ERASMUS + PROJECT : AG-LAB

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SEEDS quality parameters sampling and determination

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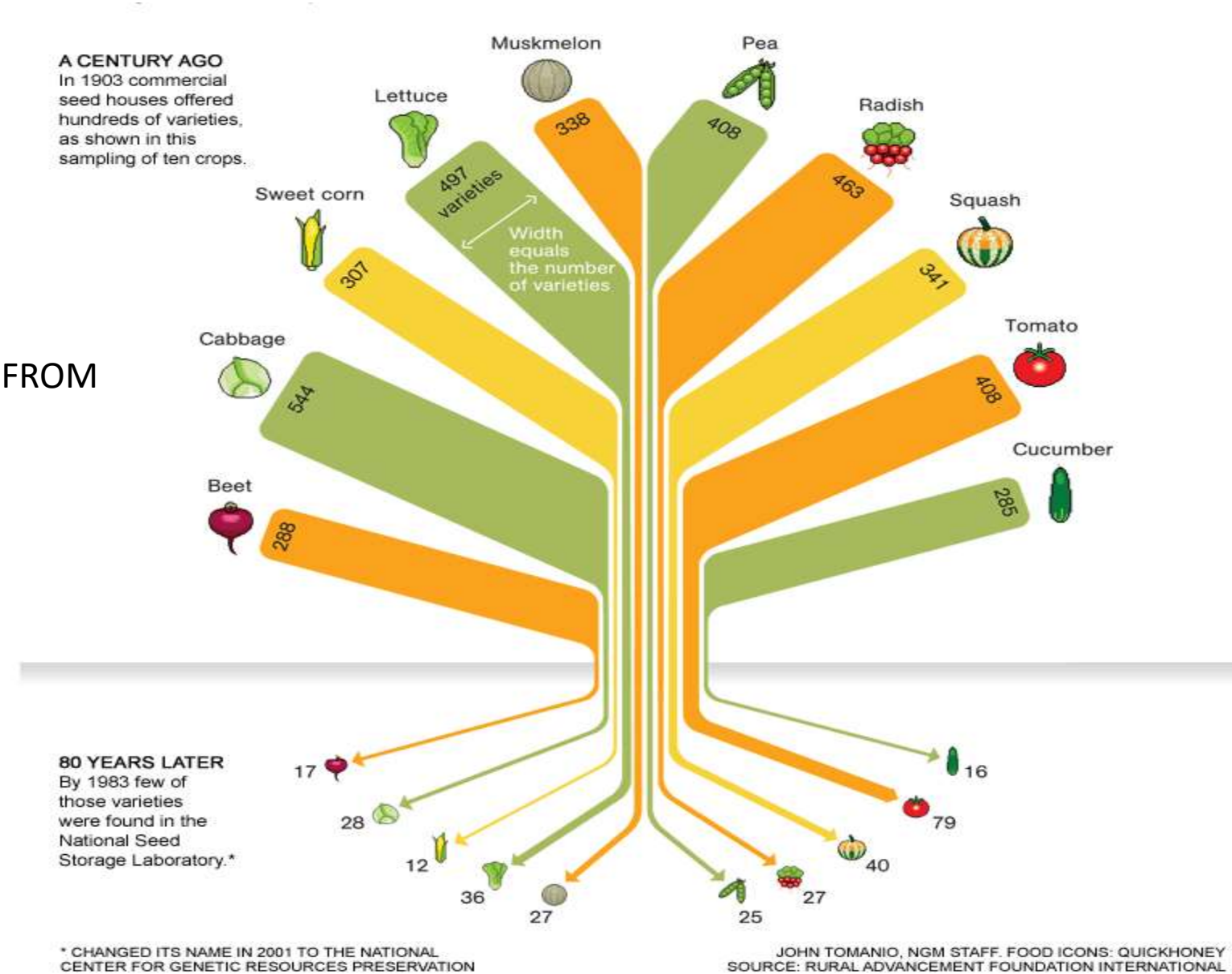
WHAT DO WE WANT FROM OUR SEED?



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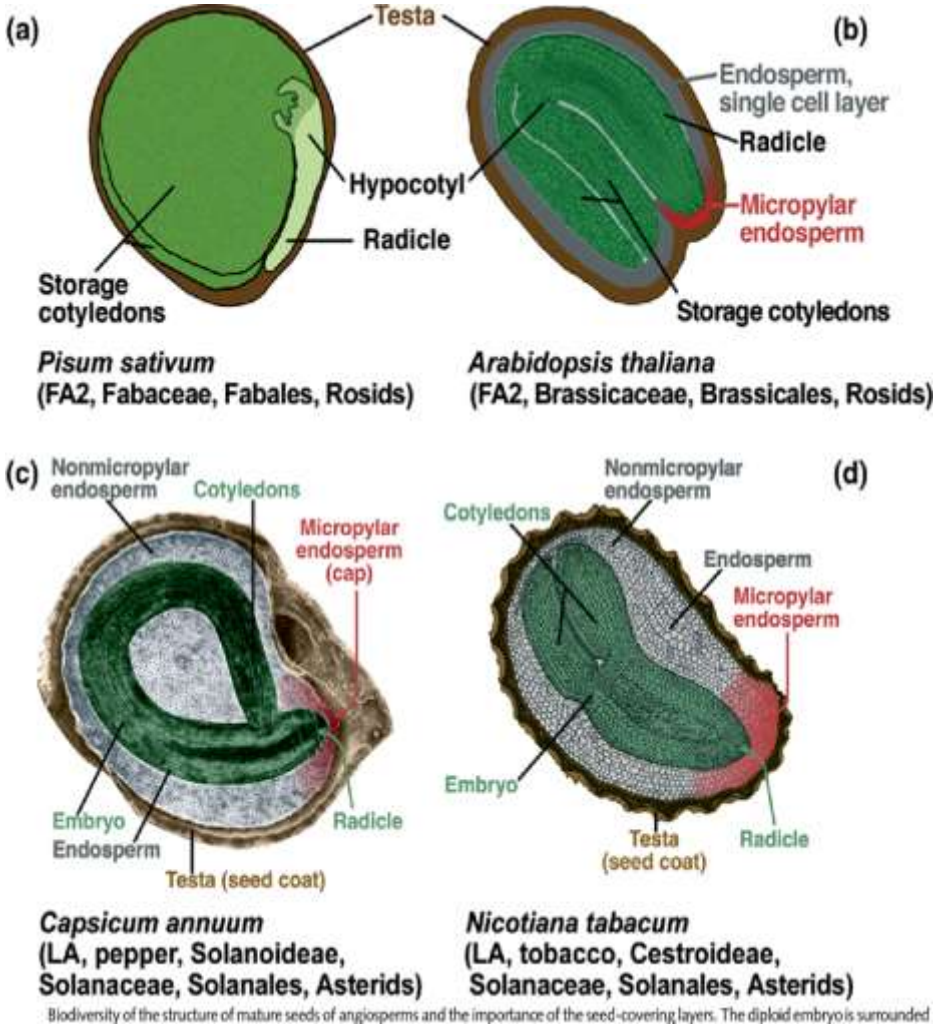
Seed:

Definition

- fertilized ovule by pollen and some growth within the mother plant. The embryo is developed from the zygote and the seed coat from the integuments of the mature ovule that possesses embryonic plant, stored material, and a protective outer covering (coat or coats).



Biodiversity of the structure of mature seeds of angiosperms and the importance of the seed-covering layers. The diploid embryo is surrounded

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The formation of the seed

- is part of the process of reproduction characteristic of all phanerogams (seed plants) the spermatophytes, including the gymnosperm and angiosperm plants.

- **Gymnosperms**
- are flowerless plants that produce cones and seeds. The term gymnosperm literally means "naked seed," as gymnosperm seeds are not encased within an ovary.

