# Seed






## Seed:

- Any plant part used for raising the crop is seed. Seed include true seed seedling cutting, rhizome, grafts, roots etc used for Propagation.
- Botanically seed is matured integument mega sporangium. Seed is also defined as matured ovule consisting or embryonic together with store of food surrounded by protective coat.

# Difference between Seed and Grain



| Sr.No | Seed | Grain |
|---|---|---|
| 1 | Any plant part used for propagation is seed. It includes seeds category , rhizome , grafts etc. | It is final produce of grain crops used for consumption. |
| 2 | Can be treated with fungicide, pesticide. | Not treated with fungicide and Pesticide. |
| 3 | Embryo is important. | Endosperm is important. |
| 4 | Viability is important. | Viability never considers. |
| 5 | Genetic purity must. | Genetic purity not necessary |
| 5 | Genetic purity must. | Genetic purity not necessary |
| 6 | Comes under preview of seed acts. | Comes under preview of food acts. |

## The Parts of a Seed and Their Functions in Seed and Plant Development

- There are three basic parts of a seed in the angiosperms:
  - (a) An embryo,
  - (b) A food storage or nutritive tissue, and
  - (c) Seed covering.

# Embryo

- A mature seed has a diploid (2N) embryo which develops from a fertilized egg or zygote. It results from the union of a sperm (1N), from a germinated pollen, with a female egg (1N) in the embryo sac.
- The embryo can be distinguished from the other major parts of a seed based on component parts and function. It consists of the epicotyl, hypocotyl, radicle, and one or two cotyledons.



## Types of Seeds According to the Number of Cotyledons:

Seeds are of two types according to the number of cotyledons.

**A. Monocotyledonous Seeds:**

- These seeds contain only one cotyledon; for example, wheat, bajra, maize and rice.

**B. Dicotyledonous Seeds:**

- These seeds contain two cotyledons; for example, mango, gram and pea.



