"You have no other choice"

"You need to win at any cost"

INDIAN IQ

Seed Technology

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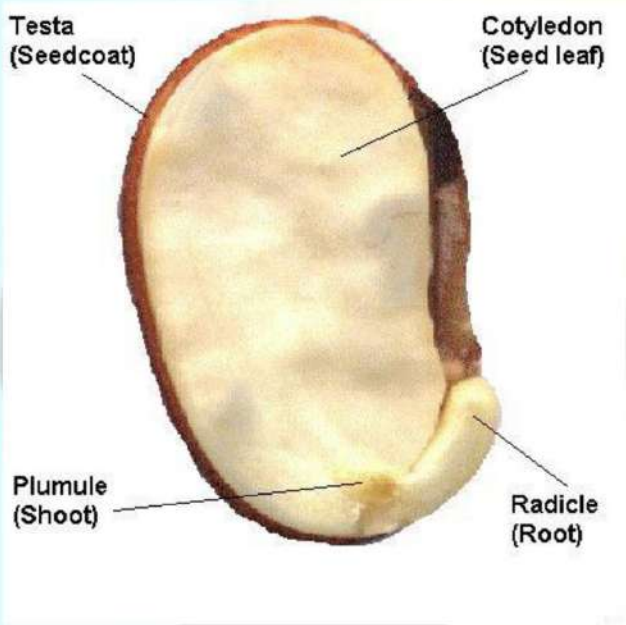
SEED TECHNOLOGY

A seed is a fertilized ovule containing the plant embryo, enclosed in seed coat.

About seed-

A seed (in some plants, referred to as a kernel) is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food. It is the product of the ripened ovule of gymnosperm and angiosperm plants which occurs after fertilization and some growth within the mother plant. The formation of the seed completes the process of reproduction in seed plants (started with the development of flowers and pollination), with the embryo developed from the zygote and the seed coat from the integuments of the ovule.

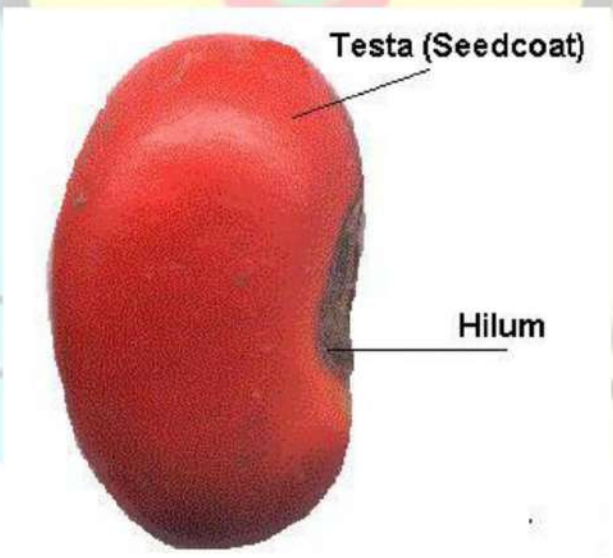


A typical seed includes three basic parts: (1) an embryo, (2) a supply of nutrients for the embryo, and (3) a seed coat.

- The embryo is an immature plant from which a new plant will grow under proper conditions. The embryo has one cotyledon or seed leaf in monocotyledons, two cotyledons in almost all dicotyledons and two or more in gymnosperms.
- The radicle is the embryonic root.
- The plumule is the embryonic shoot. The embryonic stem above the point of attachment of the cotyledon(s) is the epicotyl. The embryonic stem below the point of attachment is the hypocotyl.
- Within the seed, there usually is a store of nutrients for the seedling that will grow from the embryo. The form of the stored nutrition varies depending on the kind of plant.