Ginkgo biloba

Gymnosperms: Cycad Cones. Maxfocus/iStock/Getty Images Plus

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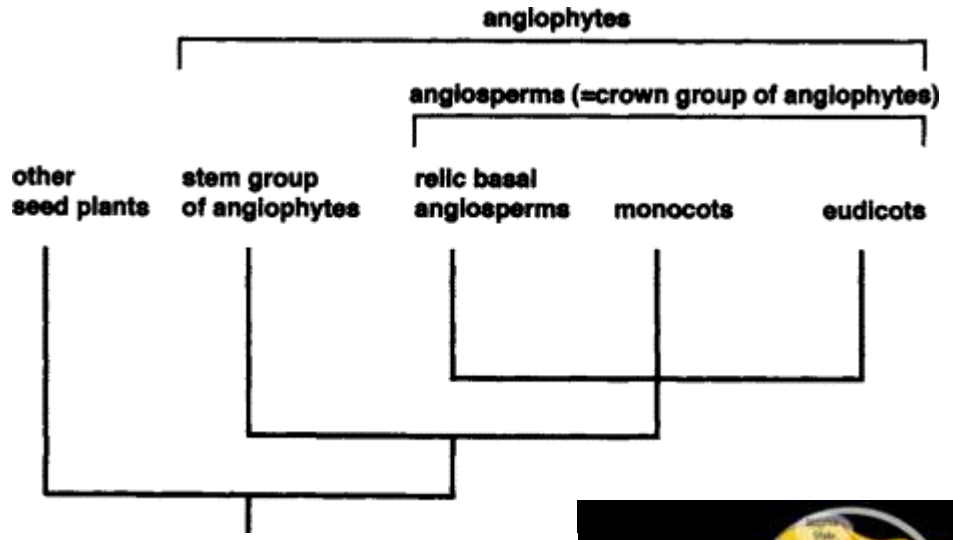
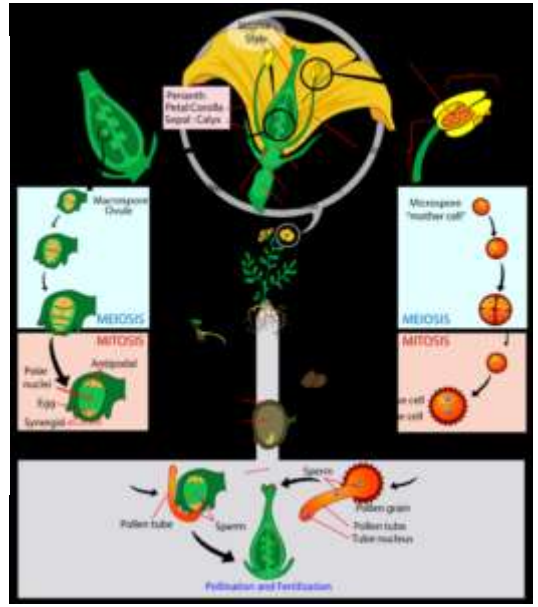
Angiosperm

- The botanical term "Angiosperm", from the Ancient Greek ἀγγεῖον, *angeíon* (bottle, vessel)
  and σπέρμα, *sperma* (seed), was coined in the form Angiospermae by Paul Hermann in 1690, as the name of one of his primary divisions of the plant kingdom. This included flowering plants possessing seeds enclosed in capsules





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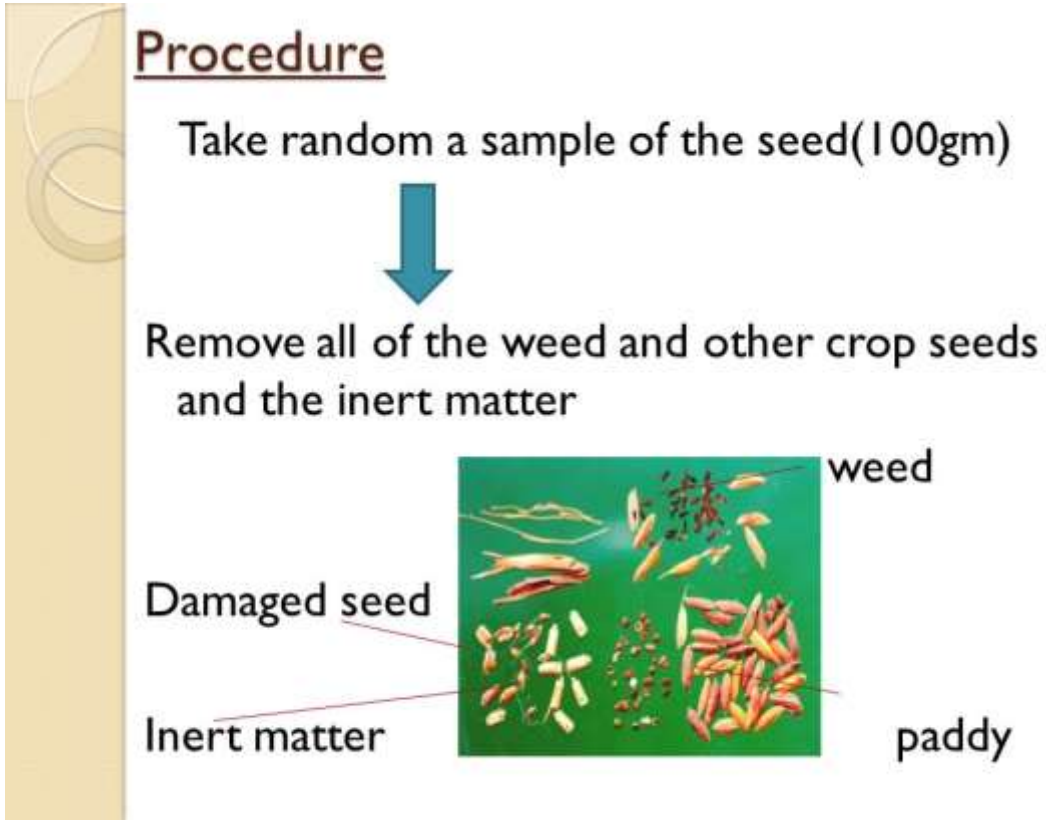
SELECTION OF SEED SAMPLES FOR ANALYSIS

- **SEED SAMPLING**
- To determine the quality of a shipment of seed, it must be sampled in such a way so that the samples taken are representative of the entire quantity of seed.



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Sampling Procedures for the Inspection of Seed

- To secure a representative sample, equal portions shall be taken from evenly distributed parts of the quantity of seed to be sampled. Access shall be had to all parts of that quantity.
- For free-flowing seed in bags or bulk, a probe or trier long enough to sample all portions of the bag or bulk shall be used.
- Non-free-flowing seed, such as chaffy grass seed, which is difficult to sample with a probe or trier, shall be sampled by thrusting the hand into the bulk and withdrawing representative portions.

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- As the seed is sampled, each portion shall be examined. If there appears to be a lack of uniformity, the portions shall not be combined but shall be retained separately for laboratory analysis. If the portions appear uniform, they shall be combined to form a composite sample.
- Composite samples shall be obtained to determine the quality of a lot of seed, such as the percentages of pure seed, other crop seed, weed seed, inert matter, noxious weed seed, germination, varietal purity, freedom from disease, and effectiveness of seed treatment.

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Sampling equipment -

- For sampling seeds in bags, a trier long enough to reach all areas in the bag shall be used. The trier shall be designed so that it will remove an equal volume of seed from each part of the bag through which the trier travels. Unless the trier has partitions in the seed chamber it must be inserted into the bags horizontally. Non-free-flowing seeds that are difficult to sample with a trier shall be sampled by thrusting the hand into the seed and removing representative portions. When a sample is taken with the hand, insert the hand flat and with the fingers together. Keep the fingers together as the hand is closed and withdrawn. Because of possible segregation, hand samples should be taken from various locations in bags or in bulk.
-

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Minimum size of submitted sample

- For composite sample to test for quality - The following are minimum weights for samples of seed to be submitted for purity, germination and noxious weed seed examination to determine eligibility of a seed lot for certification.
- For individual-bag samples to test for uniformity. The size of any individual-bag sample to determine uniformity in a lot of seed shall be not less than the quantities set out as "Minimum weight for noxious weed seed examination" for the respective kinds of seed listed in AOSA Rules for Testing Seeds. If the Sample drawn is larger than required, it shall be thoroughly mixed before it is divided to the desired size.

