Nature and Importance of Seed Technology

Whole of the world is facing a serious problem of procuring of food for the ever increasing population. By the year 2020, India would require 30 crore tonnes of food grains.
Present rate of increase in food production is 3% but need to raise it to 4%.

How do we achieve this target????

There are two ways:

- By increasing the area under production
- Increasing the yield per unit
  Cultivated area cannot be increased beyond a certain limit, unfortunately its decreasing day by day as vast areas of cultivated land are being used for housing and development of industries. Hence increasing yield is the only other possible way to attain this target.

  Next question is how to increase the yield????
- By adopting better agronomic practices
- Developing the improved plant varieties that could give more yield per unit area

But there is a limit of increasing the yield by using better agronomic practices, so development of high yielding varieties of crop plant is the only reliable and economical method.

Till mid sixties the pace of progress in Indian agriculture was very slow and the increase in production was achieved only by increasing the cultivated area.
But with the development of high yielding dwarf varieties of wheat and rice and hybrids of maize, sorghum and bajra which was responsible for Green Revolution in India the status of india changed from 'Begging Bowl' to the exporter of food grains. In this significant increase of agriculture production **Seed Technology** plays a major role as the yield potential gained by breeding can only be distributed through the seeds.

Seed technology is a science which deals with the production, processing, storage, testing and distribution of seeds.

or

A body of knowledge which deals on the production, handling and storage of seeds.

For scientific seed production, breeder seed is obtained from a recognised source and during seed production it is protected from all possible source of contamination an standard technique of seed productions are adopted. The seed thus produced has high germination ca[acity, optimum moisture content and is physically and genetically pure.

Seeds are the easiest and fastest means of plant multiplication. Therefore, knowledge in producing, handling and storing high quality seeds is necessary for successful crop production.

Concept of seed technology

The distinction between seed and grain is very important in agriculture.

What is a seed?

Seed : A seed is an "embryo", a living organism embedded in the supporting or the food storage tissue.
Or
A seed is a minute plant with nourishing and protecting tissues (Edmond et al., 1978).

Or

Seed -is a mature ovule consisting of an embryonic plant together with stored food, all surrounded by a protective coat (Copeland, 1976).

A seed is an embryonic plant in a resting stage usually – though not always – supplied with food reserves in cotyledons (seed leaves), endosperm (tissue normally derived from the triple fusion of two polar nuclei of the ovule with the second sperm nucleus of the pollen tube), or perisperm (tissue derived from nucellus); all this usually contained within protective structures consisting of the testa derived from the integuments of the mother plant and possibly other structures formed in a variety of ways (Roberts, 1972).

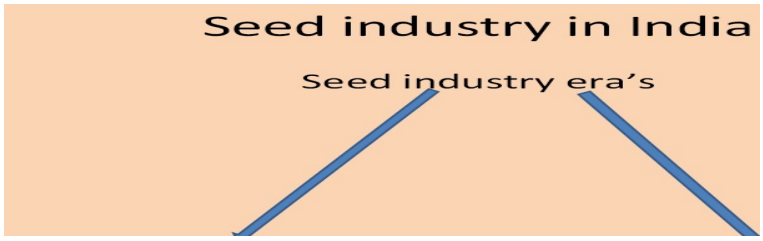
What's the difference between seed and grain?

Seed	grain
Obtained after well planned seed programme	Part of commercial produce, saved for sowing/ planting purpose
Result of sound scientific knowledge, organized efforts, investment on processing, storage and marketing facilities	No such knowledge or effort is required
Pedigree is known	Varietal purity is unknown
Good quality as off types, diseased plants, weed etc were removed at the time of production	Inferior purity and health status
Seed is tested for planting quality like germination, purity admixture of weed seeds, seed moisture content etc	Routine seed testing is not done
Seed quality is usually supervised by an agency not related with production (Seed Certification Agency)	No quality control
Seed has to meet the 'Quality standards'	No such standards apply here

Aims of the Seed technology

- High agricultural production by growing improved varieties
- Good quality of seeds re made available to the farmers
- Ensures the timely supply of seeds of new varieties to the farmers well before the time of sowing
- It also make sure that the price of the high quality seeds should remain low

History of Seed industry in india



- **Seed industry before independence**
- In the early years of 20th century, agriculture research was started at some agricultural colleges and research stations.
- In 1905 five agriculture colleges (Sabour, Lyallpur, Pune, Kanpur, Coiambatore) took up the task of agriculture research and developed the strains of Cotton , Wheat, Groundnut and Sugarcane.

