds, seeds of cattle fodder and all types of vegetative propagating material are included
3. Constitution of a Central Seed Committee (comprising eight members) to advise the Central and State Governments on matters arising out of the administration of this act and carry out other functions assigned to it by the Act
4. Establishing a Central Seed Laboratory as well as State Seed Laboratory to carry out seed analysis of notified variety

5. Empowerment of the Central Seed Committee to **notify any variety** found suitable as per the Act after notification in the Official Gazette
6. Empowerment of the committee to fix the minimum limits of germination and purity of seed for a variety to be notified as well as for marking or labeling a seed lot to be sold commercially
7. Regulation of sale of seeds of notified varieties by compulsory truthful labeling revealing the true identity of the variety, germination as well as purity
8. Constituting a certification agency for undertaking the process of certification
9. Power of certification agency to recommend notification of suitable variety and grant of notification certificate provided the seed meets minimum limits of germination and purity
10. Empowerment to the agency for revocation of certificate if the agency is convinced that holder has obtained certificate by misrepresentation or not complied with the conditions
11. Provision for an appeal by the holder on payment basis to express before an appellate authority, his limitations for not complying with the conditions
12. Appointment of a seed analyst to undertake seed testing.
13. Appointment of seed inspector who is deemed to be a public servant within the meaning or section 21 of the Indian Penal Code (45 of 1860)
14. Empowerment of seed inspector to draw samples from any seller or a purchaser and verify the quality by sending samples to a seed analyst in the seed testing laboratory
15. Laying-out of procedure for seed sample collection and other rules. The clause also entrust inspector with the power to break open any seed container or door of any premises where such seed may be kept for sale, under those circumstances when owner refuses to cooperate. The whole operation has to be done in presence of two witnesses with their signatures on a memorandum
16. Responsibility of Seed analyst to report the results in a specified format after analysis of the seed samples to Seed Inspector as well as the seller/ purchaser. Complainant if dissatisfied with the result can apply to the court for sending samples to Central Seed Testing Laboratory. Central seed laboratory shall thereupon send its report to the court in the prescribed format within one month from the date of receipt of the sample
17. Restriction on import and export of seeds of notified varieties. Any variety imported or exported should meet the minimum limits of seed germination and purity marked or labeled on the container truly
18. Recognition of seed certification agencies of foreign countries for the purpose of this act

19. Penalty or punishment or both for those who do not comply with the provisions of the act and also prevent seed inspectors from executing his power
20. Forfeiture of property (seeds) belonging to any person convicted under this act due to contravention of the procedures under this act
21. Punishment for offences committed by companies or any body corporate. All who was incharge of, when the time the offence was committed and was responsible to the company shall be deemed to be guilty of the offence and punished accordingly
22. Protection of Government action taken in good faith that is no prosecution or legal proceeding will lie against Government or any Government Officer for anything that is done in good faith
23. Power for Government to give directions for smooth conduct of the act
24. Non-application of the act to the seed exchange by the farmers without any brand name
25. Power of Government to make rules to carry out various functions of Central Seed Committee, Central Seed Laboratory, Certification Agency and Seed Inspectors

SEED RULES, 1968

The rules have been framed to implement various legislations given under Seed Act, 1966 and contain 11 sections.

I. Preliminary

This section provides definitions of various terminology used under the seed rule.

II. Central Seed committee

This section describes the specific functions entrusted to the committee by the act such as recommendation for Seed Testing fee, advice on the suitability of seed testing laboratory, **recommendation for the procedure and standards for seed certification and testing**. Also the rules provide details of traveling and daily allowances payable to the members of the committee.

III. Central Seed Laboratory

In this section it describes the specific functions entrusted to the Central Seed Laboratory such as coordinating with State Seed Laboratories for uniformity in test results, collecting data on quality of seeds available in the market and any other function assigned to it by the Central Government.

IV. Seed Certification Agency

This section deals with the specific functions entrusted to the Certification Agency such as outlining the procedure for submission of applications, growing, harvesting and processing and storage of seeds intended for certification, maintaining a list of recognized nucleus seed breeders, inspections of seed production fields, seed processing plant and seed stores, grant of certificates.

V. Marketing or Labeling

Rules for marking or labeling of seed lots intended for certification have been provided in this section. The label should contain name of the person or agency that produced the seed and shall be responsible for the accuracy of information given in the unopened original container. The label should contain the name, the address of the person offering the sale of the seed, name of the variety, germination and purity level of the seed, net weight of the seed, date of seed testing and a statement if the seed is treated. Any transparent cover used solely for the purpose of packing during transport or delivery need not be marked or labeled.

VI. Requirements for Certification

Three classes of certified seed have been specified in this section, viz. Foundation (progeny of breeder seed), Registered (progeny of foundation seed) and Certified (progeny of registered /foundation seed) and each class shall meet the specific standards. Certification agency has the discretion of producing certified seed from certified seed provided that it does not exceed three generation and the genetic purity is not significantly altered.

VII. Certification of seeds

The detailed procedure of seed certification starting from applying for certification till the grant of certificate has been provided in this section. Application has been outlined by the certification agency containing the name and details of the applicant, the name of the seed to be certified, class & source of the seed, germination and purity and mark or label. A fee of Rs. 25 is levied for certification. Once certified, the certification tag containing information such as name and address of the certification agency, name of variety, lot number, name and address of the producer, date of issue of its certificate and its validity, an appropriate sign, to designate certified seed. The color of the tag shall be white for foundation, purple for registered and blue for certified seed. The holder of certificate shall allow any seed inspector to enter and inspect the seeds kept for sale, registers or other documents.

VIII. Appeal

Provision for appeal has been provided by submitting a memorandum accompanied by a treasury receipt for Rs. 100. The appellate authority shall exercise all the powers which a court has, while deciding appeal under the code of civil procedure, 1908.

IX. Seed Analyst and Seed Inspectors

The specific qualifications and duties of seed analyst and seed inspectors have been provided in this section. Seed analyst should possess a Master Degree in Agriculture/ Agronomy/ Botany/ Horticulture from a recognized University with at least one year experience in Seed Technology or possess a Bachelors degree in Agriculture/Botany from a recognized university with a minimum of three years experience in Seed Technology for this purpose. Seed analyst shall analyze the seed samples according to the provisions of the Act. Seed Inspector shall be a graduate in agriculture with at least one year experience in Seed Technology.

X. Sealing, Dispatch and Analysis of Samples

The details of sampling, labeling, manner of packing and sealing the samples as well as its dispatch to the seed analyst has been provided.

XI. Miscellaneous

The need to maintain stock record of seeds and record of the sale of seed have been provided in this section.

THE SEEDS (CONTROL) ORDER, 1983
Government of India
Ministry of Agriculture
(DEPARTMENT OF AGRICULTURE & COOPERATION)

New Delhi, dated the 30th Dec., 1983

ORDER

GSR 932 (E) – In exercise of the powers conferred by section 3 of the **Essential Commodities Act, 1955 (10 of 1955)**, the Central Government hereby makes the following order, namely:-

PRELIMINARY

1. Short title and extent:

- (i) This Order may be called the Seeds (Control) Order, 1983.
- (ii) It extends to the whole of India.
- (iii) It shall come into force on the 30th December, 1983.

2. Definitions:

In this Order, unless the context otherwise requires,

- (a) “Act” means the Essential Commodities Act, 1955 (10 of 1955).
- (b) “Controller” means a person appointed as Controller of Seeds by the Central Government and includes any person empowered by the Central Government to exercise all or any functions of the Controller under this Order;
- (c) “Dealer” means a person carrying on the business of selling, exporting or importing seeds, and includes an agent of a dealer;
- (d) “Export” means to take or cause to be taken out from any place in India to a place outside India;
- (e) “Form” means a form appended to this Order;
- (f) “Import” means to bring or cause to be brought to any place in India from outside India;
- (g) “Inspector” means an inspector of seeds appointed under clause 12;
- (h) “Registering authority” means a licensing authority appointed under clause 11;
- (i) “Seeds” means the seeds as defined in the Seeds Act, 1966 (54 of 1966).
- (j) “State Government” in relation to a Union Territory means the Administrator thereof by whatever designation known.

DEALER IN SEEDS TO BE LICENSED

3. Dealer to obtain license

(1) No person shall carry on the business of selling, exporting or importing seeds at any place except under and in accordance with the terms and conditions of license granted to him under this order.

(2) Notwithstanding anything contained in sub-clause (1), the State Government may, by notification in the Official Gazette, exempt from the provisions of that sub-clause such class of dealers in such areas and subject to such conditions as may be specified in the notification.

4. Application for license

Every person desiring to obtain a license for selling, exporting or importing seeds shall make an application in duplicate in Form 'A' together with a fee of rupees fifty for license to licensing authority.

5. Grant and refusal of license

(1) The licensing authority may, after making such enquiry as it thinks fit, grant a license in Form 'B' to any person who applies for it under clause 4: Provided that a license shall not be issued to a person-

(a) whose earlier license granted under this Order is under suspension, during the period of such suspension;

(b) whose earlier license granted under this Order has been cancelled, within a period of one year from the date of such cancellation.

(c) who has been convicted under the Essential Commodities Act, 1955 (10 of 1955) or any order issued thereunder within three years preceding the date of application.

(2) When the licensing authority refuses to grant license to a person who applies for it under clause 4, he shall record his reasons for doing so.

6. Period of validity of license

Every license under this Order, shall, unless previously suspended or cancelled, remain valid for **three years** from the date of its issue.

7. Renewal of license

(1) Every holder of license desiring to renew the license, shall, before the date of expiry of the license, make an application for renewal in duplicate, to the licensing authority in Form 'C' together with a fee of rupees twenty for renewal. On receipt of such application, together with such fee, the licensing authority may renew the license.

(2) If any application for renewal is not made before the expiry of the license, but is made within one month from the date of expiry of the license, the license may be renewed on payment of additional fee of rupees twenty five, in addition to the fee for renewal of license.

8. Dealers to display stock and price list

Every dealer of seeds shall display in his place of business:

- (a) the opening and closing stocks, on daily basis, of different seeds held by him;
- (b) a list indicating prices or rates of different seeds.

9. Dealers to give memorandum to purchaser

Every dealer shall give a cash or credit memorandum to a purchaser of seeds.

10. Power to distribute seeds

Where it is considered necessary to do so in public interest, the Controller may, by an order in writing direct any producer or dealer to sell or distribute any seed in such manner as may be specified therein.

ENFORCEMENT AUTHORITY

11. Appointment of licensing authority

The State Government may by notification in the Official Gazette appoint such number of persons as it thinks necessary to be licensing authority and may also define in that notification the area within which each such licensing authority shall exercise his jurisdiction.

12. Appointment of Inspectors

The State Government may by notification in the Official Gazette appoint such number of persons as it thinks necessary to be inspectors and may in such notification define the local area within which each such Inspector shall exercise his jurisdiction.

13. Inspection and punishment

(1) An Inspector may with a view to securing compliance with this Order-

- (a) require any dealer to give any information in his possession with respect to purchase, storage and sale of seeds by him;
- (b) enter upon and search any premises where any seed is stored or exhibited for sale to ensure compliance with the provisions of this Order;
- (c) draw samples of seeds meant for sale, export and seeds imported, and send the same in accordance with the procedure laid down in Schedule I, to a laboratory notified under the Seeds Act, 1966 (54 of 1966) to ensure that the sample conforms to standard of quality claimed;

(d) seize or detain any seed in respect of which he has reason to believe that a contravention of this Order has been committed or is being committed;

(e) seize any books of accounts or document relating to any seed in respect of which he has reason to believe that a contravention of this Order has been committed or is being committed.

Provided that the Inspector shall give a receipt, in respect of the books of accounts or documents seized, to the person from whom they have been seized.

Provided further that the seized books of accounts or documents shall be returned to the person from whom the same had been seized after copies thereof or extracts therefrom as certified by such person have been taken.

(2) Subject to the provision of paragraph (d) of sub-clause (1), the provision, of section 100 of the Code of Criminal Procedure, 1973 (2 of 1974) relating to search and seizure shall, so far as may be, apply to searches and seizures under this clause.

(3) Where any seed is seized by an Inspector under this clause, he shall forthwith report the fact of such seizure to a Magistrate where-upon the provisions of sections 457 and 458 of the Code of Criminal Procedure, 1973 (2 of 1974) shall, so far as may be, apply to the custody and disposal of such seed.

(4) Every person, if so required by an Inspector, shall be bound to offer all necessary facilities to him for the purpose of enabling him to exercise his power under this clause.

14. Time limit for analysis

The laboratory to which a sample has been sent by an Inspector for analysis under this Order shall analyse the said samples and send the analysis report to the concerned Inspector within 60 days from the date of receipt of the sample in the laboratory.

15. Suspension/Cancellation of license

The licensing authority may, after giving the holder of the license an opportunity of being heard, suspend or cancel the license on the following grounds, namely:-

- (a) that the license had been obtained by misrepresentation as to a material particular; or
- (b) that any of the provisions of this Order or any condition of license has been contravened.

16. Appeal

Any person aggrieved by an order-

- (a) refusing to grant, amend or renew the license for sale, export or import of seeds;
- (b) suspending or cancelling any license, may within sixty days from the date of the order, appeal of such authority as the State Government may specify in this behalf, and the decision

of such authority shall be final. Provided that an application for appeal shall accompany an appeal fee of rupees fifty.

MISCELLANEOUS

17. Amendment of license

The licensing authority may, on receipt of a request in writing together with a fee of rupees ten from a dealer, amend the licence of such dealer.

18. Maintenance of records and submission of returns, etc. :

(1) Every dealer shall maintain such books, accounts and records relating to his business as may be directed by the State Government.

(2) Every dealer shall submit monthly return relating to his business for the preceding month in Form 'C' to the licensing authority by the 5th day of every month.

Seed Law Enforcement

Seed laws are designed to aid in the orderly marketing of seed. They establish regulations governing the sale of seed, thereby providing legal protection to both buyers and sellers. No country can expect to have a well-developed, effective seed industry without seed control regulations. Thus, seed laws are an essential part of any well-developed, mature seed industry which in turn, is an essential ingredient in any society with a well-developed, effective agriculture. Seed law enforcement is the responsibility of the Seed Inspector.

Seed Inspector : "Seed Inspector" means a Seed Inspector appointed under Section 13 of The Seeds Act, 1966. He is responsible for 'seed law enforcement'. Seed inspectors will visit the premises of seed distribution agencies, inspect seed lots produced, take samples of seed as per the procedure and have such samples tested to ensure that the seed conforms to the prescribed standards of certification. If found necessary seed inspectors can issue orders to stop the sale of seeds, seize the seed stocks and initiate prosecution.

Qualifications of Seed Inspector

A person who is a graduate in agriculture with not less than one year experience in seed production or seed development or seed analysis or testing in seed testing laboratory is qualified for seed inspector.

Powers of Seed Inspector

- ❖ To take samples of seed of any notified kind or variety from any person selling seed or from purchaser or consignee and to send such samples for analysis to the seed analysts.

- ❖ To enter and search any place in which an offence under this act has been or is being committed.
- ❖ To issue an order in writing the person in possession of any seed in which the offence has been committed not to dispose of any stock of such seed for a specific period not exceeding 30 days.
- ❖ To examine any record, register document or any other material in any place if he believes that an offence is committed.
- ❖ On demand to repay the cost of seeds to the person from whom the seed was taken.
- ❖ To break open any container in which any seed of any notified kind or variety may be contained or to break open the door of any premises where such seed may be kept for sale provided that the power to break open the door shall be exercised only after the owner or any other person in occupation refuses to open the door on being called upon to do.
- ❖ When the seed inspector breaks open the door he shall call not less than two person to be present and take their signatures.
- ❖ Seed inspectors should strictly follow the prescribed procedure of seed inspection for carrying out the enforcement of seed law.

Duties of seed inspectors

- ❖ Inspects frequently all places used for storage or sale of any seed of any notified kind or variety.
- ❖ Satisfy himself that the conditions of the certificates / labels are being observed.
- ❖ Takes and sends samples of any seeds which he has reason to suspect are being stocked or sold or exhibited for sale in contravention of the provisions of the act or the rules.
- ❖ Investigates any complaint made to him in writing in respect of any contravention of the provisions of the Act or the Rules.

STOP SALE ORDER :

- ❖ If the seed inspector suspects /believes that an offence under the Act has been or being committed. If the offence is such that it can be removed or corrected, he may issue a stop sale order in of the Rules, ordering the possessor of such seed not to dispose of the concerned seed lot for a specific period not exceeding 30 days.
- ❖ During this period, the possessor of seed may correct the defect(s) and intimate such action to the Inspector who, on being satisfied about the removal of the defect(s) shall

revoke the stop sale order. If the defect(s) cannot be removed or corrected, the inspector may issue a seizure order of the Rules, and seize the seed

SEEDS (CONTROL) AMENDMENT ORDER, 2006.

G.S.R.444(E).- In exercise of the powers conferred by Section 3 of the Essential Commodities Act, 1955 (10 of 1955), the Central Government hereby makes the following Order to amend the Seeds (Control) Order, 1983, namely:-

1. (1) This Order may be called the Seeds (Control) Amendment Order, 2006.

(2) It shall come into force on the date of its publication in the Official Gazette.

2. In the Seeds (Control) Order, 1983, after **clause 8**, the following clause shall be inserted, namely:- “**8A.** Dealers to ensure certain standards in respect of seeds: Every dealer of seeds in notified kind or variety or other than notified kind or variety of seeds shall ensure that the standards of quality of seeds claimed by him shall conform to the standards prescribed for the notified kind or variety of seeds under Section 6 of the Seeds Act, 1966 (54 of 1966) and any other additional standards relating to size, colour and content of the label as may be specified.”

Protection of Plant Varieties and Farmers’ Right Act 2001

Based on the need India decided to have Sui-generis system named as Protection of Plant Varieties and Farmers Rights Act, 2001 (PPV & FRA, 2001). This act contains 97 Sections and IX Chapters. This act covers all categories of plants except microorganisms.

Objectives

To provide an effective system for protection of plant varieties.

To recognize and protect the rights of farmers.

To protect the plant breeders right.

Such protections will facilitate for

- Development of new varieties
- Accelerated agricultural development
- The growth of seed industry.

PPV & FRA seeks for establishment of an independent National Plant variety and Farmers’ Right Protection Authority.

- Chairperson – appointed by GOI.
- 15 ex-officio and nominated members.
- Registrar General of plant varieties.
- Head quarters – New Delhi.

Regional offices:

- ✓ Bangalore, Pune, Bhopal, Patna and Guwahati.

Main functions of the Authority

- Registration of plant varieties.
- Characterization and documentation of registered varieties.
- Documentation, indexing and cataloguing Farmers' variety.
- Ensuring availability of seeds of all registered varieties.
- Collection of comprehensive statistics on plant varieties.
- Maintenance of national register of plant varieties.

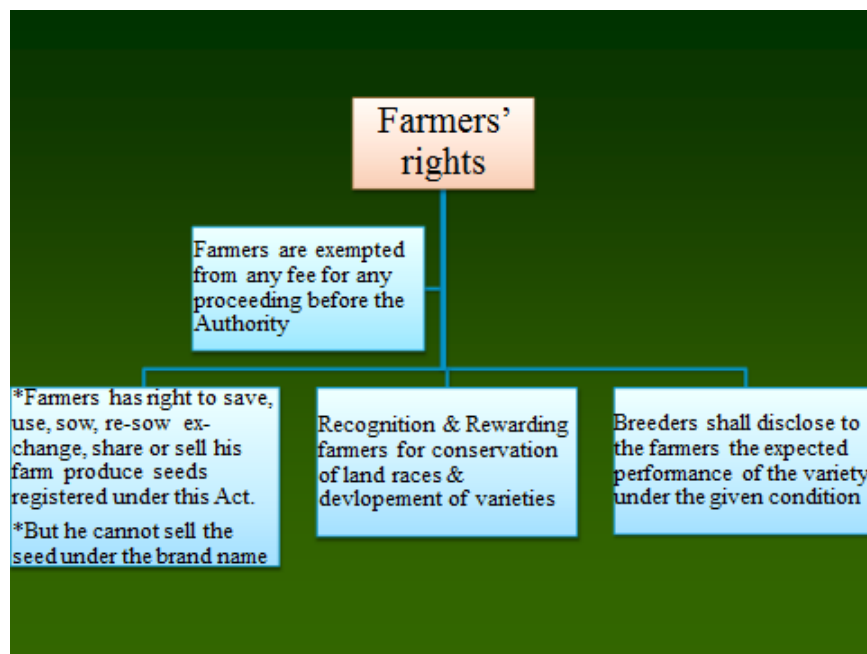
Registered plant variety will have Farmers' Right, Researchers' Right and Plant Breeders' Right.

Farmers' Right

Farmers' Right provision acknowledges the farmers as

- ✓ Cultivator
- ✓ Conservator
- ✓ Seed producer

This independence, becomes a coping mechanism for global warming and climate change.



Researcher's right

- Use of registered variety for conducting experiment.
- Use of variety as an initial source of variety for the purpose of creating other varieties.

Plant Breeders' Right

- Rights of commercialization by his own person or through anyone he designates.
- Includes Right to produce, sell, market, import, or export variety.

Gene fund

A national gene fund shall be established and will receive contributions from

- Annual fees
- Benefit sharing
- Contribution

The gene fund shall be utilized for

- Benefit sharing
- Compensation
- On farm conservation and sustainable use of land races and traditional varieties

Benefit sharing

On registration of the variety any person or group of person may submit his claim of benefit sharing in the prescribed form & with prescribed fee to the Authority if his or their material has been used in the development of that variety. The extent and nature of use of the genetic material of the claimant in the development of the variety relating to which the benefit sharing has been claimed. The commercial utility and demand in the market of the relating to which the benefit sharing has been claimed

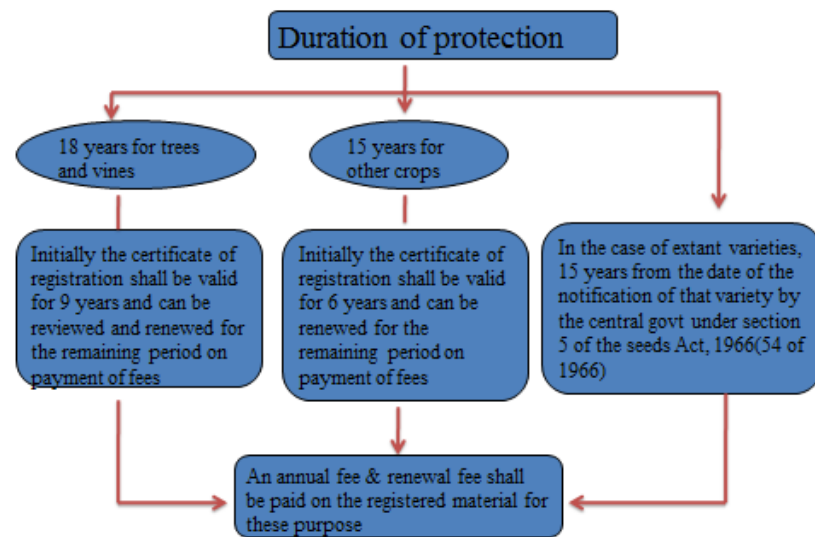
Plant Variety Registry

National register of plant varieties-Maintain Plant Variety Registry. The register will contain the name of the registered plant variety with the name, addresses and rights of their breeder and particulars of the denominations of the registered variety

Gene bank

Authority to maintain the seed samples of registered varieties for the entire period of protection. The applicant of the registered variety shall rejuvenate the seed if so desired by the registrar .

Duration for protection



Application for registration

Any person specified in section 16 may make an application to the Registrar for registration of any variety—

- (a) of such genera and species as specified under sub-section (2) of section 29; or
- (b) which is an extant variety; or
- (c) which is a farmers' variety.

“extant variety” means a variety available in India which is—

- (i) notified under section 5 of the Seeds Act, 1966 (54 of 1966); or
- (ii) farmers' variety; or
- (iii) a variety about which there is common knowledge; or
- (iv) any other variety which is in public domain;

“farmers' variety” means a variety which—

- (i) has been traditionally cultivated and evolved by the farmers in their fields; or
- (ii) is a wild relative or land race of a variety about which the farmers possess the common knowledge;

“Essentially derived variety”

- It is predominantly derived from such initial variety
- It is clearly distinguishable from such initial variety
- It conforms (except for the differences which result from the act of derivation) to such initial variety in the expression of the essential characteristics that result from the genotype or combination of genotype of such initial variety

Criteria for plant variety protection (DUS)

1.Novelty: Variety was not sold or disposed by the breeder for commercial exploitation

- (i) in India, earlier than one year; or
- (ii) outside India, in the case of trees or vines earlier than six years, or in any other case, earlier than four year

2.Distinctness: if it is clearly distinguishable by at least one essential characteristic from any another variety.