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Sampling in Seed Testing Laboratory

- The seed samples received in the laboratory (submitted sample) are required to be reduced to obtain working samples for carrying out various tests. A number of methods are available for obtaining working samples.
- Seed Sampling
- Model seed samples received from producer
- Mixing and dividing of seeds
- The main objective of mixing and dividing of seeds is to obtain the representative homogenous seed sample for analysis by reducing the submitted sample to the desired size of working sample.
- Method of mixing and dividing
- Mechanical dividing
- Modified halving method
- Hand halving method
- Random cup method
- Spoon method

Model seed samples received from producer

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- ✓ *mechanical reduction methods are often recommended*
- ✓ *Hand reduction methods are more suitable. in specific situations (very chaffy seed, unprocessed seed, seed health testing),*

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Identification and Forwarding of samples

- Before forwarding representative samples for laboratory analysis, the containers of samples shall be completely and properly identified with a Certification Sample Form.

Seed Testing Procedures -

- All seed shall be tested and analyzed in accordance with the procedures prescribed by the most recent edition of "Rules for Testing Seeds" issued by the Association of Official Seed Analysts (AOSA).

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Seed Testing

- Seed testing is determining the standards of a seed lot *viz*., physical purity, moisture, germination and ODV and thereby enabling the farming community to get quality seeds.
- The Seed Testing Laboratory is the hub of seed quality control. Seed testing services are required from time to time to gain information regarding planting value of seed lots. Seed testing is possible for all those who produce, sell and use seeds.

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Objective & Importance of Seed Testing

- Seed testing is required to achieve the following objectives for minimising the risks of planting low quality seeds.
- To identify the quality problem and their probable cause
- To determine their quality, that is, their suitability for planting
- To determine the need for drying and processing and specific procedures that should be used
- To determine if seed meets established quality standards or labelling specifications.

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- To establish quality and provide a basis for price and consumer discrimination among lots in the market. The primary aim of the seed testing is to obtain accurate and reproducible results regarding the quality status of the seed samples submitted to the Seed Testing Laboratories.

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Importance

- The importance of seed testing was realized more than 100 years ago for assured planting values. The adulteration of vegetable seeds by stone dust which was packed in some parts of the world.
- Seed testing has been developed to aid agriculture to avoid some of the hazards of crop production by furnishing the needed information about different quality attributes *viz.,* purity, moisture, germination, vigor and health.
- Quality control of seed depends on the different seed testing protocols which determine the genuineness of the cultivar.
- Testing of seed to evaluate the planting value and the authenticity of the certified lot.
- Seed testing is required to assess the seed quality attributes of the seed lots which have to be offered for sale.

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- These quality attributes are seed moisture content, germination and vigor, physical and genetic purity, freedom from seed borne diseases and insect infestation. Seed testing is done mainly for moisture, germination and physical purity of seeds.
- Standard seed testing procedures for the evaluation of the seeds were developed by ISTA. It is obligatory on the part of the seed analyst to follow rules prescribed by 1STA (1STA, 1985) if the seed is moving to the International trade.
- The seed testing procedures which are described below are based mostly on the international rules because most of our rules are based on, 1STA, 1996. Economic yield of a crop depends on the quality of seeds which can be evaluated by seed testing (1STA, 1996).
- The testing of seed quality is carried out on seed samples drawn from seed lot to be used for cultivation. The quantity of seed sample taken for testing in laboratory is minute compared to that of seed lot it represents.

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Role of Seed Testing Laboratories

- Seed testing laboratories are essential organization in seed certification and seed quality control programmes. The main objective is to serve the producer, the consumer and the seed industry by providing information on seed quality. Test results may cause rejection of poor seed multiplication or low grade seed in a count of law.
- **Analysis of seed in the laboratory**: Seed testing is possible for all those who produce, sell and use seeds. Seed testing is highly specialized and technical job. With a view to maintain uniformity in quality control the seed analysis laboratory includes for distinct sections.
- Section for purity testing: Purity analysis of seed lot is considered under two factors
  a) Testing the cleanliness of seed lot and
  b) Testing the geneuiness of the cultivar
- Section for moisture testing
- Section for viability, germination and section for vigour testing.
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MECHANICAL METHOD

The reduction of sample size is carried out by the mechanical dividers suitable for all seeds except for chaffy and fuzzy seeds.

Objective of mechanical dividing

•To mix the seed sample and make homogenous as far as possib
•le. To reduce the seed sample to the required size without any bias.
•The submitted sample can be thoroughly mixed by passing it through the divider to get 2 parts and passing
• the whole sample second time and 3rd time if necessary to make the seeds mixed and blended so as to get homogenous seed sample when the same seeds are passed through it into approximately equal parts.
•The sample is reduced to desired size by passing the seeds through the dividers repeat-edly with one half remain at each occasion.

Types of mechanical dividers

- **Boerner divider**
- It consists of a hopper, a cone and series of baffles directing the seeds into 2 spouts. The baffles are of equal size and equally spaced and every alternate one leading to one spout. They are arranged in circle and are directed inward. A valve at the base of the hopper retains the seeds in the hopper. When the valve is opened, the seeds fall by gravity over the cone where it is equally distributed and approximately equal quantity of seeds will be collected in each spout. A disadvantage of this divider is that it is difficult to check for cleanliness.

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Centrifugal or Gamet divider

- The principle involved is the centrifugal force which is used for mixing and dividing the seeds. The seeds fall on a shallow rubber spinner which on rotation by an electric motor, throw out the seeds by centrifugal force. The circle or the area where the seeds fall is equally divided into two parts by a stationary baffle so that approximately equal quantities of seed will fall in each spout.

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Definitions

- **Random cup method**
- This is the method suitable for seeds requiring working sample up to 10 grams provided that they are not extremely chaffy and do not bounce or roll (e.g.) *Brassica* spp. Six to eight small cups are placed at random on a tray. After a preliminary mixing the seed is poured uniformly over the tray. The seeds that fall into the cup is taken as the working sample.
- **Modified halving method**
- The apparatus consists of a tray into which is fitted a grid of equal sized cubical cups open at the top and every alternate one having no bottom. After preliminary mixing the seed is poured evenly over the grid. When the grid is lifted, approximately half the sample remains on the tray. The submitted sample is successively halved in this method until a working sample size is obtained.

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- ✓ *mechanical reduction methods are often recommended*
- ✓ *Hand reduction methods are more suitable. in specific situations (very chaffy seed, unprocessed seed, seed health testing),*

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- **Spoon method**
- This is suitable for samples of single small seeded species. A tray, spatula and a spoon with a straight edge are required. After preliminary mixing, the seed is poured evenly over the tray. The tray should not be shaked thereafter. With the spoon in one hand, the spatula in the other and using both small portions of seed from not less than 5 random places on the tray should be removed. Sufficient portions of seed are taken to estimate a working sample approximately but not less than the required size.
- **Hand halving method**
- This method is restricted to the chaffy seeds. The seed is poured evenly on to a smooth clean surface and thoroughly mixed into a mound. The mound is then divided into 1/2 and each half is mound again and halved into 4 portions. Each of the 4 portions is halved again giving 8 portions. The halved portions are arranged in rows and alternate portions are combined and retained. The process is repeated until the sample of required weight is obtained.

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Weight of the working sample (g)	The number of decimal places required	Example
<1	4	0.7534
1-9.999	3	7.534
10-99.99	2	75.34
100-999.9	1	753.4
1000 or more	0	7534

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Purity separation

- The working sample after weighing is separated into its components *viz.,* pure seed, other seed crop, weed seed and inert matter.
- **Pure seed**
- The seeds of kind / species stated by the sender. It includes all botanical varieties of that kind / species. Immature, undersized, shrivelled, diseased or germinated seeds are also pure seeds. It also includes broken seeds, if the size is >1/2 of the original size except in leguminacea, and cruciferae where the seed coat entirely removed are regarded as inert matter.
- **Other crop seed**
- **I**t refers to the seeds of crops other than the kind being examined.

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- **Weed Seed**
- It includes seeds of those species normally recognized as weeds or specified under Seed Act as a noxious weed.
- **Inert matter**
- It includes seed like structures, stem pieces, leaves, sand particles, stone particles, empty glumes, lemmas, paleas, chaff, awns, stalks longer than florets and spikelets.
- **Method of purity separation**
- Place the sample on the purity work board after sieving / blowing operations and separate into other crop seeds and inert matter. After separation, identify each kind of weed seeds, other crop seeds as to genus and species. The names and number of each are recorded. The type of inert matter present should also be noted.