State Department of Agriculture adopted two methods for the distribution of seeds of improved strains

1 In first methods seeds of improved varieties were multiplied at one location and distributed over large areas. This method replaced the local varieties grown by farmer with the improved varieties.

2 In the second method department distributed small quantity of seed to the farmers and expect that farmer will multiply their own seed.

- But when this method was tired in Bengal by distributing packets of jute and paddy seeds, this method was found not be useful and hence discontinued and only the first method was mainly recommended (Howard, 1928)

In United Provinces (U.P) the responsibly of replacing old varieties was placed on the State Department of Agriculture.

- Several seed multiplication laboratory were established in the state. Furthermore the seed multiplied in these laboratories were multiplied on land lord farms. This marked the beginning of the distribution of good quality seeds.
- In addition to that provision of liberal loans were also made to encourage the use of good quality seeds, particularly during uncertain weather.
- In 1922, on United province (UP) establish seed store in each Tehsil and the number of stores steadily increased.
- In 1925 Royal commission on agriculture constituted.

Suggestions of Royal commission

1. There should be separate department with in agriculture departments to deal with seed distribution and seed testing.
2. Seed distribution unit should be self sustaining.
3. Seed distribution should be organized by cooperatives, other associations, Seed merchants , seed agents and others.
4. Seed merchants of proven enterprise should be given encouragement

Following the suggestions of Royal comission

New crop research institutes in different crops were established in different states.

Improved varities of cash cops like ,sugarcane cotton, jute etc are developed.

Several Strains were howsoever developed but unfortunately seed multiplication and seed distribution work did not took pace.

Seed industry status on pre independence era

- Seed was multiplied on seed farms of agriculture department and on the farms of registered seed growers.

• Up to the yr 1939 vegetable seeds were brought from abroad.

• By the year 1945 Pvt. vegetable seed companies produced seeds in Quetta and Kashmir valley for temperate vegetable.

• On the year 1946 vegetable seed producing companies went under the association formation called as - All India Seed Growers, Merchants and Nurserymen's association.

Seed industry after independence

First five year plan (1951-56) – Greater emphasis was placed on the development of seed programmes during the First Plan Period.

- Grow More Food Enquiry Committee 1952 reported that seed impurity was the main cause of program failure.
- In the year 1952, Expert Standing Committee was setup by ICAR for the formulation of sound seed improvement program.

Benefits of the plan

- The system of distribution of improved seeds of food grains came into existence.
- The e experience gained in this was helpful in coordinating agricultural work

This plan was considered to be poor inspite of all the work. This program was only confined to seed distribution often with subsidy.

Second five year plan (1956-61) - Many important developments were took place during this period

- Special importance was given for the multiplication of nucleus seeds into foundation seeds at block level
- Setting of 4328 farms of 10 hectare each for the multiplication of nucleus seeds at the block level.
- Plans for setting up seed testing laboratories and cooperative stores were drawn

Coordinated crop improvement Schemes -

- First All India Coordinated Maize Programme (AICRP) by ICAR in collaboration with Rockfeller foundation on maize was set up in the year 1957 and this was considered to be the most significant turnign point in the Indian agriculture.
- Within the four years of establishment Four maize hybrids were released in 1961
- AICRP on Sorghum & Bajra were launched in 1960
- First sorghum and bajra hybrids were released in 1964 and 1965 respectively

Agricultural Production Team:

First Indo-American Agricultural production team (1959) headed by Dr Sherman E. Johnson from Ford Foundation examined India's food production problem. Their suggestions are :

1.Proper education of farmers for improved seed usage by the extension workers of all levels.

2.Agriculture department work on seed certification.

3.Cooperatives and private seed growers take care the work of seed supply.

4. Setting up of seed testing laboratory on the states.

5. Development of Uniform Seed Certification standards , Seed laws and Favourable economic climate.

• **Second Indo-American Agricultural production team (1959) headed by Dr Randhawa endorsed the first team observations.**

Evaluation of 2nd five year plan: The review of seed status by Programme evaluation organization (PEO)1960 made the following important observations

• Block farms of 10 hec ran into losses and handled mostly by non Agri -Graduates.

• Five % seeds farms are maintaining the purity.

• Large quantity of improved seeds are not used for sowing.