3.Uniformity: if subject to the variation that may be expected from the particular features of its propagation it is sufficiently uniform in its essential characteristics

4.Stability: if its essential characteristics remain unchanged after repeated propagation

Fees for registration of various material under the Act

A	DUS Conducting test fee	Rupees
1	Cereals/grain legumes	20,000
2	Commercial crops	35,000
3	Spices & Medicinal plants	20,000
4	Plantation crops	35,000
5	Flower and Lawn/ Fodder grasses	15,000
6	Fruit trees/Vines	20,000
7	Vegetables	20,000
8	Forest trees/other trees	20,000
9	Other (to be decided case by case)	20,000

B. Annual Fee

The Authority shall notify the amount separately in the official Gazette (in the PVJ of India).

II. Other chargers

A. Application Examination Chargers :

- | | |
|---|---------|
| 1. Application Form | : 200 |
| 2. For Extant Variety of common Knowledge where DUS test is needed. | : 2,000 |

B. Registration Certificate charges	:5,000
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C. DUS test site visit charges/persons/visit	:500
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(To be retained at DUS test site after issue of receipt)

*There will be no DUS test fee for the registration of FV.

Seed promotional policies and programmes – New policy on seed development (NPSD)

1988 - National seed policy 2002- Seeds Bill 2004 - EXIM policy.

New Policy on Seed Development, 1988

The policy was formulated to provide Indian farmers with access to the best available seeds and planting materials of domestic as well as imported

- ❖ The policy permits the import of selected seeds under Open General License (OGL), to make available to farmers high quality seeds to maximize yield, increase productivity thereby farm income. The policy allow import under OGL of items such as seeds of oilseed crops, pulses, coarse grains, vegetables, flowers, ornamental plants, tubers, bulbs, cuttings and saplings of flowers.
- ❖ While the import of horticultural crops including flowers need recommendation from Directors of Horticulture, import of crop seeds require permission from ICAR. ICAR will direct multi -locational trials in various agro-climatic conditions at least for one season.
- ❖ Evaluation of important traits such as yield, pest resistance etc. needs to be done within 3 months of harvest after which importer shall apply to the DAC for permit. Within a month, DAC will process it and thereafter controller of Imports and Exports will issue a license.
- ❖ Private seed producing firms should compulsorily register with NSC before importing the seeds.

National Seed Policy, 2002

The Seed Act, 1966, seed control order 1983 and New Policy on Seeds Development, 1988, from the basis of promotion and regulation of the Indian Seed Industry.

The “New Policy” of 1988 ushered in a new area of growth and phenomenal development. Because, it allowed limited import of commercial seed, remove curbs on imports of seeds of vegetables, flowers and ornamental plants and even allowed import of seed of course cereals, pulses and oilseeds for a period of two years.

The important constraints were

- Non existence of National Seed Policy
- IPR laws
- Restrictions and licenses on seed exports and imports
- Lack of incentives for the public and private seed sectors of the country

India later developed the National Seed Policy in 2002. The main objectives are the provision of an appropriate climate for the seed industry to utilize available and prospective opportunities, safe guarding of the interests of Indian farmers and the conservation of agro-biodiversity.

Thrust Areas

1. Varietal Development and PVP
2. Seed Production
3. Quality Assurance
4. Seed Distribution and Marketing.
5. Infrastructure facilities
6. Transgenic Plant Varieties
7. Import of seeds and planting material
8. Export of seeds
9. Promotion of Domestic Seed
10. Strengthening of monitoring system

1. Varietal Development and PVP

To stimulate investment in research and development (R&D) new varieties an effective *sui generis* system for IPR will be implemented.

- Establishment of PVPFRA (Plant Varieties Protection and Farmers Rights Authority, to implement PVPFR Act, 2001.
- Under this Act, Plant Varieties will be registered based on Novelty, Distinctness, Uniformity and Stability (DUS) characters.
- Farmers Rights: Farmers can save, use, exchange, share or sell seeds of protected variety but not under the brand name.
- Researchers Rights: Seed / planting material of protected varieties can be used for research and breeding new varieties.
- Breeders Rights: Benefit arising out of use of varieties upon commercialization of seeds of new variety, will be shared with the respective breeder.
- Community Rights: Benefit sharing with Farmers / Village communities will be ensured for contributing in evaluation of plant variety upon registration.

2. Seed Production

India seed programme will adhere to generation system of multiplication namely nucleus, breeder, foundation and certified seed.

Public seed sector will be restructured and will continue to have free access to breeder seed, while Private Seed Sector will have conditional access. Seed village scheme will be facilitated to upgrade the quality of farmers saved seeds. Seed Replacement will be raised progressively, National Seed Map will be prepared to identify potential areas of seed production, seed banks will be established with cold storage facilities, seed minikits will be supplied for popularizing new varieties and will Seed Crop Insurance will be encouraged.

3. Quality Assurance

1. New Seed Act will be enacted.
2. National Seed Board will be established as apex body in place of existing Central Seed Committee to implement New Seed Act.
3. National Seeds Register will be maintained varieties will be registered based on “Value for Cultivation and Usage”. (VCU).
4. Farmers will retain rights to save, use, exchange, share or sell seeds of any variety but not under the brand name.

4. Seed Distribution and Marketing.

1. Seed Distribution and Marketing of any variety will be subject to registry in NSB.
2. National Seed Grid will be established as a data base on seed requirement, production, distribution and farmers preference.
3. Access to finance from commercial banks will be facilitated.
4. Availability of high quality seed will be ensured through improved distribution system and efficient marketing set up.

5. Infrastructure facilities

1. National Seed Research and Training center (NSRTC) will be set up.
2. Seed processing and storage faculties will be augmented.
3. Computerized National Seed Grid will be established to provide information on seeds marketing.

6. Transgenic Plant Varieties

1. All GM crops will be tested for environment and bio safety before commercial release as per EPA (1986).
2. Seeds of GM crops will be imported only through NBPGR as per the EPA (1986).
3. Required infrastructure will be developed for testing, identification and evaluation of transgenic planting material.

7. Import of seeds and planting material

Provision will be made to make available best planting material from anywhere in the world to Indian farmers without any compromise on quarantine requirements.

8. Export of seeds

1. Long term policy will be evolved to exploit varied agro climatic condition of India and strong seed production system, to raise seed export from present level of less than 1% to 10% by 2020.
2. Seed export promotion zones will be established and strengthened.
3. Data Bank on International Market will be created.

9. Promotion of Domestic Seed Industry

It will be facilitated by providing incentives to domestic seed industry, financial support through NABARD, commercial and co-operative banks, considering tax rebate / concessions for R&D, reduction of import duty on machines and equipment used for seed production and encouragement of membership in National and International organization related to seed.

10. Strengthening of monitoring system

Strengthening of Department of Agriculture and Co-operation (DAC) will supervise the implementation of National Seed Policy.

National Seed Policy will be vital in doubling food production of India

The Seeds Bill, 2004

The seed quality regime in India is governed by the Seeds Act, 1966, the Seeds Rules, 1968 and the Seeds (Control) Order, 1983 (issued in exercise of powers under the Essential Commodities Act, 1955). In addition to these legal instruments, various guidelines and policy parameters have been laid down in the National Seeds Policy, 2002 and the New Policy on Seed Development, 1988. During the last four decades seed production technologies have changed and new technologies like transgenic, tissue culture, soil-less agriculture etc. have emerged. There is greater emphasis on seed quality assurance particularly to safeguard the interest of the farmers. The economy has been substantially liberalized and the private sector is playing an increasing role in various spheres including agriculture. In the liberalized and changed environment, India is increasingly engaging in the import and export of seeds and planting materials. The above necessitates up-gradation of seed production, quality and regulatory standards. Therefore, a need has arisen for up-scaling the seed quality regime by enacting a new legislation.

Moreover, the following deficiencies have been noted in the existing Seeds Act 1966:-

- Registration of seed variety not compulsory.
- Non-notified varieties are not covered.
- Commercial crops and plantation crops are not covered.
- Certification only through State Seed Certification Agencies.
- No provision for regulation of transgenic materials.
- Penalties for infringement are very mild.

Based on the changes that have taken place in the seed sector since 1966, the existing Seeds Act, 1966 is proposed to be replaced by a suitable legislation. Accordingly, the Seeds Bill, 2004 was drafted in consultation with the various stakeholders and introduced in the Rajya Sabha. This seeds bill contains 49 clauses and X Chapters

The salient features of the Seeds Bill, 2004 is as follows:-

- i. **Compulsory registration of varieties.** No person will be allowed to carry on the business of selling or supplying any seed which is not of a registered kind/variety. Farmers are to be exempted from compulsory registration. Registration will be for a fixed period but can be pre-maturely cancelled for stated reasons.
- ii. **Enhancement of penalties** is proposed from Rs.500 / Rs.1000 with or without imprisonment in the Seeds Act 1966 to Rs.25,000/ Rs.5,00,000 with or without imprisonment.
- iii. **Provision for labeling of expected performance** of seeds has been included so that the farmers are assured of quality of seeds purchased by them.
- iv. Provision for **compensation to the farmer** in case of seed failure has been made.
- v. The Bill proposes to emphasise the **rights of the Farmers** in conformity with the Protection of Plant Varieties and Farmers' Rights Act, (PPV & FR Act) 2001. The farmer will have the right to grow, sow, re-sow, save, use, exchange, share or sell his farm seeds and planting materials except when he sells such seed or planting material under a brand name.
- vi. The Government will have the **right to exclude certain kind or variety of seeds from registration** to protect public order or public morality or human, animal and plant health or to avoid serious prejudice to the environment.
- vii. **Seed health** has been added as an additional standard for quality seed.
- viii. Provisions to **regulate import and export of seeds** have been largely incorporated into the Seeds Bill itself as given below:-
 - a. All import of seed shall be subject to Plant Quarantine (Regulation of Import into India) Order, 2003 and other relevant Acts.
 - b. All imported seeds shall conform to minimum standards of seed health in addition to other conditions already in existence.

- c. All imported seeds shall be subject to registration on the basis of information furnished by the importer on the basis of multi-location trials.
 - d. Exports can be restricted if such exports adversely affect the food security of the country.
- ix. **GURT (Restriction technology including terminator technology) has been prohibited.** Any person intending to import seed or planting material will declare that such material is, or is not, as the case may be a product of transgenic manipulation or involves Genetic Use Restriction Technology.

EXIM POLICY

Indian **EXIM Policy** contains various policy related decisions taken by the government in the sphere of Foreign Trade, i.e., with respect to imports and exports from the country and more especially **export promotion measures**, policies and procedures related thereto. Trade Policy is prepared and announced by the Central Government (Ministry of Commerce). India's Export Import Policy also known as Foreign Trade Policy, in general, aims at developing export potential, improving export performance, encouraging foreign trade and creating favorable balance of payments position.

History of Exim Policy of India

In the year 1962, the Government of India appointed a special

Exim Policy Committee to review the government previous export import policies. The committee was later on approved by the Government of India. Mr. V. P. Singh, the then Commerce Minister and announced the Exim Policy on the 12th of April, 1985. Initially the EXIM Policy was introduced for the period of three years with main objective to boost the **export business** in India

Objectives of the EXIM policy : -

Government control import of non-essential items through the

EXIM Policy. At the same time, all-out efforts are made to promote exports. Thus, there are two aspects of Exim Policy; the import policy which is concerned with regulation and management

of imports and the export policy which is concerned with exports not only promotion but also regulation. The main objective of the Government's EXIM Policy is to promote exports to the maximum extent. Exports should be promoted in such a manner that the economy of the country is not affected by unregulated **exportable items** specially needed within the country. Export control is, therefore, exercised in respect of a limited number of items whose supply position demands that their exports should be regulated in the larger interests of the country. In other words, the main objective of the Exim Policy is:

- To accelerate the economy from low level of economic activities to high level of economic activities by making it a globally oriented vibrant economy and to derive maximum benefits from expanding global market opportunities.
- To stimulate sustained economic growth by providing access to essential raw materials, intermediates, components, consumables and capital goods required for augmenting production.
- To enhance the technological strength and efficiency of Indian agriculture, industry and services, thereby, improving their competitiveness.
- To generate new employment.
- Opportunities and encourage the attainment of internationally accepted standards of quality.
- To provide quality consumer products at reasonable prices.

Impact of Exim Policy 1997 –2002

(a) Globalization of Indian Economy:

The Exim Policy 1997-02 proposed with an aim to prepare a framework for globalizations of Indian economy. This is evident from the very first objective of the policy, which states. "To accelerate the economy from low level of economic activities to- high level of economic activities by making it a globally oriented vibrant economy and to derive maximum benefits from expanding global market opportunities."

(b) Impact on the Indian Industry:

In the EXIM policy 1997-02, a series of reform measures have been introduced in order to give boost to India's industrial growth and generate employment opportunities in non-agricultural sector. These include the reduction of duty from 15% to 10% under EPCG scheme that enables Indian firms to import capital goods and is an important step in improving the quality and productivity of the Indian industry.

(c) Impact on Agriculture:

Many encouraging steps have been taken in the Exim Policy 1997-2002 in order to give a boost to Indian agricultural sector. These steps includes provision of additional SIL of 1 % for export of agro products, allowing EOU's and other units in EPZs in agriculture sectors to 50% of their output in the domestic tariff area (DTA) on payment of duty.

(d) Impact on Foreign Investment.

In order to encourage foreign investment in India, the Exim Policy 1997-02 has permitted 100% foreign equity participation in the case of 100% EOUs, and units set up in EPZs.

(e) Impact on Quality up gradation:

The SIL entitlement of exporters holding ISO 9000 certification has been increased from 2% to 5% of the FOB value of exports, which has encouraged Indian industries to undertake research and development programmers and upgrade the quality of their products.

(f) Impact on Self-Reliance:-

The Exim Policy 1997-2002 successfully fulfills one of the India's long terms objective of Self-reliance. The Exim Policy has achieved this by encouraging domestic sourcing of raw materials, in order to build up a strong domestic production base. New incentives added in the Exim Policy have also added benefits to the exporters.

Lecture 6

Domestic and International organizations involved in seed business – NSC, SSC, NSAI-International Seed Federation (ISF) - Asia Pacific Seed Association (APSA)

1.Domestic organizations involved in seed business

The following organizations are involved in domestic seed business viz.,

- a.National Seeds Corporation Limited (NSC)
- b.State Seed Corporation (SSC)
- c.National Seed Association of India (NASI)

a.National Seeds Corporation Limited (NSC)

National Seeds Corporation Ltd. (NSC) is a Schedule 'B'-Miniratna Category-I company wholly owned by Government of India under the administrative control of Department of Agriculture Cooperation & Farmer's Welfare, Ministry of Agriculture and Farmers Welfare. NSC was established in **March-1963** to undertake production of foundation and certified seeds. At present, it is undertaking production of certified seeds of nearly 600 varieties of 60 crops consisting of Cereals, Pulses, oilseeds, Fiber, Fodder, Green Manure and Vegetables, in its Farms and through its registered seed growers. There are about 8 Farms and 12500 registered seed growers all over the country who are undertaking the seed production programmes in different agro-climatic conditions. Total Revenue of NSC for the F.Y. 2017-18 was 841.55 crores.

Functions of NSC

- ❖ There are 10 Regional Offices, 8 Farms consisting of 22,000 hectare land and 65 Area Offices/Sub-Units of the Corporation spread all over the country.
- ❖ In the seed production, emphasis is given for production of oil seeds, pulses and hybrids including vegetables.
- ❖ NSC has established strict Quality Control procedure to ensure supply of quality seed to farmers.
- ❖ NSC has established 4 Quality Control Laboratories, one each at New Delhi, Secunderabad, Bhopal and Suratgarh to undertake seed testing to check the quality of seeds.

- ❖ Besides, production and distribution of quality seeds, NSC is also involved in the production of Tissue Culture Plants like Banana.
- ❖ It also undertakes supply of seedlings/saplings of fruits crops from elite progeny orchards at its farms.
- ❖ Seed marketing is carried out through different channels namely sale through dealers/distributors, Govt. (State/Central), through NSC owned Sale counter and in KisanMelas.
- ❖ There are about 2500 dealers of the Corporation who account for more than 43% of the sale turn over.
- ❖ In the diversification front NSC has commenced Fish Seed production at its Suratgarh (Rajasthan) and Raichur (Karnataka) farms.
- ❖ NSC has established Fodder Block making unit also at its Raichur Farm, which will ensure effective utilization of crop residues for quality fodder.
- ❖ NSC has developed various infrastructure facilities at its Farms towards Micro Irrigation Systems, Water Conservation, Farm Mechanization, Threshing Floors, Seed Processing Plants, and Seed Storage Godowns.
- ❖ NSC also has developed infrastructure facilities of Seed Processing Plants and Seed Storage Godowns at relevant locations at its Regional/ Area offices. All these infrastructure will help in production of quality seed.
- ❖ NSC plays a key role in the implementation of various schemes of the Govt. of India like “National Mission on Oil Seed and Oil Palm (NMOOP)”, “National Food Security Mission (NFSM)” and “Mission for Integrated Development of Horticulture (MIDH).
- ❖ It also provides technical support to the seed producing agencies including State Seed Corporations by imparting training of personnel engaged in the production of seeds in that organization.
- ❖ NSC is the nodal agency for the implementation of the Central Sector Scheme to create infrastructure facilities for establishment of processing plants and storage godowns in different states in the private sectors.
- ❖ NSC also involves in exports of seeds across the world especially in SAARC and African countries.

- ❖ The SAARC seed bank maintained by NSC with the grant in aid of the Govt. of India holds larger qty. of seeds of different crops/varieties that are meant to meet the demand that arises during natural calamities like flood, drought etc.
- ❖ NSC also takes care to meet the demand for quality seed of the farmers in the interior parts of the country like North Eastern States & other hilly regions.
- ❖ With the launching of the National Seed Project (NSP) in 1974, NSC was assigned the lead role to develop the seed industry in the country on sound lines.
- ❖ NSC has also contributed in the establishment of various State Seed Corporations under the NSP during seventies.

b. State Seed Corporation (SSC)

Tamil Nadu State Seed Development Agency

Formed based on announcement made on floor of assembly

Established : 10/4/2015 as society in serial No. 101/2015

Registration Rule 1978, Tamil Nadu Act 27 of 1975

Objectives :

- Produce and Distribute Quality Seeds
- Plan to maintain Required seed material
- Maintain the Seed supply for timely availability to farmers by uniform price policy
- Monitoring and Release of Funds when Required

c.National Seed Association of India (NASI)

Vision

The vision of NSAI is to create “A dynamic, innovative, internationally competitive, **research based industry** producing high performance, high quality seeds and planting materials which benefit farmers and significantly contribute to the sustainable growth of Indian Agriculture”. The Association is also working towards the **responsible use of biotechnology for modernizing Indian agriculture and enhancing the livelihood** of Indian farmers. **Increasing the general awareness about crop biotechnology amongst the many stakeholders**, technology upgradation and engaging in a continuous dialogue with regulators for the establishment of a transparent, fair and equitable regulatory system, are some of the other activities of NSAI.

Mission

The mission of NSAI is to encourage investment in the state of the art R & D to bring to the Indian farmer superior genetics and technologies, which are high performance and adopted to a wide range of agro-climatic zones. It actively contributes to seed industry policy development, with the concerned government, to ensure that the policies and regulation create an enabling environment, including public acceptance, so that the industry is globally competitive.

Objectives:

- To create policy environment for the seed industry
- Create better interaction and provide business opportunities
- To hold meetings and interactions between public and private partnership

Activities :

- Scientific Seminars and Interactive meetings
- Communication and Knowledge Dissemination
- Knowledge and Skill Enhancement
- Works towards Globalizing Seed Industry
- Promotes International Collaborations

2. International organizations involved in seed business

The following organizations are involved in International seed business *viz.*,

- a. International Seed Federation (ISF), 2002
- b. Asia and Pacific Seed Association (APSA), 1994

a. INTERNATIONAL SEED FEDERATION (ISF), 2002

ISF is a non-governmental, non-profit making organization. ISF has represented its members' interests since 1924 and is widely regarded as the voice of the global seed industry. **ISF was formed in 2002 following the merger of ASSINSEL and FIS, bringing together their respective areas of expertise: plant breeding and seed trading.**

VISION

“A world where the best quality seed is accessible to all, supporting sustainable agriculture and food security.”

MISSION

“To create the best environment for the global movement of seed and promote plant breeding and innovation in seed.”

ACTIVITIES

- ISF is a non-governmental, non-profit making organization that represents the interests of the seed industry at a global level.
- ISF increases recognition of its members’ contributions to food security and sustainable agriculture.
- ISF facilitates the free movement of seed **within a framework of fair and science-based regulations**, whilst serving the interests of farmers, growers, industry and consumers.
- ISF promotes the establishment and protection of intellectual property rights for seeds, **plant varieties and associated technologies**.
- ISF publishes rules for trading seed and licensing technology to clarify and standardize contractual relations between buyers and sellers at an international level.
- ISF provides for the settlement of disputes through mediation, conciliation and/or arbitration.

- ISF fosters cooperation and collaboration through its calendar of events, enabling seed industry stakeholders to identify issues, stimulate strategic thinking and accelerate the adoption of common positions.
- ISF works in partnership with organisations responsible for international treaties, conventions and agreements and those that shape the policies affecting the global seed industry.

HISTORY OF ISF TIMELINE: 1920S – 2010S

• **1920s**

1924: First International Seed Congress in London – FIS (Fédération Internationale du Commerce des Semences) and ISTA (International Seed Testing Association) established

1928: FIS Congress in Bologna – first draft of the Rules for the International Trade in Herbage Seed presented

1929: FIS Congress in Paris – Rules for International Trade in Herbage Seed come into force

• **1930s**

1930: First edition of the FIS Rules for International Arbitration Procedure adopted; FIS Congress in Budapest

1931: First International Rules for Seed Testing adopted by ISTA who also established the ISTA Certificates Scheme

1938: International Association of Plant Breeders for the Protection of Plant Varieties (ASSINSEL – Association Internationale des Sélectionneurs pour la Protection des Obtentions Végétales) is formed with the aim of establishing an efficient system for the protection of new plant varieties.

- **1940s**
Activity in the seed sector slows during World War II
- **1950s**
1950: FIS Congress, Paris marks the re-start of activity in the post-war period – Rules and Usages for the Trade in Seeds for Sowing Purposes revised
1951: International Plant Protection Convention (IPPC) adopted
1955: FIS extends its activities beyond forage and turf to form the Cereal Section
1956: ASSINSEL Congress in Semmering, Austria – motion passed calling for a diplomatic conference to consider the protection of plant varieties
1957: First International Conference for the Protection of Plant Varieties in Paris
- **1960s**
1961: First Act of the UPOV Convention adopted
1963: Genetic code deciphered
1964: Forest and Tree Seed Group established (which later became the Tree and Shrub Seed Group)
1968: FDIS Congress, New York (*see image*)
- **1970s**
1970: 8th edition of the FIS Rules and Usages adopted – Canadian and US associations declare their commitment to the Rules
1973: Development of hybrid rice in China
1977: Merger of the FIS and ASSINSEL Secretariats as plant breeders and seed producers start to become a single entity
1978: Joint FIS/ASSINSEL Congress in Hamburg (*see image*)
- **1980s**
1980: First polymorphic RFLP marker described
1983: First stable transformations of plants by genetic engineering published
1986: First unsuccessful attempt to merge FIS and ASSINSEL
- **1990s**
1991: New Act of the UPOV Convention adopted

1992: Convention on Biological Diversity published – a pivotal document on national strategies for the conservation and sustainable use of biological diversity

1993: First international seed health initiatives by FIS members

1994: 12th edition of the Rules and Usages adopted

1995: World Trade Organization's TRIPs (Trade-Related Aspects of Intellectual Property Rights) Agreement requiring the protection of plant varieties comes into force

1995: Motions for the accreditation of seed companies for seed testing and certification adopted by FIS

1999: Accreditation of seed companies for field inspection in implementation of the OECD seed schemes

- **2000s**

2000: Cartagena Protocol on Biosafety adopted

2001: International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGFRA) adopted

2002: **FIS and ASSINEL merge to become the International Seed Federation (ISF)**

2003: Cartagena Protocol on Biosafety comes into force

2004: ITPGRFA comes into force

2005: Full accreditation of seed companies for seed certification under the OECD seed schemes and for issue of ISTA orange certificate

- **2010s**

2010: Nagoya Protocol (2010) adopted in Nagoya, Japan

b.Asia and Pacific Seed Association (APSA)

The Asia and Pacific Seed Association (APSA) was established in 1994, through the cooperation of the Food and Agriculture Organization (FAO) and DANIDA, with the aim of promoting quality seed production and marketing in the Asia and Pacific Region. Today, APSA is the largest regional seed association in the world. It has strong links with international organisations such as FAO, CGIAR institutions, ISF, ISTA, UPOV, the Organization for Economic Co-operation and Development, the World Trade Organization, among others. APSA

members include national seed associations, government agencies, public and private seed companies, and associate members.