- In angiosperms, the stored food begins as a tissue called the endosperm, which is derived from the parent plant via double fertilization. The usually triploid endosperm is rich in oil or starch and protein.
- In gymnosperms, such as conifers, the food storage tissue is part of the female gametophyte, a haploid tissue. In some species, the embryo is embedded in the endosperm or female gametophyte, which the seedling will use upon germination.
- In others, the endosperm is absorbed by the embryo as the latter grows within the developing seed, and the cotyledons of the embryo become filled with this stored food. At maturity, seeds of these species have no endosperm and are termed exalbuminous seeds.
- Some exalbuminous seeds are bean, pea, oak, walnut, squash, sunflower, and radish. Seeds with an endosperm at maturity are termed albuminous seeds. Most monocots (e.g. grasses and palms) and many dicots (e.g. brazil nut and castor bean) have albuminous seeds. All gymnosperm seeds are albuminous.

The seed coat (or testa) develops from the tissue, the integument, originally surrounding the ovule. The seed coat in the mature seed can be a paper-thin layer (e.g. peanut) or something more substantial (e.g. thick and hard in honey locust and coconut). The seed coat helps protect the embryo from mechanical injury and from drying out.



Type of seeds-

Monocot seeds- Cereals and grasses which contains single cotyledons.

Dicot seeds- Pulses which contain two cotyledons.

Positive Photoblastic seeds- Good germination in presence of light. Eg. Tobacco

Negative Photoblastic- Good germination in absence of light. Eg. Onion

Non- Photoblastic- Good germination in any condition. Eg. Most of the crops.

Note- ***662 nm wavelength (Red light) is best for seed germination. Above 730 nm germination stops.***

How Seed is formed?

Seed is formed by transfer of pollen grains from anther (male part) to stigma (female part). This process is called as pollination.

There are two types of pollination:

- Self-Pollination (Autogamy)
- Cross-Pollination (Allogamy)

The process by which pollen grains are transferred from anthers to stigma is referred as pollination. Pollination is of two types: viz. 1) Autogamy or self-pollination and 2) Allogamy or cross pollination.

I. **Autogamy**

Transfer of pollen grains from the anther to the stigma of same flower is known as autogamy or self-pollination. Autogamy is the closest form of inbreeding. Autogamy leads to homozygosity. Such species develop homozygous balance and do not exhibit significant inbreeding depression.

Mechanism promoting self-pollination

1. *Bisexuality*-Presence of male and female organs in the same flower is known as bisexuality. The presence of bisexual flowers is a must for self-pollination. All the self-pollinated plants have hermaphrodite flowers.

2. *Homogamy*-Maturation of anthers and stigma of a flower at the same time is called homogamy. As a rule, homogamy is essential for self-pollination.

3. *Cleistogamy*-When pollination and fertilization occur in unopened flower bud, it is known as cleistogamy. It ensures self-pollination and prevents cross pollination. Cleistogamy has been reported in some varieties of wheat, barley, oats and several other grass species.

4. *Chasmogamy*-Opening of flowers only after the completion of pollination is known as chasmogamy. This also promotes self-pollination and is found in crops like wheat, barley, rice and oats.

5. *Position of Anthers*-In some species, stigmas are surrounded by anthers in such a way that self-pollination is ensured. Such situation is found in tomato and brinjal. In some legumes, the stamens and stigma are enclosed by the petals in such a way that self-pollination is ensured. Examples are greengram, blackgram, soybean, chickpea and pea.

II. **Allogamy**

Transfer of pollen grains from the anther of one plant to the stigma of another plant is called allogamy or cross pollination. This is the common form of out-breeding. Allogamy leads to heterozygosity. Such species develop heterozygous balance and exhibit significant inbreeding depression on selfing.

Mechanism promoting cross-pollination

1. *Dicliny*- It refers to unisexual flowers. This is of two types: viz. i) monoecy and ii) dioecy. When male and female flowers are separate but present in the same plants, it is known as monoecy. In some crops, the male and female flowers are present in the same inflorescence such as in mango, castor and banana. In some cases, they are on separate inflorescence as in maize. Other examples are cucurbits, grapes, strawberry, cassava and rubber. When staminate and pistillate flowers are present on different plants, it is called dioecy. It includes papaya, date palm, spinach, hemp and asparagus.

2 *Dichogamy.*-(from the Greek dikho-apart and gamous-marriage) It refers to maturation of anthers and stigma of the same flowers at different times. Dichogamy promotes cross pollination even in the hermaphrodite species. Dichogamy is of two types: viz. i) protogyny and ii) protandry. When pistil matures before anthers, it is called protogyny such as in pearl millet. When anthers mature before pistil, it is known as protandry. It is found in maize, sugarbeet and several other species.