• Required amount of breeder seeds were not made available each year. • Only hybrid maize, bazra , sorghum are included in the seed programme.

Third five year plan 1961-66

•First four hybrids of maize released on yr 1961

• HYVP 1966 , for Maize, Bajra, Paddy and Wheat.

Commencement of NSC (National seed corporation)1963 by Agriculture ministry with the following objectives.

1. Establishment of foundation and certified seed corporation.

2. To encourage and assist production and marketing of seeds, seed certification programme and seed law enforcement.

3. Impart training on seed programs.

4. Acts as coordinator of seed programs.

Salient achievements of NSC

• Establishment of a **scientific seed industry**.

• Encouragement **of Indian Manufacturers for seed processing equipments**.

• Development of **field inspection methods, seed standards for seed certification and labeling.**

• Multiplication of Pre released varieties of national importance.

Annual plans 1966-1969

Enactment and Enforcement of seed act 1966

Review of seed status by Seed Review Team 1968

RECOMMENDATION OF SEED REVIEW TEAM. 1968

• Registration of Varieties

• Elimination of doubtful varieties,

• Avoidance of pre release publicity,

• SAU role for foundation seed production,

• Involvement of cooperative and private sector for seed production

Fourth five year plan (1969-74)

• GOI plan to select areas on basis of assured rainfall for food production target, by the supply of inputs for agriculture.

• Indian society of seed technology (ISST) formed on yr 1971 for sharing experience through seed research and seed technology news on yearly basis.

• Establishment of Tarai Development Corporation limited 1969 (TDC) with the assistance of world bank under National Seed programme.

• TDC has became an ideal organization for corporation for other states and in developing countries.

• TDC has been renamed as U.P. Seeds and Tarai development corporation wef 01st july 1978.

Unique features of TDC

Involvement of GBPUA&T for Supervision and guidance. • Integrated development approach Viz. Land levelling,mechanization,irrigation,electrification and credit also. • Concept of shareholders for seed growers.

• Compact area approach – under this scientist must be available on target area for the supervision and guidance.

• Strict quality control: Additional inspections made by GBPUA&T scientist , other than SSCA

• Testing of raw seed samples to ensure quality before packing.

• Money back guarantee in case of Sub standard lot. • Integrated approach of marketing to those dealers who simultaneously market fertilizer and pesticides.

Fifth five year plan (1974-79)

• National Commission on Agriculture(NCA) reviewed Indian seed industry and submitted its final report on 1976 with the recommendations on expansion, varietal registration, seed insurance, tax benefits, seed processing ,storage, seed research, seed law enforcement, seed certification, grow out tests and inclusion of seed tech as a course in Agril. university.

National seed programme (NSP)1975-76

National Seed Programme (NSP) was launched with the collaboration of world bank.

• NSP Phase I was launched in first four states Punjab, Haryana, Maharastra and Andhra Pradesh with the establishment of state seed corporation on their territory.

• NSP Phase II was launched in five states Karnataka, Rajasthan, Uttar Pradesh, Bihar and Orissa with the establishment of state seed corporation on their territory.

Sixth five year plan (1980-1985)

• Seed control order 1983 passed and enacted and declared that seed as an essential commodity under Essential Commodity Act 1955. Seventh five year plan (1985-1990)

• Strengthening of infra structure, facilities for seed production both in public and private sectors.

• NSP Phase III launched in four states namely Assam, West Bengal, Madhya Pradesh & Gujarat with the establishment of state seed corporation

Introduction of New Seed Development Policy (1988 – 1989)

was yet another significant mile stone in the Indian Seed Industry, which transformed the very character of the seed industry. The policy gave access to Indian farmers of the best of seed and planting material available anywhere on the world. Eighth five year plan (1992-97)

• High targets of seed production has been fixed.

• Emphasis given on seed production of Hybrid Varieties of Rice and other crops

ROLE OF PUBLIC & PRIVATE SEED SECTOR

The number of companies engaged in seed production or seed trade is around 400 or 500.

• The main focus of private seed companies has been on the high value low volume seeds viz. maize , sunflower and cotton. However, in the case of vegetable seeds and planting materials of horticultural crops, the private sector is the dominant player.

• The main focus of Public sector has been on for low value high volume seeds viz. cereals, pulses and oilseeds.