Mission

Sustainable agriculture through the production and trade of quality seeds for the world.

Activities of APSA

1. Organize Events for Members

- The **Asian Seed Congress is our biggest annual event**, attracting seed industry professionals from throughout the Asia Pacific regions and the world.
- Regional seminars and conferences provide a forum for the industry to address priority seed sector development, policy and trade issues, and make presentations.
- **Study Tours provide an opportunity for members to visit countries around the world, learning about seed industry development, such** as advancements made in seed research and technologies related to the improvement of seed yield.

2. Compile and/or generate for dissemination among members technical and market-related information.

3. Assist in the development of training courses through matching of needs and potentials, materials preparation, and mobilization of resources.

4. Liaise as appropriate with other regional and international organisations concerned with seed.

5. Develop position papers to provide input for the development and/or change of rules and regulations for seed and seed-related issues in the region.

6. Engage in other activities that may be required to achieve the Association's objectives.

Objectives

1. Maintain and sustain a regional forum, such as the Asian Seed Congress, for APSA members to address their needs and formulate positions and recommendations on seed issues to improve seed sector performance.
2. Promote the development of the seed industry for the betterment of crop production in the region and promote the use of quality seed.
3. Stimulate technical and business co-operation among members. Share information and experience between and among APSA members on all aspects of seed activities.
4. Represent the interests of APSA members at regional and international levels. Establish and maintain relationships with other relevant organisations pursuing similar or related objectives.
5. Encourage the establishment of Seed Associations in the region and support their development.
6. Facilitate the international movement and marketing of seeds and planting material through various actions addressing the issues of relevance to the regional seed industry including quarantine and other trade issues.
7. Facilitate and contribute to the harmonization of regulatory procedures for seed and seed related issues toward internationally accepted standards.
8. Promote the establishment and protection of intellectual property rights for seeds, plant varieties and associated technologies.

National seed quality regulatory system- Seed Certification Agencies- Notification - Seed Testing Laboratories - Central and Referral laboratories - Uniformity in quality regulation.

CENTRAL SEED CERTIFICATION BOARD

(1) The Central Government shall, by notification in the Official Gazette, establish a Central Seed Certification Board (hereinafter referred to as the Board) to advise the Central Government and the State Governments on all matters relating to certification and to co-ordinate the functioning of the agencies established under section 8.

(2) The Board shall consist of the following members, namely:-

- (i) a Chairman, to be nominated by the Central Government;
- (ii) four members, to be nominated by the Central Government from out of the persons employed by the State Governments as 'Directors 'of Agriculture;
- (iii) three members, to be nominated by the Central Government from out of the persons employed by the Agricultural Universities as Directors of Research;
- (iv) thirteen persons, to be nominated by the Central Government to represent such interests as that Government thinks fit, of whom not less than four persons shall be representatives of seed producers or tradesmen.

(3) A member of the Board shall, unless his seat becomes vacant earlier by resignation or otherwise - be entitled to hold office for two years from the date of his nomination: Provided that a person nominated under clause (ii) or clause (iii) of sub-section (2) shall hold office only for so long as he holds the appointment by virtue of which his nomination was made.

STATE SEED CERTIFICATION AGENCY (Seeds Act (1966) section 8)

The State Government or the Central Government in consultation with the State Government may, by notification in the Official Gazette, establish a certification agency for the State to carry out the functions entrusted to the certification agency by or **under this Seeds Act (1966) section 8**. At present there are “**22 state Seed Certification Agencies**” in the country.

a. Grant of certificate by certification agency (section 9 of seed act,1966)

(1) Any person selling, keeping for sale, offering to sell, bartering or otherwise supplying any seed of any notified kind or variety may, if he desires to have such seed certified by the certification agency, apply to the certification agency for the grant of a certificate for the purpose.

(2) Every application under sub-section (1) shall be made in such form, shall contain such particulars and shall be accompanied by such fees as may be prescribed.

(3) On receipt of any such application for the grant of a certificate, the certification agency may, after such enquiry as it thinks fit and after satisfying itself that the seed to which the application relates conforms to the minimum limits of germination and purity specified for that seed under clause (a) of section 6 of seed act 1966, grant a certificate in such form and on such conditions as may be prescribed.

b.Revocation of certificate (section 9 of seed act,1966)

If the certification agency is satisfied, either on a reference made to it in this behalf or otherwise, that-

(a) the certificate granted by it under section 9 has been obtained by misrepresentation as to an essential fact; or

(b) the holder of the certificate has, without reasonable cause, failed to comply with the conditions subject to which the certificate has been granted or has contravened any of the provisions of this Act or the rules made thereunder; then, without prejudice to any other penalty to which the holder of the certificate may be liable under this Act, the certification agency may, after giving the holder of the certificate an opportunity of showing cause, revoke the certificate.

The broad principles for forming a seed certification agency are:

- a. Should not involve in production and marketing seeds.
- b. It should have a autonomy body.
- c. The seed certification standards and procedure adapted by Seed certification agency should be uniform. The same standard and procedure should be adopted through out the country.
- d. It is closely associated with technical institute. Its relationship with other institute should be clearly defined.
- e. Should be operating on a no-profit-no loss basis.
- f. Technique staff (adequate) trained in seed certification should be maintained.
- g. Prevision for creating adequate facilities and timely inspections.
- h. It should be served in the interests of seed produces and buyers.

Structure of Seed Certification Agency

- a. **Director:** The director is responsible for the all over functioning of the company. He should be the member of secretary of the board of director and also the chairmen of various committees framed time to time with specific problem.
- b. **Supervisors (seed certification officers):** For each group of related species under certification e.g. cereal seeds, vegetable seeds etc. He should the put in charge of supervising the field inspector's work and observes the rules and regulations, minimum standers are met or not. He should trained seed inspectors and other personal involved in inspection.
- c. **Seed Certification Inspectors:** He should be a trained and technical based of the seed certification system. During field inspection season, he must be willing to work long hours during peak period. He should be encourage and pursuable seed growers and seed producer to adopt new techniques and scientific finding. He should be good at public relation and also to guide and lead farmers by his devotion to work.

Duties and responsibilities of Seed Certification Agency

1. To arrange for suitable application, inspection and report forms.
2. To identify source of breeders seed. That can be used as the basis for further multiplication.
3. Through field inspection, that prescribes the minimum standard for isolation, planting ratio, raguing etc.
4. To assists seed growers and producers in obtaining suitable planting seed. This is especially in case of Hybrid seed production.
5. To assists seed producer at the time of harvesting, drying & processing.
6. To draw a seed sample and inspect seed lots & submit such sample to the seed testing laboratory for maintaining the prescribed seed standards.
7. To issue appropriate seed certification tags for seed lots.
8. To maintain adequate records. So that the eligibility of specific lot can be determined in subsequent years.
9. Close working relationship between seed growers, dealers, research personals government's officials, etc.
10. To take appropriate corrective actions against rigorously any violation of prescribed standards or complaints from uses of certified seeds.

CENTRAL SEED LABORATORY AND STATE SEED LABORATORY:

(Section 4: Seeds act (1966))

(1) The Central Government may, by notification in the Official Gazette, establish a Central Seed Laboratory or declare any seed laboratory as the Central Seed Laboratory to carry out the functions entrusted to the Central Seed Laboratory by or under this Act.

(2) The State Government may, by notification in the Official Gazette, establish one or more State Seed Laboratories or declare any seed laboratory as a State Seed Laboratory where analysis of seeds of any notified kind or variety shall be carried out by Seed Analysts under this Act in the prescribed manner.

Role/Functions of Seed Testing Laboratories

Seed testing laboratories are essential organization in seed certification and seed quality control programmes. The main objective is to serve the producer, the consumer and the seed industry by providing information on seed quality. Test results may cause rejection of poor seed multiplication or low grade seed in a count of law.

Analysis of seed in the laboratory: Seed testing is possible for all those who produce, sell and use seeds. Seed testing is highly specialized and technical job. With a view to maintain uniformity in quality control the seed analysis laboratory includes for distinct sections.

1. Section for purity testing: Purity analysis of seed lot is considered under two factors
 - a) Testing the cleanliness of seed lot and
 - b) Testing the genuineness of the cultivar
2. Section for moisture testing
3. Section for viability, germination and section for vigour testing.

Total seed testing laboratories in India :111Nos

State seed testing laboratories in India	105
Central Seed Testing Laboratory	Two
ISTA Accredited Lab	Four
Referee laboratory	CSTL is also known as referee laboratory It test verify 5 per cent of seed samples tested by each STL annually for verification of uniform test results / procedures throughout the country

Central Seed Testing Laboratory

First it was functioning at NSC, then at IARI, NEW DELHI and now it is functioning at NSRTC (National Seed Research And Training Center), Varanasi and another Central Seed Testing Laboratory located at Central Institute of Cotton Research, (ICAR), Nagpur.

a. Central Seed Testing Laboratory at National Seed Research and Training Centre (NSRTC), Varanasi (For testing of all seeds except Bt. Cotton Seed)

The prime objective of establishment of National Seed Research and Training Centre (NSRTC), Varanasi is to have a separate National Seed Quality Control Laboratory, which serves as a Central Seed Testing Laboratory (CSTL) w.e.f. 1st April, 2007 by Gazette Notification No. REGD.NO. D.L-33004/99 dated: 8th March, 2007.

CSTL is maintaining the uniformity in seed testing result among all State Seed Testing Laboratories at the national level. It acts as referral Laboratory for court referred seed samples and also a member laboratory of International Seed Testing Association (ISTA) Switzerland. In addition, CSTL monitor the market seeds through purchasing the samples from various seed selling points and its testing.

b. Central Seed Testing Laboratory, Central Institute of Cotton Research, (ICAR), Nagpur. (Only for Testing Bt. Cotton Seed)

State Seed Testing Laboratories

As per Indian Seed Act, seed testing is practiced at seed testing laboratory of the particular state. The number of seed testing laboratories in each state varies based on the necessity.

State seed testing laboratories in TN	32 (30 STL+1DNA lab +1 GOT)
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**International Seed Quality Regulatory System – OECD Varietal certification –
International seed analysis certificate – ISTA membership and accreditation system**

OECD

- It is a unique forum designed to promote economic growth, prosperity and sustainable development
- Established in 1961
- Headquarters – Paris
- Ultimate goal – Sustainable economic growth
- The OECD was originally called the organization for European Economic Cooperation or OEEC
- It was started in 1947, after World War II
- OECD on December 14, 1960
- The OECD actually went into force on September 30, 1961
- The OECD extends assistance to non-European countries. Its member nations include the United states, Canada, Australia, Japan, Mexico and New Zealand

Mission

- The mission of the OECD is to promote policies that will improve the economic and social well being of people around the world.
- OECD has adopted and implemented the schemes and codes for certification of different kinds of seeds of forage crops, cereal tree seed, sugarbeet seed, oil and vegetable species.
- The government of each participating country identifies a designated authority which has the responsibility of implementation and operation of the scheme with in the country.
- Certifying agencies shall adhere to the rules and regulations as set forth by OECD for various certification schemes

Objectives

- To encourage the use of seed of high quality in the participating organizations
- Improve the standard of living
- Facilitate international movement of certified seeds
- Maintain financial stability
- Promote employment
- OECD Varietal certification

OECD varietal certification

OECD schemes for the varietal certification of seed moving in International Trade promote the use of agriculture seed of consistently high quality. Certified seeds are produced and officially controlled according to common harmonized procedures in 59 participating countries. The OECD certification is applied to varieties satisfying Distinction, Uniformity and Stability conditions having an agronomic value and published in official lists. The main objective of OECD schemes for varietal certification of seed is to encourage the use of seed of consistently high quality in participating countries. The schemes authorize the use of labels and certificates for seed produced and processed for international trade according to agreed principles. The rules are called the OECD scheme for the movement of seed in International Trade. The schemes are governed by the OECD office in Paris, France.

Objectives

To provide an international framework for the certification of high quality seed:

- harmonise certification procedures in member countries
- to facilitate trade & reduce non-tariff barriers
- to encourage the use of consistently high quality seed in participating countries
- To enhance co-operation and understanding between:
 - importing and exporting countries
 - public& private sector
 - other international organisations (FAO, UPOV, ISF, ISTA, etc.)

OECD principles

- Applied only to ONLY DUS varieties
- Generation System of Seed Multiplication should be followed
- Field inspections, satisfactory seed processing and post quality controls should be followed.

The seed scheme deal with the following species:

- Grasses and legumes
- Crucifers and other oil or fibre species
- Cereals
- Maize and sorghum
- Sugarbeet and Fodder beet
- Subterranean clover and similar species

➤ Vegetables

The OECD variety list is an official list of varieties

- Accepted as being eligible for certification by the National Designated Authorities of countries participating.
- The schemes ensure the varietal purity and identity of the seed through appropriate requirements and controls throughout the cropping, seed processing and labeling operations.
- The OECD certification provides for official recognition of quality guaranteed seed thus facilitating international trade and contributing to the removal of technical seed barriers.

How to join OECD seed schemes

- **Official letter**

Ministry of Agriculture to the OECD Secretariat

- **Basic documentation**

Seed certification in the country, imports and exports, varieties registered on the National List, post-control etc.

- **Evaluation mission**

Undertaken by the OECD (2 experts, 3-5 days)

- **Evaluation Report**

– Annual Meeting of the Seed Schemes

- **Official admission procedures**

Approval by consensus: OECD Annual Meeting, OECD Committee for Agriculture and the OECD Council

Classes and sources of seeds for OECD varietal certification System

Designation of Categories of Seed

The following categories of seed are recognized in the Scheme:

- i.Pre-Basic Seed;
- ii.Basic Seed;
- iii.Certified Seed.

5.8 Classes and Stages of Seed exist between Indian Seed Certification System and OECD Varietal Certification System

Sl. No.	Indian Seed Certification System	OECD Varietal Certification System
1.	Nucleus Seed: <ul style="list-style-type: none"> Produced through maintenance breeding by the maintainers / breeders varietal characters checked. Controlled and maintained by the maintainers/breeder. Carries breeder's certificate. Used for breeder seed multiplication. 	Breeders Maintenance Material: <ul style="list-style-type: none"> Checked against DUS Centers for the definite characters. Carries Maintainer/breeder Labels. Controlled and maintained by the maintainer/breeder. Used for pre-basic seed multiplication.
2.	Breeder Seed: <ul style="list-style-type: none"> Carries Golden Yellow Tag Controlled by monitoring team by experts of i. concerned breeder, ii. Representative of State of Seed Certification Agency iii. Representative of NSC, iv. Farmers / producers representative Grow Out Test is conducted for certain crops Produced through Breeder Seed Production Center based on the indent allocated by the Department of Agriculture and Cooperation, Govt. of India through ICAR. Used for Foundation class seed multiplication. 	Pre-Basic Seed: <ul style="list-style-type: none"> Carries White Label with diagonal Violet Stripe Controlled by official Maintainer + Designated Authority. Subject to compulsory pre-control test. Cannot be commercialized and it has to be used for further multiplication. Produced officially by the recognized Institute/organization.
3.	Foundation Seed: <ul style="list-style-type: none"> Carries White Colour Tag Controlled by official seed certification agency directly and no role of maintainer. GOT test is not compulsory and only on need based undertaken. Produced through registered seed producers / growers. Can be used for Foundation stage I (F1) to Foundation stage II (F2) multiplication on specific cases for the open pollinated varieties with specific approval from the Director of Seed Certification. Used for multiplication of Certified Class seeds. Initial validity period of 9 months from the date of test and subsequently six months provision for revalidation based on the quality test. 	Basic Seed: <ul style="list-style-type: none"> Carries White Label Controlled by official Maintainer + Designated Authority. Subject to compulsory pre-control test. Cannot be commercialized and it has to be used for further multiplication Produced officially by the recognized Institute/organization. No validity period.

4.	Certified Seed: <ul style="list-style-type: none"> • Carries Azure Blue Tag • Controlled by official seed certification agency directly and no role of maintainer. • GOT test is not compulsory and only on need based undertaken. • Produced through registered seed producers / growers. • Can be used for certified stage I (C1) to certified stage II (C2) multiplication on specific cases for the open pollinated varieties with specific approval from the Director of Seed Certification. • Can be used for certified stage II and commercial multiplication. • Initial validity period of 9 months from the date of test and subsequently six months provision for revalidation based on the quality test. 	Certified Seed <ul style="list-style-type: none"> • (C1): Carries Blue Label • (C2...): Carries Red Label • Not under Breeder's/Maintainers control however consulted for the number of multiplication. DA's and Controlling Authorities under take the quality control including post control test + provision of Patent Royalty to the Maintainers / Breeder's. • Used for the commercial multiplication/sale. • No validity period. Not Finally Certified Seed <ul style="list-style-type: none"> • Carries Grey Label • Seed which is to be exported from the country of production after field approval, but before final certification as basic or certified seed is called not finally certified seeds.
		Standard Seed: <ul style="list-style-type: none"> • Carries Dark Yellow Label • This category mainly exists in vegetable seed scheme • Seed which declared by the supplier as being true to the variety and of satisfactory varietal purity. It must conform to the appropriate conditions in the Scheme.

Guidelines for control plot tests and field inspection of seed crops

The OECD Seed Schemes are designed as procedures which enable the production of seed to be monitored to ensure that technically sound methods are followed, thus safeguarding the identity and varietal purity of varieties. There are two procedures used in OECD for checking the satisfactory progress of a variety.-Samples of seed are grown in control plots so that the plants can be examined critically throughout the period of growth to full maturity-Fields intended for the production of seed are inspected on one or more occasions to report upon their conditionIn making these particular checks, it is necessary to adopt technical methods which will achieve results of sufficient accuracy and reliability but it must be possible to work within the limits of reasonable resources. The methods described in the OECD Methods for Plot Tests and Field Inspection is those which have been found to give satisfactory results.

Seed crop inspection

Seed crops are inspected to ensure that there are no circumstances which might be prejudicial to the quality of the seed to be harvested. The main points which the inspector has to check are:

- i. That the crop as a whole is of the variety which it is supposed to be.
- ii. That there are no more off-type plants present than the standards allow.
- iii. That there are no more plants of other species present than the standards allow.
- iv. That the crop is properly isolated to provide against mechanical admixture or out-pollination.
- v. That all other aspects of the crop are satisfactory, e.g. previous cropping, freedom from disease.

The seed certification officer/inspector is required to give an independent opinion on the state of the crop and must therefore be responsible to the Designated Authority. The inspection reveals the state of the crop at the time of inspection. In some circumstances a second inspection may be needed before a decision can be reached. In all cases, the inspection must be supplemented by results from control plots which can be kept under continuous observation and generally give more accurate information on the trueness to variety and varietal purity of the seed stock. The seed certification officer/inspector should ensure that the right crop is inspected and check all relevant information such as the identity of the seed stock used to sow the crop, previous cropping of the field.

- Growers should retain at least one label from the seed lot used to sow the crop and produce it for the inspector.

- The seed certification officer/inspector should be properly trained to recognize the variety to be inspected and must be provided with an adequate description including notes of the main varietal characteristics.

- On entering the crop the seed certification officer/inspector should first walk into the field and satisfy himself that the crop conforms to the varietal characteristics of the variety.

- For some species, positive identification of individual varieties may not be possible in a seed crop, but it should always be possible to ensure that the crop is of the right variety group.

- Subsequently, in examining the field in more detail, the seed certification officer/inspector should look for signs of any part of the crop which may have been grown from different seed, such as areas which appear different or contain a higher proportion of off-type plants.
- **Evidence of contamination of a seed crop can usually be seen at the edges, at the start or finish of sowing or planting or near gate ways, etc**
- **The inspector should walk around the outside of the crop looking for contaminated areas.**
- At the same time he should check that the isolation is satisfactory and conforms to the standards
- For cross-pollinated crops this will involve checking neighbouring crops and local gardens and looking for weeds or volunteer plants which might cross-pollinate with the seed crop.
- The inspector must then finally assess the varietal purity of the crop.
- To do this he has to focus on small areas which can be examined in great detail (quadrates’).
- The number and size of these areas have to be related to the standards which the crop is required to achieve and will have to balance the need for reasonable confidence in the result against the limitations of time available and physical endurance of the individual.
- To minimise the effects of the latter it is essential to provide the seed certification officer/inspector with all possible information before he goes to the crop, in particular, results from the control plots should be available to him.
- To achieve a result within reasonable confidence limits requires that the seed certification officer/inspector work to a pre-conceived sampling procedure which will cover the entire area of the crop.
- This procedure has to be adapted to the particular features of the different species and in particular whether the standard is expressed as a percentage or as a maximum number of impurities per unit area.

Criteria for listing of varieties in the OECD seed scheme:

If a variety is to be added to the OECD List of Varieties eligible for certification it must be distinct and have an acceptable “value” in at least one participating country, (value is a measurement of the main performance characters, yield, disease resistance, and quality characters, bread making, malting, distilling, etc.).

- be maintained; (the maintainer of a variety is a person or an organization responsible for the production or maintenance of a bred variety included in a national list of varieties eligible for certification under the OECD Scheme. The maintainer shall ensure that the variety remains true to type throughout its full life-span and in the case of hybrid varieties, that the formula for hybridisation is followed. Maintenance of a variety may be shared).

- be included on the National Official Catalogue of the country of registration of the variety.

Pre-Control of the Seed

Testing procedures

Pre-control is the term applied to variety verification of early generation seed, i.e. Pre-basic and Basic seed. Although field inspections are an essential requirement of OECD Seed Schemes, there are many advantages available to Designated Authorities in conducting pre-control plots. These are as follows:

- i. Plants representing the seed lot of the variety can be observed as frequently as is necessary.
- ii. The observation period can be extended from seedling emergence to full maturity.
- iii. All plants in the control plot population can be examined in detail if necessary.
- iv. A comparison can be made with the Standard sample.
- v. Comparisons can also be made with seed lots of the same variety in the same and previous generations.
- vi. One expert can make judgements on all control plots for all varieties and categories thus ensuring the standardisation of recording.
- vii. Where the land is free from volunteers and clean machines have been used for sowing, the Designated Authority can be certain that all off-type plants observed in the control plot have arisen from the seed sample.
- viii. Designated Authorities may use an adverse pre-control plot test result to reject seed crops sown with the same seed lot.

A part of every sample of Basic Seed and of a percentage of the samples of Certified Seed shall be checked in a post-control test conducted immediately or in the season following the drawing of the samples. The test shall be conducted by, or under the supervision of, the Designated Authority. **(When a Basic Seed lot is being grown in a post-control plot test it is also a “pre-control test” of the next generation, i.e. Certified seed first generation).**

The percentage of post-control of certified seed is defined by the National Authority. Its level is generally located between 5 and 10 per cent but can be adapted annually according to the results of the previous year control. It is recommended that India post control tests a minimum of 10% of certified seed lots for at least 5 years. In pre-control such characteristics shall be checked as were used to confirm the Distinctness, Uniformity and Stability of the variety.

When a control plot is a pre-control, the Designated Authority is not entitled to certify seed derived from the lot concerned if the results from the plot test show that varietal identity or purity has not been maintained.

Post-Control Tests of the Seed

Testing procedures

A part of every sample of Basic Seed and of a percentage of the samples of Certified Seed, drawn shall be checked in a post-control test conducted immediately or in the season following the drawing of the samples. The test shall be conducted by, or under the supervision of, the Designated Authority. **The test does not apply to the samples for re-packing and re-labelling of seed lot, when seed produced in one country and re-packing and re-labeling is carrying out in other country.**

The percentage of post-control of certified seed is defined by the National Authority. Its level is generally located between 5 and 10 per cent but can be adapted annually according to the results of the previous year control. In particular the Designated Authority may increase the percentage of post-control of certified seed beyond 10 per cent for any specific case that could induce a non-conformity risk, or if the frequency of post-control failures shown the previous year is high as in the following indicative table :

Frequency of post-control Failures for certified seed Of previous year	Minimum level of checks in post-control of certified seed of current year
< 0.5%	5%
0.5% - 3.0%	10%
> 3.0%	25%

International Seed Testing Association (ISTA)

ISTA was founded in 1924 located at Switzerland for ensuring uniformity in testing and to determine different seed quality testing methods. ISTA rules for seed testing are used all over the world in developing the rules, the following objectives have served as guidelines.

