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ज्ञानम् आत्म प्रदीपाय

Principles of seed technology practical manual

Course code: CC-AGP631 Credits: 3 (1+2)

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Laboratory Manual

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Practical 1. Seed production in major cereal: Wheat

Wheat (*Triticum aestivum*) is one of the important food grain crops of India belonging to the family Gramineae. Seed production can be taken up during October – February in rainfed areas and in mid-November – March / April in irrigated areas. Method of seed production Wheat is a self-pollinated crop with crosspollination to the extent of 0 – 4%. The crop should be raised in isolation and seeds are allowed to set by open-pollination. To maintain the varietal purity an isolation distance of 3 metres is maintained in both certified and foundation stages of seed production. Seed production stages Breeder seed è Foundation seed è Certified seed Land selection

Land Preparation:

The land selected should not be cultivated with the same crop in the previous season. Land should be free of volunteer plants. Land should be fertile with good irrigation and drainage facilities and with neutral pH. Seed selection and sowing Seeds used for seed production should be of good quality certified seeds from an authentic source.

Seed Treatment:

Seeds should be healthy, uniform in size and free from the insect or disease attack and with good germination percentage. Seed rate is 35 – 40 kg/ acre (85 - 100 kg/ha). Seeds are treated with a mixture of beejamrut (150 ml) and Trichoderma viride (8 gms) for one kilogram of seeds and dried in shade. Again treat the seeds with a mixture of Azotobacter and PSB (Phosphate Solubilizing Biofertilizers) biofertilizer like Pseudomonas / Bacillus / Aspergillus @ 20 gms of each for one kilogram of seeds. Shade dry the seeds and sow within 6 - 8 hours of treatment. Treated seeds should be sown in the well ploughed, softened wet soil at a depth of 5 – 7.5 cm by drilling method or behind the plough. Spacing between the rows should be 22.5 cm.

Nutrient management

During final ploughing farmyard manure @ 5 – 6 tonnes/acre (12 – 15 tonnes/ha) should be applied and incorporated into the soil. Mix 800 gms/acre (2 kg/ha) of Pseudomonas or Aspergillus with farmyard manure or compost @ 325 – 400 kgs/acre (800 – 1000 kg/ha) or vermicompost @ 200 – 400 kg/acre (500 – 1000 kg/ha) and apply to the soil before sowing. Apply neem cake / pongam cake / castor cake / groundnut cake @ 60 – 80 kg/acre (150 – 200 kg/ha) for increased production. Apply Jeevamrut @ 200 litres/acre (500 litres/ha) along with irrigation water during first four irrigations for good crop growth.

Weed management

Weeding is important during early stages of cultivation. Manual weeding is most preferred under organic management. For rainfed crops two manual weeding is enough. For irrigated crops, a minimum of three weeding during 20 - 25 days, 40 – 45 days and 60 – 65 days after sowing is essential. Irrigation First irrigation is done before sowing since the seeds should be sown in irrigated wet soil. Crop should be irrigated at 10 - 20 days interval. Irrigation during tillering to flowering and panicle initiation stage to heading are very critical. This determines the quality of the seeds.

Pest and disease management

Wheat is commonly affected by pests and diseases like termites, army worms, brown wheat mite, aphids, jassids, rust, smut, kernel bunt etc., at different growth stages.

Roguing

Roguing should be done from vegetative phase to harvesting phase. The seed production field should be checked for off-types and diseased plants and rogued off. Major roguing is done before flowering stage to assure the genetic purity of the seeds. Off-types are identified by plant type, plant height, days for flowering, leaf colour, panicle shape and colour of glumes etc. Maximum percentage of off-types permitted at the final inspection is 0.050% for foundation seed production and 0.20% for certified seed production.

Field inspection

A minimum of two field inspections should be done between flowering and harvesting stages by the Seed Certification Officer. During inspection parameters such as isolation requirement, offtypes, volunteer plants, diseased plants etc., are checked.

Harvesting

Harvest is done soon after the maturation of the seeds that turns from green to straw yellow in colour. Earheads should be harvested when the seeds attain maximum physiological maturity. Irrigation to the seed plot should be withheld at this point to facilitate the drying of the crop/ seeds. Crop should be harvested with their panicles intact.

Threshing and processing

Harvested plants should be stacked on a clean floor of the threshing yard free from other varieties. Harvested plants with a moisture content of 15% should be threshed by hand beating or threshers. This level of moisture content is safe for threshing without any mechanical injury to the seeds. Threshed grains are winnowed and cleaned. Cleaned seeds are dried to attain a safe moisture content of 12 – 13 % and graded using a suitable sieve to remove chaffy, under and over sized seeds.

Drying and storage

The cleaned and graded seeds are dried to attain 12 - 13% of moisture content. Normally the seeds can be stored for one year under ambient storage conditions without losing much of the germination potential. Seed standards The percentage of minimum physical purity of the certified and foundation seeds should be 98% with a minimum of 80% of germination capacity and 8 - 13% of moisture content. The presence of inert and huskless seeds should not exceed 2.0%.

Exercise: Draw the inflorescence of Wheat plant.

Practical 2. Seed production in major cereal: Rice

Land requirement

The previous crop should not be the different variety of paddy. It was if same variety, it should have passed production of certified procedure

Isolation: Adopt 3m all around the field

Pre-sowing seed management:

- Egg Flotation Method for Paddy Seeds

- In dormant cultivars, break the dormancy by soaking the seeds in equal volume 0.1 N conc.HNO_3 or in 0.5% KNO_3 for a duration of 12-16 h. The seeds are to be dried to original moisture content. (or) Upgrade the seeds using specific gravity grading adopting salt water (egg flotation dissolve 1.5 kg of common salt in 1 lit of water grading) to remove ill filled and immatured seed.

- For rainfed rice or direct sowing, harden the seeds by soaking the seeds in equal volume of 1% KCl solution for 16 h and dry back the seeds to original moisture content.

- Harden the seeds with 1% KCl for 16 h and dry back to original moisture content and coating with polymer @ 3 ml/kg + imidachloprid@ 2ml / kg + carbendazim @ 2 g / kg + Pseudomonas fluorescens @ 10 g/kg + Azophos @ 120g/kg. (or)

- Soak the seeds in 3 % cowpea sprout extract for 16 h in the seed to solution ratio of 1:1 and dry back to original moisture content. (or)

Soak the seeds in 60% Pseudomonas fluorescens (80 g of powder form mixed in 100 ml of water) for 12 hrs

Method of planting

- SRI nursery

SRI method can be adopted for saline soil

- Incorporation of green manure like daincha
- Designer seed as detailed above.
- Shallow planting @ 3-4 seedlings / hill.
- Planting of seedlings with 5 days more aged seedlings than normal planting.
- Basal application of gypsum @ 500 kg/ha.
- Foliar Method of planting
- SRI nursery
- SRI method can be adopted

Fertilizer recommendation

Short duration : NPK @ 120:40:40 kg ha-1

Medium duration : NPK @ 150:50:60 kg ha-1

Long duration : NPK @ 150:50:80 kg ha-1 Zinc

deficient soils

Apply ZnSO4 @ 25 kg ha-1

Roguing space

Leave a roguing space of 30 cm between the beds size of 150 cm

Foliar application

DAP 2% or 0.5% NutriGold (organic growth promotor) at boot leaf stage and at 5-10% flowering.

Spray with 3% cowpea sprout extract at vegetative and flowering stage.

Preparation of pulse sprouts extract

Cowpea seeds were soaked overnight and incubated in a wet cloth for 12 h to enable sprouting.

Later, 100 g of sprouts were ground in a mixer grinder by using ice cubes of 100 ml of water to prepare extracts of 100 per cent concentration.

The ground material was squeezed through cloth bag to extract the sprout extract

Harvesting

When 90% of the panicle are in straw colour with the moisture content of 20% for short and medium duration varieties and 17% moisture for long duration varieties

Threshing

Threshing at 16-17% moisture content either manually or using mechanical threshers for seed separation


Drying

Dry the seeds to 12-13% moisture content for short term storage and 8-9% moisture for long term storage

Seed Treatment

Treat the seeds with carbendazim @ 2g kg-1 of seed using 5 ml of water kg-1 of seed or dry dress with halogen mixture ($CaOCl_2$ + $CaCO_3$ mixture at 1:1 ratio) of seed.

Coat the seed with polymer (3 ml kg-1 in 5 ml of water) + Royal flow 40 sc @ 2.4 ml kg-1 of seeds + imidachloprid @ 6 ml kg-1 of seed.

Expose the seeds thrice with 50 % CO_2 (4 days for 50 kg container) at 12 % moisture content at 15 days interval.

Storage

For short term storage (9-12 months), store the seeds with 12-13% moisture content in gunny bag / cloth bag.

For medium term storage (12-36 months), store the seed in HDPE bag or polylined gunny bag with 10-12% seed moisture

Exercise: Visit a nearby farm to observe local seed production techniques.

Practical 3. Seed production in maize

Land requirement

Land should be free from volunteer plants. The previous crop should not be the same variety or other varieties of the same crop.

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified quality seed production leave a distance of 200 m all around the field from the same and other varieties of maize

Season

November – February and June – September

Pre-sowing seed treatment

Soak the seeds in 2 % KH_2PO_4 in the seed to solution ratio of 1:1 for 8 h (or)

Biopriming with Pseudomonas fluorescens at 80 % concentration for 12 h. (80 g of Pseudomonas fluorescens in powder form mixed in 100 ml of water).