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Purity Work Board

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Seed Blower

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Calculation

All the four components must be weighed to the required number of decimal places. The percentages of the components are determined as follows.

$$\%\ \text{of components} = \frac{\text{Weight of individual component}}{\text{Total weight of all components}} \times 100$$

If there is a gain or loss between the weight of the original samples and the sum of all the components is in excess of one percent, another analysis should be made.

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- **Duplicate tests**
- If the analysis result is near the border line in relation to the seed standards, one more test is done and the average is reported. However, if a duplicate analysis is made of two half sample or whole samples, the difference between the two must not exceed the permissible tolerance. If the difference is in excess of the tolerance, analyze further (but not more than 4 pairs in all) until a pair is obtained which has its member within tolerance.

- **Purity analysis in groundnut**
- It should be carried out on pods and the size of working sample is 1000.

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Determination of huskless seeds

It is required in certain crops like sunflower and paddy. 400 seeds taken from the pure seed and the number of seeds without husk are counted (partly huskless seeds are excluded) and the % is calculated as

$$\% \text{ of huskless seeds} = \frac{\text{Number of huskless seeds}}{400} \times 100$$

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- **Seed germination test**
- Germination is defined as the emergence and development from the seed embryo, of those essential structures, for the kind of seed in question, indicates its ability to produce a normal plant under favorable conditions.
- **Principles**
- Germination tests shall be conducted with a pure seed fraction. A minimum of 400 seeds are required in four replicates of 100 seeds each or 8 replicates of 50 seeds each or 16 replicates of 25 seeds each depending on the size of seed and size of containers of substrate.
- The test is conducted under favorable conditions of moisture, temperature, suitable substratum and light if necessary. No pretreatment to the seed is given except for those recommended by ISTA.

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- **Materials required**
  Substratum
- The substratum serves as moisture reservoir and provides a surface or medium for which the seeds can germinate and the seedlings grow. The commonly used substrate are sand, germination paper and soil.
- 1. **Sand**
- **Size of sand particle**
- Sand particles should not be too large or too small. The sand particles should pass through 0.80 mm sieve and retained by 0.05mm sieve.

- **Toxicity**
- Sand should not have any toxic material or any pathogen. If there is presence of any pathogen found then the sand should be sterilized in an autoclave.

- **Germination tray**
- When we use the sand, germination trays are used to carry out the test. The normal size of the tray is 22.5 x 22.5 x 4 cm. The tray may either zinc or stainless steel.

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Method of seed placement

Seed in sand(S)

Seeds are planted in a uniform layer of moist sand and then covered to a depth of 1 to 2 cm with sand.

Sand method

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Top of sand (TS)

- Seeds are pressed in to the surface of the sand.
- **Spacing**
- We must give equal spacing on all sides to facilitate normal growth of seedling and to avoid entangling of seed and spread of disease. Spacing should be 1-5 times the width or diameter of the seed.

- **Water**
- The amount of water to be added to the sand will depend on size of the seed. For cereals, except maize, the sand can be moistened to 50% of its water holding capacity. For large seeded legumes and maize sand is moistened to 60% water holding capacity.

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- 2. **Paper**
- Most widely used paper substrates are filter paper, blotter or towel (kraft paper). It should have capillary movement of water, at vertical direction (30 mm rise / min.). It should be free from toxic substances and free from fungi or bacteria. It should hold sufficient moisture during the period of test. The texture should be such that the roots of germinating seedlings will grow on and not into the paper.

- **Methods**
- **Top of paper (TP)**
- Seeds are placed on one or more layers of moist filter paper or blotter paper in petriplates. These petriplates are covered with lid and placed inside the germination cabinet. This is suitable for those seeds which require light.

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Petriplate method

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Between paper (BP)

- The seeds are germinated between two layers of paper. The seeds are placed between two layers of paper and rolled in towels. The rolled towels are placed in the germinator in an upright position.

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Germination paper

Seeds germinated on paper

Roll towel method

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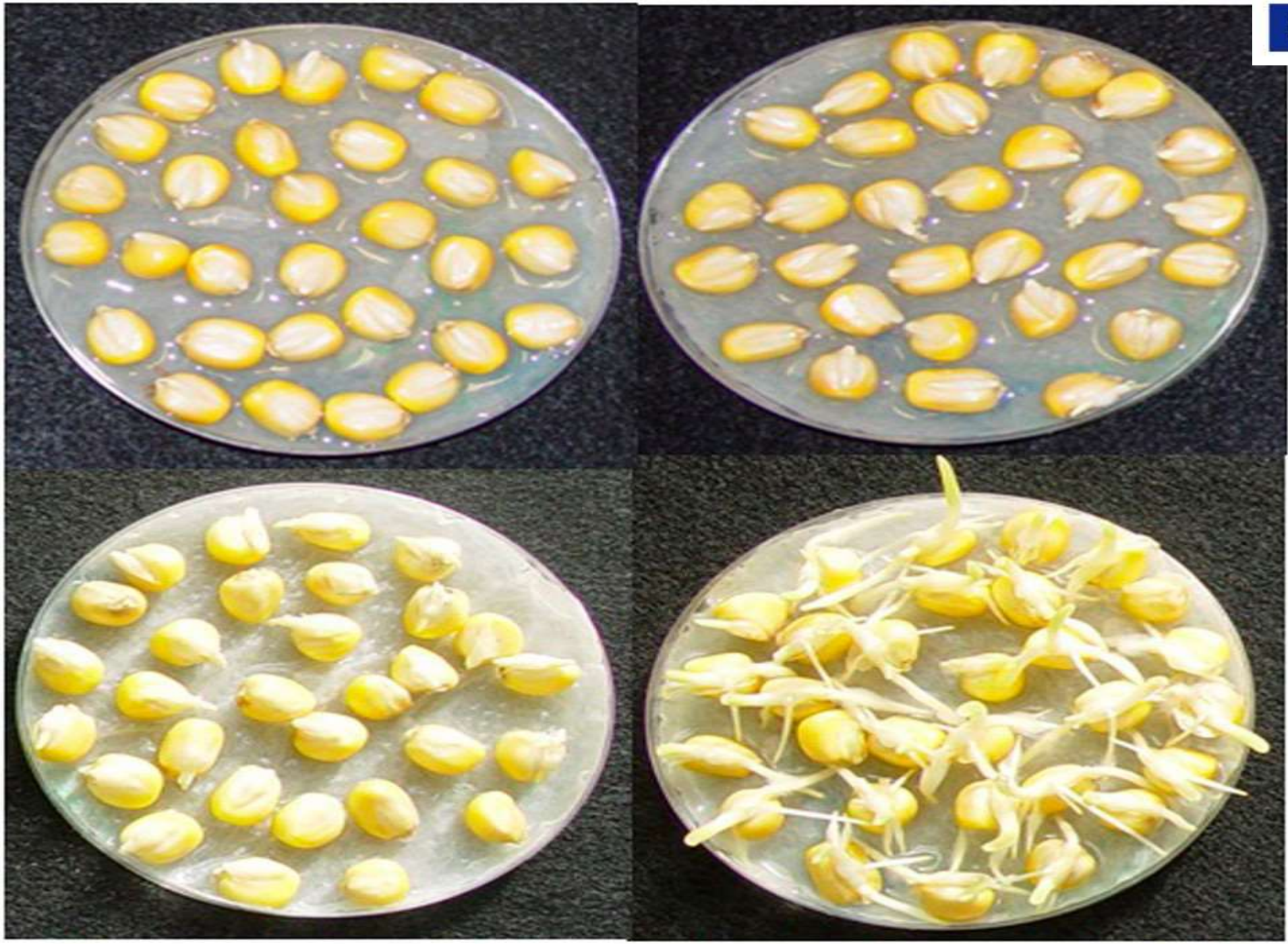