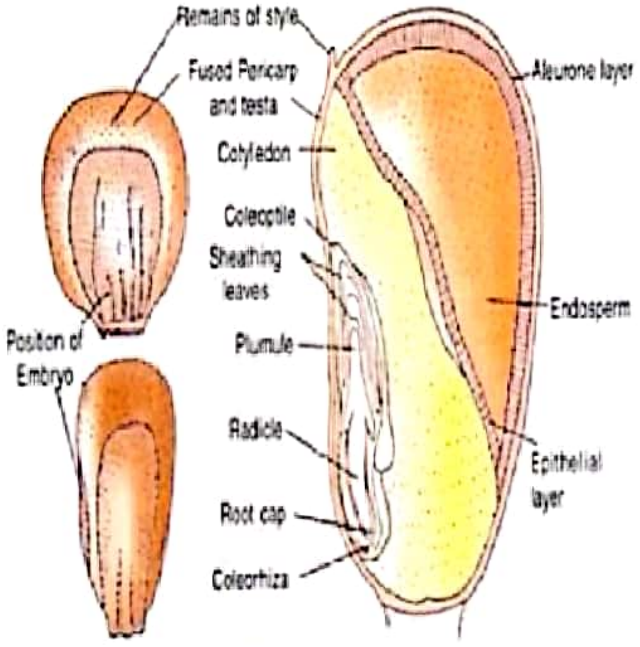



Fig. 3.1. Maize Seed

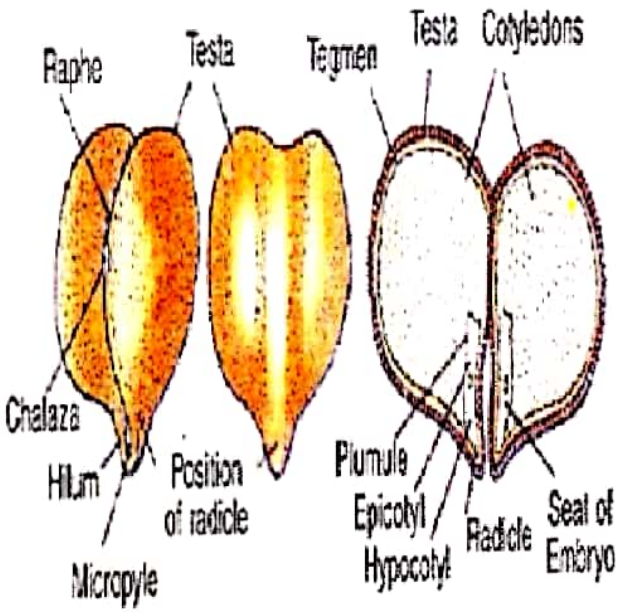
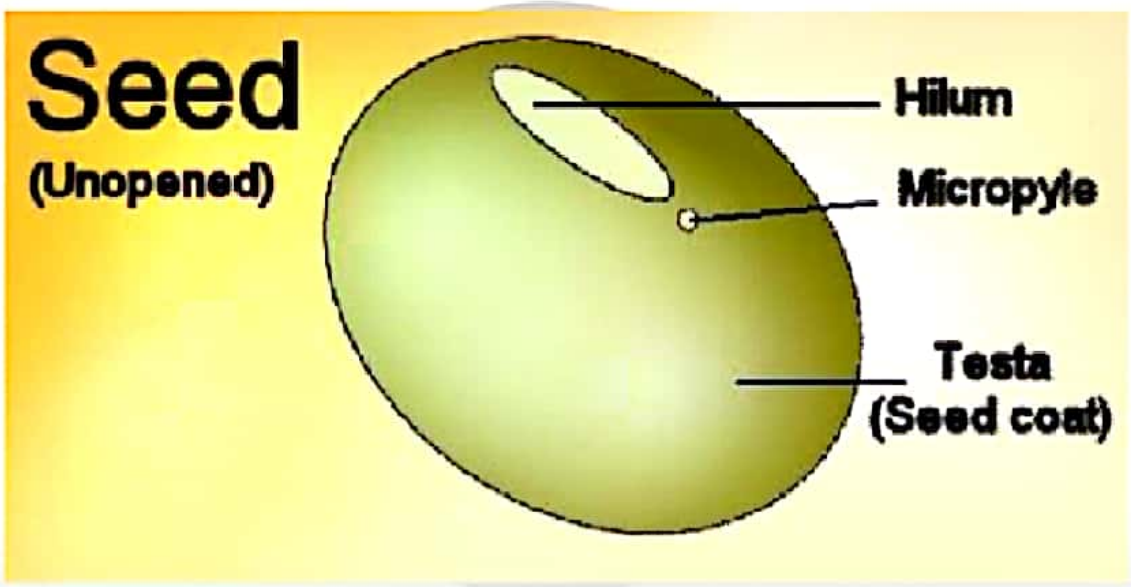



Fig. 3.2. Gram seed.