1. Acute determination of quality of the seed
2. Uniformity in the results obtained
3. Relate the laboratory results to planting value
4. Complete the test within the shortest period of time
5. Perform the test in most economic way

The ultimate object of making test is to determine the planting value of the seed which gives a nearly perfect idea about the field stand, varietal purity, total expected yield and the danger of introduction of diseases and undesirable weeds.

Vision

Uniformity in seed quality evaluation worldwide

Mission

ISTA members work together to achieve their vision of ‘Uniformity in seed quality evaluation world wide’. Their association produces internationally agreed rules for seed sampling and testing, accredits laboratories, promote research, provides international seed analysis certificates and training, and disseminates knowledge in seed science and technology. This facilitates seed trading nationally and internationally, and also contributes to food security

Objectives of the association

- The primary purpose of the Association is to develop, adopt and publish standard procedures for sampling and testing seeds, and to promote uniform application of these procedures for evaluation of seeds moving in international trade.
- The secondary purpose of the Association are actively to promote research in all areas of seed science and technology, including sampling, testing, storing, processing and distributing seeds, to encourage variety certification, to participate in conferences and training courses aimed at furthering these objectives and to establish and maintain liaison with other organizations having common or other related interests in seed

Main activities

- The ISTA International Rules for Seed Testing, guaranteeing worldwide annually updated, harmonized, uniform, seed testing methods
- The ISTA Accreditation Programme including Accreditation standard, Proficiency Testing Programme and Auditing Programme guaranteeing worldwide harmonized, uniform seed testing
- The issuing of the ISTA International Seed Lot certificates by officially independent ISTA accredited and authorized laboratories
- The promotion of research, training, publishing and information in all areas of seed science and technology and cooperation with related organizations such as ISF, OECD, UPOV and many others.

Benefits

- Provides the basis for ensuring the trade of quality seed by developing standard seed testing methods
- Provides a platform for research and cooperation between seed scientists worldwide
- Promotes research and provides the opportunity for publishing and distributing of the technological data

Membership profile

The membership is a collaboration of seed scientists and seed analysts from universities, research centres and governmental, private and company seed testing laboratories around the world. ISTA values and promotes the diversity of membership, this being the basis for its independence from economic and political influence

Technical Committees

17 subject- focused Technical Committees are responsible for the development of new methodology for seed testing. The technical committees are made up of approximately 400 energetic members many of which are active in more than one committee. Each committee is headed by a chair and vice chair

ISTA Accreditation

ISTA Accreditation verifies whether a laboratory is technically competent to carry out seed testing procedures in accordance with the **ISTA International Rules for Seed Testing**. Accredited laboratories must run a quality assurance system, fulfilling the requirements of the **ISTA Accreditation Standard**. Accreditation can be granted for:

- entities performing sampling only
- laboratories performing testing only
- Laboratories performing sampling and testing.

Laboratories accredited by ISTA are authorised to issue **ISTA Certificates**. These certificates create a common language for seed vendors and buyers, benefiting international expansion in sales. The entities accredited for sampling only can complete the ISTA Seed Sampling Templates.

ISTA Accreditation Procedure in Six Steps.

ISTA requires that its member laboratories wishing to issue ISTA Certificates should fulfill the ISTA Accreditation Standard. The quality assurance program of the laboratory should be assessed on-site by two ISTA auditors. The following six steps explain the procedure for laboratories interested to get ISTA Accreditation.

1. ISTA Membership: Laboratories intending to become accredited have to become ISTA member first. They should contact the ISTA Secretariat for the necessary application forms and complete the form (Form D) available from the Secretariat. The ISTA Executive Committee will then decide about the application and grant membership. .

Laboratory Member

Laboratory engaged in the testing of seed.

Personal Member

Person engaged in the science and practice of seed testing or in its technical control.

Associate Member

Person engaged in the science and practice of seed testing or in its technical control, who is not a Personal Member. An Associate Member cannot vote at ISTA meetings or hold office in the Association.

Industry Member

Organisation which supports ISTA's objectives, providing sponsorship to the Association through its annual membership fee

2. Participation in ISTA Proficiency Testing Program: All accredited laboratories and those interested to be accredited have to participate successfully in the ISTA Inter-laboratory ~ Proficiency Testing Program, consisting of at least three referee test rounds per year. Seed samples of known quality are sent to the laboratories to carry out the examination according to the ISTA Rules. The results have to be reported within a three months period. The results are then statistically analyzed. The participating laboratories get a detailed evaluation sheet 4 that shows their performance. In case results are out of tolerance, the participating laboratory gets a test leader report advising possible corrective actions to take to enhance the laboratory's performance continuously.

3. Establishment of Quality Assurance Program: A laboratory that wishes to be accredited has to set up its own Quality Assurance Program including quality documentation following the ISTA Accreditation Standard and its bylaws. This standard is based on ISO 25 guide, but has been especially amended to meet the needs of seed testing laboratories. For example sampling as an important preliminary stage of testing has been included and only the sampling and testing procedures prescribed in the ISTA Rules are accepted. An agreement with the current ISO 17025 for testing and calibration laboratories is previewed

4. ISTA Audit

Prior to accreditation, and every three years thereafter, the laboratories are audited by two ISTA auditors (System and technical auditor) and based on the auditions recommendation and the performance in the referee tests, accreditation is granted. Prior to the audit, the laboratories are requested to submit the quality documents translated into one of the official languages of ISTA to the secretariat. The auditors will check the appropriateness of these documents prior to the audit. If the documents are considered appropriate for auditing a date will be arranged accordingly with the laboratory. The quality documents should be at least contain a description of the quality assurance system, standard operational procedures (SOP's) and working instructions for all test methods carried out in the laboratory.

5. Authorization to issue ISTA Certificates: After having successfully fulfilled the requirements of accreditation, authorization to issue ISTA Certificates is obtained through the agreement of the government of the respective country. Therefore, the applicant is requested to complete Annex D of the application from by the respective government.

6. Establishment of Monitoring System: Upon decision of the government of each country a Monitoring System could be established for company laboratories.

Seed export and import – Procedures and guidelines – Germplasm exchange rules and directions- Plant Quarantine system and Sanitary and Phytosanitary (SPS) issues and measures for export and import of seeds –NBPGR, FAO etc.

Plant quarantine

Plant quarantine services facilitate safe introduction of new germplasm samples from other countries.

Plant quarantine regulations aim to prevent the introduction of destructive pests and diseases of plants from other countries. **All plants or plant parts (including seed) are subject to plant quarantine. In India, the plant quarantine activities are done with assistance from NBPGR, the plant quarantine authority of the Government of India.**

The Plant Quarantine Laboratory (PQL) at ICRISAT, Patancheru coordinates with NBPGR in safe introduction and exchange of the centers germplasm samples

Importance:

To protect our plant life from ravages of destructive pests and diseases by preventing entry, establishment and spread and **thereby increasing agriculture productivity in order to improve the economy of our country to facilitate export certification of plants and plant products for safe global trade in agricultural commodities and thereby fulfilling our legal obligations under the international agreements and to adopt the safe quarantine practices to protect our environment.**

Classification of quarantine

Exclusive:

Prohibit importation of plant materials into a specified area this resorted when no satisfactory way is found to permit the entry of plant materials.

Regulatory

The import permitted if a satisfactory PC accompanies the material

It can also be classified

- i. Domestic
- ii. International
- iii. Embargos – total prohibition on import / export of transport of plant material in a country.

Quarantine system in India

Import and export of plant and plant materials by DIP act 1914

Objective is to prevent and the transport from one state to other within India any insect, fungus and pest which is destructive to crops

In 1984 Govt., passed the plant fruit and seed order came into effect in 1985

Main features of these orders

To bring seed under purview of DIP act

Regarding importation of seed only through valid import permit

To permit entry of seed consignments only if they are accompanied (PSC) issued by quarantine authority of exporting country.

Requirements for seed import

- Seeds cannot be imported into India without an Import Permit (IP) issued by the NBPGR
- The incoming seeds must be accompanied by a Phytosanitary Certificate (PC) obtained from the National Plant Quarantine Service of the exporting country
- A customs declaration at the port of entry and release by the National Plant Quarantine System (NPQS) are essential
- **The Gene bank curator must obtain the required permits and send to the donating institution before ordering the seeds**
- IP initially issued is valid for six months, and the competent authority can extend the period of validity for another six months
- Import permits are not transferable and no permits are issued for lander consignments
- Seed consignment should be dispatched within 14 days of inspection and issue of the PC

Example

Sorghum: Certification that seeds are free of bacterial leaf stripe and bacterial leaf streak

Pearl millet: Downy mildew, smut and ergot

Pigeon pea: anthracnose, fusarium wilt and bacterial diseases

Groundnut: rust and scab diseases

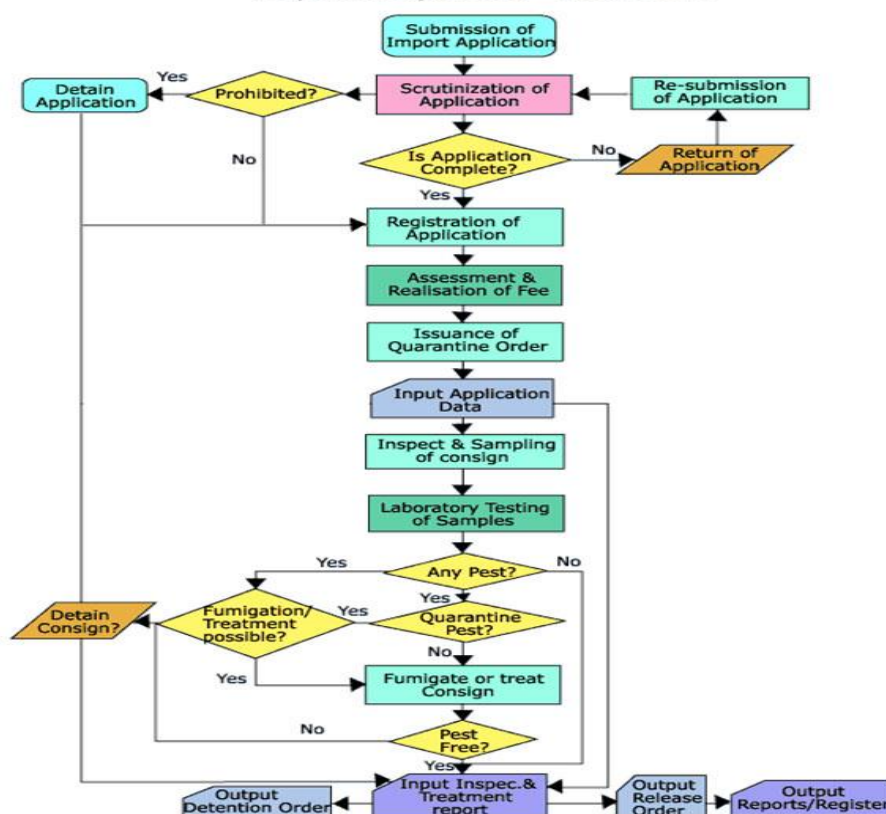
Fees and charges

Rs.150/- IP for consumption plant materials

Rs.300/- IP for seeds and plant materials for propagation

- ❖ For extending the period of validity a fee of Rs.100/- for consumption materials and Rs.200/- for propagative plant materials
- ❖ For import of soil, earth, clay and similar material any microbiologist, soil mechanics or mineralogical investigations and peat for horticultural purpose, a fee of Rs. 200/- to be paid for issuance of import permit, by Plant Protection Advisor to Government of India
- ❖ **A special permit issued by the Plant protection adviser is required for import of soil, earth, clay and similar material for any mineralogical investigations and peat for horticultural purposes**
- ❖ For import of insects or microbial cultures including mushroom, algae and or bio control agents a special permit issued by the plant protection advisor is essential
- ❖ Further a special permit issued by the Director (NBPGR) is needed for the import of germplasm/ Transgenic / Genetically Modified Organisms for research/ experimental purpose by public/ private sector institutions
- ❖ **The permit issuance for Transgenic / GMO is subject to prior approval of Review Committee on Genetic Manipulation under Department of Biotechnology**

Import Inspection - Flowchart



Export Inspection & Certification

1. Registration of Application

The exporter or his agent shall submit an application in **Appendix-5** in duplicate to officer-in-charge of concerned PQ station at the designated port through which he intends to export or to the concerned **inspecting and certifying authority** notified vide **Notification 8-97/91-PP.I, dated 26th November 1993** issued by the Ministry of Agriculture as reproduced in **Appendix-1** sufficiently in advance or at least 2-3 days prior to the actual date of shipment of consignment. However in the case of export of perishable commodities such as cut flowers, fresh fruits and vegetables, the above conditions may not apply. Also in the case of export of seed consignments such applications are filed 8-10 days prior to actual date of shipment. The application shall be accompanied by a copy of invoice, packing list,

shipping/airway bill, letter of credit or trade agreement or purchase order, export license (if applicable) and fumigation certificate, if any. Besides these a copy of permit issued by the importing country in case of export of seeds/propagating plant material and wild life clearance certificate if the export is covered under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) for the prohibited or restricted list of plants under CITES). On receipt of the application PQ officer shall scrutinize the application and if found complete in all respects shall register the application and assess the inspection fee. **The applications made in respect of export/import-prohibited consignments are withheld or refused for** issuance of PSC and also applications made in respect of preserved or pickled or frozen plant products. The exporter or his agent shall pay the inspection fee at the **prescribed rates in Appendix-2** (letter No. 16-10/58-PPS dated 21st September 1960 issued by Ministry of Agriculture) On specific request from the exporter or his agent, the consignment may be inspected at places outside PQ station on payment of Rs. 10/- per visit towards outside inspection charges within municipal limits of town or corporation limits of city as the case may be. Further the exporter or his agent shall meet the traveling and dearness allowances of the PQ officer and staff deputed for inspection outside city or town as per their entitlement and also accommodation charges, if any. The above charges are paid in advance or immediately upon completion of the tour but before issuance of PSC. **The inspection fee shall not be refunded in the case of cancelled or rejected application.** The exporter shall abide by the terms and conditions stipulated by the inspecting and certifying authority. On receipt of inspection fees, a quarantine order is issued by the officer-in-charge of concerned PQ station for presenting the consignment for inspection by the applicant.

2. Inspection / Sampling & Laboratory testing

The exporter or his agent shall present the consignment either at the office of PQ station or **arrange for inspection at his premises or present the containers at any other approved place on scheduled date and time of inspection as per the quarantine order issued.** The exporter or his agent shall provide necessary transport, labour and other facilities for **opening, sampling, repacking, sealing etc.** Sampling of seed for propagation shall be in accordance with the International Seed Testing Association (ISTA) Rules, 1976. Sampling of cereals, pulses, oil seeds and others for consumption as per Bureau of Indian Standards (IS:

2814/1978 and IS: 3714/1978). The exporter or his agent shall associate with inspecting officer while undertaking inspection. The PQ officer deputed for inspection shall draw appropriate size of sample for detailed laboratory testing. The samples of grain, pulses, dry fruits, nuts, spices, fresh fruits & vegetables, cut flowers, coffee beans, groundnut, turmeric etc., that are meant for consumption are visually inspected with the help of illuminated magnifier specifically for live insect infestation. Pulses are usually subjected to **X-Ray examination**.

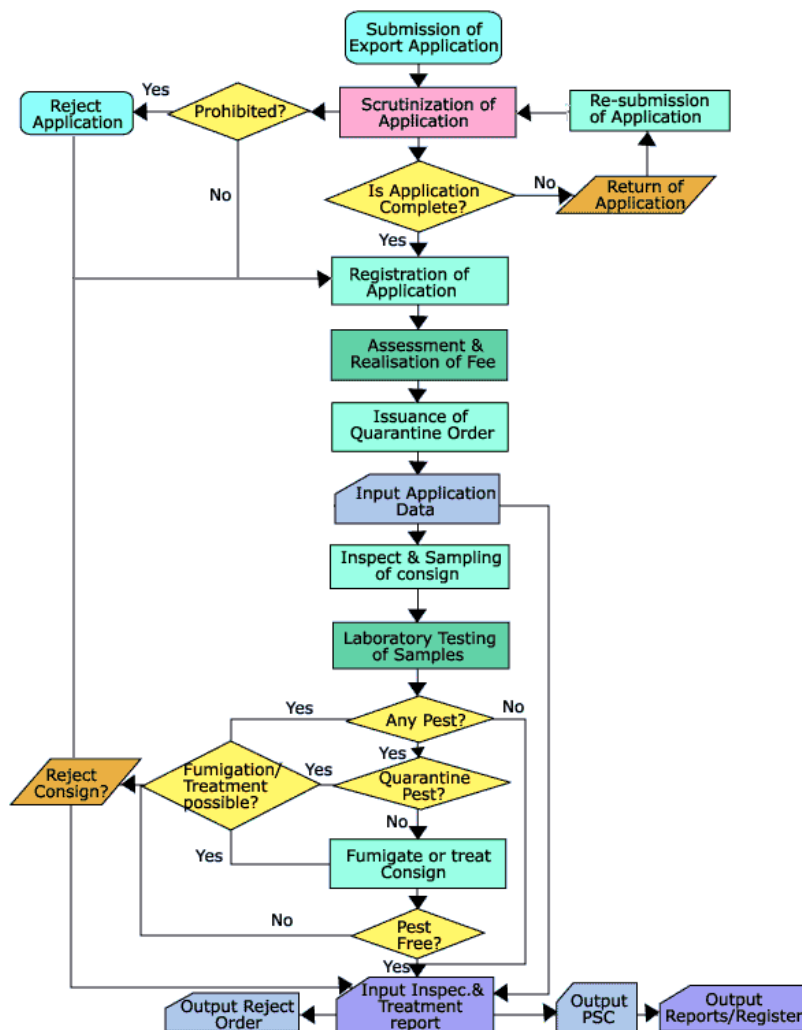
3. Fumigation & treatment of consignment

In the event of live insect infestation is noticed, the exporter or his agent shall arrange for fumigation of consignment or container at his premises or any other approved place by an **approved pest control operator under the supervision of PQ officer**. The exporter or his agent shall submit an undertaking for the purpose in **Appendix-6** along with payment of supervision charges of Rs.25/- per container. The exporter or his agent shall provide necessary transport/labour facilities, if the fumigation is carried out in the fumigation chambers at PQ station and pay fumigation or disinfestation or disinfection charges as prescribed above. The exporter or his agent shall pay storage charges @ Rs. 10/- per cu. m. space per day or part thereof, **if the consignment is not immediately removed after degassing and re-inspection**. The consignments shall be re-inspected after degassing of consignment or container to ensure freedom from live infestation.

4. Issuance/Rejection of Phytosanitary Certificate Phytosanitary Certificates (PSCs) are issued in duplicate viz., original for the exporter and duplicate copy for office record, if consignment on inspection is found to be free from quarantine pests. However in case of re-exported consignments the PSCs are issued in re export format prescribed under IPPC. On specific request from the exporter or his agent PSC is re-issued after canceling the earlier original certificate to facilitate **the incorporation of corrections/ amendments**, subject to the production of shipping documents in proof thereof. Such re-issuance of PSC, for incorporating amendments / corrections, is done within 7-10 days from the date of issue of original certificate and thereafter no such requests shall be entertained. **The issue of PSC will be rejected if the commodity on inspection is found to be a prohibited one or found affected by quarantine pest or the commodity could not be fumigated to render it pest-free as it is packed in**

impermeable container or packed with objectionable plant material or contaminated with soil or noxious weed seeds or processed food containing additives and preservatives and reasons for rejection shall immediately be communicated in writing to the exporter or his agent under intimation to customs/port authorities

Export Inspection - Flowchart



The SPS Agreement

The agreement on the application of Sanitary and Phytosanitary Measures sets out the basic rules for food safety and animal and plant health standards

It allows countries to set their own standards. But it also says regulations must be based on science

They should be applied only to the extent necessary to protect human, animal or plant life or health

And they should not arbitrarily or unjustifiably discriminate between countries where identical or similar prevail

Member countries are encouraged to use international standards, guidelines and recommendations where they exist

The agreement still allows countries to use different standards and different methods of inspecting products

Key features

All countries maintain measures to ensure that food is safe for consumers and to prevent the spread of pests or diseases among animals and plants

These sanitary and phytosanitary measures can take many forms, such as requiring products to come from a disease free area, inspection of products, specific treatment or processing of products, setting of allowable maximum levels of pesticide residues or permitted use of only certain additives in food

Sanitary and Phytosanitary measures apply to domestically produced food or local animal and plant disease as well as to products coming from other countries

NBPGR:

National Bureau of Plant Genetic Resources was established by Indian Council of Agricultural Research (ICAR) in 1976 in New Delhi. In India, introduction started in 1946 at IARI. New Delhi in the division of Botany. In 1961 a separate division of Plant Introduction was established under the leadership of Dr. H.B. Singh who made remarkable contribution in the field of plant Introduction in India. **He made huge collections of germplasm of various crop species and systematized the work.** In 1976, the division of plant Introduction was elevated to the status of independent agency known as NBPGR.

The basis function of NBPGR is to conduct research and promote collection, conservation, evaluation, documentation and utilization of crop genetic resources in India. NBPGR is assigned by various crop research institutes in the collection, conservation, evaluation and documentation of crop genetic resources. The main function of NBPGR is briefly presented below:

Functions:

1. NBPGR is the sole agency in India for Import and export of plant genetic resources. Thus it helps in exchange of germplasm.
2. It promotes, national genetic resources activities, viz collection, conservation, evaluation, documentation and utilization of crop plants, and coordinates in all these activities.
3. NBPGR has five stations which are located at 1) Shimla, Himachal Pradesh, 2) Jodhpur, Rajasthan, 3) Akola, Maharashtra, 4) KanyaKumari, Kerala, and 5) Shillong, Meghalaya. Collections of various crops are evaluated by these centres.
4. NBPGR also organise short term training courses on collection, conservation, evaluation, documentation, and utilization of crop genetic resources.
5. National and International exploration and collection trips are also organised by NBPGR, National collection trips are organised in collaboration with the help concerned Crop Research Institutes and International trips are arranged with the help of IPGR/FAO.
6. NBPGR provides guidance about development of cold storage facilities for medium and short term conservation of germplasm.
7. NBPGR also takes decision about setting up of gene sanctuaries for endangered crop species.

Food and Agriculture Organization (FAO)

Founded in 1945, the FAO has **five strategic objectives**:

1. Help eliminate hunger and malnutrition (including food security concerns)
2. Make agriculture (and forestry and fisheries) more sustainable (and productive)
3. Reduce rural poverty
4. Enable inclusive food systems
5. Increase resilience of food related livelihoods (e.g., farmers) to threats and crises.

These are discussed individually on their 'about' website - follow the link below.

Last year, 2014, FAO members joined with members of government and the private sector to endorse the Rome Declaration on Nutrition and the Framework of Action. This Declaration states that everyone has the right to access safe, sufficient, and nutritious food. The Framework of Action specifies that governments have the greatest role in achieving this.

The **actions of the FAO also fall into five distinct categories**:

1. Presenting information for the transition to sustainable agriculture.
This includes specialists, nutritionists, economists, statisticians and other researchers.
2. Strengthening Policy
Both strengthening existing policy, but also advocating global policy development.
3. Increasing public-private collaboration
Where rich and poor nations can talk to the Food Industry to facilitate greater investments.
4. Field Projects
Currently there are thousands of field projects under way.
5. Mitigating risk
develop monitoring strategies for threats to agriculture, food and nutrition.

Human Resource skill development-Financial requirements and their significance in successful seed company management

Human Resource Development (HRD) is the framework for helping employees develop their personal and organizational skills, knowledge, and abilities. HRD is one of the most significant opportunities that employees seek when they consider you as an employer. The ability, and encouragement, to continue to develop their skills help you to retain and motivate employees.

What Is Human Resource Development?

Human Resource Development includes such opportunities as employee training, employee career development, performance management and development, coaching, mentoring, succession planning, key employee identification, tuition assistance, and organization development.

The focus of all aspects of Human Resource Development is on developing the most superior workforce so that the organization and individual employees can accomplish their work goals in service to customers.

Organizations have many opportunities for human resources or employee development, both within and outside of the workplace.

Motivation of employees

An employee is considered a resource, a factor of production, like money or machines, but the staff complement is made up of people, and therefore it is a different kind of resource. People are unique: they think, are creative, able to learn, have emotions and feelings, and can answer back! Therefore, human resources cannot be treated as mere money or machines.

A manager, whether he or she is the owner, department manager, foreman or supervisor, has authority over employees, and thus it is important for the manager to understand what this authority means. Authority means that the manager has power, or the strength to get things done.