For mine spoils, soak the seeds in 2 % KH_2PO_4 for 8 h and coat with pink polymer @ 3g/kg + carbendazim @ 2 g/ kg + imidachloprid @ 1 ml / kg + DAP 30 g / kg + micro nutrient mixture @ 20 g / kg + Azospirilum @ 60 g / kg

Spacing :

45 x 10 cm

Fertilizer requirement

The crop requires NPK @ 150:75:75 kg ha-1. Apply NPK @ 40:75:40 kg ha-1 as basal, 50 kg of N at 20 days after sowing as first top dressing and 60:0:35 kg of NPK at 40 days after sowing as second top dressing

Foliar spray

0.5 % Nutrigold spray at silking and maturity stage (or)

% cowpea sprout extract at silking and maturity stage. (Preparation as in

rice) Preparation of pulse sprout extract

Cowpea seeds were soaked overnight and incubated in a wet cloth for 12 h to enable sprouting. Later, 100 g of sprouts were ground in a mixer grinder by using ice cubes of 100 ml of water to prepare extracts of 100 per cent concentration. The ground material was squeezed through cloth bag to extract the sprout extract

Harvest

Harvest the cobs as once over harvest.

Verify true to type cobs based on kernel and shank color (cob sorting) variation.

Remove the diseased cobs and do not select for seed purpose

Shelling

Shell the cobs either by beating with pliable bamboo stick or using maize sheller with required rpm at a seed moisture content of 15 – 18%.

Improper shelling leads to pericarp injury up to 48% and will promote saprophytic

fungal growth.

Estimate mechanical / pericarp injury through 20% FeCl3 test or using 0.25% Tetrazolium solution

Size grading

Grade the seeds using 18/64" round perforated metal sieve

Seed treatment

- Slurry treat the seeds with carbendazim @ 2 g kg-1 of seed using 5ml of water kg-1 of seed.
- Dry dress the seeds with halogen mixture @ 3g kg-1 of seed (CaOCl2 + CaCO3 + arappu (Albizzia amara) leaf powder mixed in the ratio of 5:4:1) for grain cum seed storage

Storage

- Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 10-12 %.
- Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 - 9 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content of less than 8%

Practical 4. Seed production in sorghum

Land requirement

- Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop. It can be the same variety if it is certified as per the procedures of certification agency

Isolation

- For certified / quality seed production leave a distance of 100 m all around the field from the same and other varieties of the crop
- The distance may be extended to 400 m for the presence of Johnson grass

Season

- June - July and October - November



Pre-sowing seed treatment

Soak the seeds in 2% KH_2PO_4 for 16h in a seed to solution ratio of 1:0.6 and dry back the seeds to original seed moisture content (8 – 9%) under shade. This can be adopted both for the garden and dry land ecosystem

For better establishment in mine spoils harden the seed with 2 % KH_2PO_4 for 6 h and coat the seed with pink polymer @ 3g / kg of seed + carbendazim @ 2g/kg + imidachloprid @ 1 ml / kg + DAP @ 30 g / kg + micro nutrient mixture @ 20 g / kg + Azospirillum @ 40 g / kg of seed

Fertilizer requirement

As basal application, apply NPK @ 100 : 50 : 50 kg ha-1

Pre-harvest sanitation spray

Ten days before harvest, spray 2% carbendazim against black mould

Harvesting

Seeds attain maturity 40 – 45 days after 50% flowering with 25-28% seed moisture content.

Harvest the earheads when the seed attain the characteristic yellow colour, as once over harvest

Threshing

Thresh the earheads either manually or mechanically at a moisture content of 15 – 18 %.

Seed grading

Size grade the seeds either with 9/64" (3.6mm) or 10/64" (4.0mm) round perforated metal sieve depending upon the size distribution in a variety

Seed treatment

Slurry treat the seeds with carbendazim @ 2g kg-1 of seed along with carbaryl @ 200 mg kg-1 of seed (or)

Slurry treat the seeds with halogen mixture @ 3g / kg- ($CaOCl_2$ + $CaCO_3$ + arappu (Albizzia amara) leaf powder mixed in the ratio of 5:4:1) as eco – friendly

treatment

Storage

Store the seeds in gunny or cloth bags for short term storage (8-9 months) with the seed moisture content of 10 - 12%.

Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with the seed moisture content of 8 – 9 %.

Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with the seed moisture content of less than 8%.

Practical 5. Seed production in Pearl Millet

Land requirement

Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop. It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified/ quality seed production leave a distance of 200 m all around the field from the same and other varieties of cumbu

Season

October – December and June-September.



Spacing

- 45 x 20 cm

Pre-sowing seed treatment

- Soak the seeds in 2% KCl for 16h in a seed to solution ratio of 1:1 and dry back the seeds to original seed moisture content (8 – 9%) under shade. This can be adopted both for the garden and dry land ecosystem.

Fertilizer requirement

- The crop requires NPK @100 : 50 : 50 kg ha-1. Apply NPK @ 50 :50:50 kg ha-1 as basal and 50 kg N on 30 days after sowing as top dressing

Threshing

- Thresh the earheads either manually or mechanically at moisture content of 15 - 20 %.

Harvesting

- Seeds attain physiological maturity 27-30 days after 50% flowering.
- Harvest the earheads when the seed attained the characteristic pale green colour, as once over harvest at 20-25 % moisture content.
- Harvest the crop as two pickings when the tiller number is more.
- Earheads from late-formed tillers (after 7 earheads from first formed tillers) should not be selected for seed purpose

Foliar spray

- At peak tillering stage, spray DAP @ 1 % to enhance pollen viability and enhanced seed set

Drying

- Dry the seed either under sun or using mechanical hot air driers to reduce the moisture content to 10%.

Seed grading

- Dry the seed either under sun or using mechanical hot air driers to reduce the moisture content to 10%.

Storage

- Store the seeds in gunny or cloth bags for short term storage (8-9 months)with the seed moisture content of 10-12 %
- Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with the seed moisture content of 8 – 9 %
- Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with the seed moisture content of less than 8%.

Practical 6. Seed production in Finger millet

Ragi can be grown in poor to fertile soil. The crop can tolerate salinity better than any other crops. The selected land should be free from volunteer plants. The land should not be cultivated with same crop in the previous season. Land should be ploughed 2 - 3 times to get fine tilth and levelled.

Seed selection and sowing

Ragi is a season bound crop and the best season to take up sowing is December - January and June - July. Seeds used for seed production should be of good quality certified seeds from an authentic source. Seeds should be healthy with required germination percentage. Recommended seed rate is 2 kg/acre (5 kg/ha). Selected seeds should be treated with *Azospirillum* @ 125gms/kg of seeds.

Nursery preparation

Nursery should be raised in an area of 500m2 to plant one hectare of main field (200m2 per acre). Selected nursery plot should be ploughed for two to three times to have fine tilth of soil. Raised beds should be formed and shallow rills are formed over the beds by passing the fingers vertically. Seed should be broadcasted and covered with a thin layer of farmyard manure @ 500 kg/ha (200 kg/acre).

Main field preparation

The main field is prepared with 2 – 3 ploughing to make it a fine tilth and formed into ridges and furrows. During final plough apply compost or farmyard manure @ 5 tonnes/acre (12.5 tonnes/ ha) and incorporate into the soil. 20 - 25 days old seedlings transplanted to the main field. Two seedlings per hill should be planted. Follow a spacing of 15× 15 cm.

Nutrient management

Before final ploughing compost or farmyard manure @ 5 tonnes/acre (12.5 tonnes/ha) should be applied and ploughed into the soil. Instead of this cattle penning can also be practiced. 50 kg neem cake and 500 kg vermicompost per acre (125 kg neem cake and 1250 kg vermicompost per hectare) should be applied as basal manure. After first weeding at 20 – 25 days after sowing first top dressing should be done using enriched vermicompost (2 kg *Azospirillum*, *Panchagavya* mixed with 250 kg vermicompost and kept covered for a week and then used) @ 250 kg/acre (600 kg/ha) followed by the second top dressing at 40 – 45 days after sowing using 25 kg neem cake and 250 kg vermicompost per acre (60 kg neem cake and 600 kg vermicompost per hectare). During flower initiation stage 10% tender coconut solution (1 litre tender coconut water + 9 litres of water) should be sprayed. For rainfed crop, 50 kg pungam cake and 250 kg vermicompost should be applied as basal manure just before sowing. First top dressing should be done at 20 – 25 days after sowing using 250 kg/ acre of enriched vermicompost. At 40 – 45 days after sowing apply 25 kg pungam cake and 250 kg vermicompost per acre (60 kg pungam cake and 600 kg vermicompost per hectare) as second top dressing. Spray 10% tender coconut water at the time of flower initiation. All the above mentioned inputs should be applied to the rainfed crop only when the soil is wet.

Weed management

The seed production field should be maintained weed free from the initial stage. The first weeding should be done on 15th day after planting and followed by the second one on 30th day. After hand weeding allow the weeds to dry for 2 – 3 days.

Irrigation

The irrigation should be done once a week after life irrigation on the third day of sowing. Irrigation during flowering and grain setting stages are very critical.

Pest and disease management

Ragi is affected by pests and diseases like pink stem borer, aphids, root aphids, earhead caterpillars, blast, brown spot, mottle streak virus etc., at different growth stages.