3 *Heterostyly*- When styles and filaments in a flower are of different lengths, it is called heterostyly. It promotes cross pollination, such as linseed.

4 *Herkogamy*- Hinderance to self-pollination due to some physical barriers such as presence of hyline membrane around the anther is known as herkogamy. Such membrane does not allow the dehiscence of pollen and prevents self-pollination such as in alfalfa.

5 *Self-Incompatibility*- The inability of fertile pollen to fertilise the same flower. It prevents self-pollination and promotes cross pollination. Self-incompatibility is found in several crop species like Brassica, Radish, Nicotiana, and many grass species. It is of two types sporophytic and gametophytic.

6 *Male Sterility*- In some species, the pollen grains are non-functional. Such condition is known as male sterility. It prevents self-pollination and promotes cross pollination. It is of three types: viz. genetic, cytoplasmic and cytoplasmic genetic. It is a useful tool in hybrid seed production.

Mode of pollination and reproduction	Examples of crop plants
A. Autogamous Species	
1. Seed Propagated	**Rice, Wheat,** Barley, Oats, Chickpea, Pea, Cowpea, Lentil, Green gram, Black gram, Soybean, Common bean, Moth bean, Linseed,Sesame, Khesari, Sun hemp, Chillies, Brinjal, Tomato, Okra, Peanut, etc.
2. Vegetatively Propagated	Potato
B. Allogamous Species	
1. Seed Propagated	**Maize, Pearl millet**, Rye, Alfalfa, Radish, Cabbage, Sunflower, Sugar beet, Castor, Red clover, White clover, Safflower, Spinach, Onion, Garlic, Turnip, Squash, Muskmelon, Watermelon, Cucumber, Pumpkin, Kenaf, Oilpalm, Carrot, Coconut, Papaya, etc.
2. Vegetatively propagated	Sugarcane, Coffee, Cocoa, Tea, Apple, Pears, Peaches, Cherries, grapes, Almond Strawberries, Pine apple, Banana, Cashew, Irish, Cassava, Taro, Rubber, etc.
C. Often Allogamous Species	Sorghum, Cotton, Triticale, **Pigeon pea**, Tobacco.

Sometimes two more terms are used they are

Geitonogamy is the type of self-pollinations where the transfer of pollen grains from the anther to the stigma takes place between different flowers in the same plant. Though it seems like cross-pollination and takes place with the help of pollinator, both the gametes have the same plant as their origin.

Xenogamy is the cross-pollination where the pollen grain transfer occurs across flowers of two different plants. In other words, the transfer of pollen from the anther of one plant to the stigma of another plant.

Important Terms:

Genetic purity- Seed should be free from other variety seed or other crop seeds.

Physical purity- Seed should be free from gravels, stone and broken seeds.

Seed Germination- Emergence and development of seedlings from the seed-embryo which is able to produce a normal plant under favourable condition.

Types of germination-

Hypogeal- The cotyledons remain under the soil. Eg. Cereals, Gram.

Epigeal- The cotyledons pushed above the soil surface. Eg, Tamarind, mustard, castor, sunflower, onion.

Essential factors for germination- Moisture, Temperature and Oxygen supply

Germination %= Number of seeds germinated X 100/Total number of seeds

Methods for testing Germination- Petridish method, Rolled towel method, Folder paper towel method, Sand method, Mechanical method, Gunny sacs method etc.

Seed Purity- Real percentage of desirable seed from a lot of seeds with various impurities. Purity %= Weight of pure seeds / Total weight of the working sample X 100

Real Value of seeds- Purity % X Germination % / 100

Viability test of seeds- Viability is the capacity of seed to germinate.

Potassium permanganate method- Qualitative method of testing viability.

Electrical conductance method- Seeds are soaked in distilled water and EC is tested.

Embryo culture method- Embryo is removed from cotyledons and it is placed on peat mass or agar medium. It takes 7-10 days for result.