But, at the same time, it means that the manager has responsibility, in that he or she is accountable for the results and has responsibilities to the well-being and performance of employees. **Power may be abused and responsibilities avoided, but both will lead to a breakdown in productivity and relationships with employees.**

A relationship is formed whenever two people are in association. In any relationship, be it personal or work, there is mutuality. In other words, both parties, in this case the manager and the employee, have to contribute to the relationship to make it work. It also means that **if the relationship breaks down there is always fault on both sides**, and for reconciliation to occur, both sides have to act. Relationships in a business are different from those in social circles, since they are generally functional and not intimate. Nevertheless, the basic elements for a good relationship are:

Appreciation: in the work environment those in authority ought to appreciate those entrusted into their realm of authority. Such appreciation may be expressed by friendliness, kindness and seeking the best for the other person. The manager's role is to enable the employee to perform their job effectively and efficiently. **Therefore, there is no room for cruelty, meanness, or jealousy in healthy relationships.**

Trust: Managers are in a position of trust and they have to trust their workers. Trust takes a long time to build and develop, and involves being reliable, honest and consistent, while giving employees opportunity to perform their work. **Employees develop trust in their superiors when they see them doing what they promised.** ³ Adapted from H. Marshall, Ellet Grange, UK. 201 Human Resource Management Sadly, **trust may be destroyed in a short time through dishonesty, broken promises and lack of support, and once disrupted, trust is very difficult to restore.**

Respect: People need to be respected, whether they are a manager or an employee. Managers need to value their workers and show that they respect them. A manager will lose respect if he evades responsibility, or unduly or publicly criticizes his workers.

Understanding: People desire to be understood, but it takes a lot of effort to understand someone, and our perceptions of people are often influenced correctly or incorrectly by external factors. This therefore **depends greatly on how we communicate. The better that managers**

and workers communicate, the more they will understand one another, and the more they will be able to appreciate, trust and respect one another and so work together more effectively to achieve the company's vision.

It is thus clear that it takes special skill to manage and motivate staff and labor, but there are a number of points that may help to do this.⁴ People are the most important resource in a business. They are creative, but they will only be as creative as they are allowed to be. **Stimulating creativity in the right direction will increase both the individual's and the firm's productivity. Consequently, a manager must: 1. treat employees in such a way that they have no genuine cause for complaint or dissatisfaction, and 2. motivate employees so that they perform at a high level of productivity.**

Employee expectations from management Managers will only be effective to the extent to which they meet the expectations of their employees. **Competent employees expect to be treated** fairly and with respect, while being **provided with the necessary facilities, equipment and systems to carry out their tasks.** To be motivated, an employee expects to be able to participate in defining what is required of them, to have the opportunity to prove him or herself, and to know how well they have performed. **If their performance is below expectation, employees appreciate help to improve, while if they have performed well, they expect a commensurate remuneration.** Employee performance levels There are basically three levels of performance: minimum, expected and maximum; or below, as per and above expectation. Employees generally perform at a minimum level or at a level below expectation when they are dissatisfied with the working conditions (i.e., poor **working environment, lack of appropriate tools or low pay**). When they are not dissatisfied, they will tend to work at the expected level, carrying out their duties faithfully. In this situation an employee has neither satisfaction nor complaints with the job. However, employees may do more than expected when they obtain satisfaction from performing their work. In this situation, the working conditions are fine, the pay is sufficient, relationships are good, but, most of all, the job is enjoyable and rewarding because there is an experience of success, there is responsibility and participation in decision-making, and there is recognition of achievement. **Consequently, to encourage job satisfaction amongst employees:**

- **Meet the needs of the employees so that they are not dissatisfied.**
-

Give employees responsibility and build into their jobs motivating factors that will enable them to attain satisfaction from the job.

The motivational cycle: When a person carries out a task with dedication because he or she enjoys doing it, that person is motivated. **Thus, motivation involves creating an intrinsic condition that energizes, activates or moves a person's behavior in the direction of pre-determined goals** (Box 7.2). The basic method of motivating a person in a job involves the following steps: 1. Identify the task needing to be done. A job well defined is a job half done. 2. Set measurable and attainable goals with the employee, which are related to the task to be done. **For example, set the number of customers to be visited per week, or the quantity of seed to be processed per shift.** 3. Give responsibility for decision-making to the employee. People need to be identified with the problem or task if they are to be part of the solution or production thereof. 4. Let the employee carry out the task. **As the manager, do not interfere. The issue is not so much whether the worker is being active, but whether or not the task is being done, and that is the responsibility of the worker who has been given the task to do.** 5. Measure the performance of the worker in relation to the objectives set in point 2. Give feedback to the workers on their performance. Were the goals achieved? If yes, give recognition and encouragement. If no, then determine the causes for failure to meet expectations and establish means to improve.

Performance appraisal People who remain with a company usually do so because they find satisfaction in working with the company. In contrast, companies retain employees because the employee performs and contributes to the attainment of the vision of the company. Performance appraisal is one means of ensuring a long-term productive relationship between employees and the company.

Employment appraisal is a function of:

- Results or what was achieved in terms of measurable outputs (e.g., quantity of seed processed or the number of bags of seed sold). This is an objective measure related to the task(s) of the job, as defined in the job description.
- Behaviors or how the individual performed. This is related to the person's competencies, style, manner and appearance, and is therefore more subjective.

Training of employees to build competency

While every attempt is made to employ competent people into positions to carry out critical tasks, it is rare that everyone is perfectly qualified and proficient to perform tasks efficiently and effectively. Furthermore, as technology advances, employees may not have the necessary skills to make best use of the improved technology or new ways of doing tasks. Consequently, **appropriate employee training is essential to any seed business. This may involve simply demonstrating improved techniques to employees**, such as bag stacking with a new conveyor belt, or providing opportunities for specialized training, such as for new machine operation or software use. Whatever the situation, **a manager should ensure that workers have the necessary skills to perform their duties in such a way to achieve not only quantity targets, but also the required quality of outputs.**

Reasons for training and developing employees Training is about improving the knowledge, skills and experience of an individual or group in order to increase productivity and make greater progress towards achieving the company's vision. Personal development is not restricted to training, but includes anything that may help a person to grow in ability, skills, confidence, tolerance, commitment, initiative, inter-personal skills, understanding, self-control and motivation. **Training not only benefits the company, but it contributes to employee achievement and satisfaction.** As employees obtain training and acquire new knowledge and job skills, they increase their market value, earning capacity and power. **Training may also qualify employees for promotion to more responsible jobs and so provide a motivational stimulus to employees.**

Effectiveness of training and development For **training to be effective** it must be targeted to the **specific needs of the company and employee** (Box 7.5). A needs-analysis that examines the present skills' profile of employees and the skills need of operations **will identify skills gaps and training objectives. Identifying suitable training providers may be difficult in some specialized situations, but time and effort spent on defining training needs, obtaining the best trainers and using the most appropriate training techniques will be worthwhile.** Training may be provided either informally within the organization or formally by contracting trainers.

The process of organizing training and staff development 1. Establish the training needs. 2. Set specific training goals. 3. Compile the training curriculum, specifying the training topics and outcomes (new skills or changes expected in trained employees). 4. Use effective training techniques and competent trainers. 5. Evaluate the outcomes of the training.

The effectiveness of training is not only measured by the cost-benefit of the training or the number of hours employees attend training sessions, but by the changes in behavior of employees, the increase in productivity and/or the improvement in quality as a result of the training. Furthermore, training and development effectiveness involves evaluating reductions in such factors as staff turnover, absenteeism, staff grievances and customer complaints.

Remuneration Employees need to be rewarded for the work done, but determining the amount of pay for a given job is often difficult. Nevertheless, compensation needs to be fair and sufficient for the work done. Basically, an employee should be paid according to what he or she is worth to the business, for the work performed and for commitment and performance. Remuneration is not a weapon, but a reward, and is only one aspect of human resource management and employee motivation.

Principles of wage and salary determination 1. Pay schedules should be based on job requirements in terms of skill, effort, responsibility and working conditions. 2. Salary levels should be in general agreement with industry standards and labor market, or **defined according to prevailing labor laws**. 3. Different jobs with equivalent requirements should receive equivalent pay. 4. The pay level for a job should be the same regardless of who is employed to fill the position. 5. Equitable means should be used to compensate individual differences in ability and contribution in a job position. 6. Pay structures should be transparent and communicated to employees, worker committees and unions. Source: Adapted from Beach (1985)

Some of the factors to consider in setting salaries and wages include:

Supply and demand. Jobs vary in the **numbers of people available to fill the position**, and consequently pay levels will vary accordingly. **Where there are many people available for a particular position**, a company may have greater leeway in the salary or wage attached to the position.

- **Scarcity of skills.** In the seed industry there are certain positions which require specialized skills, particularly related to seed production and processing. **The scarcity of skills amongst people may require setting of higher salaries and wages to attract those people with the necessary qualifications and skills to meet the needs of the company.**

Affordability. Although salaries and wages will normally constitute a relatively small proportion of the total costs of a seed company, sustainable profits must still be made, and therefore companies are not at liberty to pay exorbitant salaries and wages. Since salaries and wages are a fairly consistent monthly expense they can have a significant impact on cash flow. Furthermore, **salaries and wages are mostly accounted for under operational expenditure, and so influence operational profits.**

Competitors. Seed companies face competition for their employees from other seed companies and other businesses. Consequently, **the level of pay offered to staff may be more influenced by external factors than internal considerations.** To keep abreast with industry-wide salary levels, managers should subscribe to salary surveys, examine job adverts and discuss with colleagues in other industries as this will help to maintain salaries competitive and prevent dis-satisfaction amongst staff.

Remuneration of employees is not simply the provision of a time-based salary or wage. Some jobs may lend themselves to compensation based on piecework or an output based scale, such as production staff or sales representatives. In most cases, the cost of employment goes beyond the salary or wage paid. **Fringe benefits may also be provided as additional compensation to employees. These may include such benefits as medical.** Principles of wage and salary determination

1. Pay schedules should be based on job requirements in terms of skill, effort, responsibility and working conditions.
2. Salary levels should be in general agreement with industry standards and labor market, or defined according to prevailing labor laws.
3. Different jobs with equivalent requirements should receive equivalent pay.
4. The pay level for a job should be the same regardless of who is employed to fill the position.
5. Equitable means should be used to compensate individual differences in ability and contribution in a job position.
6. Pay structures should be transparent and communicated to employees, worker committees and unions.

Source: Adapted from Beach (1985). 208 Seed Business Management in Africa assistance, pensions, transport allowances, overtime allowances, annual bonus and so on. These

benefits must be well-defined and specified to employees on appointment to avoid misunderstandings or false expectations at a later date. Furthermore, the tax implications of fringe benefits must be determined and communicated to employees. **In certain jobs, employees may receive use of company assets to carry out their tasks, such as vehicles or phones. The conditions of use of these assets needs to be clearly specified, so that abuses or presumptuous use does not become a point of conflict with supervisors.**

Seed company –corporate affairs-components-registration and establishment-grant and issue of license

Seed company –corporate affairs

Seed companies produce and sell seeds for flowers, fruit and vegetables to the amateur gardener. The production of seed is a multibillion-dollar business, which uses growing facilities and growing locations worldwide. While most seed is produced by large specialist growers, large amounts are produced by small growers that produce only one to a few crop types. These larger companies supply seed both to commercial resellers and wholesalers. The resellers and wholesalers sell to vegetable and fruit growers, and to companies who package seed into packets and sell them on to the amateur gardener.

Most seed companies or resellers that sell retail, produce a catalog – generally published during early winter for seed to be sown the following spring. These catalogs are eagerly awaited by the amateur gardener, as during winter months there is little that can be done in the garden, so this time can be spent planning the following year's gardening. The largest collection of nursery and seed trade catalogs in the U.S. is held at the National Agricultural Library. The earliest catalogs there date from the late 18th century, with most published from the 1890s to the present. Shakers were among the earliest commercial producers of garden seeds; the first seeds sold in paper packets were produced by the Watervliet Shakers.

Seed companies produce a huge range of seeds from highly developed F1 hybrids to open pollinated wild species. Many gardeners like to stick to old familiar varieties but each year seed companies produce new varieties for gardeners to try. They have extensive research facilities to produce plants with better genetic materials that result in improved uniformity and gardening appeal. These improved qualities might include disease resistance, higher yields, dwarf habit and vibrant or new colors. These improvements are often closely guarded to protect them from being utilized by other producers, thus plant cultivars are often sold under their own names and by international laws protected from being grown for seed production by others. Along with the growth in the allotment movement, and the increasing popularity of gardening, there have

emerged many small independent seed companies. Many of these are active in seed conservation and encouraging diversity.

They often offer organic and open pollinated varieties of seeds as opposed to hybrids. Many of these varieties are **heirloom varieties**. The use of old varieties will continue to maintain diversity in **the horticultural gene pool**. There is a good case for amateur gardeners to use older (heirloom) varieties as the modern seed types are often the same as those grown by commercial producers, and so characteristics which are useful to them (e.g. vegetables ripening at the same time) may be unsuited to home growing.

The Seed Industry - a Time Line (1)

- 1740 – 1850: First companies specialising in horticultural crops established
- 1850 – 1900: Modern Plant Breeding begins
- Public sector involvement in plant breeding and protection of farmer & consumer interests
- New companies established for numerous crops
- First National Seed Associations established

1900-1970s: Transition and Modernization

- Growth of the seed sector, private and public
 - Forerunners of ISF established (FIS: 1924 / Assinsele: 1938)
 - International regulations affecting seed in force – 1970s - First wave of consolidation
 - Chemical & oil industry acquire seed companies – 1980s - Biotechnology in plant breeding
 - DNA marker assisted selection, genetic engineering – 1990s - Second wave of consolidation
 - Birth of 'life-science' companies – International Treaties and Conventions
- The Seed Industry Today
1. Increasing global seed market
 2. Growing use of hybrid seed with several technological components (e.g. seed coatings)
 3. Growing international seed trade
 4. Increasing number of regulations
 5. Increasing number of multinational companies

Components of seed industry

- Breeding of New Varieties
- Seed Multiplication
- Seed processing
- Seed certification
- Seed Storage
- Marketing and Distribution
- Publicity

Registration and establishment of Seed Company

Producing seeds is a capital intensive business, I suggest you to register your company as a Pvt ltd company.

Here is the brief representation of the procedure involved.

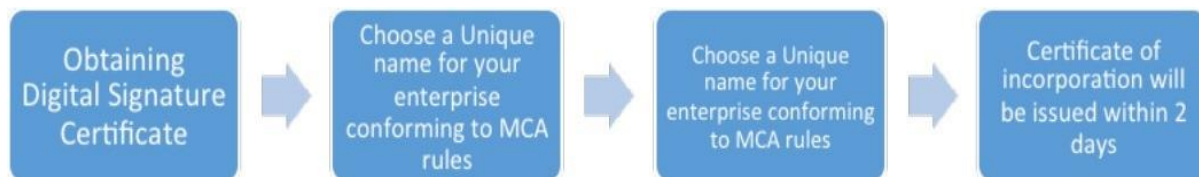
Private Limited Company

It is the most popular legal structure for business and allows outside funding and also employee stock options. More stringent compliance measures to be followed, hence more credibility. **The company need to appoint an auditor and the audited financial statements are to be submitted to MCA annually.** The company is eligible to issue debentures and convertible debentures. **The service charge ranges from Rs.7000/- to Rs.15500/-**

Company incorporation is streamlined with the introduction of INC-29

From May-2015, company incorporation can be divided to 2 broad steps

- Obtaining Digital Signature Certificate
- Preparing and submitting INC-29



Government Fees for various types of companies

- Private Limited Company – Rs.7800/-

Documents Required for INC-29

- Director Identification Number (DIN)
- Memorandum of Association (MOA)
- Articles of Association (AOA)
- Affidavit and declaration by first Subscribers and Directors.
- Proof for Registered Office Address. – Rental Agreement / Sale Deed.
- Copies of utility bill of the registered office address that are not older than 2 months.
- If the proposed company name is a filed or registered trademark, then NOC from the trademark applicant or owner must be attached

Lecture 13

**Seed preference assessment - Seed rolling plan – OPVs and hybrids – Role of
Seed Multiplication Ratio (SMR) – Varietal Replacement Rate (VRR)**

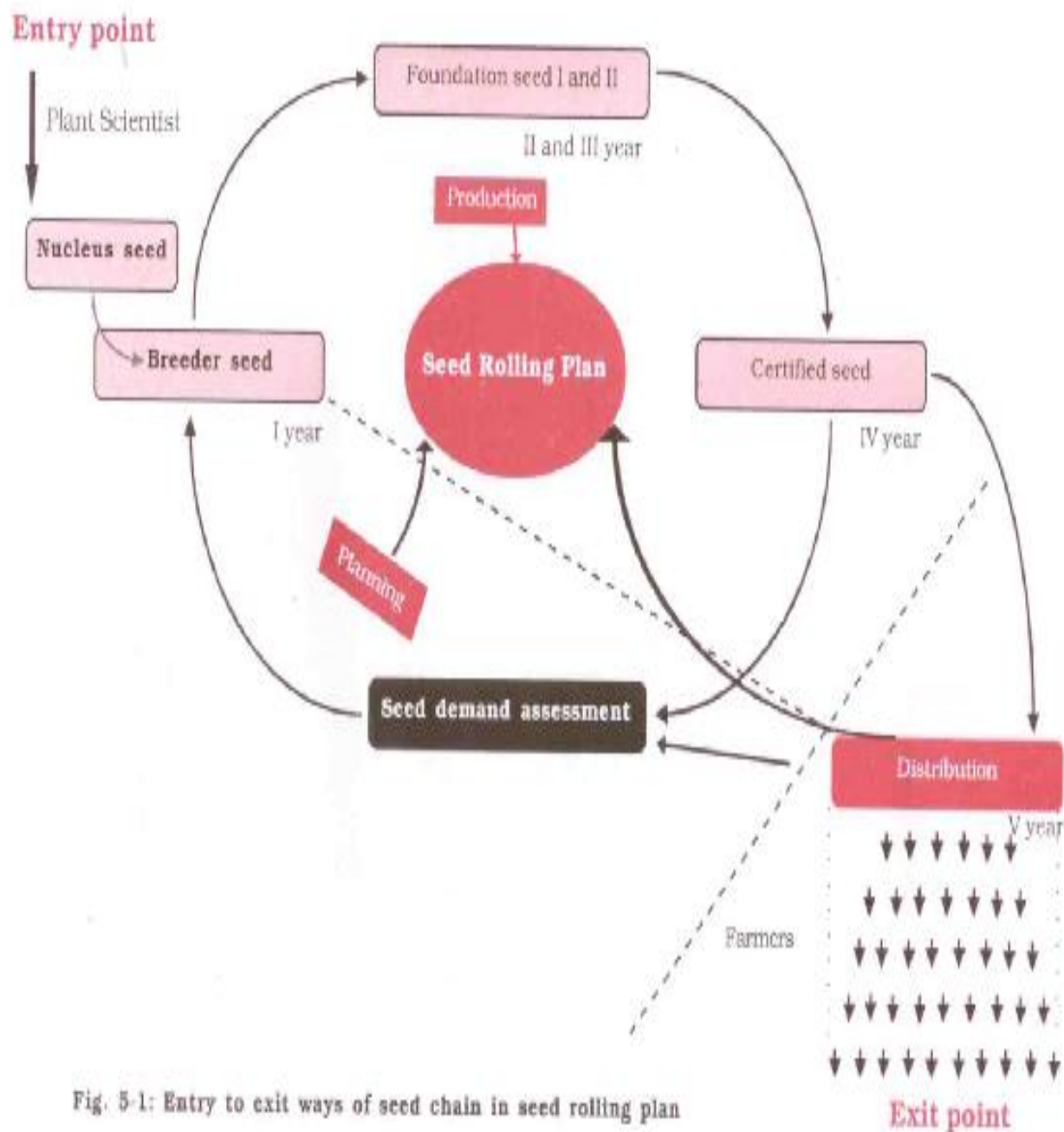


Fig. 5-1: Entry to exit ways of seed chain in seed rolling plan

Seed Multiplication Models

Each time a variety goes through the cycle of multiplication; there is chance of its deterioration through mechanical admixture, pollination by alien pollen or mutations. The possibility of contamination by alien pollen is greater in cross pollinated species

than the self fertilized ones. However, even in species classified as self fertilized there can be small proportion of cross fertilization, for cross pollination in wheat occur with a frequency of 4 % while 1.1 to 8.7 % of out crossing takes place in oats.

At the time of release of a variety, small quantity of seed normally known as nucleus seed is available with plant breeder. Commercial quantity of seed is produced from the nucleus seeds after a series of multiplication steps. Starting from maintenance programme in which nucleus seed is produced by the breeder or sponsored breeder, the seed is multiplied as breeder seed in the first generation, followed by foundation (second generation) and certified seeds (third generation). This process of systematic multiplication of quality seed is called as *Generation System of Seed Multiplication* (Figure 5).

In India, seed firms whether in the private or public sector, outsource the production of certified (commercial) seeds to contract growers. These growers are supplied with the foundation seed that is used to produce certified (commercial) seed. The seed industry is one of the earliest examples of contract farming in India.

A. Classes and Sources of Seed

The classes of seeds followed in the generation system of seed multiplication are i. Breeder seed, ii. Foundation seed (Stage I and II) and iii. Certified seed. The characteristics of the different classes of such are described hereunder.

Breeder Seed (BS)

Breeder seed is a seed or vegetative propagating material directly controlled by the originating or sponsoring plant breeder of the breeding programme or institution and or seed whose production is personally supervised by a qualified plant breeder and which provides the source for the initial and recurring increase of foundation seed.

Breeder seed is exempted from certification. However, the breeder seed crop is being inspected at appropriate stages by a Monitoring Team consisting of breeder, representative of NSC and representative of Seed Certification Agency. The breeder seed lots are affixed with Golden Yellow tags.

Foundation Seed (FS)

It is the progeny of breeder seed, or be produced from foundation seed, which can be clearly traced to breeder seed. The production is supervised and approved by Certification Agency and so handled to maintain genetic purity and physical purity and required to conform to certification standards. Thus, foundation seed (Stage II) can even be produced from foundation seed (Stage I). Indian Minimum Seed Certification Standards (IMSCS) are same for Stage I and II. The foundation seed lots are affixed with white bags.

Certified Seed (CS)

Certified class seed shall be the progeny of foundation seed and its production shall be so handled to maintain specific genetic identity and purity according to standards prescribed for the crop being certified. Certified seed (Stage III) may also be the progeny of certified seed (Stage I). Such multiplication should be done after getting permission from the Certification Agency. The certification agency shall give such permission provided the genetic purity will not be significantly altered. The certified seed lots are affixed with azure blue tags.

B. Seed Multiplication Models

The objective designating the seed multiplication models for a crop is to enable quick supply of seed of a newly released variety to the farmer, without genetic deterioration upto the stage of certified seed. The choice of a seed multiplication model is the key to further the success of a seed programme, which basically depends on i. Rate of genetic deterioration, ii. Seed multiplication ratio and total seed demand.

The rate of genetic deterioration depends on the breeding behavior of the crop. All crops may be classified according to the nature of their pollination as (Table 5) i. Self pollination, ii. Cross pollinated and iii. Often cross pollinated.

In cross pollinated crops there is always a danger of out crossing leading to genetic deterioration of a variety. In self pollinated crops a larger number of generations may be permitted provided there is little chance for deterioration due to mechanical

admixture or seed infection with designated seed borne diseases. Plants in which cross pollination may take place upto 50 % besides self pollination is categorized as often cross pollinated crops.

Table 5. Pollination behavior of different crops

Sl. No.	Nature of pollination	Crops
1	Self pollinated (1-5 % cross pollination)	
	a) Cereals	Rice, Triticale, Wheat
	b) Millets	Barley, Oats, Ragi
	c) Pulses	Blackgram, Greengram, Cowpea, Lentil, Soyabean
	d) Oilseed	Groundnut, Linseed
	e) Fibre crops	Jute
	f) Vegetables	Cluster bean (Guar), Fenugreek, French bean (Rajmash), Lab lab, Lettuce, Pea, Tomato
2	Often cross pollinated (5-50 % cross pollination)	
	a) Millets	Sorghum
	b) Pulses	Redgram
	c) Oilseeds	Sesame
	d) Fibre crops	Cotton
	e) Forages	Berseem, Lucerne
	f) Vegetables	Brinjal, Bhendi, Chillies
3	Cross pollinated (< 50 % cross)	
	a) Millets	Bajra, Maize
	b) Oilseeds	Castor, Niger, Mustard, Safflower, Sunflower
	c) Vegetables	Gourds and cole crops

The seed multiplication ratio (SMR) implies as to how much quantity of quality seed can be produced from a unit quantity of seed used to produce it. The seed multiplication ratio of different crops is depicted in Table 6.