Roguing

Roguing should be done often to remove the offtypes, volunteer plants and diseased plants from

the seed production field to avoid the geneticcontamination. Roguing should be done upto the flowering stage. Maximum percentage of offtype permitted at the final inspection is 0.05% for foundation and 0.10% for certified seed production.

Field inspection
A minimum of two inspections should be done between flowering and maturity stages by the Seed Certification Officer. The first inspection is done at the time of flowering to check the isolation and off-types and the second done during the maturity stage prior to harvest to check the off-types and to estimate the yield.

Harvesting and processing
Harvest is done once the earheads are physiologically mature. Physiologically mature earheads will turn from brown to green colour. Harvesting is done in two pickings since, the maturation of the earheads are not uniform because of the tillering habit of the crop. Second harvesting should be done seven days after the first one. Mature earheads should be harvested and threshed with bamboo sticks. Threshed grains are further cleaned by winnowing.

Drying and storage
The cleaned seeds should be sun dried to attain a safe moisture level of 12%. Care should be taken while drying to avoid mechanical injury to the seeds and contamination. Seeds can be stored upto 13 months under proper storage conditions.

Seed standards
The percentage of minimum physical purity of certified and foundation seeds should be 97% with a minimum of 75% of germination capacity and 12% of moisture content. The presence of inert matter should not exceed 2.0%.

Practical 7. Seed production in Lentil

LENTIL Botanical Name - Lens culinaris Medikus subsp. culinaris
Synonym - Masur, Malka (bold seeded),
lentil Origin – Turkey to South Iran

Soil Type and Field Preparation

Well drained, loam soils with neutral reaction are best for lentil cultivation. Acidic soils are not fit for growing lentil.

The soil should be friable and weed free so that seeding could be done at uniform depth. On heavy soils, one deep ploughing followed by two to three cross harrowing should be done.

After harrowing, the field should be levelled by giving a gentle slope to ease irrigation.

- Sowing Time
- Recommended sowing time for Rainfed: First fortnight of October in Central and South India and second fortnight of October in North India;
- Under irrigated conditions- First fortnight of November in North India and for Late sowing: First week of December

- Seed Rate and Sowing For small seeded: 40-45 kg/ha; Bold seeded: 45-60 kg/ha; Late sown condition: 50-60 kg/ha;
- Sowing should be done in rows 30 cm. apart and it should be sown at a lower depth (3-4 cm). This could be done either by using a Ferti-seed-drill or by seeding behind desi plough.

- Seed treatment Fungicide: Thirum (2 gm) + Carbendazim (1gm) or Thirum @ 3 gm or Carbendazim @2.5 g per Kg. of seed; Insecticide: Chlorpyriphos 20E.C. @8 ml./Kg. of seed; Culture: Rhizobium + PSB, one packet each for 10 kg seed.
- Irrigation
- First irrigation should be given at 40-45 days of planting and second at pod filling stage. Most critical stage for moisture stress is pod formation followed by flower initiation. In absence of winter rains and where contribution of soil moisture is negligible viz. in Central India, two light irrigations may be applied for significant yield improvement. More irrigation may affect the crop performance adversely.

- **Plant nutrient management**
- Generally Nitrogen 20 kg. Phosphorus 40 kg. and 20 kg. Sulphur per hectare in medium to low fertile soils as basal dressing.
- **Weed Control**
- Two manual weeding, one at 25-30 days and another 45-50 days after sowing should be done.
- Weedicide like Pendimethalin 30 EC @ 0.75-1 kg active ingredient per hectare may be used as a pre-emergence treatment. A weed-free period of early 45-60 days is important.
- Plant Protection Measures
- Treat the seed with systemic fungicide Carbendazim @ 2.5 g/kg of seed; iii) Plant resistant varieties like Pant L-406 etc.
- Keep the field clean and follow a three year crop rotation. This will help in reducing the disease incidence;
- Use tolerant and resistant varieties like Pant Lentil 5, IPL-316, RVL-31, Shekhar Masoor 2, Shekhar Masoor 3 etc; iii) Seed treatment.
- Harvesting, threshing, storage Crop become ready for harvest when leaves begin to fall, stem and pod turn brown or straw in colour and seeds are hard and rattle with 15% moisture inside them.
- Over ripening may lead to fall of pods as well as shattering and seed cracking if seed moisture fall below 10% due to delay in harvesting.

- The crop should be allowed to dry for 4-7 days on threshing floor and threshed by manually or bullock/power drawn thresher.
- The clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10%. The seed should be safely stored in appropriate bins and fumigated to protect them from bruchids.

Practical 8. Seed production in chickpea

Varietal Seed Production

Land requirement

Land should be free of volunteer plants.

The previous crop should not be the same variety or other varieties of the same crop.

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified / quality seed production leave a distance of 5 m all around the field from the same and other varieties of bengalgram.

Pre-sowing treatment

- Soak the seeds in 1% aqueous solution of KH_2PO_4 for 3-4 h at 1/3rd volume of seeds and are dried in shade.
- Avoid bruchid-infected seed for seed purpose.

Harvesting

- Seeds attain physiological maturity 35 – 40 days after anthesis.
- Harvest the crop as once over harvest when 70 – 80% of pods are creamy in colour

Seed grading

- Grade the seeds using 13/64" (5.2 mm) or 18/64" (7.2 mm) round perforated metal sieve depending on the variety
- Dry the seeds to 8-10% moisture content.

Seed treatment

- Slurry treat the seeds with carbendazim @ 2 g kg-1 of seed.

- Slurry treat seeds also with halogen mixture (CaOCl2 + CaCO3 + arappu (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) @ 3g kg-1 of seed as eco – friendly treatment.

Storage

- Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 8 - 9%.
- Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 – 9 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than 15 months) with seed moisture content of less than 8%.

Practical 9. Seed production in LabLab

Land requirement

Land should be free of volunteer plants.

The previous crop should not be the same variety or other varieties of the same crop

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified seed production leave a distance of 5 m all around the field from the same and other varieties of the crop.

Pre-harvest sanitation spray

Spray malathion 0.07% before harvesting the pods for seed crop.

Harvest

Harvest the pods as they turned straw yellow in color

Discard the terminal pods for seed as they invariably contain immature and diseased seeds

The seed moisture content at the stage will be about 15% and the green colour of the seed coat will turn to chocolate brown colour

Dry the pods to 15-18% moisture content

Seed treatment

Slurry treat the seeds with carbendazim @ 2g kg-1 of seed along with carbaryl @ 200 mg kg-1 of seed (or)

Slurry treat seeds with halogen mixture ($CaOCl_2 + CaCO_3$ + arappu (Albizzia amara) leaf powder mixed in the ratio of 5:4:1) @ 3g kg-1 as eco – friendly treatment.

Storage

Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 8-9 %.

Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 – 9 %

Store the seeds in 700 gauge polythene bag for long term storage (more than 15 months) with seed moisture content of less than 8%.

Practical 10. Seed production in Garden Pea

Land Requirement and Isolation Distance:

- It can be grown on all types of soils but well drained fertile loamy soils are best for the crop. Peas do best in soils having pH 6.0 to 7.5.
- An isolation distance of 10 metre for the production of foundation seed and 5 metre for the production of certified seed should be kept between fields of two cultivars.
- **Sowing Time and Seed Rate**
- Sow seed crop in last week of October to first week of November. For mechanized sowing, seed rate of 30 kg per acre is sufficient for early and main season varieties. Manual sowing can reduce the seed rate to 10 kg per acre.
- Line x Plant spacing should be 30 x 10 cm for early and main season varieties.

Pea-stem fly (Ophiomyia phaseoli) sometimes causes serious damage at the seedling stage. Therefore apply 3kg Thimet 10G (phorate) or 10kg Furadan 3G (carbofuran) granules per acre in furrows at sowing. The sowing of pea can also be done with Seedcum-Fertilizer pea drill on ridges which are 60 cm wide. This drill sows two rows of pea which are 25 cm apart on each ridge. This drill can sow one acre per hour.

- Seed Treatment and Nitrogen Fixation: Treat the seed with Bavistin @1g or Captan @ 2g per kg seed before sowing. One acre culture packet should be mixed with half litre of water.
- It is better to add Bavistin or Captan for 30 kg seed in the same half litre water while treating with bacterial culture. Rub the mixture thoroughly on seed to give a fine covering

of the culture to every seed. Thereafter, spread the seed in shade for drying and plant it immediately afterwards.