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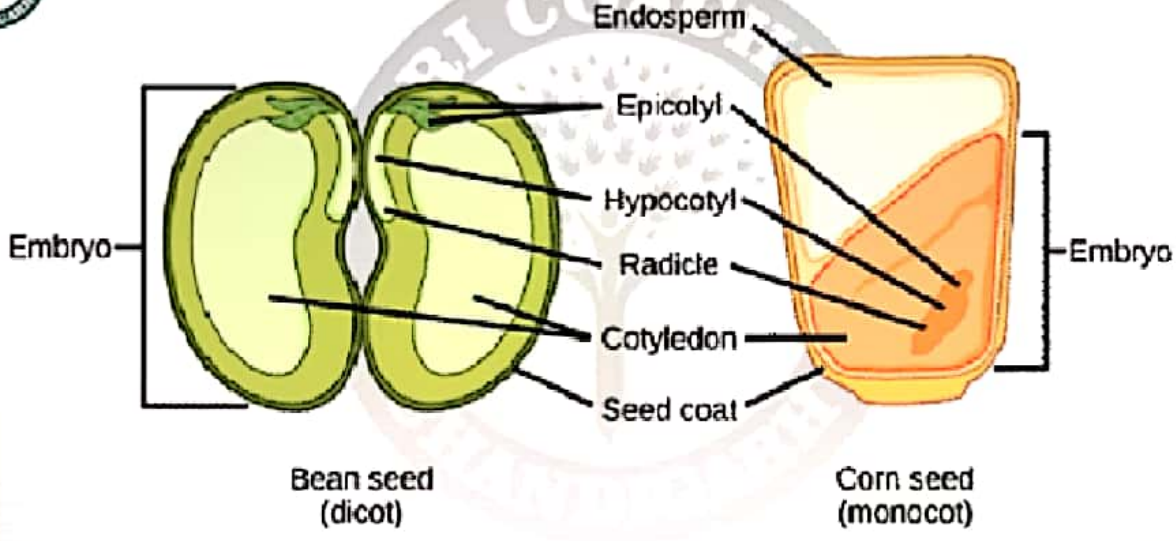
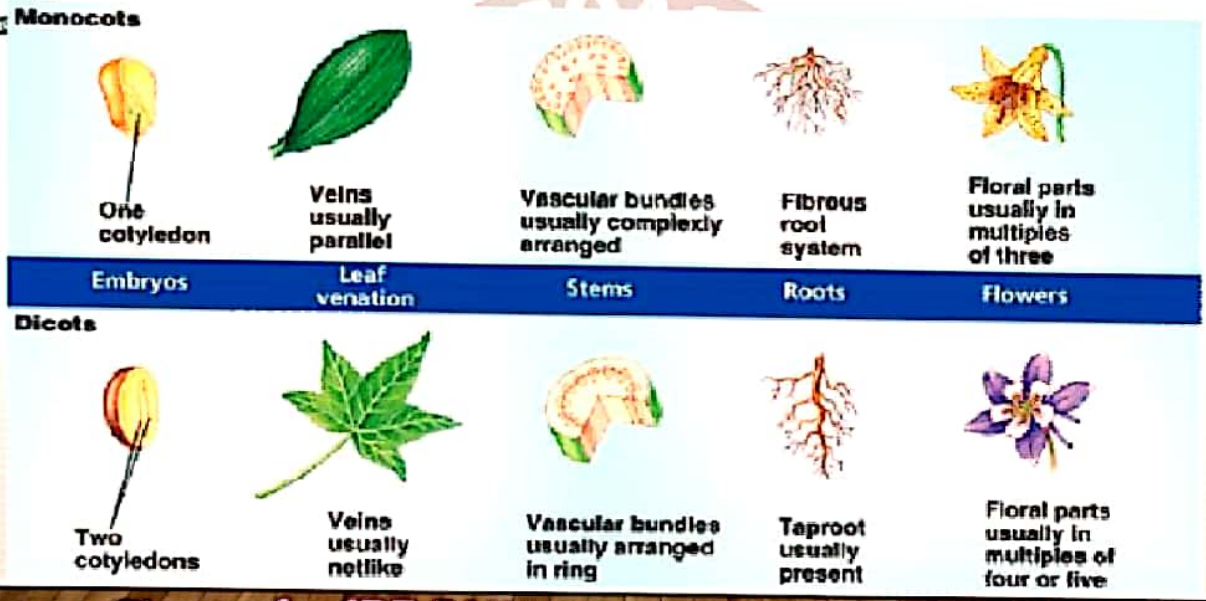
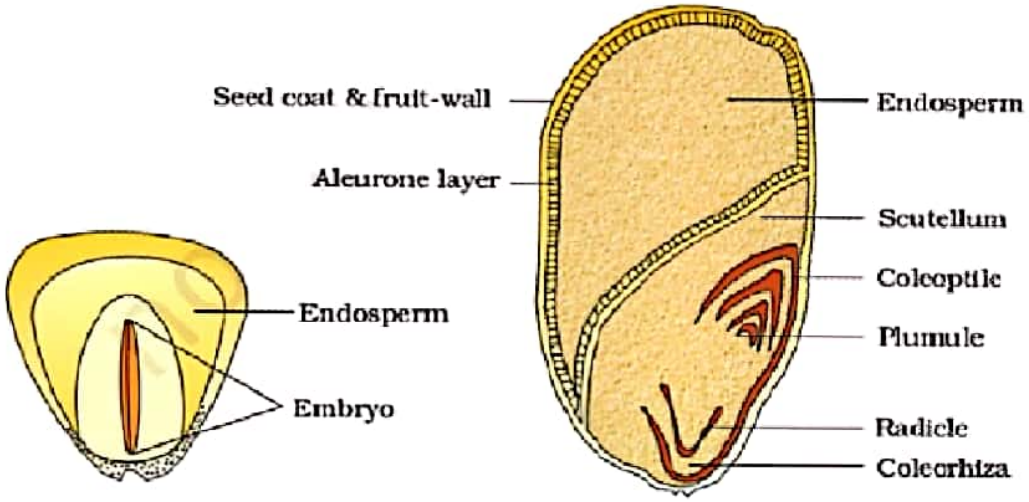


# Monocotyledons and Dicotyledons






Structure of a monocotyledonous seed



# Storage Tissues

- The stored food is present in most seeds in the form of carbohydrates, fats and proteins. This stored food may be found in the following parts of a seed: endosperm, cotyledons, or in the perisperm.
- The endosperm differs from other parts of a seed by having a triploid chromosome complement (3N).
- The perisperm is a storage tissue that originates from the nucellus.
- When the plant food is stored outside of the embryo in a large endosperm, the seed is called albuminous.

## Seed Covering

- The seed coat is developed from the outer covering of the ovule, or integument.
- There are usually two layers of the seed coat. The outer layer, known as the testa, is thicker. The inner one is more delicate, known as tegmen.
- The hilum is usually visible also, the scar left by the stalk which attached the seed to the placenta.
- On some seed coats, the opening in the integuments of the ovule, called micropyle, is visible. Which is present near hilum.



## Dispersal of Seed

- The scattering of seed for growing away from their parent plant is called dispersal of a seed.
- There are following types of dispersal of seeds.
- **1. Wind**
- **2. Water**
- **3. Animals**
- **4. Explosion of fruits**



# Seed Technology

# History of seed technology

- Seed certification begin in Sweden
  - ISTA 1924
  - 1919- International crop improvement Association renamed as Association of seed certification agency in 1969
  - 1946 Association gives four classes of seed in forage crops( propose the same for grain crop in 1968)
  - 7th March, 1963 National seed Corporation
  - 1966 Indian seed act come into force in 1969
    seed (Amendment) Act 1972



- The enactment of first Indian Seed Act in the year 1966 and formulation of Seed Rules in 1968. The Seed Act of 1966 provided the required impetus for the establishment of official Seed Certification Agencies by the States.
- Maharashtra was the first State to establish an official Seed Certification Agency during 1970 as a part of the Department of Agriculture, whereas Karnataka was the first State to establish the Seed Certification Agency as an autonomous body during 1974.
- At present 22 States in the country have their own Seed Certification Agencies established under the Seed Act, 1966.
- In India, seed certification is voluntary and labelling is compulsory.