In view of these basic factors, the chain of seed multiplication could be selected from the following three or four or five generation models of seed multiplication (Table 7). The longer the sequence of multiplication, greater is the possibility that one or

all the type of contamination may occur to erode the essential genetic qualities of a cultivar.

1. Three generation model
 - I. BS-FS-CS
2. Four generation model
 - II. (a). BS-FS-CS 1 - CS II
 - II. b. BS-FS I - FS II - CS
3. Five generation model
 - III. BS-FS I – FS II – CS I – CS II

The generation system of seed multiplication is followed to accomplish multiplication of seeds upto required quantities without causing contamination in the different generations of seed multiplication so as to prevent serious reduction in yield potential due to genetic deterioration. It is also important to understand the types of contaminants and the basics of seed deterioration due to different types of contaminants that may occur in the seed production plots.

A. Seed demand

High (in lakh tones)	:	H
Moderate (in lakh tones)	:	M
Low (in hundred tones or less)	:	L

B. Multiplication rate on reproduction

Greater than 1:100	:	HM
Lower than 1:100	:	LM

C. Speed of genetic deterioration

Rapid (cross pollinated and often cross pollinated crops)	:	RD
Slow (self pollinated vegetatively propagated crops)	:	SD

SEED MULTIPLICATION RATIO

It is nothing but **the number of seeds to be produced from a single seed when it is sown and harvested**. According to expert group on seeds (1989), the seed multiplication ratio for different crops are as follows.

CROP	SEED MULTIPLICATION RATIO	CROP	SEED MULTIPLICATION RATIO
Wheat	1:20	Gram	1:10
Paddy	1:80(Variety) 1:100 (Hybrids)	black gram, Green gram	1:40
Maize	1:100(Hybrids) 1:80 (Varieties)	Moth bean, Cowpea Horse gram	1:40
Sorghum	1:100	Red gram	1:100
Bajra	1:200	Ground nut	1:8
Ragi	1:80	Soy bean	1:16
Sunflower	1:50	Colecrops	1:433
Sesame	1:250	Potato	1:4
Mustard and rape	1:100	Oats	1:15
Safflower and castor	1:60	Bhendi	1:100
Linseed	1:50	Tomato	1:400
Cotton	1:50	Brinjal	1:450
Jute	1:100	Chilies	1:240
Mestha	1:40	Watermelon	1:100
Sun hemp	1:30	Pumpkin	1:160
Berseem	1:10	Bitter guard	1:41
Lucerne	1:25	Bottle guard	1:99
Peas	1:19	Ridge guard	1:83
Onion	1:171	Cucumber	1:200
Radish	1:100	French bean	1:9

Carrot	1:83	Cluster bean	1:50
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VARIETAL REPLACEMENT (VR)

It is the replacement of old varieties with new varieties. New varieties are being released with more newer objectives, but farmers may stick on to the varieties fearing for the risk, at that stage the extension officials are to promote the supply of new varieties to enjoy the benefit of farmers from using old varieties. This will also help to avoid the use of deteriorated varieties.

$$\text{VR} = \text{Newer Variety Used} / \text{Demand On Older Varieties} \times 100$$

Varietal replacement depends on

1. **Notification of variety:** All released varieties are to be notified to be brought under certification. Extent of notification of varieties by State Govt/ Central Govt. will decide varietal replacement.
2. **Duration of notification :** All notified varieties can be used only for 10 years beyond which they are unnotified. Hence after a decade of notifying a variety, it has to be replaced.
3. **Breakdown of variety:** Varieties become susceptible to pest and diseases thus leading to their replacement.
4. **Demand by farmers / market:** Consumer market evolves constantly needing for a variety to be replaced.
5. **Government programs:** Several government programs like ISOFA, SRI, NADP, RKVY promote use of new varieties replacing the old varieties.

Lecture No.14

Post harvest handling and machineries-principles of seed drying, cleaning and upgradation- their significance in seed shelf life preservation

Seed Drying

The process of elimination of moisture from the seed is called drying.

Stage of moisture elimination

The moisture from the seed is eliminated in 2 stages

1. Surface moisture of the seed that initially removed by the drying air.
2. The removal of the moisture in the surface cause an imbalance in the moisture potential in the surface of the seed and the inner portion of the seed which leads to the migration of moisture from the inner organ to the surface.

The migration of moisture to the surface is slower than the evaporation and a moisture gradient is developed in the kernal.

Elimination of moisture from the seed depends upon the relative humidity and temperature of the environment surrounding the seed. When RH of the atmosphere is less than the seed, moisture is eliminated from the seed. While drying, care should be taken to minimize /prevent oxidation and decomposition and volatilization. In this process there will be loss of dry weight of seed which is widened when the processes take place at high temperature. Hence, high moisture seeds should be dried at low temperature.

Equilibrium moisture content

A seed is in equilibrium with the environment when the rate of moisture loss from the seed to the surrounding atmosphere is equal to the rate of moisture gained by the seed from the atmosphere.

Drying temperature

Greater the seed moisture content lesser should be the drying temperature and vice versa.

10%	MC and below	110 ° F (43.3° C)
10-18 %	MC	100 ° F (42.2 ° C)
18-30 %	MC	90 ° F (32.2 ° F)

The rate of drying depends on

- Initial seed moisture content
- Size of the bin and capacity
- Depth of spread of seed
- The rate of air blow
- Atmosphere air temperature and relative humidity
- Static pressure
- Drying temperature

Methods of drying

1. Physical drying (or) natural drying (Or) sun drying
2. Mechanical (or) artificial drying
 - Drying with forced natural air
 - Drying with forced artificially heated air
 - Drying with desiccants
 - Drying with infrared rays

Different types of dryers

1. Natural dryers
2. Artificial dryers
 - a) Batch bin dryers (or) Metal bin dryers
 - i) Rectangular metal bin dryers
 - ii) Circular metal bin dryers
 - b) Continuous flow dryers
 - i) L.S.U. dryers
 - ii) Non mixing column dryers

I. Physical drying / Natural drying / Sun drying

This is the common conventional method in which drying of the harvested crop is carried out in the field or threshing floor by the radiant energy of the sun. This does not involve any expenditure. To achieve uniform drying, the seed should be spread in thin layer. High moisture content seed with a moisture content of more than 17% should be dried first under shade / light to reduce the moisture content less than 17% and then dried under heavy sun i.e. noon drying. Sun dried seeds should not be allowed to remain open in the floor during night, since seed will absorb moisture from air. 2-4 days are needed to reduce the moisture content to 10-12%.

Advantages

1. Easy and cheap
2. Does not require any expenditure or fuel.

Disadvantages

1. The rate of drying is slow
2. Loss due to attack by insects, birds and animals
3. Large floor area is required
4. Involves extra labour for collecting and reexposing during the day
5. Sun drying cause sun checks or hot spots due to variation in temperature from time to time
6. This checks or spots induce high amount of breakage while processing
7. Dust, dirt and other foreign materials get admixed
8. High weather risks and damage by heavy wind and rains

II. Mechanical drying or artificial drying

This involves the use of heated or unheated air or others which are forced through a drier holding the seeds.

1. Forced natural air drying

Generally ordinary seed godowns are provided with two types of ventilators for free movement of air circulation. In modern godowns, provisions are to be made for forcible circulation of air with the help of an electronic blower. The outside air which is comparatively dry is circulated in the godown and thereby the seed get dried up in this process. This is possible only in dry months.

2. Forced heated air drying

In this method, the outside air is heated with the help of burner heater and circulated into the godown for drying. This principle is employed in several types of the modern dryers.

Dryers

1. Metal bin dryers or batch bin dryers

a) Circular metal bin dryers

Such dryers usually consist of perforated floor, fan, heater and seed spreader. Here the seeds are spread in a thin layer over a perforated metal sheet while the heated air is blown to pass through the seeds. This heated air removes the moisture from the seed.

b) Rectangular metal bin dryers

Basic principles of operation and construction are essentially the same as for circular metal dryer. Mainly differ in the mode of air circulation and seed movement in or outside the bin. Metal screens are with opening not larger than the size of the seed. Their capacity is limited by the strength of the screens used.

II. Continuous flow dryers

a) **L.S.U. dryers (Louisiana State University dryers):** This is a continuous column heated air drier largely used for paddy. **The paddy seeds are fed from the top with the help of gravity force in zigzag manner and heated air is blown from the bottom usually at right angles to the direction of seed motion. The falling seeds get dried up by the heated air and this process is repeated till to get a reduction of moisture content to the expected level.**

Advantages over bin dryers

1. Short drying period
2. Less damages or spoilage during wet weather
3. Drying is more uniform.

b) Non mixing column dryer

These dryers consist of a tall vertical column through which paddy flows by gravity. **No provision is made for agitating the paddy as it flows and hence there is no attempt to drive the paddy from a straight path.** Paddy descends gradually between two parallel screens and heated air is forced through the screens.

Advantages of mechanical drying

1. Quick method, timely and uniform drying is possible
2. Makes early harvest possible
3. It reduces the chances of losses due to over ripening and shattering of seed
4. Losses due to rodents and birds are prevented.
5. Less damage during processing operation.
6. Permits long time storage by preventing sun checks and other damages.

Disadvantages

1. Initial cost of drying the equipment is high
2. Fuel is expensive
3. It produces possible fire hazards
4. Considerable supervision is necessary.

Tempering

Seed is usually dried in stages with heated air each stage consisting of a pass through the drier. Between passes the seed is stored in bins for an equilibrium period known as tempering period. This period of tempering shortens the total drying time. During drying surface moisture is removed and internal moisture moves towards the surface is slower than evaporation, and a moisture gradient develops in the kernel. The outside becomes drier than the inside and evaporation rate decreased. During tempering moisture concentration equalizes in the kernel and then evaporation of surface moisture is nearly as rapid as at the start of drying.

Seed Processing

Seed processing is to narrow down the level of heterogeneity of the lot by using suitable processing methods.

The seed lot is heterogeneous due to the following reasons

1. The soil is heterogeneous and there is a lot of variability in the fertility status of the soil due to the availability of nutrients, physical, chemical and biological properties.
2. Variability is introduced due to the position of seed set on the plant / fruit , time of pollination and fertilization over a period of time
3. Variability is created by biotic factors like pest and variability infestation.
4. Variability is also due to the management practices like water, land preparation, leveling, staggered sowing, uneven distribution of fertilizer and irrigation water, uneven plant protection sprays and uneven maturity at harvest.

This heterogeneity can be narrowed down in the processing of seeds by eliminating the undersized, shrivelled, immature, ill filled seeds using appropriate sieve size. The germinability and vigour of the seed lot can be upgraded by grading the seeds according to size, specific gravity, length and density of the seeds. The inherent qualities such as germinability and vigour are exemplified by certain physical characteristics of the seed i.e., large size, a denser seed, optimum length etc., So, if grading is done to obtain a particular range of size, shape, length and density of the seeds, the quality of the lot is upgraded.

Requirements in seed processing

1. There should be complete separation
2. Minimum seed loss
3. Upgrading should be possible for any particular quality
4. Efficiency
5. It should have only minimum requirement

Use of processing equipments in seed production

Seed lots received from the field possess high moisture content and contain thrashes and other inert materials, weed seeds, deteriorated and damaged seeds, ill-filled seeds small sized and empty seeds, off coloured seeds etc., Seed processing is necessary in order to dry the seeds to a safe moisture level, remove or reduce to the extent possible the various undesirable materials, weed seeds, other crop seeds, deteriorated or damaged seed, and match uniform size grading, seed treatment etc., to upgrade the overall seed quality. In its common usage in India, seed processing refers to all the steps necessary for preparation of harvested seed for marketing namely, handling, drying, shelling, preconditioning, cleaning, size grading, treating and packaging etc., Mechanical processing in post harvest handling of seed is not only for cleaning and processing but also improve the quality of seed through perfection.

Movement of seed in a processing plant

Handling of seed at the processing plant adheres to a definite path irrespective of crop for easy management of seed which is sensitive at each and every step of handling and ready to lose or gain its quality all through the steps.

Physical characteristics used to separate seeds are

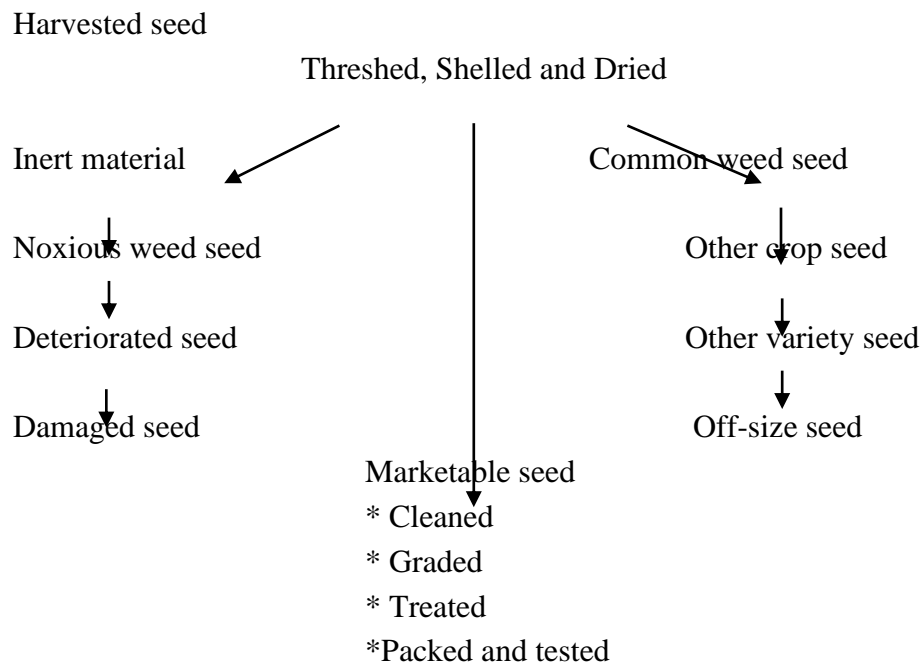
1. Size : Based on size it can be separated with air screen cleaner cum grader
2. Length : Disc or indented cylinder separator
3. Weight : Specific gravity separator
4. Shape : Spiral separator or draper separator for round and flat seeds
5. Surface texture : Rough from smooth surface seed- dodder mill
6. Colour : Electronic colour separator
7. Electrical conductivity

Seed differing in their ability to conduct electrical charge can be separated with electronic separator.

8. Affinity to liquid

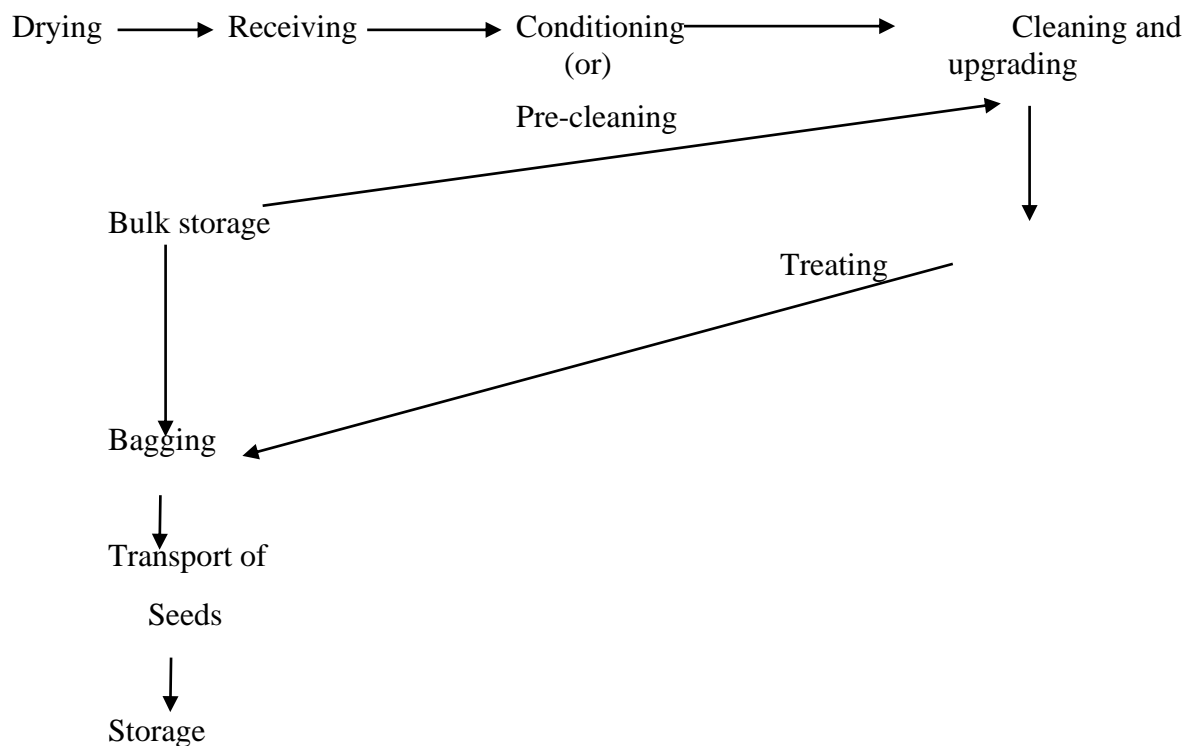
The seed coat of seed will absorb water, oils etc., which provides a means of separating seed on the magnetic separator.

The flow charts illustrating the types of materials removed from harvested produce during processing.



Receiving The field run produce after threshing is received in the processing plant.

Seed movement /basic steps in seed processing plant



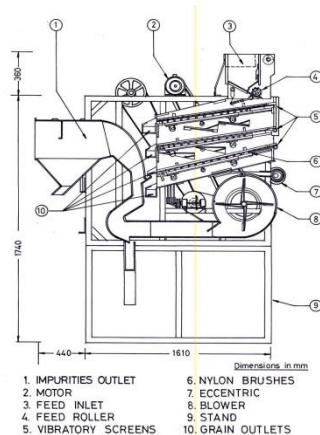
Seed processing equipments

I. Cleaner cum grader

The dried seeds should be cleaned and graded with help of a cleaner cum grader. For large scale cleaning and grading the commonly available machine is the “Crippen Model Seed Cleaner cum Grader”.

It consists of the following parts

- ❖ A hopper in the top for seed filling
- ❖ A fluted roller below the hopper to regulate the seed flow to the screen.
- ❖ Screen (or) sieves : Perforated metal sheet with specific size of perforation in which there are two types.
 - Rectangular perforations for paddy and
 - Round perforations for seed other than paddy
- ❖ Screen shaking unit : for oscillating the sieves to move the seeds on the screens
- ❖ Screen brushes to remove the blocked seeds
- ❖ Air blower with adjustments for air outlet
- ❖ Collecting outlet
- ❖ Air duct for directing the blown up light particles to outside
- ❖ Collecting bins.



Working principle

The seeds are fed into the hopper and they are guided to fall on the first sieve. The first sieve is a scalping screen which scalps all the foreign materials larger and heavier than seed and the entire quantity of seed passes through the first sieve. The second sieve is a cleaning sieve which removes all the unwanted particles larger in size than the seed. The third sieve is actually the grading sieve which size grade the seed lot and bring into a uniform size and which also screen the undersized, shriveled and immature seed, dust and dirt. The seeds are then rolled and

passed through air column, where they are relived of the light chaffy and other materials by the blowing air.

Adjustments

Fluted roller

The speed of this roller can be adjusted so as to increase (or) decrease the flow of seeds to the hopper of the sieves.

Slope (or) inclination of the screen

The angle of inclination of the screens can be adjusted according to the nature of seeds.

Rate of vibration of sieve

This can be adjusted either to increase or to decrease the speed of the rolling seeds on the screen.

Volume of air flow :By increasing (or) decreasing the air inlet.

Choice of screens :According to variety we have to change the screen

Screen dams

Small check dams, which can be provided here and there on the screens so that the seeds can be stopped a while and takes the charge either to pass or to roll.

Types of seed cleaner cum grader

- I) Crippen model cleaner cum grader
- ii) Clipper model cleaner cum grader
- iii) Petkas cleaner cum grader

II. Disc separator

It consists of a series of discs, which revolve together on a horizontal shaft inside the cylindrical body. Each disc contains many under cut pockets. The seed enter the intake end of the separator and move through the open centers of the discs towards the discharge end of machine. As the discs revolve through the seed mass the pockets lift out short seed but rejects longer seed. Longer seeds are conveyed by flights on the disc spokes towards the discharge end of the machine where they go out through the tailings gate. The rate of seed travel through the open disc centers is controlled by conveyor or blades attached to the spokes of the discs. The disc separator makes a very precise separation. No factor other than seed length and shape affects its separation. Flexibility is obtained by varying size of the pockets.

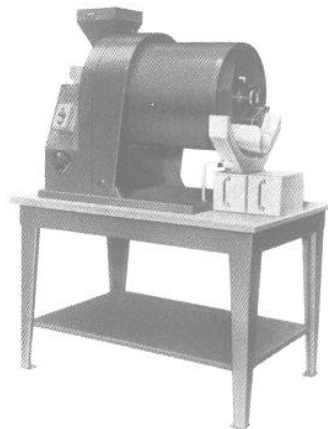
III. Indented cylinder separator

The indented cylinder separator is a rotating, almost horizontal cylinder with a movable, horizontal separating adjustments which are mounted inside it. Indent lines are there inside the surface of the cylinder. The indented cylinder revolves, turning the seed mass to give each seed a chance to fit into indent. Short seeds are lifted out of the seed mass and are dropped into the lifting and long seeds remain in the cylinder and are discharged out via., a separate spout at the end of the cylinder.

As the cylinder revolves, it creates centrifugal force which helps to hold the seed in the indent. Short seeds are held in the indent until the cylinder turns to the point where the indent is inverted enough for gravity to cause the seed to fall out of the indent. The length, surface texture

and size of seeds determine how they fit into the indent, so that it can be lifted out of the seed mass. The speed of the cylinder creates centrifugal force which holds the seeds in the indent as it is lifted upward. Thus the shape and size of the seed to cause some seeds to fall out after being lifted only a short distance, while other seeds are lifted closer to the top of the cylinder before they fall out.

As the seeds enter the cylinder, the small, short, easy to separate seeds are quickly removed. The center cylinder section removes the intermediate sizes of seeds still in the cylinder. All indents in a cylinder are the same size, only the progressively declining amount of material to be lifted causes this difference in separating action.



Adjustments

1. Cylinder speed 2) Size of the indent 3) Through setting 4) Tilt of the cylinder 5) Adjustable retarder.

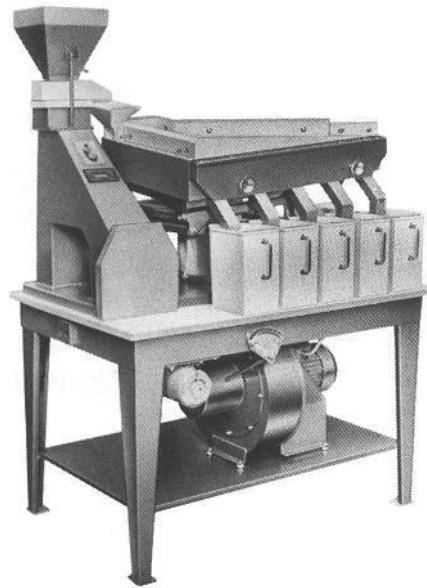
IV. Specific gravity separator

Seeds of the same size and general shape can often be separated because they differ in specific gravity or relative weight. This difference is very useful in removing light, immature seeds or heavy sand and rocks to improve the purity and germination of crop seeds.

If seeds which differ in specific gravity (relative weight / unit of volume) are placed on substrate of intermediate density, seeds of higher specific gravity will fall down through the substrata, while seeds of lower specific gravity will be buoyed up the substrata. Here air is used as a separation substrata.

As seeds flow on the deck of the gravity separator, they enter a column of air coming up through the porous surface of the deck. The pressure of terminal velocity of the air rising through the deck can be controlled very closely to separate two kinds of seeds differing in specific gravity, the air is adjusted so that only the lighter seeds are lifted up off the deck surface. These lighter seeds are held up by air pressure and tend to float on the deck surface.

The heavier seed possess a velocity greater than that of the air columns so they are not lifted and so will lie on the deck surface. The air column thus stratifies the seed mixture into vertical zones of relative weight with the heavier seed lying on the deck and the lighter seeds lifted up to the top of the seed mass.



Adjustments

1. Feed rate 2) Air flow 3) End slope 4) Side slope 5) Deck oscillation speed 6) Deck speed.

V. Roll mill or dodder mill or velvet roll mill

It is used to separate the seeds based on surface texture and shape. This separator should be used only after the seed has been carefully cleaned and separated from the chaff. These are effective in separating seeds with a rough seed coat or shape angles from smooth seeds.