- **Manures and Fertitizers**: Apply 8 tons of farmyard manure and 20 kg of N (a5 ke of Urea) and 25 kg of 155 kg of Superphosphate per acre before sowing.
- **Weed Control:** The field should be kept free from weeds by giving two hoeings after four and eight weeks of germination respectively. For chemical weed control, use Stomp 30 EC (pendimethalin) @1.0 litre per and spray uniformly over the entire field.
- **Irrigation**: It is very important to sow the seed in proper soil moisture condition when it is sown flat. First irrigation should be given after 15-20 days of sowing. Next irrigation should be given at flowering and then at fruit set if necessary. Pea can be grown as rainfed crop with limited irrigations. The total number of irrigations required are 3-4 depending upon the soil type and weather conditions.
- **Field inspection** The three inspections shall be made, the first before flowering, the second at flowering and third at edible pod stage. The maximum off-type permitted percentage for foundation and certified seed is 0.10 and 0.50 respectively. Although a self pollinated crop, pea is well known for producing off type plants. Hence, rigorous rouging must be undertaken at flowering and fruiting stage as mentioned above.
- **Harvesting, Seed Extraction and Yield**
- When almost 90% pods on the plants mature and turn dry, the whole plants are uprooted and collected on the threshing floor. After about a week the seeds are separated out from the pods by threshing and winnowing.
- Threshing is done by a thresher and extreme care should be taken during threshing to prevent injury to the seed. The ripe and dry pods can also be picked up by hand and threshed on small scale.
- Usually the moisture content of seeds at this time is higher therefore the diying must be resorted to maintain the specified moisture content of 8% for ordinary pack and 6% for vapour proof pack. The seeds maintain viability for two years under normal storage conditions. On an average, from a acre of seed crop about 500-1000 kg pea seeds can be obtained depending upon the variety.

Practical 11. Seed production in Black gram

Land requirement

- Land should be free of volunteer plants.
- The previous crop should not be the same variety or other varieties of the same crop.
- It can be the same variety if it is certified as per the procedures of certification agency

Isolation

- For certified / quality seed production leave a distance of 5 m all around the field from the same and other varieties of the crop

Pre-sowing seed treatment

- Remove all discoloured seeds and use only normal coloured seeds (black coloured in blackgram).
- Do not select bruchid infested seeds for sowing.
- If the presence of hard seed percentage exceeds more than 10 %, scarify the seeds with commercial H_2SO_4 for 2 min.
- Both for the garden and dry land ecosystem, harden the greengram seeds in 100 ppm $MnSO_4$ for 3h in a seed to solution ratio of 1:0.3 and for blackgram seeds in 100 ppm $ZnSO_4$ for 3 h in a seed to solution ratio of 1:0.3 and dry back the seeds to original seed moisture content (8 - 9%) under shade (or)
- In blackgram, fortify the seeds with $ZnSO_4$ 0.2%, $MnSO_4$ 0.2% and Na_2MO_4 0.1% in 1/3 volume to enhance the field establishment under irrigated conditions (or)
- In both the crops as organic treatment, soak the seeds in 3 % cowpea sprout extract for 3 h in seed to solution ratio of 3:1 ratio.
- In mine spoils, soak seeds with 100 ppm $ZnSO_4$ for 3 h in seed solution ratio of 1:1 and coat with black polykote @ 3 g/ kg + carbendazim @ 2g / kg + dimethoate @ 5 ml / kg+ DAP @ 30 g kg-1 + micro nutrient mixture @ 20 g / kg + *Rhizobium* @ 30 g / kg suitable for mine soils

Fertilizer

- NPK @ 25 : 50 : 25 kg / ha + 5 kg / ha of TN micro nutrient mixture

Foliar application

- Spray 2% DAP at the time of first appearance of flowers and a second spray 15 days after first spray for enhanced seed set.
- Spray NAA 40 ppm at first flowering and a second spray after a fortnight to reduce the flower drop.NAA can be mixed with insecticides and fungicides.
- Spray 0.1 % brassinoloid on 35th and 45th day after sowing (or) spray with 3 % cowpea extract at 30 days after sowing (or) spray with 0.5 % Nutrigold at 30 / 40 days after sowing

Harvest

- Harvest the pods 30 days after the 50 per cent flowering for blackgram and greengram.
- At this stage the colour of majority of the pods (80%) will be black in blackgram and brown in greengram.
- The pod moisture content will be about 17 – 18%.
- Harvest the pods as pickings if the flowering period is longer.
- Dry the pods to 13 to 15 per cent moisture content

Threshing

- Thresh the pods either with pliable bamboo stick or pulse thresher

Drying

- Dry the seeds to 8 - 9 per cent moisture content

Seed grading

- Grade the seeds using BSS 7 x 7 wire mesh sieve for large seeded varieties.
- Do not select the discoloured and broken seeds for seed

Seed treatment

- Slurry treat the seeds with carbendazim @ 2g kg-1 of seed along with carbaryl @ 200 mg kg-1 of seed (or)
- Slurry treat the seeds with halogen mixture (CaOCl2 + CaCO3 + arappu (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) @ 3g kg-1 of seed as eco – friendly treatment
- Treat the seed with neem oil/ groundnut oil or leaf powder of tobacco/ notchi/ neem/ *Albizzia amara* (arappu) or fruit rind powder of *Sapindus laurifolius* (Poochi kottai) or *Acacia concinna* (Soapnut powder) in the ratio of 1:100. (or)
- Expose the seeds thrice with 50 % CO2 (4 days for 50 kg container) at 8 % moisture content at 15 days interval

Storage

- Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 8 – 9%.
- Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 – 9 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content of less than 8

Practical 12. Seed production in Mung bean

Land requirement

- Land should be free of volunteer plants.
- The previous crop should not be the same variety or other varieties of the same crop.
- It can be the same variety if it is certified as per the procedures of certification agency

Isolation

- For certified / quality seed production leave a distance of 5 m all around the field from the same and other varieties of the crop

Pre-sowing seed treatment

- Remove all discoloured seeds and use only normal coloured seeds (olive green in greengram).
- Do not select bruchid infested seeds for sowing.
- If the presence of hard seed percentage exceeds more than 10 %, scarify the seeds with commercial H_2SO_4 for 2 min.
- Both for the garden and dry land ecosystem, harden the greengram seeds in 100 ppm $MnSO_4$ for 3h in a seed to solution ratio of 1:0.3 and for blackgram seeds in 100 ppm $ZnSO_4$ for 3 h in a seed to solution ratio of 1:0.3 and dry back the seeds to original seed moisture content (8 - 9%) under shade (or)
- In blackgram, fortify the seeds with $ZnSO_4$ 0.2%, $MnSO_4$ 0.2% and Na_2MO_4 0.1% in 1/3 volume to enhance the field establishment under irrigated conditions (or)
- In both the crops as organic treatment, soak the seeds in 3 % cowpea sprout extract for 3 h in seed to solution ratio of 3:1 ratio.
- In mine soil, soak seeds with 100 ppm $ZnSO_4$ for 3 h in seed solution ratio of 1:1 and coat with black polykote @ 3 g/ kg + carbendazim @ 2g / kg + dimethoate @ 5 ml / kg+ DAP @ 30 g kg-1 + micro nutrient mixture @ 20 g / kg + *Rhizobium* @ 30 g / kg

Fertilizer

- NPK @ 25 : 50 : 25 kg / ha + 5 kg / ha of TN micro nutrient mixture

Foliar application

- Spray 2% DAP at the time of first appearance of flowers and a second spray 15 days after first spray for enhanced seed set.
- Spray NAA 40 ppm at first flowering and a second spray after a fortnight to reduce the flower drop.NAA can be mixed with insecticides and fungicides.
- Spray 0.1 % brassinoloid on 35th and 45th day after sowing (or) spray with 3 % cowpea extract at 30 days after sowing (or) spray with 0.5 % Nutrigold at 30 / 40 days after sowing

Harvest

- Harvest the pods 30 days after the 50 per cent flowering for greengram.
- At this stage the colour of majority of the pods (80%) will be brown in greengram.
- The pod moisture content will be about 17 – 18%.
- Harvest the pods as pickings if the flowering period is longer.
- Dry the pods to 13 to 15 per cent moisture content

Threshing

- Thresh the pods either with pliable bamboo stick or pulse thresher

Drying

- Dry the seeds to 8 - 9 per cent moisture content

Seed grading

- Grade the seeds using BSS 7 x 7 wire mesh sieve for large seeded varieties.
- Do not select the discoloured and broken seeds for seed

Seed treatment

- Slurry treat the seeds with carbendazim @ 2g kg-1 of seed along with carbaryl @ 200 mg kg-1 of seed (or)
- Slurry treat the seeds with halogen mixture (CaOCl2 + CaCO3 + arappu (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) @ 3g kg-1 of seed as eco – friendly treatment
- Treat the seed with neem oil/ groundnut oil or leaf powder of tobacco/ notchi/ neem/ *Albizzia amara* (arappu) or fruit rind powder of *Sapindus laurifolius* (Poochi kottai) or *Acacia concinna* (Soapnut powder) in the ratio of 1:100. (or)
- Expose the seeds thrice with 50 % CO2 (4 days for 50 kg container) at 8 % moisture content at 15 days interval

Storage

- Grade the seeds using BSS 7 x 7 wire mesh sieve for large seeded varieties.
- Do not select the discoloured and broken seeds for seed

Seed treatment

- Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 8 – 9%.
- Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 – 9 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content of less than 8

Practical 13. Seed production in Pigeonpea

Land requirement

- Select fields on which the same kind of crop was not grown in the previous season unless the previous crop was same variety and approved by the certification agency for varietal purity. In addition, the soils should be light, well drained with a natural pH.

Isolation requirements

Redgram is often cross-pollinated by bees and other insects. Therefore, for maintaining varietal purity an isolation of 200 meters for foundation seed class and 100 meters for certified seed class is necessary.

- **Preparation of land**
- Preparation of land by repeated ploughings and harrowings to obtain a fairly pulverised seed bed free from weeds.
- Time of sowing: Sowing of seed crop may be taken up from May to July. However, early sowing is advantageous for better yields.
- Source of seed: Obtain nucleus/breeder/foundation seed from approved source. About 15-20 kg seed is required per ha depending upon seed size.