Seed Quality

The quality of seed is considered as an important factor for increasing yield. The use of quality seeds helps greatly in higher production per unit area to attain food security of the country. Farmer spend huge money in raising a crop by spending it on fertilizers, irrigation water, plant protection measures and some other operations like seed bed preparation, hoeing, weeding, harvesting, threshing, processing besides the costs of seed for sowing which is very nominal in comparison to the other inputs. So paying a little more towards the cost of good quality seed is a highly recommended. Only good quality seeds could give the expected response to fertilizers, irrigation water and other inputs. In seed industry special emphasis is given to the seed quality.

Good quality seeds mean the seed of an improved variety which is genetically and physically pure, have high germination and vigour. Has optimum moisture content and is of good health.

As per Seed Act (1966) seed includes

- Seed of food crops including edible oil seeds and seeds of fruits & vegetables.
- Cotton seeds
- Seeds of cattle fodder
- Jute seeds
- Seedlings, tubers, bulbs, rhizomes, roots, cuttings, all types of grafts and other vegetatively propagated material for food crops (or) cattle fodder

Why do we use quality seeds what are the benefits of using quality seeds?????

Benefits of using quality seeds

- They are genetically pure (true to type)
- The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited
- Less infestation of land with weed seed/other crop seed
- They are vigorous and free from pests and diseases

- Minimization of seed/seedling rate i.e., fast and uniform emergence of seedling
- Quality seeds respond well to the applied fertilizers and nutrients
- Uniform in plant population and maturity
- Aesthetically pleasing
- Yield prediction is very easy

Major seed quality characters

Knowledge about the various aspects of seed quality greatly contributed to agricultural development in the past and will continue to play a major role in future enhancement of crop production. The major seed quality characters are summarized as below:

1. **Physical Quality**: Physical qualities of the seed in a seed lot are characterized by the following:

• **Minimum of damaged seed**: Damaged (broken, cracked or shrivelled) seed may not germinate and is more likely to be attacked by insects or micro organisms. It is possible to eliminate most of the damaged seed during seed processing (conditioning).

• **Minimal weed seed or inert matter**: Good quality seed should be free of weed seeds (particularly noxious types), chaff, stones, dirt and seed of other crops. Almost all these impurities can be discarded during processing/conditioning.

• **Minimum of diseased seed**: Discoloured or stained seed are symptoms of seed that may carry micro organisms that already have attacked or will attack the seed when it starts to grow. The plant may live and spread the disease to other plants.

• **Near uniform seed size**: Mature medium and large-size seed will generally have higher germination and vigour than small and immature seed. In the conditioning (processing) of seed lot, undersized and light seed is normally eliminated.

Physical quality parameters such as seed uniformity, extent of inert material content, and discoloured seed can be detected by **visually examining seed samples**. **Closely examining handfuls of seed** is the **first step to better understanding the quality of seed**. This quality character could be obtained with seed lots by proper cleaning and grading of seed (processing) after collection and before sowing / storage.

(It is the cleanliness of seed from other seeds, debris, inert matter, diseased seed and insect damaged seed. The seed with physical quality should have uniform size, weight, and colour and should be free from stones, debris, and dust, leafs, twigs, stems, flowers, fruit well without other crop seeds and inert material. It also should be devoid of shrivelled, diseased mottled, moulded, discoloured, damaged and empty seeds. The seed should be easily identifiable as a species of specific category of specific species. Lack of this quality character will indirectly influence the field establishment and planting value of seed. This quality character could be obtained with seed lots by proper cleaning and grading of seed (processing) after collection and before sowing / storage.)

2 **Genetic purity:** This quality character is important for achieving the desired goal of raising the crop either yield or for resistance or for desired quality factors. Genetic qualities of the seed in a seed lot are characterized by the following:

• **Seed of the same variety:** Within crops (species) such as maize, rice or groundnuts there are thousands of distinct kinds of these crops. These distinct kinds of the particular crop are referred to as varieties or cultivars. Plants produced by seeds of a variety have the same characteristics and that these characteristics are reproducible from a generation to another. It is important to use the seed pof same variety.