The roll mill consists basically of two rollers, covered with flannel or velvet, placed side by side, so that they touch each other down their entire length. The rollers are mounted on an incline and they turn in opposite directions. A curved adjustable shield is mounted above the rollers.

Separating action

The mixture of smooth and rough seeds is fed into the place, where the rollers touch each other, at the high end of the machine. As the rollers turn up and out, seeds that are rough or have sharp or broken edges are caught by the nap of the fabric covering the rollers. These seeds are thrown up against the curved shield. They strike the shield at an angle, bounce back down to the roller and are again thrown up against the shield. Smooth seeds bounce down the inclined position forward between the rollers, and discharge at the lower end of the machine. They are not affected by the fabric roller covering, and are not pitched over the side of the rollers.

Adjustments

1. Rate of feed 2) Speed 3) Clearance between shield and rolls 4) The angle of inclination of rolls.

VI Magnetic separator

The separation is mainly based on the affinity for liquids which is used for separation. Since seeds contain no free iron and are not attracted by a magnet they must be selectively pretreated with a magnetic material such as finely ground iron powder. Rough seed coats, cracked or broken seed coats, dirt lumps, chaff or seed with a sticky residue on the surface will hold the liquid and become sticky, so that iron powder will adhere to them. Smooth coated seeds will not absorb liquid. So no iron powder will adhere to them.

The seeds are then discharged from mixing chamber and brought into contact with a powerful magnet, which removes the iron coated seeds. Most magnetic separators pass the seeds over a revolving drum which has a high intensity magnetic field. Seeds with an affinity for liquids which are now coated with iron powder are attracted by the magnet and adhere to the drum until they are removed by a brush or scraper. Seeds which are relatively free of iron powder are not attracted by the magnet and will fall into a separate discharge spout.

The first requisite of magnetic seed separation is that the seed to be separated must possess different seed coat characters. Crop seeds should have a smooth surface, while the seeds to be removed should have a rough surface which will retain liquid and can accept the iron powder. Success in separating the components depends upon the magnitude of seed coat differences and thoroughness with which the moistened seeds and the iron powder are blended.

VII Colour separator

Many large crop seeds such as peas and beans differ in colour between varieties. Colour variation may also occur due to immaturity or disease. Electronic colour sorting machines can separate such seeds by difference in colour and also remove mud balls and discoloured seeds in the same operation.

The electronic colour sorter views each seed individually with photo electric cells. The seed is compared with a selected back ground or colour range and is discharged from the machine according to its colour. If it is the great desired colour, the seed is discharged through the good seed spout. If its colour or shade falls within the reject range, a blast of compressed air deflects the seed and sends it in to the reject discharge spout. These are highly sensitive. Since the machine views each seed individually, capacity is low, but the initial cost is high and operating cost is less. The usefulness of machine is greater with large seeded crops.

VIII. Spiral separator

The separator, which classifies seed according to its shape and rolling ability, consists of sheet metal strips fitted around a central axis in the form of a spiral. The unit resembles an open screw conveyor standing in a vertical position. The seed is introduced at the top of the inner spiral. Round seeds roll faster down the incline than flat or irregularly shaped seeds, which tend to slide or tumble. The orbit of round seed increases with speed on its flight around the axis, until it rolls over the edge of the inner flight into the outer flight where it is collected separately. The slower moving seed does not build up enough speed to escape from the inner flight. Most spirals have multiple inner flights arranged one above the other to increase the capacity.

Processing equipments used for improving the quality of the seed

From harvest upto final stage of seed storage, the seeds are to pass through various seed processing equipments depending upon the speciality and specificity. But some equipments like driers and seed cleaner cum graders are common for all types of seed. The processing machineries and equipments used in the seed handling are as hereunder.

S.No.	Processing equipments	Usage with reference to specific seed management
A.	Threshing with extraction equipments	
1.	Thresher	To remove the seeds from the inflorescence especially in cereals
2.	Ginning machine	To separate the lint and seed from kapas in cotton
3.	Maize sheller	To shell the seed from the cobs
4.	Pulse thresher	To remove seed from the pods
5.	Tomato seed extractor	To extract tomato seed from fruit without wasting the pulp

6.	Chilli seed extractor	For easy removal of seed from chilli fruits
7.	Groundnut decorticator	To shell the kernel (seed from the pods
8.	Sunflower thresher	For removal of seeds from the head
9.	Debearder	To remove the awns form (Barley) the seed
10.	Mechanical scarifier	To scarify the hard seed mechanically to improve the germination of seeds
11.	Pebble mill	To remove webby hairs from grasses
12.	Timothy bumper mill	To remove weed seed from timothy seed
13.	Hammer mill	To remove the hook or appendages from the seeds (i.e. Stylosanthus)
B.	Driers	To reduce the moisture content to lower or needed level for safe handling both for processing and for storage at the final stage
C.	Grading equipments	
14.	Cleaner cum grader	This homogenize the precleaned seed based on size and is known as basic grading in seeds. The sieve sizes requirement vary with crop

15.	Precleaner and aspirator	This remove the inert material and dust particles from seed and improve the grading efficiency
D.	Upgrading machines	
16.	Specific gravity separator	Improve the quality of graded seed further using its weight or specific gravity. Heavier seeds are good storers and expresses maximum field establishment
17.	Indent cylinder	In lengthier seeds it maintains the size of seed (breadth and length). The broken / damaged are removed and good seeds are selected
18.	Disc separator	It is for removal of weed seeds and to improve the general appearance of seed
19.	Roll mill	To separate smooth seed from rough seed based on the surface texture especially the weed seed
20.	Magnetic separator	Removal of weed seed from clovers, alfalfa, trefoils and vetch
21.	Inclined draper	Separation of smooth or round seeds from rough, flat or elongated seeds
22.	Electronic colour sorter	Separation of off-coloured seed

23.	Electrostatic separator	Based on electrical properties removes Johnson grass from sesamum seeds (Specific utility)
24.	Spiral separator	Separation of seeds based on shape (eg.) separation of rape, vetch and soybean seed from wheat, oat or rye grass
25.	Polishers	To improve the luster of seed
26.	Picker belts	To remove undesirable ears / pods from shelled seeds (eg.) Groundnut, Corn
27.	Vibratory separator	Removal of weed seed
28.	Seed treater	To treat the seed with fungicide and pesticide
29.	Seed packing machine	To easier the work and to avoid human error of mixing
30.	Conveyors / Elevators (Belt , Bucket)	Easier the transfer of seed from machine to machine and avoids the contamination of seed at various level.

Though all the machines are highly useful in improving the seed quality, specific machines are utilized for specific crop. The sequential usage of machineries vary with crop seeds (Gregg, 1967).

Precautions in handling processing equipment

All machine adjustments like the speed, oscillation and duration should be perfect. Otherwise, it will result in mechanical damage of seed which reduces the quality of seed in terms of vigour, viability, storability and field stand. Drying of seed should be designed properly as the moisture content needed for threshing, grading, treating and bagging vary with operations. Dosage, exposure period and choice of chemical are important in mechanical seed treatment.

Risk coverage of carry over seeds - factors affecting seed storage - infrastructure facilities - ambient and advanced storage structures

SEED STORAGE

What is seed storage - preservation of seed with initial quality until it is needed for planting.

Introduction

The ability of seed to tolerate moisture loss allows the seed to maintain the viability in dry state. Storage starts in the mother plant itself when it attains physiological maturity. After harvesting the seeds are either stored in ware houses or in transit or in retail shops. During the old age days, the farmers were used farm saved seeds, in little quantity, but introduction of high yielding varieties and hybrids and modernization of agriculture necessitated the development of storage techniques to preserve the seeds.

The practice of storing the seeds starts from the ancient days itself, following simple and cheap techniques eg. Placing the seeds in salt or red earth treatment to red gram etc. But the same practices are not hold good for the present day agriculture, because

- large quantity to be stored
- exchange of varieties and species
- exchange of genes

The type of material to be stored decides the techniques to be followed for safe storage. Now a day, storage technique changed from ordinary godown storage to cr yogenic tank storage and even gene storage.

Objective of seed storage

To maintain initial seed quality viz., germination, physical purity, vigour etc., all along the storage period by providing suitable or even better conditions.

Stages of seed storage

The seeds are considered to be in storage from the moment they reach physiological maturity until they germinate, or until they are thrown away because they are dead or otherwise worthless. The entire storage period can be conveniently divided into following stages;

1. Storgae on plants (Physiological maturity until harvest)

2. Harvest, until processed and stored in a warehouse
3. In storages (Warehouse)
4. In transit (Rail wagons, trucks, carts, railway sheds)
5. In retail stores
6. On the users farm

Factors influencing seed storage

1. Biotic
2. Abiotic

1. Biotic factors

- a. Factors related to seed
 - Genetic make-up of seed
 - Initial seed quality
 - Composition of seed
 - Seed Moisture content
- b. Other biotics
 - Insects
 - Fungi
 - Rodents
 - Mishandling during sampling, testing

2. Abiotic factors

- Storage temperature
- Storage relative humidity
- Provenance
- Pre harvest weather condition
- Seed store sanitation
- Gaseous atmosphere
- Packaging material

a. Seed factors

1. Genetic factors

The storage is influenced by the genetic make up of the seed. Some kinds are naturally short lived (e.g) onion, soybeans, ground nut etc., Based on the genetic make up seeds are classified into

Microbiotic – short lived

Mesobiotic- medium lived

Macrobiotic – long lived

2. Initial seed quality

Barton (1941) found that the seeds of high initial viability are much more resistant to unfavourable storage environmental conditions than low viable seed. Once seed start to deteriorate it proceeds rapidly. The seed which injured mechanically suffered a lot and loses its viability and vigour very quickly. Generally small seeds escape injury whereas large seeds are more likely to be extensively damaged (e.g) bean, lima-bean and soybean. Spherical seeds usually give more protection than flat or irregularly shaped seeds

3. Effect of provenance

The place where the seed crop was produced greatly influences the storability. (e.g.) Red clover seeds grown in Canada stored for 4 years with 80% germination whereas seeds grown in England and New Zealand stored only for 3 years with 80% germination. This is due to different climatic conditions and soil types prevailing in different places.

Effect of weather

Fluctuating temperature during seed formation and maturity will affect seed storage. Pre-harvest rain may also affect the viability.

Pre harvest sanitation spray

In pulses, insect infestation comes from field (e.g.) bruchids.

4. Seed moisture content

Most important factor influence the storability. The amount of moisture in the seeds is the most important factor influencing seed viability during storage. Generally, if the seed moisture content increases storage life decreases. If seeds are kept at high moisture content the losses could be very rapid due to mould growth very low moisture content below 4% may also damage seeds due to extreme desiccation or cause hard seededness in some crops.

Since the life of a seed largely revolves around its moisture content it is necessary to dry seeds to safe moisture contents. The safe moisture content however depends upon storage length, type of storage structure, kind / variety of seed type of packing material used. For cereals in ordinary storage conditions for 12-18 months, seed drying up to 10% moisture content appears quite satisfactory. However, for storage in sealed containers, drying upto 5-8 % moisture content depending upon particular kind may be necessary.

Harringtons thumb rule on seed moisture content

For every one per cent decrease in seed moisture content the life of seed will be doubled. This is again hold good between 4- 12 C. Based on the tolerance and susceptibility of seeds towards moisture loss seeds are classified into

Orthodox – the seeds able to tolerate moisture loss and less seed moisture favours the storage. i.e. decreased moisture increased storage period. Eg. Rice, sorghum , and most of the cultivated species.

Recalcitrant – just opposite to the orthodox. Seeds not able to tolerate moisture loss. Required high moisture for viability maintenance.

b. Microflora, Insects and Mites

The activity of all these organisms can lead to damage resulting in loss of viability. The microflora activity is controlled by Relative Humidity, temperature and moisture content of seed. Treated seeds with fungicides can be stored for longer periods. Fumigation to control insects will also help in longer period of stroage.

Fumigants - (e.g) methyl bromide, hydrogen cyanide, ethylene dichloride, carbon tetra chloride, carbon disulphide and naphthalene and aluminium phosphine.

Abiotic factors:

1. Relative humidity

Relative humidity is the amount of H₂O present in the air at a given temperature in proportion to its maximum water holding capacity. Relative Humidity and temperature are the most important factors determining the storage life of seeds. Seeds attain specific and characteristic moisture content when subjected to given levels of atmospheric humidities. This characteristic moisture content called equilibrium moisture content.

Equilibrium moisture content for a particular kind of seed at a given Relative Humidity tends to increase as temperature decreases. Thus the maintenance of seed moisture content during storage is a function of relative humidity and to a lesser extent of temperature. At equilibrium moisture content there is no net gain or loss in seed moisture content.

2. Temperature

Temperature also plays an important role in life of seed. Insects and moulds increase as temperature increases. The higher the moisture content of the seeds, more they are adversely affected by temperature. Decreasing temperature and seed moisture is an effective means of maintaining seed quality in storage. The following **thumb rules by Harrington** are useful measures for assessing the effect of moisture and temperature on seed storage. These rules are as follows.

1. For every decrease of 1% seed moisture content the life of the seed doubles. This rule is applicable between moisture content of 5-14%.
2. For every decrease of 5 °C in storage temperature the life of the seed doubles. This rule applies between 0 °C to 50 °C.
3. Good seed storage is achieved when the % of relative humidity in storage environment and the storage temperature in degrees Fahrenheit add upto one hundred but the contribution from temperature should not exceed 50 °F.

3. Gas during storage

Increase in O₂ pressure decrease the period of viability. N₂ and CO₂ atmosphere will increase the storage life of seeds.

Types of seed storage

- Storage of commercial truthfully labelled and certified seed
- Storage of carry over seeds
- Storage of foundation seed stocks and enforcement seed samples
- Storage of germplasm seeds

4. Seed storage sanitation or godown sanitation

- Storage environment should be free from insects and rodents
- Chemicals such as insecticides, fertilizers should not be stored along with seeds.
- Storage room should be kept cool and dry
- Use wooden pallets for arranging the bags in criss-cross manner for effective ventilation on all sides of the bags.
- Seed bags should be stacked upto 6-8 tiers depending upon density of seeds
- Restacking once in 3 months or less is important for prolonging seed viability

- Before storage disinfect godowns by spraying malathion 50% E.C. @ 5 lit /100 m² area.
- If old gunnies, cloth bags and containers are to be used these should be fumigated with aluminium phosphide.
- Size of the stack should be 30x20 feet facilitate fumigation under gas proof or polythene covers.
- Periodical inspections should be carried out and control measures to be taken i.e. malathion 50% E.C. @ 5 lit /100 m² area should be applied in every 3 weeks
- Fumigation may be done whenever needed
- It must be borne in mind that fumigation, particularly repeated fumigation, may seriously reduce the vigour and even the germination capacity of seeds. Seeds with m.c. greater than 14% should be dried to below this value before fumigation

Maintenance of viability in storage

1. Store well mature seeds
2. Store normal coloured seeds
3. Seeds should be free from mechanical injury
4. Seeds should be free from storage fungi or micro organisms
5. Seeds should not have met with adverse conditions during maturation
6. Storage environment or godown should be dry and cool.
7. Seeds should be dried to optimum moisture content
8. Required R.H. and temperature should be maintained during storage.
9. Seeds should be treated with fungicides before storage
10. Storage godown should be fumigated to control storage insects, periodically
11. Suitable packaging materials should be used for packing.

PRE and MID STORAGE TREATMENTS

The treatments given to the seeds prior to or during storage to protect the seed from deteriorative changes and from pest and diseases are called pre storage treatments.

Types of pre – storage seed treatments

1. Halogenation
2. Antioxidant treatment
3. Seed sanitation
4. Seed fumigation

i) Halogenation

a) Dry dressing

It is application of halogens like chlorine, bromine and iodine to seeds before storage as dry dusting to stabilize the lipoprotein biomembrane.

Procedure : Calcium carbonate, fresh chalk, talc charcoal or activated clay are first exposed to vapours of halogens and alcohols @ 2-5 g /Kg seed. An alternative method is to add the chemicals directly to the carrier (50 – 500 mg of chemical added to 2-5 g carrier for treating 1 Kg seed) in a closed container. Calcium carbonate has proved to be a good carrier. After equilibrating the carrier- chemical mix the seed is thoroughly dressed with the same and kept for 24-72 h in the **closed container** and thereafter stored in the usual way .**Bleaching powder (calcium oxy chloride) may be directly mixed with the seed at the rate of 1-4 g / Kg seed.**

b) Vapour treatment

Exposure of seeds to halogen vapour in a closed container for 16-72 h, to very low concentrations of halogens The concentration of chemicals and the time of exposure would depend on the material concerned.

ii) Antioxidant treatment

Application of antioxidants such as vitamin A,C,E, **butylated hydroxyl toluene (BHT)** to seeds before storage as wet or dry treatments which delays the physiological ageing. The seeds are applied with antioxidants through soaking in respective solutions at particular concentration. Antioxidants such as vitamin A,C and E provides hydrogen atom for quenching the lipid radical thereby putting an end to free radical propagation and subsequent damage to cell membrane and ultra cellular structures.

iii) Seed sanitation

The seed sanitation treatments refers to the application of pesticides (fungicides, insecticides or a combination of both) to seeds to disinfest and disinfect them from various seed borne and soil borne pathogenic organisms and storage insect pests to safe guard the seed and seedlings against the seed and soil borne pathogens. Seed borne pests and diseases may be carried within seeds or on seeds or they may accompany the seed as free living organisms or in debris.

The seeds are simply dipped or soaked in the chemical solutions and the fungicides applied as dust, slurry or liquid in recommended concentrations.

a) Seed disinfection

This refers to the eradication of fungal spores that have become established within the seed coat or in more deep-seated tissues. For effective control the fungicidal treatment must actually penetrate the seed in order to kill the fungus that is present.

b) Seed disinfection

This refers to the destruction of surface borne organisms that have contaminated the seed surface but have not infected the seed surface.

iv) Seed Fumigation

It is a process of exposing the seeds to fumigants (gaseous form of chemical) to control **seed borne fungi and insects which** cause seed deterioration during storage. The seeds should be brought to equilibrium moisture contents at 60 per cent RH, then they should be enclosed in air tight containers and fumigated at temperature of 27 ± 1.5 °C for required durations. After fumigation seeds placed in cloth bags are aerated for 21 weeks under room condition. **Subsequent second and third fumigations are repeated after 3 and 6 months after first fumigation.**

Examples of fumigants are ethylene oxide, aluminium phosphide, calcium cyanide, ethylene dichloride and carbon tetrachloride, ethylene dibromide, carbon disulphide or hydrogen phosphide. The toxic effects on the fumigants bring about the control of fungi or insects. The fumigant can penetrate into the seeds to control the deep-seated pathogens. Before going for fumigation a thorough knowledge of seed moisture level and type of infestation, choice of fumigant, its doses and exposure time and jmn vgt5tfvfr43edcfr3wqaZxfgiunecessity of number of fumigation is very essential.

MID STORAGE TREATMENTS

Seeds in storage accumulate damage to cell membranes during senescence. Mid storage seed treatments are capable of reducing the age induced damages and restoring the seed vigour to a certain extent besides, the seed viability and productivity of stored seeds are also improved.

Hydration – Dehydration (H–D)

It is the process of soaking the low and medium vigour seeds in water with or without added chemicals usually for short durations to raise the seed moisture content to 25 – 30% and drying back the seeds to safe limits for dry storage.

Types of H-D treatments

The wet treatments include soaking-drying, dipping-drying, spraying-drying, stepwise hydration-drying, moisture equilibration-drying, moisture equilibration soaking-drying, moist and conditioning-drying, etc. The choice of the treatment depends upon the characteristics of seed and initial vigour status of the seeds.

Soaking – Drying (S-D)

Stored seed is soaked in water or solution of chemicals sufficient to cover it and kept at room temperature for 2-6 hour depending on the material with occasional stirring. The soaked seed is taken out and after surface drying in the shade for some time, dried back to the original moisture content Dilute solution of chemicals such as sodium or potassium phosphate (di and mono basic), sodium chloride, p-hydroxy benzoic acid, p-amino benzoic acid, oxalic acid, potassium Iodide, etc can also be used at 10^{-4} to 10^{-3} M concentrations. Fungicidal and insecticidal formulations can also be incorporated in the soak water.

Dipping – Drying (D-D)

Seeds are dipped in water or solutions of the aforesaid chemicals for only 2-5 minutes and the wet seed is taken out immediately and kept covered for 2 – 6 hours depending on the material, for absorption of surface water followed by drying back in S-D. This treatment is effective in most high and high-medium vigour seeds of rice, wheat, jute, summer and winter vegetables

Spraying – Drying (S-D)

Seeds are spread in a thin layer and then an amount of water (approximately 1/5 to 1/4 of the seed weight) is sprayed on to it in two equal installments (turning over the seed layer after the first spray) and then kept covered by a polythene sheet for 2-4 hours before drying back. This treatment is similar to D-D in its efficacy and suitability.

Moisture equilibration – drying (ME – D)

Here, the seeds are placed in thin layers on trays kept on a raised platform in a closed moisture saturated chamber lined internally with moist blotters giving nearly 100% RH at room temperature. After 24-48 hours, depending on the material and ambient temperature, the seed is dried back in the usual way. **For soaking injury prone seeds this treatment, which gives a slow and progressive rise in moisture content, is very effective. ME-D, however, difficult to practice on a large scale and is not advocated for low vigour non leguminous seeds because of possible aging effect of the treatment especially when given for prolonged periods.**

Moist sand conditioning – drying (MSC-D)

This treatment is similar to the moisture equilibration treatment but easier to practice. For slow and progressive moisture uptake, the seed is thoroughly mixed with pre-moistened sand, using 3 times the amount of air dry sand than seed. Moisture content of sand is adjusted to 5-10 by adding the requisite amount of water or solution of chemicals to previously washed and dried fine grain building grade sand.

The addition of water should be so adjusted as to get the required hydration effect without initiating the germination process. After mixing the dry seed with the premoistened sand, the mixture is kept at room temperature for 16 – 36 hours depending on the material and sand moisture content. The seed absorbs moisture from sand and after incubation the hydrated seed is separated from sand by sieving and dried back to the original weight.

Mode of Action:

The main purpose of hydration is to raise the seed moisture content to 25 –30% (wet weight basis) before drying back to safe limits for dry storage. The hydration - dehydration treatment may improve the vigour by controlling free radical reactions and consequent peroxidative damage to lipoprotein cell membranes.

The hydration – dehydration treatments

1. should be given only to stored seeds.
2. effective in low and medium vigour non- leguminous seeds,
3. the moisture equilibration and moist sand conditioning treatments in which moisture is taken up by the seed in a slow and progressive manner, are recommended for relatively high-vigour seeds and seeds of pulses and leguminous vegetable crops
4. Direct soaking of leguminous seeds should be avoided.
5. Would not make a seed germinable, which has already lost viability.

Advances in seed storage techniques

Ultra-dry seed storage

Ultra-dry storage, also called low moisture content storage, is a technique for decreasing seed moisture content to below 5-6 percent using different methods and then stored hermetically at ambient, but preferably cooler temperatures. Some studies have confirmed that low moisture content storage can not only be used to maintain the quality of seeds, but also improve their storability. It can greatly reduce the cost of constructing and maintaining the gene bank. It is a

suitable technology to low volume seeds, seed companies and seed banks to store precious seed material for a longer period.

Different Ultra drying methods

1. Dry room or drying chamber

♣ **Drying rooms should be fitted with an airlock to minimize moisture entering from outside.**

♣ **A typical dry room, set at 10-15% RH at 10-25°C, will dry seeds of any species and at any mc in about 30 days.**

2. Desiccant - Silica gel / charcoal

Seed drying procedures, drying time (~one month) depends on the initial moisture content of the seeds, the amount of seeds and the dryness of the desiccant.

3. Saturated salts / Lithium Chloride solutions

Lithium Chloride: at 20°C produces a RH of about 12% Calcium Chloride: at 25°C produces a RH of about 30% Air-tight jar with lithium chloride solution, showing plastic mesh support to hold seeds above solution. Only plastic coated metal components should be used as salts may be very corrosive.

4. Air conditioned room / vehicle

5. Incubator drier

Modified atmosphere seed storage

Proper storage of seeds in seed production programme is an important activity in order to maintain its quality parameters like viability, vigour and seed health until it is sown. Now a day's both seed consumer, and tiller of the land demands for high quality seeds. Supplying high quality seeds can be achieved by an appropriate post-harvest technology and, suitable technology of storage. A major cause of seed degradation and deterioration during storage are the incidence of insect pests and microorganisms. Many studies have shown that modified atmosphere of elevated carbon dioxide and depleted oxygen is an effective method against insects and microorganism attacks during storage.