- Method of sowing: After land is ready for sowing, apply the entire dose of fertilizers and sow the seeds with seed drill or by plough sole in 90 cam rows at 20 cm apart (for May sowing) and provide 60 cm between rows for July sowing. The depth of seeding should not be more than 5 cm.
- Manures and fertilizers: Incorporate about 7.5 tonnes of FYM or compost per ha at the time of land preparation. Apply 25 kg N and 50 kg P_2O_5 and 25 kg K_2O per ha as basal dose at the time of sowing.
- Irrigation and interculture: Light irrigation is required after sowing to ensure good germination. One irrigation at flowering and subsequent irrigations after flowering is necessary depending upon the soil and weather conditions.
- Intercultivate the crop 2-3 times and earthup the crop before flowering to keep the seed plots free of weeds.

Plant protection

- **Important insects and diseases**
- **Insects**
- Pod borer, stem weevil and web worm

Disease

- Wilt and Mosaic

Schedule

- Spray the crop with 18 ml Methyl parathion 50 EC or 36 ml endosulfan 35 EC or 36 ml quinolphos 25 EC or 18 ml Monocrotophos 40 EC or 36 ml phosalene 35 EC in 18 litres of water just before flowering.
- Repeat the same spray after 15 days
- Give the third spray 15 days after the second spray, if the insect persists.
- In place of spraying, dust the crop with 25 kg malathion 5 per cent dust per ha.

Rogueing

- Rouge out the off type and diseased plants (affected by wilt, leaf spot, stem canker, yellow mosaic virus and sterility virus) from the seed fields as and when noticed.
- Rogueing of off types should be done at the time of pre-flowering, initiation of flowering and at maturity every alternate day based on identifiable characters of off types. This is a very important practice for achieving the highest genetic purity.

Harvesting and Threshing

- The crop is harvested soon after the seed is mature. The harvesting is normally done with sickle and the crop is left in the field to dry for about a week. Threshing is done by beating the plants with sticks. It is better to harvest the pods as and when they reach physiological maturity without being delayed or exposed to wetting and drying to maintain high germination with the least deterioration in storage.
- **Drying, grading, treating and bagging**
- Threshed seed produce should be dried properly on a tarpaulin in sun and graded by using 9.52 mmR x 3.97 mmR or 3.18 mm oblong sieve with the help of seed cleaner-cum-grader. Even after grading, it is better to hand pick discoloured and broken seeds, if found to improve seed quality. Seeds having a moisture content of not more than 9 per cent should be packed preferably in polythene lined gunny bags or cloth bag and kept on wooden pallets in a cool and dry ventilated seed store.
- Treat the seed with Thiram 75 per cent WP at 2 gm per kg and also dust the seed bags with 5 per cent malathion dust before storage.

Practical 14. Seed production in Soyabean

Land requirement

Land should be free of volunteer plants.

The previous crop should not be the same variety or other varieties of the same crop

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified / quality seed production leave a distance of 3 m all around the field from the same and other varieties of the crop.

Pre-sowing seed treatment

Pellet the seeds with ZnSO4 @ 0.25 to 0.3 g kg-1 of seed using 2% CMC or 10% maida as adhesive @ 250 ml kg-1 of seed and arappu leaf powder / vermicompost as filler @ 300g kg-1 for better field establishment.

Harvest

Seeds attained physiological maturity 27 –30 days after flowering

Harvest the pods as they turn yellow in colour

Threshing

Thresh the pods either manually or mechanically using pliable bamboo sticks

Seed grading

Grade the seeds using 14/64"(5.6mm) to 12/64"(4.8mm) round perforated metal sieve based on varieties.

Drying

Dry the seeds to 7- 8% moisture content

Seed treatment

Slurry treat with carbendazim @ 2g kg-1 of seed along with carbaryl @ 200 mg kg-1 of seed. (or)

Slurry treat seeds with halogen mixture ($CaOCl_2$ + $CaCO_3$ + arappu (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) @ 3g kg-1 as eco – friendly treatment

Storage

Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 10-12%

Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 8 – 10%

Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content of less than 7%

Practical 15. Seed production in Sunflower

Land requirement

Land should be free of volunteer plants.

The previous crop should not be the same variety or other varieties of the same crop.

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified / quality seed production leave a distance of 200 m all around the field from the same and other varieties /hybrids of sunflower

Spacing

45*30

Pre-sowing seed treatment

- Soak the seeds in water at 1:1 seed to solution ratio by volume for 16h and dry dress with thiram @ 2.5g kg-1 of seed for enhanced seed germination and field establishment
- Soak the seeds with 2% KH2PO4 for 16 h and dry back to original moisture content and coat with polymer @ 3 ml/kg + imidachloprid@ 5 ml / kg + carbendazim @ 2 g / kg + *Pseudomonas fluorescens* @ 10 g/kg (or)
- Soak seeds in 2 % KNO3 for 6 h in 1:1 seed to solution ratio and dry back to original moisture content
- **Fertilizer**
- Apply NPK @ 60:45:45 kg ha-1 as basal application
- **Foliar application**
- At the stage of button opening, spray 0.5% borax for increased seed set
- **Supplementary pollination**
- During flowering (7-10 days), rub the heads with muslin cloth between 8 – 11 AM at alternate days till the completion of flowering

Harvesting

- Harvest the heads when the drooping peduncular receptacle (thalamus) turns lemon or pale yellow in colour.
- At this stage the seed moisture content will be 25 % and the seeds will be black in colour
- Harvest the heads and dry immediately until the seed moisture content reduced to 15 – 16 %.
- Separate the seeds either with mechanical thresher or by manual labour

Seed grading

- Grade the seeds using 9/64" (3.6 mm) round perforated metal sieve or BSS 7 x 7 wire mesh sieve
- Upgrade the size graded using specific gravity separator
- Remove the broken and dehulled seed from the lot

Harvesting

- Harvest the heads when the drooping peduncular receptacle (thalamus) turns lemon or pale yellow in colour.
- At this stage the seed moisture content will be 25 % and the seeds will be black in colour
- Harvest the heads and dry immediately until the seed moisture content reduced to 15 – 16 %.
- Separate the seeds either with mechanical thresher or by manual labour

Seed grading

- Grade the seeds using 9/64" (3.6 mm) round perforated metal sieve or BSS 7 x 7 wire mesh sieve
- Upgrade the size graded using specific gravity separator
- Remove the broken and dehulled seed from the lot

Practical 16. Seed production in Rapeseed

Land selection

The land selected should be fertile and free from volunteer plants. It should not be cultivated with the same crop in the previous season. The land should be tilled twice to make the soil smooth. Seed selection and sowing Good quality certified seeds should be sourced from an authorised dealer. Seeds should be healthy with a good germination percentage.

Seed rate is 4 – 5 kg/acre (10 - 13 kg/ha).

Selected seeds should be treated with bio-control agents like Trichoderma viride @ 4 g/kg of seeds. Mix Trichoderma in rice gruel and mix the solution with seeds. Shade dry the seeds for 30 minutes before sowing. This will help in the control of root rot and Fusarial wilt disease.

Treated seeds should be sown in ridges and furrows at 4 – 5 cm depth. The spacing maintained is 45 x 15 cm. After sowing planking is done to cover the seeds.

Nutrient management

FYM or compost @ 4 tonnes/acre (10 tonnes/ ha) or vermicompost @ 1.6 – 2 tonnes/acre (4 - 5 tonnes/ha) should be applied and thoroughly incorporated into the soil before the last tilling. This will help to improve the texture as well as the nutrient content of the soil. Green manure crops like Sunhemp or Sesbania are grown in the field and ploughed into the soil after 40 – 50 days of sowing. This enhances the nitrogen, phosphorous and other nutrients in the soil. Trichoderma viride @ 1.5 kg/acre is mixed with 300 kg compost and kept as such for a week and then applied to the field as top dressing. It will protect the crop from root rot and pathogens like Pythium and Phytophthora.

Weed management

In kharif crop harrowing is done 25 – 30 days after sowing. The first weeding is done 45 – 50 days after sowing.

Weeding is repeated before budding stage followed by harrowing with hand harrow. Pest and disease management Mustard aphid, painted bug, sawfly, Alternaria blight and white rust are some of the common pests and diseases affecting mustard crop. The management techniques for these pests are provided in Appendix – I. Irrigation Irrigation should be done once in 15 days. It is critical during flowering and pot filling stage.

Roguing

Roguing should be done from the vegetative phase to the harvesting phase. Off-types are removed based on the branching type, capsule size and colour and colour of the seeds.

Maximum percentage of off-types permitted is 0.10% for foundation seed production and 0.50% for certified seed production.

Field inspection

A minimum of three field inspections should be done from pre flowering stage to maturity stage by the Seed Certification Officer. First inspection is done before flowering followed by second inspection during flowering. The third inspection is scheduled at maturity

Harvesting

Harvesting should be done when 75% of the pods become golden yellow in colour. The moisture content of the seeds will be 25% in this stage. Delaying harvest may result in yield loss. The crop is harvested at the level of lowest pods.

Threshing and drying

The harvested plants are heaped and dried under the sun for 4 – 5 days to attain 12 – 13% of moisture level for uniform maturation of seeds. This is called swathing. During swathing the immature pods with green seeds mature. Threshing is done after 10 – 12 days by hand using stick. Threshed seeds are cleaned by winnowing and sieving using suitable size of sieve.