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Crop	Substratum	Temp (°C)	First count days	Final count days	Pre-treatment
Paddy	BP,TP,S	20-30	5	14	Preheat (50°C) soak in H2O or HNO3 24hrs
Maize	BP,S	20-30	4	7	-
Bajra	TP,BP	20-30	3	7	0.2%KNO3(2-3hrs) pre chill
Sorghum	TP,BP	20-30	4	10	-
Redgram	BP,S	20-30	4	6	-
Black gram	BP,S	30	4	7	-
Green gram	BP,S	20-30	5	8	-
Bengal gram	BP,S	20-30	5	8	-
Cowpea	BP,S	20-30	5	8	-
Peas	BP,S	20	5	8	-
Castor	BP,S	20	7	14	
Groundnut	BP,S	20-30	5	10	-
Sunflower	BP,S	20-30	4	10	-
Sesame	TP	20-30	3	6	-
Cotton	BP,S	20-30	4	12	Remove shells
Brinjal	TP,BP	20-30	7	14	Ethrel (25ppm) 48hrs
Tomato	TP,BP	20-30	5	14	-
Chillies	TP,BP	20-30	7	14	Hot water 85°C 1min.
Bhendi	BP,S	20-30	4	21	-
Onion	TP,BP	15-20	6	21	KNO3
Carrot	TP,BP	20-30	7	14	KNO3
Radish	TP,BP	20-30	4	10	Pre chill
Cauliflower	TP	20-30	5	10	Pre chill, KNO3
Ashgourd	S	30-35	5	14	-
Bitter gourd	BP,S	20-30	4	14	-
Bottle gourd	BP,S	20-30	4	14	-

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Germination apparatus

- **Germination cabinet / Germination room**
- This is called chamber where in temperature and relative humidity are controlled. We can maintain the temperature, relative humidity and light required for different crops.

- **Room germinator**
- It works with same principle as that of germinator. This is a modified chamber of larger one and the worker can enter into it and evaluate the seedlings. Provisions are made to maintain the temperature and relative humidity. This is used widely in practice.

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Seed germinator

Plant Growth Chamber

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Seed counting board

- This is used for accurate counting and spacing of seeds. This consists of 2 plates. The basal one is stationary and top one is movable. Both top and basal plates are having uniform number of holes *viz*., 50/100, when the plates are in different position.
- After taking the sample, the top plate is pulled in such a way that the holes are in one line so that the fixed number of seeds falls on the substratum.

- **Seed counting board**

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Vacuum seed counter

- Consists of a head, pipe and wall. There are plates of 50 or 100 holes which can be fitted to the head.
- When vacuum is created the plate absorbs seeds and once the vacuum is released the seeds fall on the substrate.

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Impression board

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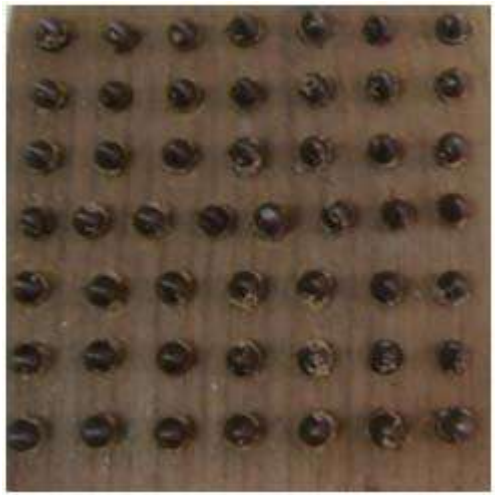
- Made of plastic / wood with 50 or 100 holes / pins. Here the knobs are arranged in equal length and space. By giving impression on the sand it makes uniform depth and spacing for seed.



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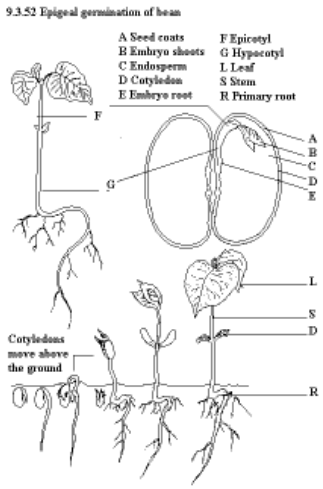
Evaluation of germination test



- The germination test is evaluated as
- Normal seedlings
- Abnormal seedlings
- Hard seeds
- Fresh and ungerminated seeds
- Dead seeds
- ISTA classified the seedlings into different categories based on the development of essential structures.

- **Normal seedlings**
- Seedlings which has the capacity for continued development into normal plant when grown in favorable conditions of soil, water, temperature and light.

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Characters of normal seedlings

- A well developed root system with primary root except in certain species of graminae which normally produce seminal root or secondary root.
- A well developed shoot axis consisting of elongated hypocotyls seedlings of epigeal germination.
- A well developed epicotyl in seedlings of hypogeal germination
- One cotyledon in monocotyledon and two in dicotyledons.
- A well developed coleoptiles in graminae containing a green leaf.
- A well developed plumule in dicotyledons.
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Normal seedlings

- Seedlings with following slight defects are also taken as normal seedlings.
- Primary root with limited damage but well developed secondary roots in leguminaceae (Phaseolus, Pisum), graminae (Maize), cucurbitaceae (Cucumis) and malvaceae (cotton)
- Seedlings with limited damage or decay to essential structures but no damage to conducting tissue.
- Seedlings which are decayed by a pathogen with a clear evidence that the parent seed is not the source of infection.

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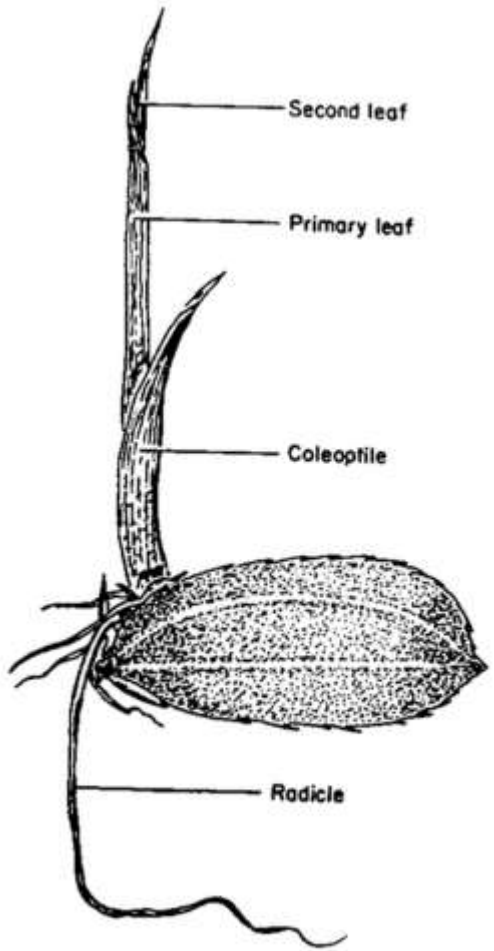
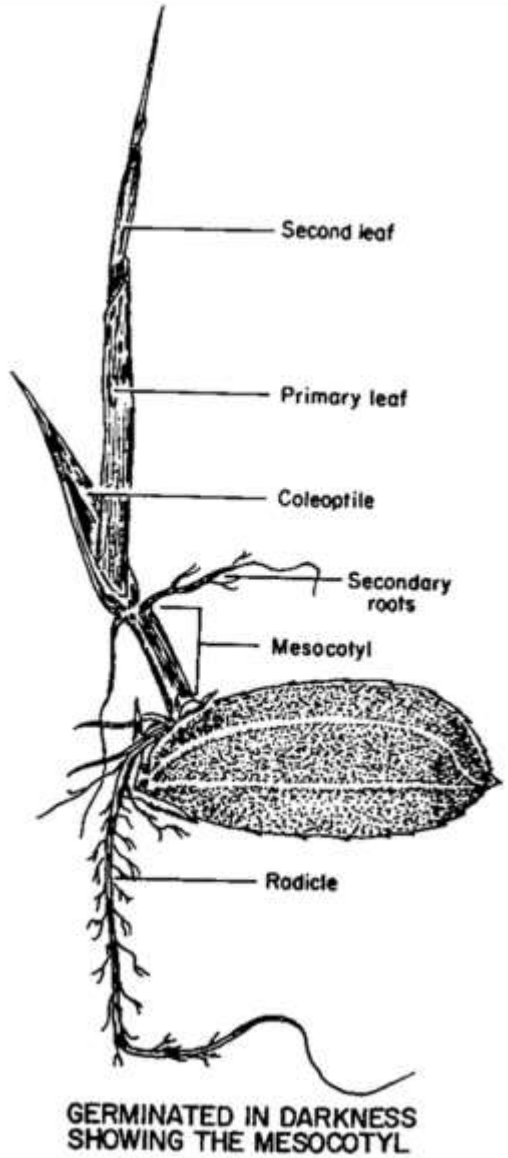
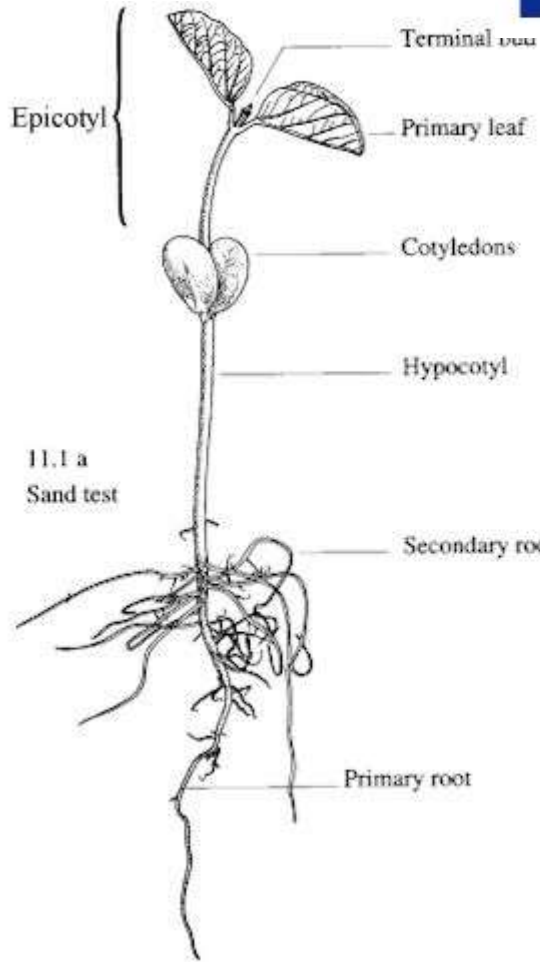