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## Significant landmarks in the development of Indian Seed Industry & legislation

| Year | Important Event |
|---|---|
| 1963 | Establishment of National Seed Corporation in New Delhi. |
| 1966 | The first Indian Seed Act was formulated. |
| 1968 | Seed Rules were framed to implement various legislation given under seed act 1966. |
| 1972 | The seed act 1966 was amended |
| 1974 | The Seeds (amendment) rules 1974 were introduced. |
| 1976 | The National Seed Project was launched by ICAR New Delhi. |
| 1978 | The UPOV Seed Act was introduced. |
| 1983 | The Seed (Control) order 1983 was introduced. |
| 1988 | The New policy on seed development was introduced. |
| 1989 | Plants, Fruits and Seed order 1989 was introduced. |
| 2001 | The protection of plant varieties and farmers rights act was formulated. |
| 2002 | The National Seed Policy was formulated. |
| 2003 | Plant quarantine (regulation of import into India) was introduced. |
| 2003 | Protection of plant varieties rules 2003 was introduced. |
| 2004 | The New Seed Act was formulated and introduced to replace seed act of 1966. |
| 2005 | The Seed Act 2004 came into force in Jan. 2005 |

# Organizations

| CSC | Central Seed Committee |
|---|---|
| CSCB | Central Seed Certification Board |
| FIS | Federation of International Seed Trade |
| HSS | Herbage Seed Scheme |
| ISST | Indian Society of Seed Technology |
| NSC | National Seeds Corporation |
| NSDC | National Seeds Development Council. |
| NSP | National Seeds Programme |
| NSSL | National Seed Storage Laboratory |
| SCST | Society of Commercial Seed Technologists |
| SIDP | Seed Improvement and Development Programme |
| SRT | Seed Review Team |
| SSC | State Seed Corporation |
| SSCA | State Seed Certification Agency |
| SSCB | State Seed Certification Board |
| UPS & TDC | Uttar Pradesh Seeds and Taral Development Corporation |

## NATIONAL SEEDS CORPORATION: ( NSC):

- The NSC was established to serve two main objectives: first, to promote the development of a seed industry in India and second to produce and supply the foundation seeds of various crops.

### The NSC performs following functions:

- Production and supply of foundation seed.
- To maintain improved seed stocks of improved varieties
- Interstate marketing of all classes of seed.
- Export and import of seed.
- Production of certified seed where required.



- Planning the production of breeder seed in consultation with ICAR.
- Providing technical assistance to seeds corporations and private agencies.
- Co-ordinating certified seed production of several State Seeds Corporations.
- Conducting biennial surveys of seed demand.
- Coordinating market research and sales promotion efforts.
- Providing training facilities for the staff participating in seed industry development.
- Providing certification services to states lacking established and independent seed certification agencies.

## STATE SEED CERTIFICATION AGENCIES (SSCA) :

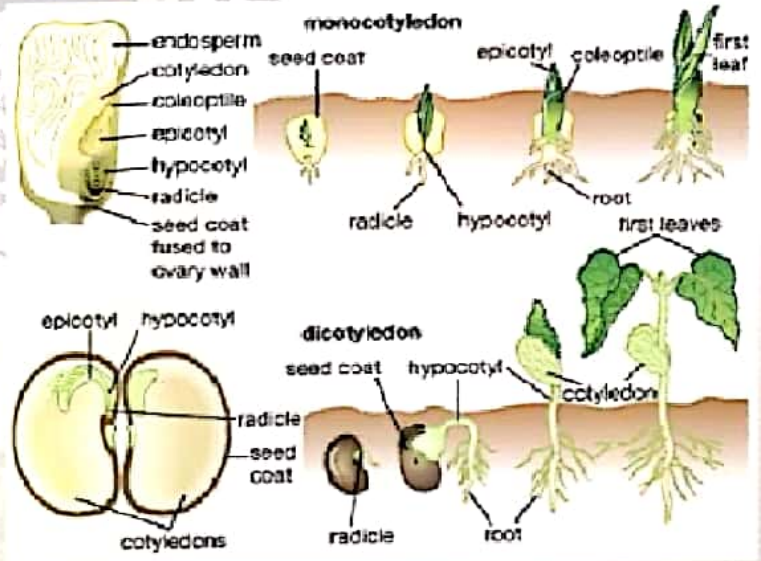
The SSCA's perform the following functions:

- They screen the applications from seed growers for seed certification and decide on their fitness,
- They also check and verify the appropriateness of the source seed used for growing the seed crop under certification,
- They carry out the requisite field inspections,
- They conduct the seed tests,
- They certify the seeds found suitable and issue the appropriate tags both for certified and foundation seeds,
- They guide the seed growers on production, processing and distribution of seeds,
- They conduct short courses on seed production,etc.for seed growers,
- and they participate in other activities conductive to the development of seed industry, e.g. preparing and publishing lists of plant breeders, seed growers, etc.