Seed storage

Seeds are dried under the sun to attain 8% of moisture content. This is safe for mustard seeds and can be stored in gunny or cotton bags upto one year under open storage conditions. Seed standards The minimum percentage of purity of foundation and certified seeds should be 97% with 85% of minimum germination capacity and 8% of maximum moisture content. Presence of other distinguishable variety in foundation seed should be 0.10% and that of certified seed should be 0.50%.

Practical 17. Seed production in groundnut

Land requirement

Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop.

It can be the same variety if it is certified as per the procedures of certification agency

Isolation

For certified / quality seed production leave a distance of 3 m all around the field from the same and other varieties of the crop.

Season

June – July and December – January

Spacing

25 x 15 cm

Pre-sowing seed management

Foliar Spray

Obtain seeds only from healthy pods

Discard shrivelled and disfigured seeds.

Pre-sowing seed hardening

Harden the graded seeds by soaking in 0.5% CaCl2 (50% seed volume) for 6 h.

After 6 h soaking, incubate the seeds in between moist gunny bags for 12 – 18 h.

Observe the sprouting of radicle periodically at 2 h interval after 12 h of incubation.

Separate the seeds with sprouted radicle (just visible expression of radicle) and dry under shade.

Soak the seeds in 3 % spent wash, half of the volume of the solution for 2 h in areas of availability.

Fertilizer requirement

Apply NPK @ 40:40:60 kg ha-1 as basal application

In boran deficient soils, apply borax @ 10 kg ha-1 as basal dressing.

At peg formation stage, apply gypsum @ 200 kg ha-1 and earth up the plants

Harvest

Harvesting

Harvest the pods as and when the colour of the inner side of the shell turn black and dry to 10 – 12 per cent moisture.

Reject mechanically injured pods for seed purpose

Remove all discolored pods.

Practice pod verification based on varietal characteristic before grading to remove genetically impure seed

Drying

Stake the plants as the pods are exposed outside for easy drying of pods.

Dry the pods to 15 – 20 % moisture content under sun.

Decortication

Dry the pods to 16 per cent moisture content and decorticate manually

Using hand operated decorticator with proper adjustment.

Dry the kernels to 7 to 8 per cent moisture

Seed treatment

Treat the pods with carbendazim @ 2 g kg-1 at 6 -7 % moisture content.

Seed Storage

Store the pods in closed plastic container or gunny bags with Calcium chloride @ 250g/30 kg of pods.

Store the seeds in gunny or cloth bags for short term storage (8-9 months) with seed moisture content of 8 - 9%.

Store the seeds in polylined gunny bag for medium term storage (12- 15 months) with seed moisture content of 6-8 %.

Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content less than 5%

Practical 18. Seed production in Mustard

Land selection

The land selected should be fertile and free from volunteer plants. It should not be cultivated with the same crop in the previous season. The land should be tilled twice to make the soil smooth. Seed selection and sowing Good quality certified seeds should be sourced from an authorised dealer. Seeds should be healthy with a good germination percentage.

Seed rate is 4 – 5 kg/acre (10 - 13 kg/ha).

Selected seeds should be treated with bio-control agents like Trichoderma viride @ 4 g/kg of seeds. Mix Trichoderma in rice gruel and mix the solution with seeds. Shade dry the seeds for 30 minutes before sowing. This will help in the control of root rot and Fusarial wilt disease.

Treated seeds should be sown in ridges and furrows at 4 – 5 cm depth. The spacing maintained is 45 x 15 cm. After sowing planking is done to cover the seeds.

Nutrient management

FYM or compost @ 4 tonnes/acre (10 tonnes/ ha) or vermicompost @ 1.6 – 2 tonnes/acre (4 - 5 tonnes/ha) should be applied and thoroughly incorporated into the soil before the last tilling. This will help to improve the texture as well as the nutrient content of the soil. Green manure crops like Sunhemp or Sesbania are grown in the field and ploughed into the soil after 40 – 50 days of sowing. This enhances the nitrogen, phosphorous and other nutrients in the soil. Trichoderma viride @ 1.5 kg/acre is mixed with 300 kg compost and kept as such for a week and then applied to the field as top dressing. It will protect the crop from root rot and pathogens like Pythium and Phytophthora.

Weed management

In kharif crop harrowing is done 25 – 30 days after sowing. The first weeding is done 45 – 50 days after sowing.

Weeding is repeated before budding stage followed by harrowing with hand harrow. Pest and disease management Mustard aphid, painted bug, sawfly, Alternaria blight and white rust are some of the common pests and diseases affecting mustard crop. The management techniques for these pests are provided in Appendix – I. Irrigation Irrigation should be done once in 15 days. It is critical during flowering and pot filling stage.

Roguing

Roguing should be done from the vegetative phase to the harvesting phase. Off-types are removed based on the branching type, capsule size and colour and colour of the seeds.

Maximum percentage of off-types permitted is 0.10% for foundation seed production and 0.50% for certified seed production.

Field inspection

A minimum of three field inspections should be done from pre flowering stage to maturity stage by the Seed Certification Officer. First inspection is done before flowering followed by second inspection during flowering. The third inspection is scheduled at maturity

Harvesting

Harvesting should be done when 75% of the pods become golden yellow in colour. The moisture content of the seeds will be 25% in this stage. Delaying harvest may result in yield loss. The crop is harvested at the level of lowest pods.

Threshing and drying

The harvested plants are heaped and dried under the sun for 4 – 5 days to attain 12 – 13% of moisture level for uniform maturation of seeds. This is called swathing. During swathing the immature pods with green seeds mature. Threshing is done after 10 – 12 days by hand using stick. Threshed seeds are cleaned by winnowing and sieving using suitable size of sieve.

Seed storage

Seeds are dried under the sun to attain 8% of moisture content. This is safe for mustard seeds and can be stored in gunny or cotton bags upto one year under open storage conditions. Seed standards The minimum percentage of purity of foundation and certified seeds should be 97% with 85% of minimum germination capacity and 8% of maximum moisture content. Presence of other distinguishable variety in foundation seed should be 0.10% and that of certified seed should be 0.50%.

Practical 19. Seed production in vegetables-chillies

Season: June – July ; November – December

Seed rate- 1 kg/ha.

Pre-sowing seed treatment

Seed fortification with 1000 ppm gelatin or 2% KNO3 or 200 ppm salicylic acid (soaking in equal the volume for

12 h) followed by coating with carbendazim (2 g / kg) + imidachloprid (6 g / kg) + polymer (20 g / kg) of seed in 40 ml of water

Nursery treatment

The nursery is drenched with Metham sodium @ 28 ml/sq.m.(VEPAM) 15 days before sowing for controlling the nematodes. After 7 days, to prevent damping off, the soil is drenched with copper oxychloride @2.5 g/lit.

Age of seedling

35 – 40 days.

Fertilizer

Basal

FYM: 25 t/ha, 140:70:70 kg NPK/ha.

Top dressing

50 kg N 15 days after transplanting, 50 kg N 45 days after transplanting and 40 kg N 90 days after transplanting.

Foliar application

At 65 and 75 days after transplanting NAA @ 20 ppm is sprayed to prevent flower drop.

Harvest

Seeds attain physiological maturity 40 - 45 days after flowering.

The fruits are harvested when they turn to capsicum red in colour.

Fruits obtained from first 5 to 6 pickings alone are used for seed extraction

Seed extraction

Dried fruits are filled in gunny or cloth bag and threshed with a pliable bamboo stick or chilli seed extractor and seeds are separated from the fruit pulp.

Grading

Seeds are graded with BSS 8 x 8 wire mesh sieve or 8/64 round perforated metal sieve (3.1 mm)

Seed yield
350 – 400 kg/ha

Storage
Seeds dried to 7 - 8 % moisture content and treated with carbendazim 50 % WP @ 2 g / kg seed or Halogen formulation (Bleaching powder + $CaCO_3$ + arappu leaf powder @ 5:4:1) @ 3 g / kg seed can be stored upto10 months in cloth bag and upto 18 months in moisture vapour proof containers. Intact pods can also be stored upto 20 months

Practical 20: Seed Viability Test

What is seed viability?

The viability of the seed accession is a measure of how many seeds are alive and could develop into plants which will reproduce themselves, given the appropriate conditions.

Why do we test seed viability?

It is important to know that the seeds that are stored in a genebank will grow to produce plants. Therefore they must have a high viability at the start and during storage. The viability of seeds at the start of storage will also determine, within the environmental conditions, the storage life of the accession.

When should viability be determined?

Viability will need to be determined at the start of storage and at regular intervals during storage to predict the correct time for regeneration of the accession. The viability test takes from a few days to weeks or even months to give an accurate result. If possible the results should be available before the seeds are packaged and placed in the genebank so that poor quality seeds can be identified and regenerated before storage. Where the viability cannot be determined before storage, the seeds should be placed into long-term storage to ensure their safety whilst awaiting the results of the test.

How should viability be determined?