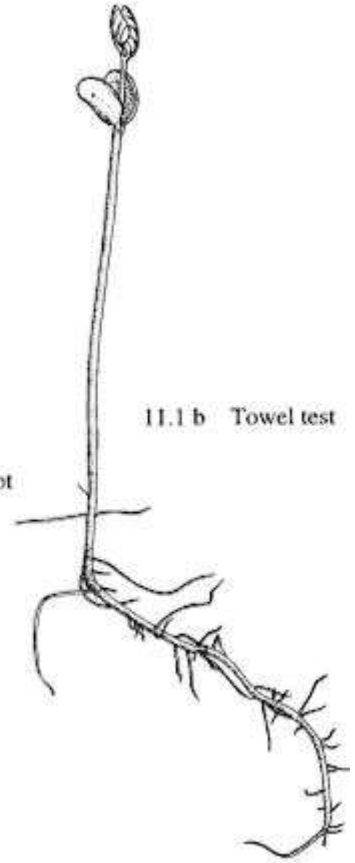
GERMINATED UNDER LIGHT



GERMINATED IN DARKNESS
SHOWING THE MESOCOTYL



11.1 a
Sand test



11.1 b Towel test

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Abnormal seedlings

- Seedlings which do not show the capacity for continued development into normal plant when grown in favourable condition of soil, water, temperature and light.

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Types of abnormal seedlings

- **Damaged seedlings**
- Seedlings with any one of the essential structures missing or badly damaged so that the balanced growth is not expected.
- Seedlings with no cotyledons, with splits, cracks and lesions or essential structures and without primary root.

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Deformed seedlings

- Weak or unbalanced development of essential structures such as spirally twisted or stunted plumule or hypocotyls or epicotyls, swollen shoot, stunted roots etc.
- **Decayed seedlings**
- Seedlings with any one of the essential structures showing diseased or decayed symptoms as a result of primary infection from the seed which prevents the development of the seedlings.

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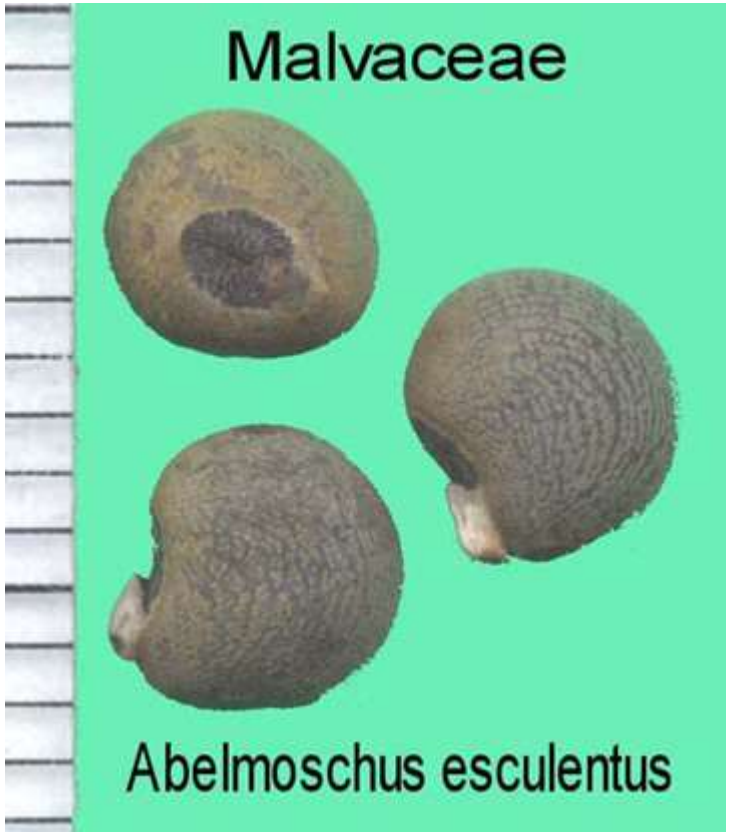
Hard seeds

- Seeds which do not absorb moisture till the end of the test period and remain hard (e.g.) seed of leguminaceae and malvaceae



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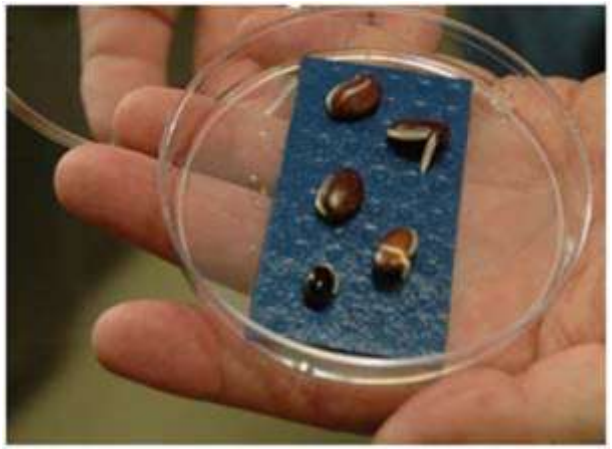
Fresh and ungerminated seeds(Dead Seeds)

- Seeds which are neither hard nor have germinated but remain firm and apparently viable at the end of the test period.
- at the end of the test period are neither hard or nor fresh or have produced any part of a seedling. Often dead seeds collapse and milky paste comes out when pressed at the end of the test.



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Retesting

- If the results of a test are considered unsatisfactory it will not be reported and a second test will be made by the same method or by alternative method under the following circumstances.
- Replicates performance is out of tolerance
- Results being inaccurate due to wrong evaluating of seedlings or counting or errors in test conditions
- Dormancy persistence or phytotoxicity or spread of fungi or bacteria. The average of the two test shall be reported.

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Use of tolerances

- The result of a germination test can be relied upon only if the difference between the highest and the lowest replicates is within accepted tolerances.
- To decide if two test results of the same sample are compatible again the tolerance table is used.

Reporting results

- The result of the germination test is calculated as the average of 4x100 seed replicates. It is expressed as percentage by number of normal seedlings. The percentage is calculated to the nearest whole number. The percentage of abnormal seedlings, hard, fresh and dead seeds is calculated in the same way. These should be entered on the analysis of certificate under appropriate space. If the result is 'nil' for any of these categories it shall be reported as ‘0’.