## Four essential factor for germination of seed:

- Capacity of seed to germinate.
- Moisture
- Temperature
- Oxygen supply

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- **Seed index:**
  - Weight of 100 seed is called seed index.
- **Test weight:**
  - Weight of 1000 seed is called test weight.

# Importance of Seed in Crop Production:

- The green revolution was only possible with production of generally pure seeds.
- Only seeds of assured quality can be expected to respond to fertilizer and other inputs in expected manner, otherwise see of hope may turn into seed of frustration.
- The good seed also increase the efficiency of the factor of crop production.



# Role and Goal of Seed Technology in Crop Production

- 1. A carrier of new technologies:
- 2. A basic tool for secured food supply:
- 3. The principle means to secure crop yield in less favorable area of production:



# Goals of Seed Technology:

- 1. Rapid Multiplication:
- 2. Timely supply:
- 3. Assured high quality of seeds:
- 4. Reasonable price:

## Characteristics of good quality seed

- It must be genetically pure
  - Breeder /Nucleus - 100%
  - Foundation seed - 99.5%
  - Certified seed - 99.0%
- It should have the required level of physical purity for certification
  - All crops - 98%
  - Carrot - 95%
- It should have high pure seed percentage
  - Ladyfinger -99.0 %
  - Other crops -98.0 %
  - Sesame, soybean &jute -97 .0 %
  - Ground nut - 96.0 %



- It should be free from other crop seeds, expressed in number /kg
- It should be free from designated diseases
- It should have good shape ,size ,colour, etc., according to specifications of variety
- Should have high physical soundness &weight
- It should posses high physiological vigour and stamina
- It should posses high longevity and shelf life
- It should have optimum moisture content for storage
  - long term storage - 8 % & below
  - short term storage -10-13%
- It should have high market value



## Seed formation

- A true seed is defined as a fertilized mature ovule consisting of embryo, stored food material and protective coats. The important events involved in seed development and maturation include
- Pollination
- Fertilization
- Development of the fertilized ovule by

  a. cell division

  b. accumulation of reserve food material and

  c. dehydration.

# Principles of Quality Seed Production

- Genetic principles
- Deterioration of varities
- **Genetic purity (trueness to type) of a variety can be deteriorating due to several factors during production cycles.**



## The important factor & real deterioration of varities listed by Kadam (1942) & these are

- Developmental variations
- Mechanical mixtures
- Mutations
- Nature crossing
- Minor genetic variations
- Selective influence of diseases
- The technique of plant breeder



# Genetic Purity during Seed Production

- Providing adequate isolation to prevent contamination by natural crossing or mechanical mixtures.
- Rouging of seed fields, prior to the stage at which they could contaminate the seed crop
- Periodic testing of varieties for genetic purity
- Avoiding genetic shift by growing crops in areas of their adaptation only.
- Certification of seed crops to maintain genetic purity & quality seed.
- Adopting generation system. (the seeds produced is restricted to four generation only i.e. starting from breeders seeds.) and the seeds can be multiplied up to three more generations i.e. foundations, registered and certified.

# Control of seed source:

- For raising a seed crop the seeds should be required from an approved source and from an appropriate class is necessary.
- Four classes of seeds are generally recognized in seed certification namely breeder seed, foundation registered and certified. These classes are recognized by AOSCA i.e. Association of official seed certifying agencies.



# Preceding Crop Requirements:

- Preceding Crop Requirements has been fixed to avoid contamination through volunteer plants and also from soil borne diseases. (Volunteer plants mean plants grown in the field from previous crops).

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# Isolation:

- Isolation is required during seed crop production to avoid contamination due to natural crossing and diseases infection by wind and insects from neighboring field and also during sowing, harvesting, threshing and handling of seeds to avoid mechanical mixtures.

## Isolation Distance of Different Crops

| Crop | Distance for Foundation seed (m) | Distance for Certified seed (m) |
|---|---|---|
| **Self-pollinated crops** | | |
| Wheat | 3 | 3 |
| Rice | 3 | 3 |
| Rice (hybrid) | 200 | 100 |
| Barley | 3 | 3 |
| Oats | 3 | 3 |
| Groundnut | 3 | 3 |
| Black gram | 20 | 10 |
| **Cross Pollinated Crop** | | |
| Maize, Mustard/ rapseed | 400 | 200 |
| Pearl millet (Hybrid) | 1000 | 200 |
| Pearl millet (common) | 400 | 200 |
| Cauliflower | 1600 | 1000 |
| Cucurbits | 800 | 400 |
| Cabbage | 1600 | 1000 |
| Carrot | 1000 | 800 |
| **Often Cross pollinated crop** | | |
| Cotton | 50 | 30 |
| Sorghum | 200 | 100 |

## Rouging of seed fields:

- The off time plants i.e. plants offering in their characteristic from those of the seeds variety is another source of genetic contamination. Their continued presence would certainly deteriorate the genetic purity of the variety. The removal of such type of plant is referred as "rouging".