The most accurate test of viability is the germination test and this will be described here. The germination test is made under controlled conditions to find out how many seeds will germinate and produce normal seedlings which could develop into normal reproductively mature plants. The IBPGR Advisory Committee on Seed Storage recommends that for the initial germination test of species where a reasonable germination technique is available, a minimum of two replicates using 200 seeds (100 seeds per replicate) is acceptable, providing that germination is above 90%. If not, a further 200 seeds should be tested as before and the overall result for seed viability taken as the mean of the two tests. Other biochemical tests are available to test viability. These have the advantage of being quicker, but are not as accurate and require considerable skill and practice in their implementation and interpretation. These are not recommended by the IBPGR Advisory Committee on Seed Storage for general use as tests for seed viability.

Germination testing

How is germination tested?

There are many methods available which can be used to test germination. Seeds of different species have different requirements for light, substrate, temperature and water during germination. For an initial germination test the IBPGR Advisory Committee on Seed Storage recommends that a fixed sample size test should be used.

How do we choose which conditions to use in the germination test?

There is no general set of conditions which can be used to germinate seeds of all different species. Each species is different and must be treated separately. Guidelines for germination of seeds of the most common crop species and some of their wild relatives which are likely to be stored in genebanks are given in Vol. II of Ellis, Hong and Roberts (1985). Seeds of some species are more tolerant and can germinate under a wide range of conditions but complete germination will only be achieved under optimum conditions.

Why do some seeds fail to germinate in the test?

Two main reasons for the failure of seeds to germinate in suitable conditions are because they are either dead or dormant. Dead seeds can be identified because they usually soften and rot during the test as a result of attack by bacteria and fungi. Seeds which remain hard or absorb water, but remain firm and in good condition during the germination test are probably dormant. Seed dormancy is common in some crops straight after harvest (post harvest dormancy) and in many wild species related to crop plants.

How can dormant seeds be stimulated to germinate?

Special treatments are required to overcome seed dormancy. Treatments vary among species and more detailed advice can be found in Vol. II of Ellis, Hong and Roberts (1985).

How should non-dormant seeds be germinated?

The most appropriate test conditions should be selected for the test. A summary of suitable test conditions is given in Vol. II of Ellis, Hong and Roberts (1985). A fixed sample size germination test should be used as explained here.

STEP 1. DETERMINE THE GERMINATION TEST CONDITIONS

1. Use the normal germination test procedure for the species in your genebank.

2. If there is no standard, ask the curator for advice on the best germination test conditions to use.

3. Check that the equipment and environments are available to fulfil these conditions.

4. If not, a compromise will have to be found using the best possible alternatives available.

5. A fixed sample size germination test using 200 seeds is recommended to determine viability at the start of storage.

Notes and Examples

Choosing the best conditions for germination is difficult because species and even accessions of the same species vary in their requirements. Methods for germinating seeds of major crop species are usually well-documented. Often there is no information on the methods needed for lesser known crops or wild and weed species.

The viability at the start of storage should be determined accurately to allow more accurate predictions of the storage life of the seeds. The germination test should be statistically accurate

and therefore sufficient seeds should be used for the test. The sequential test described in Section VIII less seeds and is recommended for monitoring but not for the initial test for viability.

STEP 2. PREPARE THE SEEDS FOR THE TEST

1. Take a random sample of seeds from the accession.

2. Count out 200 seeds for each test.

3. Divide these seeds into at least two replicates. More replicates of fewer seeds in each can be used to fit into the equipment at your genebank.

4. In order to prevent damage to the seeds from the rapid uptake of water (imbibition damage), seeds with a low moisture content must imbibe water slowly. Any seeds known to be prone to imbibition damage should be placed in a humid atmosphere to equilibrate as a pre-treatment. This is especially important for many species of legumes.

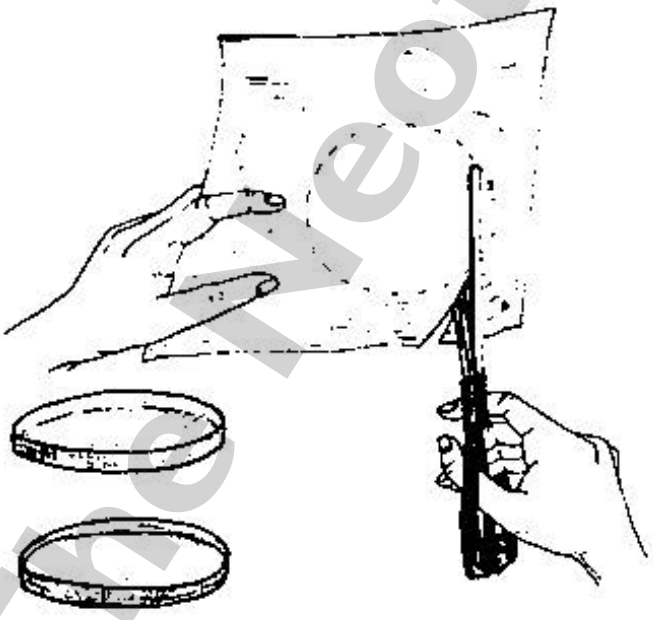
STEP 3. SET UP THE GERMINATION TEST

Although several methods are available for germination testing, it is suggested that you use one of the two major methods described here because these are adaptable to most environments and in general give uniform results.

Germination using absorbent paper

Top of paper method

1. Cut the paper to the size and shape of the dishes.



Notes and Examples

Several types of absorbent paper are available. Choose paper that is relatively cheap, easily available and strong enough to withstand handling and the weight of the seeds when damp. It must be free from chemical residues that could interfere with the germination of the seeds. The most common papers used are towelling, filter paper or rice straw paper. Filter paper and paper towelling are more expensive. Rice straw paper is cheap but fungal spores from the plant material can cause contamination unless heat-treated before use.

The petri dish/container method has the advantage that the seeds can be observed through the transparent lid and the germinating seeds are therefore easy to count. There is the disadvantage that the dishes soon dry out and need daily watering.

Equipment

Petri dishes or other containers
Filter paper, paper towelling or rice straw paper
Water
Forceps
Incubators
Permanent markers

2. Place a layer of paper in each dish. If the paper is too thin use a double layer.

3. Label the top and bottom of each dish with the accession number, number of the replicate and date of the test.

4. Moisten the paper with water.

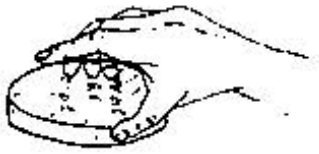
Notes and Examples

The thickness of paper used should be more than 2 mm when moist.

The water used must be reasonably free from acid, alkali, organic material or other impurities. It can be either tap, distilled or de-ionized water.

5. Arrange the seeds in a regular equidistant pattern on the surface of the paper.

6. Add more water if required and replace lid.



Notes and Examples

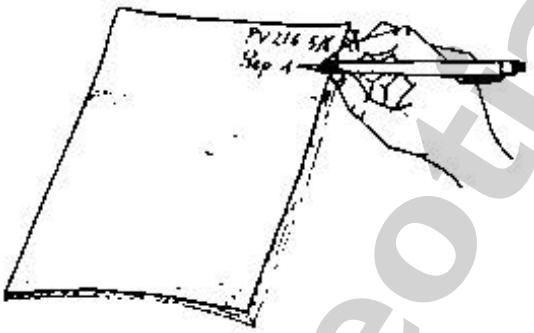
Seeds arranged in an orderly way are easier to count.

Between paper method

1. Cut the paper to a convenient size to hold one replicate of the seeds when spaced at regular intervals. If the paper is too thin use a double layer.

2. Label each sheet on the outside of the paper at one end with the accession number, replicate of the test and the date of the start of the test.

3. Moisten the paper with water.



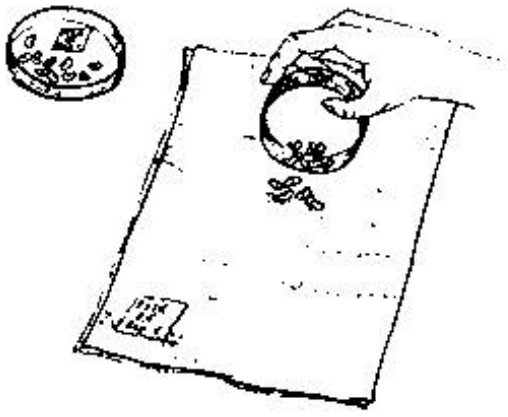
Notes and Examples

The between absorbent paper method is cheap and easy to prepare, but the seeds cannot be observed without unrolling the paper. The use of new paper at each test has the advantage that fungal contamination cannot be carried from one test to another.

Equipment

Filter paper, paper towelling or rice straw paper
Plastic bags
Water
Forceps
Incubators
Permanent marker

4. Arrange the seeds at regular intervals on the paper, leaving at least two centimetres clear from the edges all round.



Notes and Examples

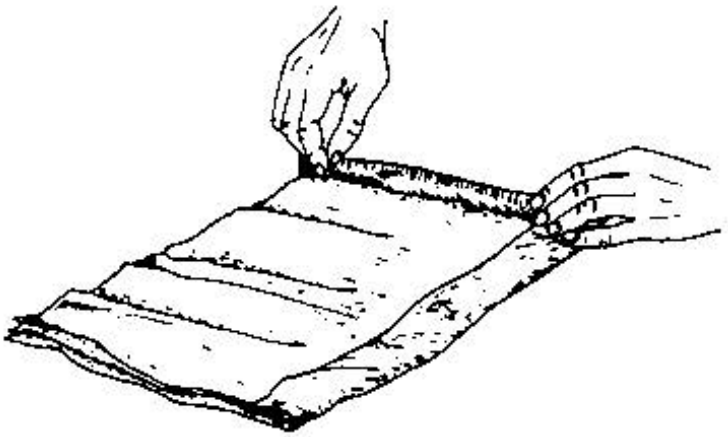
Leave enough room around the edges of the paper so that the paper can be folded back without damaging the seeds.