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Growth Tests:Principles:

- Growth tests are based on the principle that vigorous seeds grow at a faster rate than poor vigour seeds even under favourable environments. Vigorous seeds rapidly germinate, metabolize and establish in the field. 'Iherefore, any method used to determine the rapidity of growth of the seedling will give an indication of seed vigor level.

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Procedure

- (a) First count: The test is done along with the regular germination test. The number of normal seedlings, germinated on the first count day, as specified in the germination test for each species, are counted. The number of normal seedlings gives an idea of the level of seed vigour in the sample. Higher the number of normal seedlings greater is the seed vigour.

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(b) Seedling growth rate and dry weight:

- The seedlings are grown either in laboratory, green house or field. In laboratory, in between rolled towel paper method should be followed. Ten seeds are planted in the centre of the moist towel papers in such a way that the micropyles are oriented towards bottom to avoid root twisting. The rolled towel papers are kept. in the germinator maintained at a temperature recommended for crop in reference. After a specified period of time (5-10 days) towel papers are removed and five seedlings arc selected, their length is measured and mean seedling length is calculated. Seed lots producing the taller seedlings are considered more vigorous than the seed lots producing shorter seedlings. For dry weight determination, the seedlings are removed anddried in an air oven at 100°C temperature for 24 hours. The seedling dry weight provides additional information for assessing seed vigour.

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(c) Speed of germination :

- One hundred seeds each in four replications are planted in recommended substratum for germination. The substratum is kept in a germinator maintained at recommended temperature for the crop in reference .Number of seedlings emerging daily are counted from day of planting the seeds in the medium till the time germination is complete.

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- Thereafter a germinationindex (G.I.) iscomputedbyusingthe followingformula:
- Germination Index G.I.=$\frac{n}{d}$
- where, n =numberofseedlingsemergingonday 'd'
- d = dayafterplanting
- Theseedlothavinggreatergerminationindexisconsideredtobl~ morevigorous.

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Determination of moisture content

- **Objective**
- To determine the moisture content of seeds by methods suitable for routine use.
- **Definition**
- The moisture content of a seed sample is the loss in weight when it is dried. It is expressed as a percentage of the weight of the original sample. It is one of the most important factors in the maintenance of seed quality.
-

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Method of moisture determination

- **1. Air oven method**
- In this method, seed moisture is removed by drying the seed sample at a specified temperature for a specified duration.
- **2. Moisture meters**
- Moisture meters estimate seed moisture quickly but the estimation is not as precise as by the air oven method.
- **Weight of the submitted sample**
- 100 g for species that have to be ground. 50 g for all other species. The sample should be submitted in polythene bag of 700 gauge.

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Air oven method for seed moisture estimation

- **Materials required**
- **Grinding mill**
- It should be constructed of non-absorbent material. It should grind evenly and should be operated at such a speed that during grinding, it should not cause heating of the ground material. Air currents that might cause loss of moisture must be reduced to a minimum. The fineness of grinding should be adjustable.

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Container

- Container of glass or non-corrosive metal (e.g.) stainless steel should be used.
- **Oven**
- A good quality electric air oven with a thermostatic electronic temperature control for maintaining temperature within ±1°C is required.

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Desiccator, Analytical balance, Sieves. A set of wire mesh sieves with meshes of 0.5 mm, 1.0 mm and 4.0 mm.

Desiccators

Balance

Sieves

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Grinding

- For some seeds (e.g. Cereals and Cotton) fine grinding is essential before the moisture content is determined. In such cases, at least 50% of the ground material should pass through a wire sieve with meshes of 0.5 mm and not more than 10% remain on a wire sieve with a mesh of 1.0 mm. For leguminous seeds, coarse grinding is recommended; at least 50% of the ground material shall pass through a wire sieve with meshes of 4.0 mm.
- **Pre drying**
- If the species is one for which grinding is necessary and the moisture content is more than 17%. (or 10% in the case of soy bean and 13% in rice) pre drying before grinding is necessary. For this purpose, two 50 g portions are weighed and placed on open trays at 130°C for 5-10 min. If seed moisture content is about 25% or more it should be pre-dried at 70° C for 2-5 hours, depending on the initial water content. The pre dried seeds should be kept in a closed desiccator for cooling. Then each of the duplicate quantities is weighed separately and about 20 g is ground. The ground material is then subjected to moisture testing using a hot air-oven as described below.

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Moisture estimation

- It should be carried out in duplicate on two independently drawn 5-10 g working samples, weighed with an accuracy of 1 mg. Most species are dried for 1 hr at 130° C, cereals for 2 hours (130°C) and maize for 4 hours (130°C). Seeds containing high percentage of oil should be dried at 103°C for 17 hours.

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Crop	Grinding	Drying temp °C	Drying time (hrs.)	Predrying necessary above the moisture Content %.
Paddy	FG	130	2	13
Ragi	-	103	17	-
Maize	FG	130	4	17
Cumbu	FG	130	1	17
Sorghum	FG	130	2	17
Blackgram	FG	130	1	17
Greengram	FG	130	1	17
Cowpea	C.G	130	1	17
Redgram	C.G	130	1	17
Castor	C.G	130	17	17
Groundnut	C.G	103	17	17
Sesame	-	103	17	17
Soybean	C.G	103	17	-
Sunflower	-	102	17	17
Cotton (delinted)	FG	103	17	-
Ash gourd	C.G	130	1	17
Other gourds	-	130	1	17
Brinjal & Chillies	-	103	17	-
Bhendi	C.G	130	17	-
Tomato	-	130	1	-
Cabbage	-	130	17	-

F.G. : Fine grinding ; C.G. : Coarse grinding

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Steps

- Empty container along with its cover should be weighed
- The submitted sample should be mixed thoroughly and two small portions or seed sample are to be drawn and it should be ground as per the requirements.
- Then fill the container with 5 grams of ground sample and weigh it.
- After weighing, remove the cover or lid of the container and the open container should be kept in the oven which has already been heated to the prescribed drying temperature.
- At the end of the drying period, container should be closed with its cover or lid. The container should be transferred into a Desiccator. The Desiccator should be closed and the sample should be allowed to cool for 30 minutes.

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The sample should be weighed again and the moisture content may be calculated to one decimal place by the following formula:

$$m = \frac{m2-m3}{m2-m1} \times 100$$

Where, m = Seed moisture content
m_1 = Weight of *the* empty container with its cover
m_2= Weight of the container with its cover and seeds before drying
m_3 = Weight of the container with its cover and seeds after drying
The duplicate result of the determination may not differ by more than 0.2% otherwise the analysis should be repeated.
If pre dried, the moisture content is calculated from the results obtained in the first (pre-drying) and second stages of the procedure. If SI is the moisture lost in the first stage and S2 is the moisture lost in the second stage, each calculated as above and expressed as a percentage, the original moisture content of the sample is calculated as below.

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The original moisture content of the sample is calculated as below.

- $$m = S_1 + S_2 - \frac{S_1 \times S_2}{100}$$

- m= moisture content
  S_1 =Moisture percentage lost in predrying stage
  S_2= Moisture percentage lost in drying stage

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Moisture meters: Universal (OSAW) digital moisture meters

- The principle involved in these moisture meters is that wet grains are good conductors while dry grains are less conductors of electricity. So, the moisture content is directly proportional to the electrical conductivity of the seed.
- It consists of a compression unit to compress the sample to pre -determined thickness. The thickness setting is very easily read on a vertical and circular scale. The seed material on test is taken in a test cup and is compressed. Then press the push type switch till the reading comes in the display. Here no temperature reading and correlated dial are required. The computer version of digital moisture meter automatically compensate for temperature corrections.