## Seed certification:

- The genetic purity in commercial seed production is maintained through a system of seed certification.
- After harvest crop they variety the quality and at the processing plants they take samples for seed testing and also for grow-out-test.

## Seed Multiplication Ratio

| Crop | Seed Multiplication Ratio | Crop | Seed Multiplication Ratio |
|---|---|---|---|
| Wheat | 1:20 | Lucerne | 1:25 |
| Paddy | 1:80 (Varieties) | Oats | 1:15 |
| | 1:100 (Hybrids) | Bhendi | 1:100 |
| Maize | 1:80 (Varieties) | Tomato | 1:400 |
| | 1:100 (Hybrids) | Brinjal | 1:450 |
| Sorghum | 1:100 | Chillies | 1:240 |
| Bajra | 1:200 | Watermelon | 1:100 |
| Ragi | 1:80 | Pumpkin | 1:160 |
| Gram | 1:10 | Bittergourd | 1:41 |
| Blackgram | 1:40 | Bottlegourd | 1:99 |
| Greengram | 1:40 | Ridgegourd | 1:83 |
| Cowpea | 1:40 | Cucumber | 1:200 |
| Horsegram | 1:40 | French bean | 1:9 |
| Moth bean | 1:40 | Clusterbean | 1:50 |
| Red gram | 1:100 | Peas | 1:19 |
| Cole crops | 1: 433 | Onion | 1:171 |
| Potato | 1:4 | Radish | 1:100 |
| Groundnut | 1:8 | Carrot | 1:83 |
| Linseed | 1:50 | Mustard and rape | 1:100 |
| Cotton | 1:50 | Soybean | 1:16 |
| Jute | 1:100 | Sunflower | 1:50 |
| Sunhemp | 1:30 | Safflower and castor | 1:60 |
| Berseem | 1:10 | Lucerne | 1:25 |

# Seed vigour

- Seed vigour as " the sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence'".
- Seed vigour is still a concept rather than a specific property of a seed or seed lot. Several factors like; genetic constitution, environment and nutrition of mother plant, maturity at harvest, seed weight and size, mechanical integrity, deterioration and ageing and pathogens are known to influence seed vigour.



# Seed Purity

- To avoid admixture in seed of a particular variety or crop the buyer can be protected by the seed regulation laws or acts in many countries, for this purpose in many countries "seed testing stations or seed testing laboratory" are set up & these stations or laboratory are associated with ISTA (International seed testing association)

## Grow - Out Test

- **Grow - Out Test** is performed to determine the genetic purity status of a given seed lot of the notified cultivar / hybrid and the extent to which the sample in question conforms to the prescribed standards.
- Grow-out Test is the official measure for controlling the genetic purity of the seed lot. It serves as a pre-control as well as a 'post-control' test for avoiding genetic contaminations.



## Tetrazolium chloride test

- Tetrazolium salt stains all living tissue in the seed embryo red, thus enabling trained analysts to determine the seeds viability or otherwise.
- The tetrazolium test is used to give a quick estimate of germination potential.
- The tetrazolium test will not detect certain types of abnormalities nor will it give any indication of disease levels, chemical damage or dormancy.



## Stages of Seed Multiplication

- **Nucleus seed**
- **Breeders seed**
- **Foundation seed**
- **Registered seed**
- **Certified seed**

# Nucleus seed:

- It is the initial amount of pure seed of an improved variety available with plant breeder who has involved it. The nucleus seed is sent per sent pure genetically as well as physically and is very limited in quantity.