Tetrazolium chloride test- Also known as Biochemical test. Seeds are soaked in 0.5 to 2% solution of tetrazolium chloride. The viable or living seeds take bright red colouration which becomes more intense in the embryo while the dead seeds remain in their original colour.

Grodex test- Grodex test is a germination indicator test based on triphenyl tetrazolium bromide powdered from.

Classes of Seed

The four generally recognized classes of seeds are: Breeder's seed, Foundation seed, Registered seed and Certified seed. The Association of Official Seed Certifying Agencies (AOSCA) has defined these seed classes as follows:

A. **Nucleus seed-**

These are initial seed of an improved variety, developed by plant breeder at research institute. Genetic and Physical purity is 100%, there is no need of certification and no tag color is assigned.

B. Breeder seed

It is the progeny of nucleus seed. The seed or vegetatively propagated material directly controlled by the originating or the sponsoring breeder or institution which is the basic seed for recurring increase of foundation seed. Genetic and Physical purity is 100%, Tag color is Golden yellow and tag size is 12x6 cm.

C. Foundation seed

It is the progeny of breeder seed. The seed stock handled to maintain specific identity and genetic purity, which may be designated or distributed and produced under careful supervision of an agricultural experiment station, National Seed Corporation or at Government farm and Agriculture universities. This seed is the source of all other certified seed classes either directly or through registered seed. Genetic purity is 99.5% and Physical purity should be 98%. It is used fir production of registered and certified seeds. Tag colour is white and size is 15x7.5 cm.

D. Registered Seeds

The progeny of the foundation seed or registered seeds so handled as to maintain its genetic identity and purity and approved and certified by a certifying agency. Not used in India. It should be of quality suitable to produce certified seed. Tag colour is Purple and size is 15x7.5 cm.

E. Certified seed

It is the progeny of the foundation seed or certified seeds itself. Its production is so handled to maintain genetical identity and physical purity according to standards specified for the crop being certified. It should have the minimum genetical purity of 99% or more and physical purity of 98% is required. Certified seed may be the progeny of certified seed, provided this reproduction does not exceed two generations beyond foundation seed and provided that if certification agency determines the genetic and physical purity, if not be significantly altered. In case of highly self-pollinated crops certification of one further generation may be permitted. Tag colour is blue and size is 15 x 7.5 cm.

Other Types of seed

Orthodox seeds are capable of being dried to internal seed moisture of less than 12% water, stored at freezing temperatures, and surviving. Eg. Cereals and Pulses.

Recalcitrant seeds cannot be stored in a conventional freezer as they cannot survive after drying and/or freezing at -20°C. Eg. Mango, Coconut and most of the fruit crops.

Intermediate seeds tend to age faster than orthodox seeds and may have only a 5-year lifespan when stored at -20°C. They have greatest longevity when dried between 45 and 65% RH.

Truthful Labelled Seeds- It is the category of seed produced by cultivators, private seed companies and is sold under truthful labels.

- This type of seeds **does not come under the purview of the Department of Seed Certification**.
- Rather, field standard and seed standard should be maintained as per seed act and certified seed stage.
- Under the seed act, the seed producer and seed seller are responsible for the seed.
- Truthful labelling is compulsory for notified kind of varieties and it is tested for physical purity and germination.
- Tag colour- Opal green.
- **Notified Variety:** 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.

Difference between certified seed and truthful labelled seed

Certified seed	Truthful labelled seed
Certification is voluntary. Quality guaranteed by certification agency.	Truthful labelling is compulsory for notified kind of varieties. Quality guaranteed by producing agency
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.

Attributes of international seed analysis certificate

Orange certificate- Issued when the sample is drawn officially from the lot under the authority of a member station. The lot is sealed, labelled and tested for seed quality attributes from the same member station.

Green certificate- Issued when the sample is drawn officially from the lot under the authority of a member station and seed is tested for seed quality attributes from the member station of different country.

Blue certificate- Issued when testing is done by a member station in same country, sampling not done under the responsibility of member station.