Seed standards for moisture content

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Crop	Type of storage	FS (% max)	CS (% max)
Paddy	Open storage	13.0	13.0
	Vapour proof	8.0	8.0
Maize	Open storage	12.0	12.0
	Vapour proof	8.0	8.0
Sorghum,cumbu&ragi	Open storage	12.0	12.0
	Vapour proof	8.0	8.0
Black gram	Open storage	9.0	9.0
	Vapour proof	8.0	8.0
Groundnut	Open storage	9.0	9.0
	Vapour proof	5.0	5.0
Sesame	Open storage	9.0	9.0
	Vapour proof	5.0	5.0
Soybean	Open storage	12.0	12.0
	Vapour proof	7.0	7.0
Sunflower	Open storage	9.0	9.0
	Vapour proof	7.0	7.0
Castor	Open storage	8.0	8.0
	Vapour proof	5.0	5.0
Cotton	Open storage	10.0	10.0
	Vapour proof	6.0	6.0
Cucurbits	Open storage	7.0	7.0
	Vapour proof	6.0	6.0
Brinjal & Chillies	Open storage	8.0	8.0
	Vapour proof	6.0	6.0
Bhendi	Open storage	10.0	10.0
	Vapour proof	8.0	8.0
Tomato	Open storage	8.0	8.0
	Vapour proof	6.0	6.0
Cabbage&cauliflower	Open storage	7.0	7.0
	Vapour proof	5.0	5.0
Onion	Open storage	8.0	8.0
	Vapour proof	6.0	6.0
Carrot	Open storage	8.0	8.0
	Vapour proof	7.0	7.0
Beet root	Open storage	9.0	9.0
	Vapour proof	8.0	8.0
Radish	Open storage	6.0	6.0
	Vapour proof	5.0	5.0

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Determination of the mass of 1000 seeds in different crops

- Only pure seeds are used, as per the definition given in the Purity Analysis section above; however, seed from the official purity analysis may not be used to determine TSW due to the possibility of moisture changes in seeds during longer exposure to ambient conditions. For this reason, TSW tests should be completed quickly to minimize weight errors.
- Eight (8) pure seed replicates of 100 seeds must be drawn randomly from the submitted sample. Each replicate weight is recorded in grams to three decimal places and the mean weight determined from these 8 replicates. The mean weight of 100 seeds is then used to calculate the weight of 1000 seeds. Variance, standard deviation and coefficient of variance must be calculated using the following formulas:

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$$\text{Variance} = \frac{n(\Sigma x^2) - (\Sigma x)^2}{n(n-1)}$$

where : x = weightofeachreplicateingrams n = numberofreplicates Σ = sumof

Standard deviation $s = \sqrt{\text{Variance}}$

Coefficientofvariation $CV = \frac{sx100}{x}$

where: x = average (mean) weightof 100 seeds

Ifthecoefficientofvariationdoesnotexceed 4.0 thenthethousandseedweightisacceptedandisreportedto 3 decimalplaces. Forgrassseedthecoefficientofvariationmustnotexceed 6.0. An Excel toolcanbeprovidedfortheabovecalculationsuponrequest.

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Determination of seed purity

- Theobjectiveofpurityanalysisistodeterminethepercentagecomposition byweightofpureseedsversusseedsofotherspeciesanddebris (inertparticles) thatmakeupthesample.
- Thepureseedpercentageshouldbereportedandiscalculatedbythefollow ingformula:
-
- Pure seed%=$\frac{\text{weight of pure seed fraction}}{total\ working\ sample\ weight}\ x100$
- Pureseedpercentageisroundedandreportedtoonedecimalplace.
-

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1. Calculate the seed rate of mung bean for sowing 1 hectare of crop from the following:
spacing=30cm×10cm
germination %=92%
purity %=85%
1000 grain weight =36g

Solution:

Plant population= $\frac{10000m^2}{0.3m \times 0.1m}$=333333.33

Seed rate =$\frac{333333.33 \times 36 \times 100 \times 100}{92 \times 85 \times 1000 \times 1000}$=**15.34 kg/ha** (Ans).

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- **QUALITY DECLARED SEED (QDS)**
- Seed for emergency operation should comply with quality standards to ensure quality seed is provided to the vulnerable farmers. The FAO developed Quality Declared Seed scheme provides seed quality standards that are used as a minimum standards for seed purchased in seed relief activities.

- **SEED DETERIORATION**
- Temperature and relative humidity of the storage environment are two critical factors to pay attention for an environment favourable for seed storage. The moisture content of the seed and the particular crop are also important factors in seed storage. The lower the temperature and relative humidity, the longer the seeds can be safely stored. Therefore in emergency operation seeds should not be stored for extended periods in tropical conditions to avoid problems with seed deterioration due to high temperature and relative humidity.

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SEED STORAGE

- Effective seed storage requires: the seed to be dried to the prescribed moisture content, a clean well ventilated storage area, if needed treatment of the seed to prevent insect attack, and periodic inspection of the stored seed. Seed should not be stored for extended periods when there is high temperature and relative humidity.

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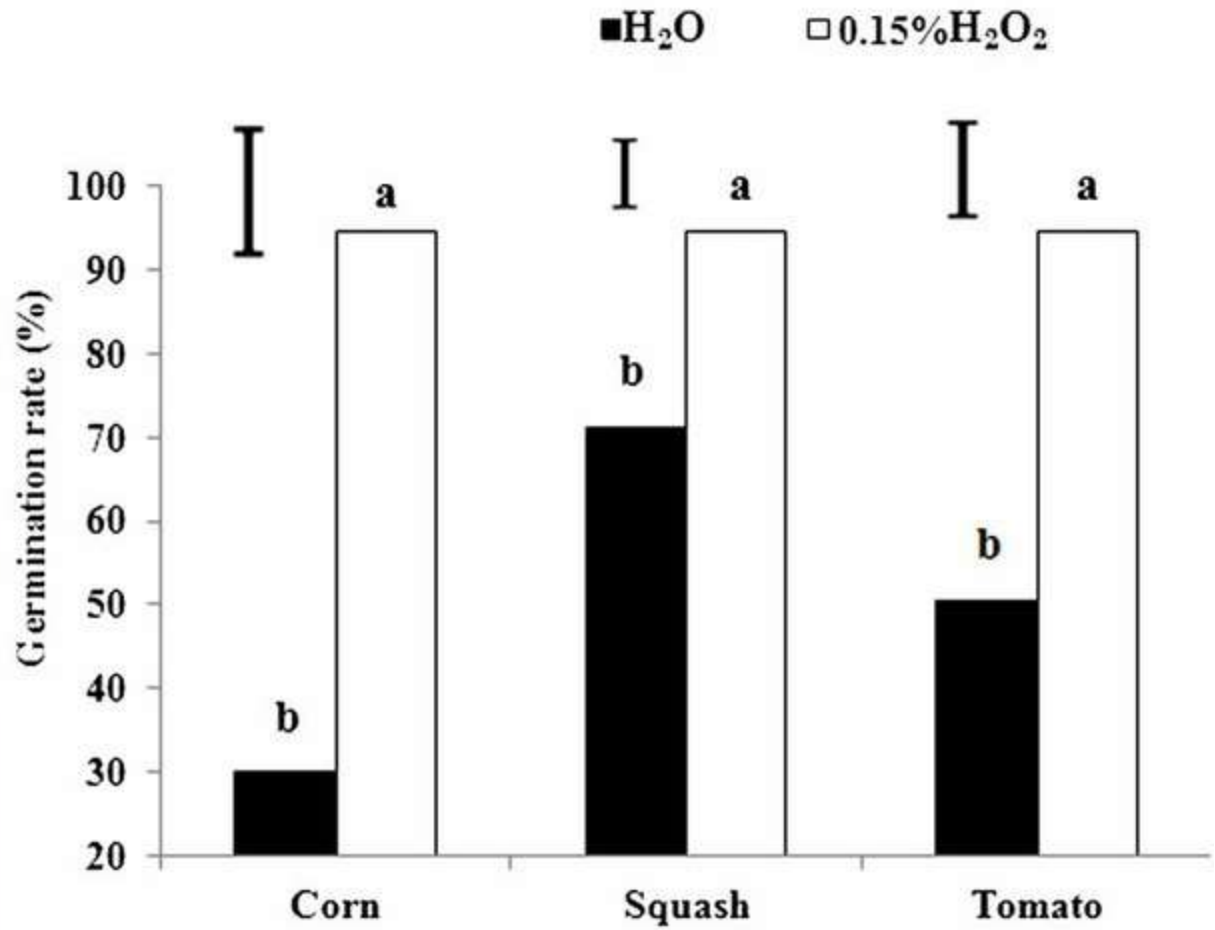

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