Modified atmosphere storage is one of the seeds and food preservation methods that maintains the natural quality of seeds and food products besides extending the storage life. **Modified atmosphere (MA) reduces the respiration rate of seeds and activity of insects or microorganisms in seeds. After the harvest, controlling quality deterioration becomes more difficult because the seeds are much more sensitive to conditions and environments that cause variable loss of quality seeds. Modified atmosphere (MA) method offers, an alternative that is safe and environmentally benign to the use of conventional residue-producing chemical fumigants for controlling insect pests attacking stored grains, oilseeds. Although the economics involved in the application of MAs prevent their full replacement of conventional fumigants, novel approaches to the use of MAs indicate their suitability for niche applications.**

Disinfestation of stored seeds using modified atmospheric storage (MA) involves the alteration of the natural storage gases such as carbon dioxide (CO₂), oxygen (O₂) and nitrogen (N₂), to render the atmosphere in the stores lethal to pests. The MA includes neither alteration of the storage atmosphere by addition of toxic gases such as phosphate methyl bromide nor regulation or **alteration of the atmospheric water content**. The MA may be achieved in several ways: by adding gaseous or solid CO₂, by adding a gas of low O₂ content (e.g., pure N₂ or output from a hydrocarbon burner) or by allowing metabolic processes within an airtight storage to remove O₂, usually with associated release of CO₂. Such atmospheres are referred to as 'high-CO₂', 'low-O₂', and 'hermetic storage' atmospheres, respectively. They are collectively known as 'modified atmospheres'.

Modified atmosphere storage of seeds is a suitable alternative to the use of chemical fumigants and contact insecticides that are known to leave carcinogenic residues in the treated

products. The most important component in MA is carbon dioxide which is a non flammable, colorless and odorless gas, about 1.5 times heavier than air.

Modified atmosphere storage of seeds is a suitable alternative to the use of chemical fumigants and contact insecticides that are known to leave carcinogenic residues in the treated product. The effectiveness of modified atmosphere for controlling various stored product pests depends on the temperature and moisture content of the seeds, species and life storage of pests, gaseous composition, and uniformity of gas distribution and exposure time of the MA treatment.

Cryopreservation

Cryo is greek word (Krayos-frost).It literally means preservation in “Frozen state”. Cryopreservation is a long term storage technique with very low temperature to preserve cells, whole tissues or any other substances susceptible to damage for extended period of time at a relatively low cost.

It can be done:

In liquid nitrogen (at -196 degree)

Over solid carbon dioxide (at -79 degree)

Low temperature deep freezer (at -80 degree)

In vapor phase nitrogen (at -150 degree)

These crystals may disrupt the cell membrane leading to the death of the cell. The goal of cryopreservation is to replace some of the water with other compound like DMSO (dimethyl sulfoxide) and glycerol and these are mixed into a solution with media in which cells are placed in a liquid nitrogen freezer usually at -196°C. When the media begins to freeze, salt concentration outside the cells will become greater than inside the cell and the water will leave the cells to be replaced by the cryopreservation. The main objective is to minimize damage to biological material during low temperature freezing and storage.

Types of cryoprotective agents

There are two broad categories of cryoprotective agents exist- i) Permeating cryoprotectants and ii) Non-permeating cryoprotectants. **Cryoprotectants that are permeable to cell membrane like DMSO, methanol, propanediol, ethylene glycol and glycerol. Non-permeating cryoprotectants are not permeable to cell membrane.e.g- sucrose, glucose, dextran, egg, yolk serum, skim milk. The functions of a cryoprotective agents are to increase the extra cellular osmolality to promote dehydration during cooling and to bind residual water thereby preventing the deleterious effects of ice formation(IIF). Many compounds have been tried as cryoprotective agents, either alone or in combination.although there are no absolute rules in cryopreservation, glycerol and DMSO have been widely used and**

traditionally have been demonstrated to be the most effective agents for preserving living cells and organism. The choice of cryopreservative agent is dependent upon the type of cell to be preserved. For most cell glycerol is more preferable than DMSO due to its less toxicity. However DMSO is more penetrating and is usually the agent of choice for larger, more complex cells such as protists.

Method of cryopreservation

There are three main methods of freeze samples at ultra low temperature (i.e. with liquid nitrogen) – i) slow freezing ii) Vitrification& iii) ultra-rapid freezing.

i) Slow freezing: - It involves step-wise programmed decrease in temperature. The procedure is lengthy and requires the use of expensive instrumentation. The process does not exclude ice crystal formation.

ii)Vitrification :-It refers to any process resulting in “**glass formation**”, the **transformation from a liquid to a solid in the absence of crystallization. It involves the use of a medium that has a very high solute concentration to begin with. Thus ice cannot form.** The vitrified state & the associated physico-chemical condition obtained using vitrification methods are to some extent similar to those obtained by slow cooling, but the way of reaching those point is quite different⁵ . It is rapid cooling of a sample in the presence of a cryopreservation that increases viscosity and depresses the freezing temperature inside of the cell. It is a simple, inexpensive and rapid process of more newly developed technology. It increase the embryos and oocyte survival rate. Unfortunately common cryoprotectants are toxic and the immersion of solution directly in liquid nitrogen can be cause of contamination of embryos and oocytes with bacterium, mushroom and virus.

iii)Ultra-rapid freezing :-It is a midway technique between slow freezing and vitrification. It is quicker than slow-freezing technique, does not involve the use of programmable machines and requires lower concentrations of cryoprotectant agents (CPA) than those used invitrication Experimental results demonstrate that this technique has lower performances than slow freezing’s and vitrification’s one.

Conservation of plant biodiversity

The conservation of plant biodiversity is an important issue concerning the human population worldwide. Conservation of plant biodiversity can be performed in situ and ex situ. These two methods are complementary and are not exclusive. They offer different alternatives for conservation, but selection of the appropriate strategy should be based on a number of criteria, including the biological nature of the species and the feasibility of applying the chosen methods. At present biotechnological methods have been used to conserve endangered, rare crop ornamental, medicinal and forest species for short-,medium-, and long- term. For **long-term conservation cryopreservation is the most effective tool**, as it maintain the **living cells**,

tissues, organs at ultralow temperature(usually that of liquid nitrogen,-196°C).At liquid nitrogen temperature, **all metabolic activity and cell divisions are stopped and cells will not undergo genetic changes during storage.** Cryopreservation is the only technique that ensures the safe and cost-efficient long term conservation of various categories of plants, including non-orthodox seed species, vegetatively propagated plants, rare and endangered species and biotechnology products.

Pre and Post quality control-Management checks and balances- their significance in seed trade-Linkages with various organizations for effective seed trade and business management

Pre and Post quality control:

Pre quality control: Seed certification and Field inspection are pre quality control systems
(Write in detail about seed certification how it is significance in seed trade)

Post quality control: Seed testing and Seed inspections are post quality control systems
(Write in detail about seed testing and seed inspection are how their significance in seed trade)

SEED MARKETING

Seed marketing: The place where selling or buying the seeds for seed production is known as seed marketing.

The concept of seed marketing has been developed from the fact that **certified quality seeds must be available to the farmers well ahead in time and in sufficient quantity so that the planting schedule of the variety / varieties is not disturbed and the cost of these seeds should be within the reach of the average farmers.** For this, a market serving the zone must have a pre-planner worksheet prepared (depending on demand) for the certified seed of the kinds and varieties necessary as well as the quantity required and should develop strong linkage with production and processing pipelines for feedback of information. The business functions of an organized market system begin with:

- i. Distribution or selling of the basic seed (Foundation seed) produced by the assigned centers / organizations (i.e. NSC, SSCs, Agricultural Universities) to the registered seed growers at price which should not adversely affect certified seed production and fix a reasonable price.
- ii. Procurement or collection of certified seed produced.
- iii. Processing of the certified seed lots collected into packages or bags conforming to seed rules.

- iv. Selling of the seeds at reasonable price.
- v. Making the packages / bags of seed available to the buyers as per their demand at a convenient place (market / store) and at the suitable time.
- vi. Advising the farmers through orientation programmes and pamphlets / leaflets the best schedule of cultivation to be followed to fully exploit the potentiality of the seeds they have purchased.
- vii. Feedback of information on the difficulties or bottle necks faced by the certified seed growers or farmers in production of seed and crop to the technologists involved in the seed production programme through workshops and conferences.

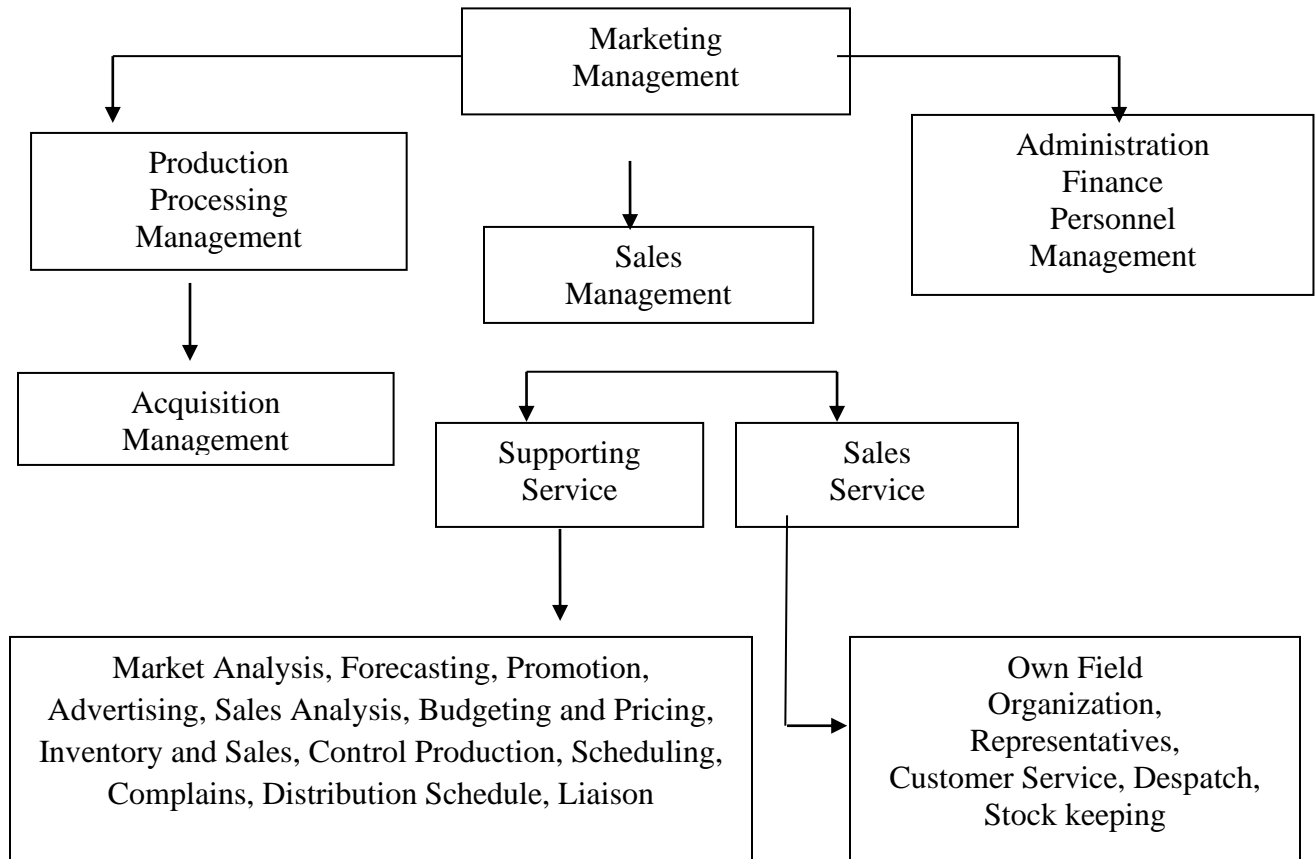
Basic requirements for organized market

The basic requirements to develop comprehensive seed markets are:

- i. Personnel should have broad knowledge of agriculture, horticulture and commerce and should be updated for the new developments.
- ii. A clear cut national policy for developing the seed industry, defining the task and responsibilities of the public and private economic sections involved.
- iii. Availability of seeds of well-defined and well adapted established varieties as well as official information on seeds of new varieties that have been notified and released for crop production and passed through quality control schedule as per Seed Act.
- iv. Ensured supply of seeds required according to demand in the marketing zone.
- v. Comprehensive marketing intelligence on the consumer requirements, production area, location and size of market demand as well as cost.
- vi. Adequate facilities for storage, processing and testing for effectively maintain the legally enforced standards of quality of the seeds procured in the wholesale sector as well as transpiration and storage facilities for the retail sale sectors.
- vii. Reliable information system to keep official and private institutions updated on production supply pattern.

Thus successfully marketing of seed is closely linked to the overall seed situation of a country. It is basically related to the seed industry and is a major component in the country's economic development.

The organization of a comprehensive seed marketing enterprise is, shown in flower chart.



Checkpoints in Seed Marketing

Since seed is strictly a season and location bound commodity, its effective seed marketing endeavor would require the following infrastructural information :

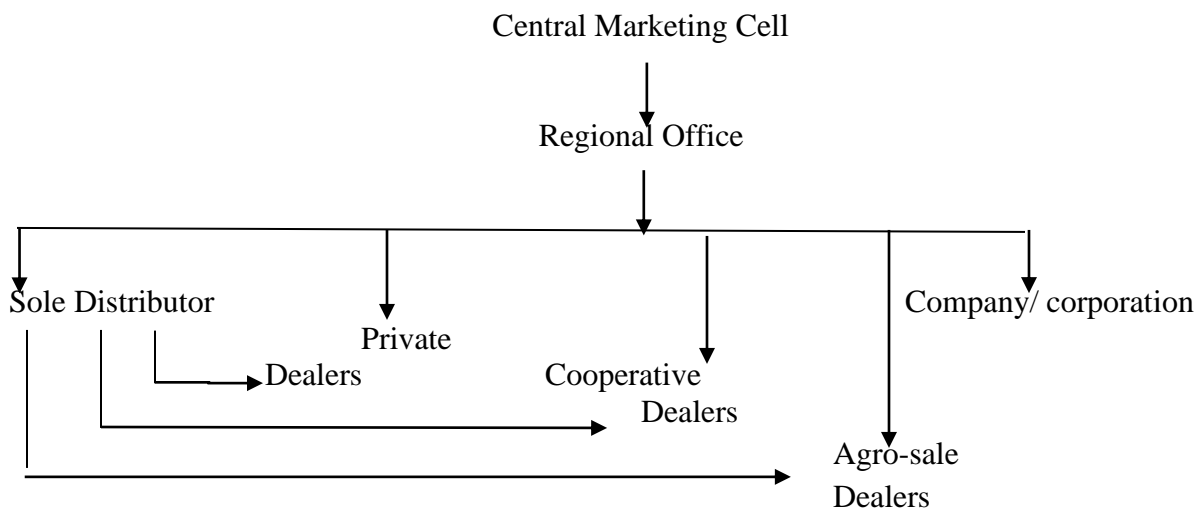
Marketing structure

Success in seed marketing depends on establishment of effective channels of seed distribution from a central storehouse (with good facilities for seed storage) until the last possible moment because storage in farms is likely to be less suitable and seed could deteriorate if not sown soon after delivery. Distribution has to be arranged so that the seeds required by the farmers reach in right quantity and in right time for sowing when conditions are best. There are five types of seed distribution system in India, e.g.,

- a. **Farmer to farmer distribution.** This is the traditional method, whereby farmers obtain their requirements from neighbors either on cash or on exchange basis. No formal marketing organization is required for this type of distribution.
- b. **Registered grower's distribution.** The registered growers are expected to distribute the registered (certified / truthful label) seeds to farmers on cash or on exchange basis.
- c. **Distribution by Co-operatives.** This includes procurement of seeds by Co-operatives which subsequently distribute the seed to farmers on cash or on exchange basis.
- d. **Distribution by Department of Agriculture.** Seeds are purchased by the Agriculture Dept. of Government and are distributed through District Agricultural Officer and Block Development Officers.
- e. **Distribution by non-Government organizations.** The seeds are distributed through a network a private seed distributors and seed dealers.

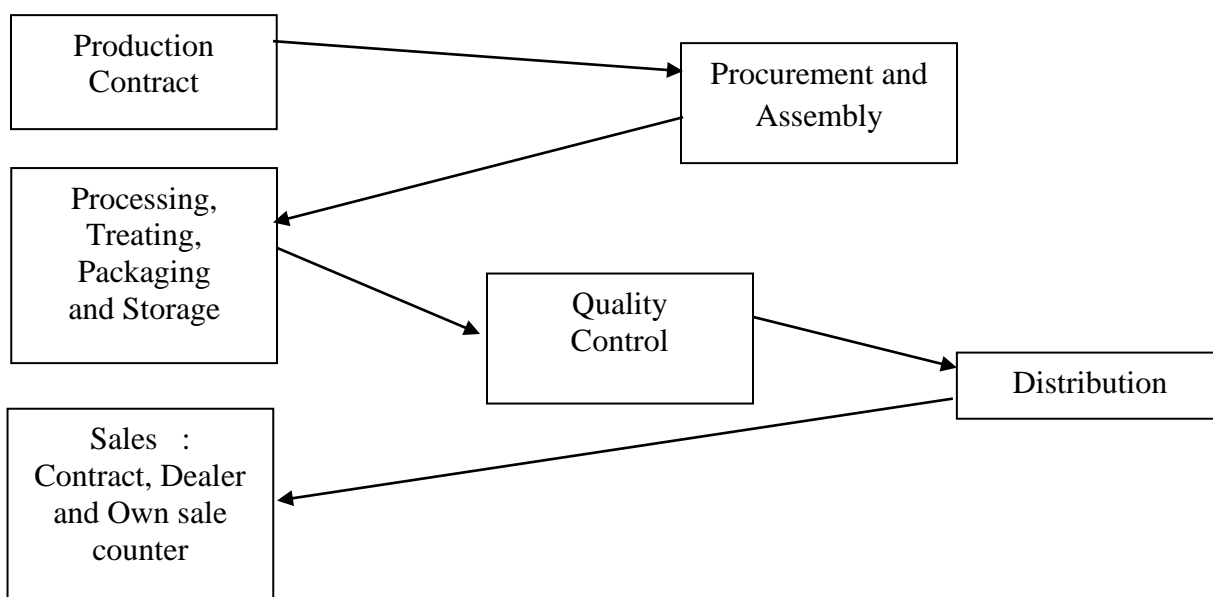
Marketing organization

The simplest and most efficient system, out of a number of possible ways in which marketing network could be organized is to establish a central marketing cell distributing seed to several channels through regional offices in the target end use areas as shown in flow chart.



Seed Marketing Chain

Close coordination can be achieved by cooperation among the executive managers of production, processing and marketing so that programmes in each section can be oriented to provide rapid feedback from the customer on seed quality, quantity, packaging and other important areas. This then lead to the concept of seed marketing chain as shown in flow chart.



FACTORS AFFECTING SEED MARKETING

Seed marketing is greatly affected by the following factors:

1. Clear-cut policy. A clear-cut policy for developing the seed industry, defining the tasks and responsibilities of the official, semi-official, and private economic sectors is necessary for the development of seed marketing on sound footings.

2. Availability of well-identified and adapted varieties. Needless to say, a seed programme would not have any impact unless superior varieties are regularly funnelled into the seed programmes.

Without these, the seed marketing programme cannot expand. Current official information on new varieties that have been recommended, and released, for crop production helps in accelerating the programme.

3. Adequate production, storage and testing facilities. These are necessary for producing and maintaining seed quantities and qualities in accordance with established standards vital for the development of sound marketing.

4. Official programme. When new varieties/hybrids are first being introduced, particularly among small-scale farmers, the government generally has to take the initiative and promote the supply arrangement. Another important role of government is to provide market information, to set targets and to regulate and control agencies and enterprises.

5. Demand forecast. Realistic assessment and targets of seed demand are very necessary. Excessive quantities result in large carry-over stocks and subsequent losses, due to loss in germination and vigour of seeds if carried over for too long. On the other hand, short supplies would deprive the seed company/corporation of profits it could have made. It may also encourage unscrupulous elements to take advantage of the situation.

6. Market intelligence. Comprehensive market intelligence to show the needs of cultivators, location of production areas, location and size of market demands and marketing costs, are important factors influencing seed marketing. A market intelligence system should be so developed as to provide reliable information to keep official and private institutions up to date on production and supply patterns.

7. Transport and storage arrangements. Adequate intermediate storage buffer godowns, transport arrangements for timely supply of seeds, and their proper storage in end-use

areas/dealer/distributors godowns are also very important. Poor transport arrangements add to the risks, and poor storage results in rapid losses in seed germination and viability; rendering them worthless for planting purposes.

8. Nature of product. Seeds are a perishable commodity and get easily damaged' if seed handling is not satisfactory at any stage in the overall chain of seed marketing. Seed marketing is .seasonal. Unsold stocks if carried over for too long will bring heavy losses.

9. Quality control programme. Effective, legally-enforced control procedures to ensure uniform quality levels, according to internationally recognized standards, are necessary. In the absence of these, unscrupulous elements may create unhealthy competition with bonafide seed companies/*corporations*.

10. Publicity. A vigorous policy of publicity on value, availability and returns from certified seed of the recommended varieties is a potent tool for increasing seed sales.

11. Financial rewards. A clear-cut policy of financial rewards to those dealers who make outstanding records as salesmen is also of considerable importance, and goes a long way in the development of seed marketing.

International seed movement

The following organizations are involved in international seed movement.,

- 1.The Organization for Economic Co-operation and Development (OECD)
- 2.World Trade Organization (WTO)
- 3.International Seed Testing Association (ISTA)
- 4.International Seed Trade Federation (FIS)

The Organization for Economic Co-operation and Development (OECD)

- **History: established in 1961**
- **Headquarters: Paris, France**
- **Membership: 36 countries**
- India is also member in OECD
- Inter-governmental Organization

The Organisation for Economic Co-operation and Development (OECD) **Seed Certification Schemes** is a global framework for the varietal certification of internationally-traded seed. The OECD schemes have made a substantial contribution to growth in the global seed trade, especially with respect to **field crops**. The United States, China, France and Brazil are the **largest seed markets in terms of value**. OECD **varietal certification standards are developed by an expert committee** consisting of the National Designated Authorities (NDA), researchers, industry and farmer representatives, as well as representatives of other international organizations. The certification standards are based on two key criteria: **varietal identity and varietal purity**.

The OECD Seed Certification Schemes

Schemes established in 1958

- Grass and legume seed
- Cereal seed
- Crucifer and other oil or fiber species seed
- Maize and sorghum seed
- Sugar beet and fodder beet seed
- Seed of subterranean clover and similar species
- Vegetable seed.

The Maize and Sorghum Seed Scheme is the largest of the seven. The schemes facilitate **imports and exports of seed** by the removal of technical barriers using labels recognized globally which, in effect, act as a “**passport**” for the seed traded.



World Trade Organization (WTO)

- **Inter-governmental Organization** that regulates international trade.
- **Established during 1st January 1995.**
- **WTO is result of “Uruguay round of Negotiations”**
- **Membership: 164 member countries**
- **India is also one of the member**
- **Headquarters: Geneva, Switzerland**
- **The WTO is a successor to GATT (General Agreement on Tariffs and Trade)**

Objectives of WTO

1. **To improve the standard of living of people** in the member countries.
2. **To ensure full employment** and broad increase in effective demand.
3. **To enlarge production and trade of goods.**
4. **To increase the trade of services.**
5. **To ensure optimum utilization of world resources.**
6. **To protect the environment.**
7. **To accept the concept of sustainable development.**

Functions of WTO

1. **To implement rules and provisions** related to **trade policy** review mechanism.
2. **To provide a platform** to member countries to **decide future strategies related to trade and tariff.**
3. **To provide facilities** for implementation, administration and operation of **multilateral and bilateral agreements** of the world trade.
4. **To administer the rules and processes** related to **dispute settlement.**
5. **To ensure the optimum use of world resources.**

International Seed Testing Association (ISTA)

- **History: established in 1924**
- **Headquarters: Zurich, Switzerland**
- **Membership: 225 Member Laboratories,**

35 Personal Members

63 Associate Members

Functions:

- To ensuring the uniformity in seed testing methods
- For global seed trade issue the international certificates

1. Orange or green-**Seed lot** Blue –**Sample**
2. Orange-Sampling and testing done in **same country**
3. Green-Sampling in one country and testing in **another country**

International Seed Trade Federation (FIS)

- **History: established in 1924**
- Objectives and functions
- -To **formulate and deliberate opinion of all concerned** in the seed trade
- -To **carry out Improvement of seed trade condition** between various countries
- -To **find out the solution to problems** in international seed trade
- -To **facilitate settlement of international disputes** in seed trade