Kind of certificate	Certificate relates to	Sampling	Testing	Issuance of certificate
1. Orange	Seed lot	done by a member station as per ISTA procedure	in the same country by the same station who has done sampl-ing.	by the station which had done testing.
2. Green	Seed lot	– do –	in another country by a member station.	by the station which had done testing.
3. Blue	Seed sample	sample submitted and not done under the responsibility of a memebr station.	by a member station in the same country.	by the station which has done testing.

Model of seed generation

Generation system of seed multiplication is nothing but the production of a particular class of seed from specific class of seed up to certified seed stage. The choice of a proper seed multiplication model is the key to further success of a seed programme.

This is basically depending upon,

i. The rate of genetic deterioration

ii. Seed multiplication ratio and

iii. Total seed demand

Moisture content in seed for storage- long term (6-8%), short term (10-13%), cereals (10-12%), pulses (8-10%), oil seeds- (6-8%).

Storage substances-

Rice- Oryzein, Wheat-Glutenin, Barley- Hordein, Maize- Zein, Soybean- Nodulin, Sunflower- Inulin, Pea-Legumin, Grain legumes- Phaseolin

Various policies related to seeds
National Seed Corporation established in- 1963
National Seed Act passed in 1966
International Seed Testing Association- 1924
First Seed Testing Lab, IARI- 1961
Indian Seed Act- 1966, Came into force- 1969
Seed Rules- 1968
PPV&FR Act 2021
National Seed Policy- 2002
New Seed Act formulated- 2004, came into force- 2005

Isolation distance:

It is the minimum separation required between two or more varieties of the same species for the purpose of keeping seed pure.

TYPE	Distance

	Foundation seed	Certified seed
SELF POLLINATED CROPS Rice, Wheat, Ragi, Groundnut, Green gram, Cowpea, Oat, Barley, Soybean	3mtr	3mtr
Black gram, Greengram, Field pea, Chickpea	20 m	10 m
Tomato	50 m	25 m
CROSS POLLINATED CROPS	**Foundation seed**	**Certified seed**
Maize and Mustard/Rapeseed	400 m	200 m
Pearl millet	1000 m	200 m
Sunflower,Safflower	400 m	200 m
Cabbage, Cauliflower	1600 m	1000 m
Onion	1000 m	400 m
OFTEN CROSS POLLINATED		
Pigeon pea	100 m	50 m
Cotton	50 m	30 m
Sorghum, Red gram, Brinjal	200 m	100 m
Okra, Chilli	400 m	200 m

Seed Replacement Rate:

Seed Replacement Rate is the rate at which the farmers replace the seeds instead of using their own seeds.

In terms of percentage:

Horticultural Crop SRR (%)

• Brinjal 63.4	• Melons 89.2
• Cabbage 100	• Okra 92.4
• Cauliflower 86.4	• Tomato 99.3
• Chilli 83.7	• Beans 62.2
• Gourds 73.5	• Onion 87.3
• Peas 93.5	

Field Crop SRR (%)	
Paddy	17
Bajra	8
Maize	6
Redgram	6.1
Blackgram	17.7
Greengram	11.7
Cowpea	14.2
Groundnut	5
Sunflower	50
Sesame	15

Seed Multiplication Ratio

SMR is number of seeds to be produced from a single seed when it is sown and harvested, which can be altered by adoption of proper seed and crop management techniques.

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 rapeseed	1:100
Cotton	1:50	Soybean	1:16
Jute	1:100	Sunflower	1:50
Mestha	1:40	Sesame	1:250
Sunhemp	1:30	Safflower and castor	1:60
Berseem	1;10	Lucerne	1:25

Germination and purity standard for foundation and certified seeds of different crops.