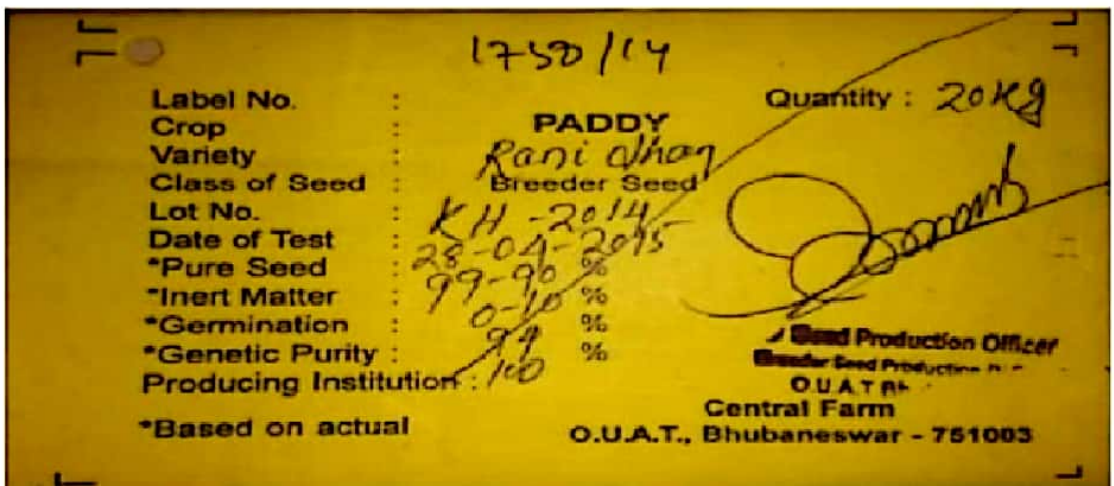


# Breeder's seed:

- It is the seed obtained from the progeny of nucleus seed. It is directly supervised by a breeder concern with the crop. Its genetically and physical purity to be 100 per cent.
- After passing the seed lot, breeder seed tags in buff colour or Golden Yellow are signed by the concerned breeder and tagged to the breeder seed bags size of tag 12X 6 cm



## Breeder's tag (Golden yellow)



# Foundation seed:

- It is seed obtained from nucleus or breeder's seed. It is produced on seed multiplication farm of a state govt. Universities.
- Foundation seed plots are jointly inspected by the SCA (seed certification agency), it is not as pure as the nucleus and breeder's seeds are.
- The bags are sealed with white colored label & sealed the bag by using lead seal size of foundation tag is 15 X 7.5



## Foundation tag (White)




# Registered seed:

- It is raised from nucleus, breeders or foundations seeds. Registered seed growers are selected from progressive farmers. The maintenance of purity from time to time. The purity is maintained through field inspections by seed certifying agencies and seed tests.
- The bags are sealed with purple colored label.




# Certified seed:

- It is progeny of registered or foundation seed. When the amount of seed registered seed id supposed to be inadequate to meet farmers agency.
- The bags are scaled with Azar blue colored label. Size of tag 15X 7.5 cm.

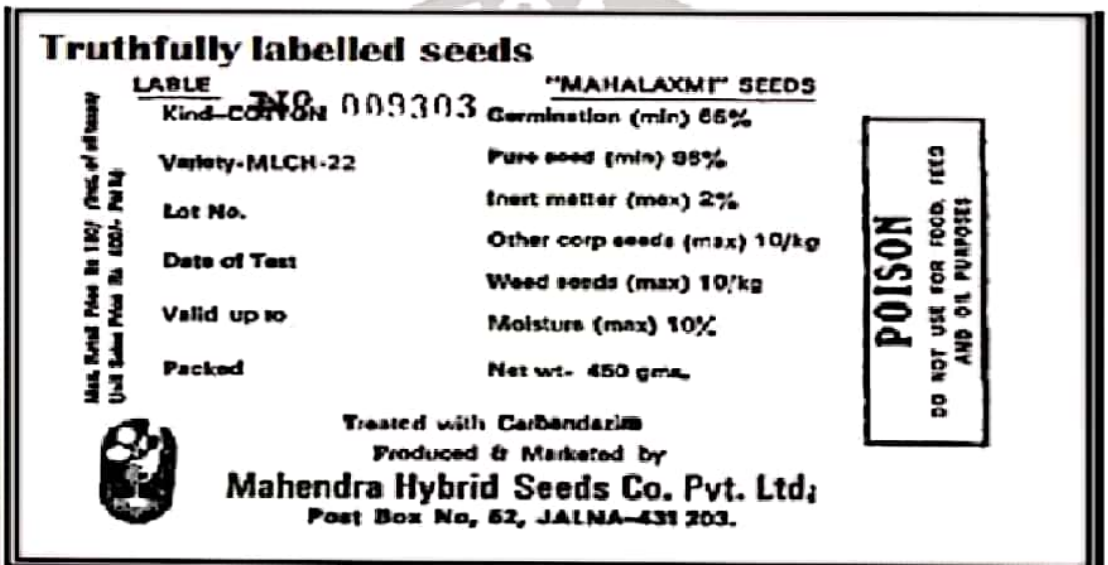


# Truthful Seed:

- It is the category of seed produced by cultivators, private seed companies and is sold under truthful labels. But field standard and seed standard should maintain as per seed act and certified seed stage. Under the seed act, the seed producer and seed seller are responsible for the seed.





| Certified seed | Truthful labelled seed |
|---|---|
| Certification is voluntary | Truthful labelling is compulsory for notified kind of varieties |
| Applicable to notified kinds only | Applicable to both notified and released varieties |
| It should satisfy both minimum field and seed standards | Tested for physical purity and germination |
| Seed certification officer, seed inspectors can take samples for inspection | Seed inspectors alone can take samples for checking the seed quality. |



## Seed Replacement Rate (SRR)

- 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.

| 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 |



## Validity Period of the Certificate

- The validity period shall be nine months from the date of test at the time of initial certification.
- The validity period could be further extended for six months provided on retesting seed conforms to the prescribed standards in respect of physical purity, germination and insect damage for all seeds except vegetatively propagating material for which lot shall be re-examined for seed standards specified for respective crop.
- A seed lot will be eligible for extension of the validity period as long as it conforms to the prescribed standards.