• **Avoid mixing of different varieties of the same crop or species:** There are modern varieties that are the result of plant breeding and varietal development programmes, etc. Another kind of crop varieties are traditional varieties (landraces) that are produced and conserved by farmers which can be local population of plants selected by farmers or sometimes are modern varieties that were released many years ago. Seed of different varieties of the same crop are often difficult or impossible to distinguish once it is harvested. Mixing of different varieties of the same crop or species can occurs when the grain/seed is sold and it enters into the formal and informal marketing system. A mixture of varieties can be a problem because: mixed varieties may mature at different times which lead to problems in harvesting, post harvest handling, and results in lower yields. Additionally, each seed of an undesired variety in a mixture will produce seed when it is planted and those seeds will produce more seed so that each year the proportion of the undesired variety becomes greater. Field inspection followed by roguing (removal of undesirable plants) during the growing period of the seed crop is one of the steps taken to insure varietally pure seed in certified seed.

• **Adapted to the local conditions:**

Adaptation to soil, soil fertility, diseases, pests, day length, and moisture regimes are all important characteristics of a crop variety. Plants will grow well and produce an abundance of seed only in the proper environment. It is difficult to anticipate how a variety will respond to a different agro-ecological zone until it is actually grown there. It is also important to note that crop adaptation has a limit and it is wrong to believe that a variety can do well under all growing conditions.

• **Proper characteristics for use**: A crop must have the right organoleptic characteristics and this refers to processing, cooking, colour, and taste characteristics that are compatible with local preferences. Farmers have rejected many new varieties because of poor taste or cooking and processing factors.

• **Pest and disease tolerance:** Tolerance to pests and diseases (biotic factors) means that a plant can live with these organisms without significant loss of yield and quality. Obviously tolerance to important diseases and pest is extremely important and a major objective of plant breeders. Tolerance and resistance can breakdown with time due to mutations in the parasites or hosts. New sources of resistance and tolerance are always being sought by plant breeders. Having precise information on disease and pest tolerance of a variety is important when considering the introduction of new crops and varieties.

• **High yielding ability :** High yielding ability is linked to a range of plant characteristics including plant architecture, nutrient use efficiency and factors mentioned above i.e. adaptation to local conditions, pest and disease tolerance etc. Higher yields mean more food and income for farmers. For poor farmers it is important that the high yield can be achieved under low input conditions (minimal or no fertilizer and pesticides) or with the use of organic or mineral soil amendments.

(It is the true to type nature of the seed. i.e., the seedling / plant / tree from the seed should resemble its mother in all aspects.. The success of hybrid seed production is dependent on the genetic purity of parental lines. Both outcrossing and the inadvertent mixing of seed can compromise seed quality, therefore genetic purity tests are critical tools for seed producers and plant breeders.

Higher genetically purity:

- Breeder /Nucleus - 100%
- Foundation seed - 99.5%
- Certified seed - 99.0%)

3 Physiological Quality

High germination and vigour: The germination percentage is an indicator of the ability of the seed to emerge from the soil to produce a plant in the field under normal conditions. Seed vigour is the capacity of seed to emerge from the soil and survive under potentially stressful field conditions and to grow rapidly under favourable conditions. Decrease in seed vigour and other physiological changes happen before loss of germination. Therefore seed with acceptable germination can be low in vigour. Seed can only fulfil its biological role if it is viable. Therefore, physically uniform seed of an adapted variety will be useless if it is low in germination and vigour or if it fails to germinate when planted. The difference between grain and seed is that the former may or may not germinate while he latter must germinate. This is why the germination, particularly high percentage of it, is such an important technical specification for seed.

How to achieve this??

Physiological quality of seed could be achieved through proper selection of seed (matured seed) used for sowing and by caring for quality characters during extraction, drying and storage. Seed with good vigour is preferable for raising a good crop. Hence selection of seed based on seed vigour is important for raising perfect finalize plantation.

Or

Physiological Quality: It is the actual expression of seed in further generation / multiplication. Physiological quality characters of seed comprises of seed germination and seed vigour. **The liveliness of a seed is known as viability**. The extent of liveliness for production of good seedling or the ability of seed for production of seedling with normal root and shoot under favourable condition is known as germinability. Seed vigour is the energy or stamina of the seed in producing elite seedling. It is the sum total of all seed attributes that enables its regeneration of under any given conditions. Seed vigour determines the level of performance of seed or seed lot during germination and seedling emergence. Seed which perform well at sowing are termed as quality seed and based on the degree of performance in production of elite seedling it is classified as high, medium and low vigour seed. The difference in seed vigour is the differential manifestation of the deteriorative process occurring in the seed before the ultimate loss of ability to germinate. Difference in seed vigour will be expressed in rate of emergence, uniformity of emergence and loss of seed germination. Hence it is understood that all viable seeds need not be germinable but all germinable seed will be viable. Similarly all vigourous seeds will be germinable but all germinable seed need not be vigourous. Physiological quality of seed could be achieved through proper selection of seed (matured seed) used for sowing and by caring for quality

characters during extraction, drying and storage. Seed with good vigour is preferable for raising a good plantation as the fruits, the economic come out are to be realized after several years. Hence selection of seed based on seed vigour is important for raising perfect finalize plantation.)