	Percent of total seed (on weight basis)			
S. No.	Crop	Pure seed (min.)	Moisture (max)	Germination (min)
1	Hybrid maize (other than single cross)	98	12	90
2	Maize composites and open-pollinated varieties	98	12	90
3	Hybrid Jowar and varieties	98	12	80
4	Hybrid bajra*and open -pollinated varieties	98	12	75
4	Rice*	98	13	80
5	Wheat*	98	12	85
6	Barley	98	12	85
7	Cotton varieties and hybrids	98	10	60
8	Gram	98	9	85
9	Arhar	98	10	75
10	Urid	98	9	65
11	Mung	98	9	75
12	Rapeseeds and mustard	97	8	85
13	Sesamum (til)	97	9	80
14	Groundnut	96	9	70
15	Sunflower	98	9	60

16	Linseed	98	7	80
17	Soyabean	97	12	70
18	Peas	98	9	75
19	Cowpeas	98	9	75
20	Tomato	98	8	70
21	Cauliflower	98	7	65
22	Bhindi	99	10	65
23	Watermelon and other cucurbits	99	7	60
24	Onion	98	8	70
25	Carrot	95	8	60
26	Chillies	98	8	60
27	Radish	98	6	70
28	Brinjal	98	8	70

Dormancy of seeds-

- Temporary suspension of growth of any viable seeds with reduced metabolic activities. Dormancy is actually the resting stage, it delays germination.
- Due to unfavorable climatic conditions, presence of hard testa, immature embryo or due to presence of germination inhibitors dormancy may occur.

Types of dormancy-

Innate dormancy

It is the condition of seeds which is incapable of germination even if conditions suitable for seedling growth are supplied. This inability to germinate may be due in certain species to the embryo being immature at the time of dispersal.

Enforced dormancy

It is the condition of seeds which is incapable of germination due to an environmental restraint which includes, an adequate amount of moisture, oxygen, light and a suitable temperature.

Induced dormancy

This type of seed dormancy occurs when the seed has imbibed water, but has been placed under extremely unfavourable conditions for germination. Finally, seed fails to germinate even under more favourable conditions.

Germination inhibitors in crops-

S.No	Species	Location of inhibitor	Name of inhibitor
1	*Gossypium* spp.	Pericarp, testa	Absicic acid (ABA)
2	*Coriandrum sativum*	Pericarp	Coumarin
3	*Helianthus annus*	Pericarp, testa	Hydrocyanic acid
4	*Oryza sativa*	Hull	Probably ABA
5	*Triticum spp.*	Pericarp, testa	Catechin, catechin tannins, several unknowns
6	*Hordeum vulgare*	Hull	Coumarin, Phenolic acids. scopoletin
7	*Elaegnus angustfolia*	Pericarp, testa	Possibly coumarin
8	*Beta vulgaris*	Pericarp	Phenolic acids, Possibly ABA, high concentration of inorganic ions
9	*Avena sativa*	Hull	Unknown

Classification of seed dormancy-

Types	Reasons	Treatment
Physical dormancy	Impermiability of seed coat	Scarification
Physiological dormancy	Inhibitory mechanism of germination inside embryo	Soaking seeds in GA3, Ethrel, KNO3 (Strongest), Thiourea (Used for potato)

Combination of Physical and Physiological dormancy	Physical + Physiological	Scarification & Chemical
Morphological dormancy	Embryo not fully developed properly	Cold stratification
Morphological-Physiological dormancy	Underdeveloped embryo and physiological factors responsible for dormancy	Stratification + Chemical soaking

Dormancy Breaking Treatments-

1. Scarification (Acid/Mechanical)
2. Hot water treatment
3. Stratification (Cold/Warm)
4. Leaching of inhibitors (Metabolites)
5. High/Low Temperature treatment

Scarification- These treatments make a hard seed coat permeable to water or gases either by softening or cracking. This process is called scarification. The treatment can be either chemical or physical in nature. It weakens of soften the seed coat. Generally used for seeds of crops of Malvaceae and Leguminaecae family.

a) Acid scarification- Concentrated H_2SO_4 @ 100 ml/kg (2-3 minutes), Concentration may vary according to species as tree cops may take 2-4 hours.
b) Mechanical scarification- Rubbing seeds in sandpapers or by puncturing seed coat with needle, increases moisture absorption. Eg. Sand scarification where ratio of sand:seed is 2:1
c) Hot water treatment- Seed soaked in boiled water for 2-5 minutes. It is generally used for leguminous species. We need to be careful as In come crops like groundnut and Bengal gram, if soaked for more than 1 minutes, it may be injurious.