# Real value of seed

- The real value of seed is percentage of a seed sample that would produce seedling of variety under certification.

- Real value of seed (%) = Purity(%) x Germination(%) / 100



# Seed Dormancy

- Non – germination of seeds due to absence of suitable conditions is termed as dormancy.

OR

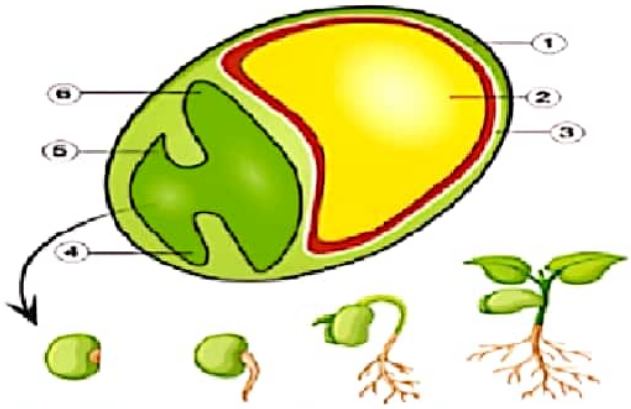
- A physical or physiological condition of viable seed, which prevents germination even in the presence of favorable conditions



**Following are some of the causes of seed dormancy:**

- Factors
  - Environmental –
    - negative or positive light requirement
    - high temperature
    - absence of water
  - Internal –
    - seed coat (no gas exchange)
    - seed coat (mechanical effects)
    - immature embryo
    - low ethylene
    - inhibitor present (coumarin, para0ascorbic acid, etc.)
    - Growth promoters absent
  - Timing mechanism –
    - after ripening
    - loss of inhibitor
    - appearance of growth promoter

# Methods of Breaking Seed Dormancy




1 Testa | 2 Endosperm | 3 Aleurone Layer | 4 Radicle
5 Epicotyl | 6 Cotyledon



# A. Scarification:



## Softening seed coats and other coverings (Scarification)

**Mechanical Scarification**

- Sandpaper, hammer, knife, tumbler.

**Hot Water Scarification**

- Drop into hot water (77 to 100°C), remove from heat, allow to cool and soak for 24 hours.

**Acid Scarification**

- Seeds, in small batches, are brought into contact with 93% Technical Grade sulphuric acid.
- From as little as a minute to as much as an hour and a half and seeds are rinsed and acid is neutralized with baking soda. Initially shiny seed coats would appear dull after this treatment.

**Warm Moist Scarification**

- Keep plants in warm moist soil or unsterilized sand for several months to soften seed coats through microbial activity.
- Seeds may also be planted directly in the summer or fall while soil temperatures are warm.

## B. Stratification:

**Refrigerated Stratification**

- Stratification is accomplished by placing seeds in moist planting medium in a cold environment for a period of time (two weeks to three months). Seeds require moisture, cold and oxygen. In general, this period of time allows an undeveloped embryo to mature.

**Outdoor Stratification**

- Seeds may be kept outdoors through the winter in lined pits or raised beds. They must be protected from freezing, drying and rodent predation (use wire netting in the soil). Pits or beds are layered with clean sand, medium with seeds, more clean sand, etc.

**Outdoor Planting**

- Some categories of seeds may simply be planted outdoors in the fall and natural stratification is allowed to happen.



## Laboratory Treatments

**Pre chilling**

- Store imbibed seeds at 5 to 10°C for five to seven days before attempting germination.

**Pre drying**

- Subject dried seeds to 37 to 40°C for five to seven days prior to germination.

**Alternating Temperatures**

- Use daily alternation of temperatures , going from 15-20°C to 30°C, with seeds held out the lower temperature for 16 hours and the higher temperature for 8 hours.

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**Light Exposure**

- Same seeds do not germinate in dark thus it provides continuous or periodic exposure of light is essential e. g. Lettuce (Lactuca Sativa) required red light (660nm) or white light is essential for germination to occur.

**Potassium Nitrate**

- Moisten substratum with 0.1 to 0.2 percent potassium nitrate solution.

**Hormones**

- Soak in gibberellic acid or cytokinin (kinetin) solution.
- Twelve to 24 hour soak is recommended. Concentrations also vary.

# Parthenocarpy



## Parthenocarpy & Parthenogenesis

- **Parthenocarpy** is the production of fruits from unfertilized ovules in plants. The fruits produced by **parthenocarpy** do not contain seeds. For example, seedless watermelon and oranges.
- **Parthenogenesis** is a type of reproduction in which the ovum develops into an individual without fertilization.

# Apomixis

- **Apomixis** is the process by which seeds develop without fertilisation. this takes placewhen the megaspore mother cell does not undergo meiosis or a cell from the nucellus develops into the embryo.