4 **Seed health**

Seed health refers to the presence or absence of disease-causing organisms, such as fungi, bacteria and viruses, and animal pests, including nematodes and insects. Seed health testing can be carried out in seed laboratories in orders to assess seed sanitary quality, Ensuring seed health is important because :

• The diseases initially present in the seed may give rise to progressive disease development in the field and reduce the commercial value of the crop.

• Imported seed lots may introduce diseases or pest into new regions.

The main way of avoiding the contamination of seed by pests and diseases is to use proper seed production practices, i.e. to control pest and disease during the seed production process. However, if a seed becomes infested with insects then it can be fumigated. Some seed borne diseases can be controlled or suppressed by the seed treatment during the seed processing or just prior to planting.

Seed Health - Health status of seed is nothing but the absence of insect infestation and fungal infection, in or on the seed. Seed should not be infected with fungi or infested with insect pests as these will reduce the physiological quality of the seed and also the physical quality of the seed in long term storage. The health status of seed also includes the deterioration status of seed which also expressed through low vigour status of seed. The health status of seed influences the seed quality characters directly and warrants their soundness in seed for the production of elite seedlings at nursery / field.

Categories of Seeds

Seed production is a continuous process and every year a huge quantity of seed is needed to meet the demands of crop production. This huge quantity of improved variety cannot produce in single year and quality and cost of seed has to be kept under control. Therefore, seeds of improved varieties are produced in several stages and each stage generate a particular class of seeds.

Improved seeds till some years ago, had the following five classes:

a. Nucleus or basic

b. Breeder seed
c. Foundation seed
d. Registered seed
e. Certified seed

But at present registered seed is not produced in our country. Therefore we will discuss 4 classes of seeds.

1 **Basic or Nucleus Seed**: Basic or nucleus seed is the original or first seed (propagating material) of a variety available with the producing breeder. This seed has 100% genetic dm physical purity along with high standards of all other quality parameters. Nucleus seed is multiplied and maintained by selection individual pos/spikes/plants and growing individual pod/spike/plant progenies. This process is repeated continuously. Therefore, nucleus seed is available only in small quantities.

Nucleus seed is further divided into two subclasses: (1) Nucleus seed stage I (NSSI) and (2) Nucleus Seed stage II (NSS II).

Nucleus Seed Stage I is obtained as follow: the true –to- type plants/ears/pods are selected from a field of nucleus seed of the variety in question, sees are grown in separate progeny rows and seeds form true to type rows are composite to constitute NSS I seed.

When NSSII is to be produced, seeds from the true to type progeny rows (obtained as described for NSS I) are harvested separately and grown in separate progeny plots. True to type plots are selected and their seeds are composited to obtain NSS II. Generally NSS II is produced only when the demand for nucleus seed is high and cannot met with the nucleus seed I.

2 **Breeder seed: Breeder** seed is the progeny of the nucleus seed and is produced under the direct supervion of the concerned plant breeder in th crop improvement programme of the concerned crop and quality of the seed is supervised by a Breeder Seed Monitoring Team which provides a certificate that the quality of seed has been tested by it and found satisfactory. Minimum seed standard for the breeder seed is less stringent than the nucleus seed but more stringent than the foundation seed. A golden yellow coloured certificate is issued for this category of seed by the producing agency. This seed is used for the production of foundation seed.

3 **Foundation seed:** It is the progeny of the breeder's seed It is produced by government farms, experimental centres or competent growers under the supervision of a seed certification agency (N.S.C). Sometimes the foundation seed is produced form the foundation seed to increase it quantity. The certification agency issues a white coloured certificate to this category of the seed. It is not as pure as the breeder's seed. It is used for the

production of certified seeds. It's important to produce this class of seed in the area of adaptation of concerned variety.