Stratification- It is used when caused of dormancy is internal (embryonic factor). *Cold stratification*- Seeds incubated at 0-5 degree Celsius over a moist substrate for 2-4 days to a few months. It is used for cole crops. *Warm stratification*- Some seeds required warm temperature to break dormancy. Eg. Rice and Oil palm.

Chemical methods- KNO_3 (Strongest dormancy breaker), Thiourea (1%) used in potato.

Leaching of metabolites- To leach inhibitors, seeds are soaked in water for 3-4 days. In every 12 hours, water should be changed.

Temperature Treatment- *High temperature*- Early flowering winter annuals need high temperature to germinate. Eg. Blue bell (*Hyacinthoides nonscripta). Low temperature*- It is used for plants growing in cool temperature. They require a period of chilling. Eg. Apple seeds are store at 5 degree Celsius.

Seed Processing

The process of removal of dockage in a seed lot and preparation of seed for marketing is called seed processing. The price and quality of seed is inversely related to dockage, which should not exceed a maximum level permitted for different crops for seed certification.

Basic steps

Sequence of operations are based on characteristics of seed such as shape, size, weight, length, surface structure, colour and moisture content. Because each crop seed possesses individually seed structure. Therefore, sequence of operation will be applied proper equipments. However, It is also involved stages following as

- Drying
- Receiving
- Pre-cleaning
- Conditioning
- Cleaning
- Separating or Upgrading
- Treating (Drying)
- Weighting
- Bagging
- Storage or Shipping

Principle of seed processing:

The processing operation carried out based on the principle of physical differences found in a seed lot.

Process followed in Seed certification

- **An Administrative check on the origin of the propagating material**
- **Field Inspection**
- **Sample inspection**
- **Control plot testing:** Here the samples drawn from the source and final seed produced are grown side by side along with the standard samples of the variety in question. By comparison it can be determined whether the varietal purity and health of the produced seed are equal to the results based on field inspection.
- **Grow-out test:** Evaluation of the seeds for their genuineness to species or varieties or seed borne infection. Here the samples drawn from the lots are grown in the field along with the standard checks. Growing plants are observed for the varietal purity. Grow-out test helps in the elimination of the sub-standard seed lots.

Seed Treatment-

Benefits of Seed Treatment:

- Prevents spread of plant diseases.
- Protects seed from seed rot and seedling blights.
- Improves germination.
- Provides protection from storage insects.
- Controls soil insects.

Types of Seed Treatment

1. Seed Disinfection:

Seed disinfection 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.

2. Seed Disinfestations:

Seed disinfestations refer to the destruction of surface borne organisms that have contaminated the seed surface but not infected the seed surface. Chemical dips, soaks, fungicides applied as dust, slurry or liquid have been found successful.

3. Seed Protection:

The purpose of seed protection is to protect the seed and young seedling from organisms in the soil which might otherwise cause decay of the seed before germination.

Seed treatment can be done in one of the following types.

1. **Seed dressing:** This is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation. Dressings can be applied at both farm and industries. Low-cost earthen pots can be used for mixing pesticides with seed or seed can be spread on a polythene sheet and required quantity of chemical can be sprinkled on seed lot and mixed mechanically by the farmers.
2. **Seed coating:** A special binder is used with a formulation to enhance adherence to the seed. Coating requires advanced treatment technology, by the industry.
3. **Seed pelleting:** The most sophisticated Seed Treatment Technology, resulting in changing physical shape of a seed to enhance palatability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive application.

Phases of Seed Certification

Seed Certification is carried out **in six** broad phases listed as under:

- Receipt and scrutiny of application.
- Verification of seed source, class and other requirements of the seed used for raising the seed crop.
- Inspection of the seed crop in the field to verify its conformity to the prescribed field standards.
- Supervision at post-harvest stages including processing and packing.
- Drawing of samples and arranging for analysis to verify conformity to the seed standards; and
- Grant of certificate, issue of certification tags, labelling, sealing etc.

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.

Seed Village

What is seed village?

- A village, wherein trained group of farmers are involved in production of seeds of various crops and cater to the needs of themselves, fellow farmers of the village and farmers of neighbouring villages in appropriate time and at affordable cost is called "a seed village".