4 **Certified seeds:** The certified seed is the progeny of foundation seed, registered seed or certified seed itself. It is produced on government farms or by registered seed grower as per minimum seed certification standards under the supervision of a seed certification agency, so the genetic purity and quality is maintained. The certified seed is supplied to the farmers for commercial crop production. The tag of certified seed is of blue colour and carries all the relevant information about the certified seed lot contained in the bag.

Seed deterioration

Seed deterioration is loss of seed quality, viability and vigor due to effect of adverse environmental factors. Deteriorative changes enhance when seed exposure to external challenges increases and decrease the ability of the seed to survive. It is an undesirable attribute of agriculture. Annual losses due to deterioration can be as much as 25% of the harvested crop. It is one of the basic reasons for low productivity (Shelar et al., 2008). Several factors are responsible for the deterioration in the genetical and physical purity of a variety and other quality characters during seed multiplication, processing and distribution cycle:

(1) **Environmental factors**: Although, the variation caused by environment factors is not hereditary, the environment does affect the expression of the characters of economic importance fully. The type of soil, soil moisture and temperature, etc., affects the germination, while the soil fertility and fertilizers affect the quantity and quality of the produce. So, in scientific seed production, every effort is made to provide favorable environmental conditions.

(2) **Genetic Changes**: Genetic shifts appears in the seeds of many varieties of crop plants due to the following factors:

   (a) **Developmental variations**: if a variety of some crop that is adapted to a particular set of environmental conditions is grown in a quite different environment for several consecutive generations, it tries to acclimatize and in doing so, developmental variations may arise. So, the varieties should be grown in areas and climatic conditions recommended for their cultivation.

   (b) **Natural Crossing**: Some amount of out-crossing (1-5%) occurs even in self-pollinated crops. So, natural crossing with undesirable type is most important source of deterioration in genetic purity due to introgression of undesirable genes into the variety, particularly in cross-pollinated crops. So, in scientific seed production, besides verification of seed source and fulfillment of the preceding crop requirements, the seed crop is grown in proper isolation and undesirable plants (diseased, other crop plants and weeds) are rouged out from the standing crop.

(c) **Spontaneous mutations**: Mutations are very infrequent and slow in occurrence and micro mutations are difficult to be detected and are not of much consequence. However, mutations with large and perceptible effects constitute a major factor in changing the genetic makeup of the varieties. Such plants should be rouged immediately when they are noticed in the field.

(d) **Segregation**: Sometimes, a new variety is recommended for cultivation in haste before completing the evaluation process, even though it may continue to segregate for some characters. Eventually this variety may face rapid run off. Care during maintenance of breeder's seed should be taken in such case.

(3) **Mechanical mixture:** During seed production, harvesting, threshing, processing and storage, seeds of other varieties and crops can get mixed with the seed crop, which may cause considerable damage to the quality of the seed to be used to raise the next crop. Machines used in these operations, threshing floors, seed bins, elevators, seed bags, volunteer plants and harvesting of undesirable plants with the seed crop are source of mechanical contamination. Seed need to be protected from all possible source of contamination at all stages of seed production, processing and distribution.

(4) **Diseases and pests**: If the seed used for sowing the seed crop is not treated with fungicides and insecticides, it may carry seed-borne diseases and insects and pests which may attack the seed crop. Secondly, an improved variety which showed resistance at the time of release, fails to show the same intensity of resistance as new races of pathogens may arise subsequently due to evolutionary mechanism. Thus, the yield and quality of seed crop are reduced. So, in scientific seed production, plant protection measures are adopted, the seeds are treated before storage and grow out tests are conducted before sowing.

(5) **Moisture content**: Moisture is the most important factor affecting the health and viability of the seeds. Safe moisture content is required in the seed during processing, storage and distribution to maintain desirable quality and viability of the seed. The moisture content in the seed should not so low that it may affect the viability and not so high that it may get attacked by the diseases and insect pests easily. When the moisture content of the seeds is high, heat evolved due to increased rate of respiration, harm the seeds, the seeds are decayed and germination percentage is decreased. In scientific seed storage, the rate of respiration is checked by lowering the moisture content of the seed.

(6) **Mechanical injury**: Sometimes, the seeds are mechanically injured during harvesting, threshing and processing due to mechanical faults or high moisture content in the seeds. Such seeds are more susceptible to the microorganisms and insects-pests and cannot tolerate the chemicals during seed treatment. So it is necessary that machines function efficiently.

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