Concept

- Organizing seed production in cluster (or) compact area.
- Replacing existing local varieties with new high yielding varieties.
- Increasing the seed production.
- To meet the local demand, timely supply and reasonable cost.
- Self sufficiency and self reliance of the village.
- Increasing the seed replacement rate.

Features

- Seed is available at the door steps of farms at an appropriate time
- Seed availability at affordable cost even lesser than market price
- Increased confidence among the farmers about the quality because of known source of production
- Producer and consumer are mutually benefited
- Facilitates fast spread of new cultivars of different kinds

Important Points

Biologically Seed is a matured Ovule.
Seed contains Embryo, Endosperm, Seed coat.
Embryo consists of Embryonic axis, Cotyledons. Embryonic root is called Radicle .
In monocots only one cotyledon which is reduced and modified to form Scutellum.
In maize the hypocotyls is modified to form Mesocotyl.
The base of hypocotyls sheathing the radical is termed as Coleorhizae.

In castor, the embryo acts as a Storage structure.
Endosperm is developed from Primary endosperm nucleus (PEN).
The ploidy of endosperm of angiosperm is 3n.
The intermediate of nuclear and cellular endoplasm development is Helobial endosperm.
Helobial type of endosperm development is prevalent in Monocotyledons.
Seeds with well developed endosperm are called Aluminous seeds.
The seeds which are having small amount of endosperm are called Exalbuminous seeds.
Examples of endospermic seeds of Monocots: Rice, Wheat, Dicots : Castor, Legumes: Fenugreek, Opium. Examples of non-endospermic seeds monocots: Orchids, water plantain, dicots; Grams, peas, beans.
In some of the plant species like coffee and pigweed Endosperm is absent and Perisperm acts as storage tissue.
All seeds bear scar like point is called Hilum .
The small hole at one end of the hilum is present in the seed coat of many species is called Micropyle.
In castor bean the axil is associated with micropyle is called Caruncle.
In dicots the ratio of embryo to endosperm is ore.
In monocots the ratio of embryo to endosperm is less.
Phytin is a rich source of Phosphorous.
During the seed development the moisture content drops to 10-15%.
Phtyin deposited as Myo- inosital hexa phosphoric acid.
The stage at which the seed reaches to its maximum dry weight, viability and vigour Physiological maturity.
Physiological maturity will occur 35-40 days after anthesis in sorghum.
At the time of physiological maturity the colour of the seed coat will be Pink.
The total soluble solids in sugarcane can be measured by Brix sugar hydrometer.
The value of brix reading for harvesting sugarcane crop is >17.
Harvest which coincide with the ripening process of the seed beyond physiological maturity Harvestable maturity.
Rice crop harvested at 15% seed moisture content instead of 21% moisture content results in a yield reduction by 20%.
The capacity of the seed to germinate and produce a normal seedling is called seed Viability.
The condition of active good health and robustness in seed is called Seed vigour.
During storage the vigour and viability of seed will be decreased.
Seed viability and vigour are maximum at the time of Physiological maturity.
If the seed moisture content increases storage life will be Decreases.
Tetrazolium test is used to measure Seed viability.
In tetrazolium test Dehydrogenase enzyme activity will be measured.
Tetrazolium test is conducted by using Tri phenyl tetrazolium chloride solution.
The colour of the formazan is Red.
In sulphuric acid test the living portion of the cut surface of the seed develops Deep rose colour.

In exhaustion test the seedlings with roots and shoots extending more than 2 inches are said to be vigorous.
Sulphur containing amino acids are Cysteine and Methionine.
The normal concentration of gases like O2, CO2 and N2 for good seed germination is 20% 30% ,80%.
Rice seeds can be germinated even under absence of Oxygen although the seeds are weak and abnormal.
The effect of temperature on germination can be expressed in terms of Cardinal temperature.
The optimum temperature for germination of seeds is in between 15-30ºC.
The low temperature pre-treatment before germination is usually called Stratification.
The greater promotion of light on germination occurs in Red region.
Seed index- Weight of 100 seeds, Test weight- Weight of 1000 seeds
First seed testing laboratory was established at IARI in 1961

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