5. Cover the seeds with another sheet of paper and fold in the edges to prevent the seeds from falling out.

Notes and Examples

Folding the edges is especially important for large spherical seeds which tend to fall out because of their weight and shape.

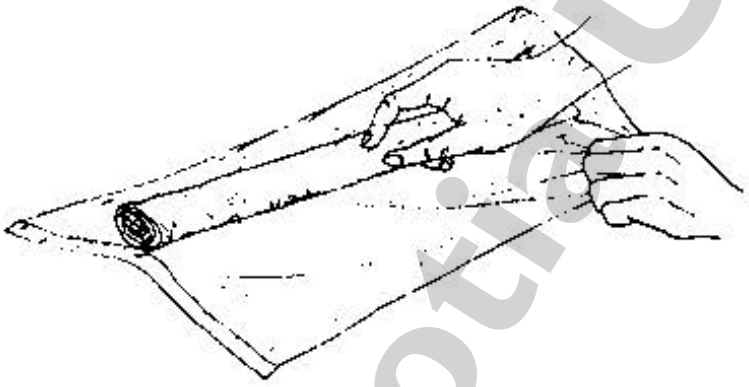
6. Roll the paper loosely towards the end with the label.



Notes and Examples

Do not roll the paper too tightly because the compression and lack of oxygen resulting from this can cause the seedlings to develop contorted roots and shoots. These are hard to separatefrom abnormalities caused by genetic factors.

7. Place the rolled papers inside ventilated plastic bags or boxes.

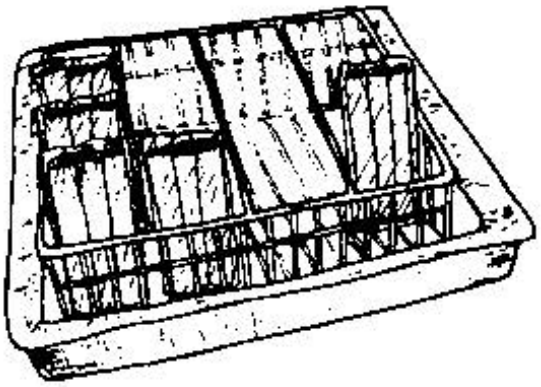


Notes and Examples

Oxygen is essential for respiration during germination. Therefore, any containers used should be adequately ventilated.

8. Put these in an upright position in wire baskets or plastic boxes.

9. Keep the paper moist with water.



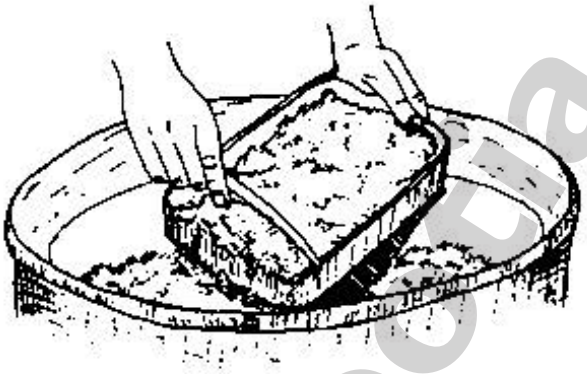
Notes and Examples

Root and shoot development is geotropic. Placing the rolled papers in an upright position allows seedling development in the natural vertical position.

Germination in sand

1. Pack clean sterile sand into pots or trays with drainage holes in the bottom.

2. Water the sand until it is moist. Do not use excess water.



Notes and Examples

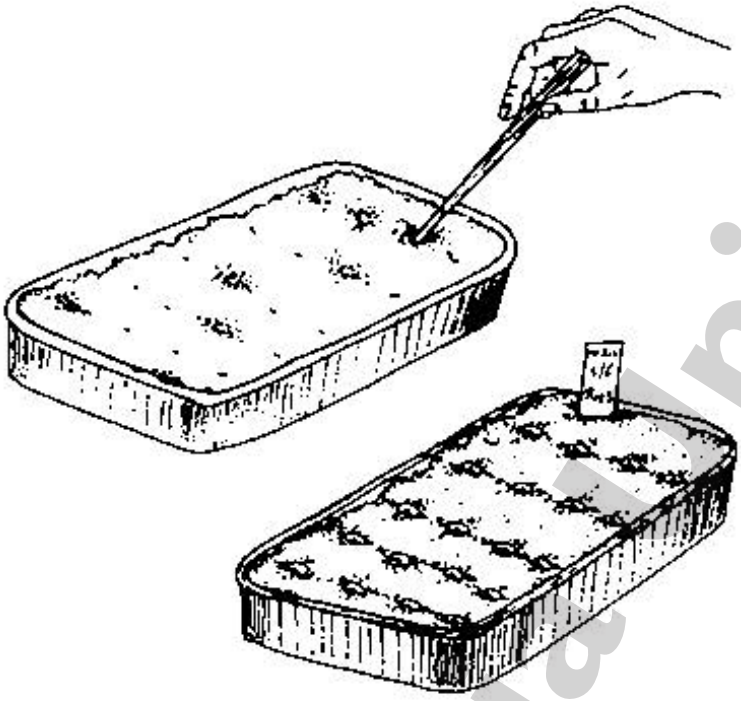
Fine sand should be used. Make sure that the sand is clean by sterilizing before use. Quarry or river sand is better than shore sand, which must be washed thoroughly to remove all salt.

Equipment

Sand
Labels
Permanent markers
Pots or trays
Tools for planting
Water
Forceps
Incubators

3. Make holes in a regular equidistant pattern at about the same depth as the size of the seeds for each replicate of the seeds. Ideally, the distance between holes should be at least three to five times the seed diameter.

4. Prepare a label with the accession number, date of sowing and replicate of the test and place in each pot or tray.



Notes and Examples

Germination in sand is especially useful for large seeds which are too large to be germinated in petri dishes or too heavy for the between paper method.

5. Fill seeds from each replicate into the holes and cover with sand.

6. Water the sand again to cover the seeds, but do not make it too wet.

Notes and Examples

Sprinkle with water slowly, so that the seeds do not float out from the holes and become mixed. Bottom watering is better than top watering.

STEP 4. CARRY OUT THE GERMINATION TEST

1. Place the prepared germination tests under the light and temperature conditions which were determined in Step 1.

2. Keep the substrate moist during the test with water, but do not over-water.

3. Run the test for a sufficient period to determine whether the seeds have germinated, or are dead or dormant. A fixed interval can be used based on previous experience, but the time taken to germinate will vary among species and accessions of the same species.

Notes and Examples

Seeds absorb most water during a rapid imbibition phase at the start of the test. Make sure that there is enough water at this stage but remember that too much water at a later stage can limit the oxygen for the seeds and also lead to rotting.

STEP 5. COUNT THE GERMINATED SEEDLINGS

Germination using absorbent paper

1. Seeds sown on top of paper can be counted either through the transparent cover or after removing the cover of the container. For those between paper, unroll the paper carefully to avoid tearing the paper or damaging the roots of the young seedlings.

2. Count and record the number of normal seedlings in each replicate.

3. Count and record the number of abnormal seedlings in each replicate. Examples of the types of abnormal seedlings found in different species have been described by ISTA (1976b).

4. Once a seed has been counted as germinated, the resulting seedling can be discarded.

5. If the seeds are dormant, treat with the appropriate technique to stimulate germination as advised in Vol. II of Ellis, Hong and Roberts (1985) and continue the test to allow those to germinate.

Notes and Examples

Normal seedlings are those which show the capacity for continued development into normal plants if grown on a suitable substrate and under favourable conditions of water supply, temperature, light and oxygen. Abnormal seedlings are those which do not appear as if they will develop into normal plants. There are three classes of abnormality - damage, deformity and decay.

Germination in sand

1. In this case the number of seedlings emerged from the sand is usually counted because early root growth cannot be seen without disrupting the test.

2. Count and record the number of normal seedlings emerged in each replicate.

3. Count and record the number of abnormal seedlings emerged in each replicate.

4. If any fungal or insect infestation is seen during the germination test, sterilize the sand before using again.

STEP 6. INTERPRET THE RESULTS

1. For each accession, consider the total number germinated in each replicate.

2. Check that the results of the different replicates are compatible by using tolerance tables (see chapter 14 Ellis, Hong and Roberts, 1985).

3. If the results are compatible, calculate the mean percentage viability of that accession from the results of all replicates.

4. If the results are not compatible consult the curator for advice on how to proceed.

Notes and Examples

Tolerance tables can be consulted to check that the results of your work are valid because all replicates of a test should be compatible and within certain limits.

Here a problem may arise. If the results of one replicate are not compatible with the others, the curator will have to decide either to repeat the test or accept these results. It may be possible to accept the results of other replicates and ignore the one that is not compatible only if there is a good reason why one replicate differs, e.g. the dish dried out during the test, etc.

STEP 7. DECIDE WHETHER TO REPEAT THE TEST

1. Consider the mean percentage viability of the accession.

2. If it is above 90%, accept the test as valid and use this value as the true viability.

3. If the result is 90% or below, repeat the test using a further 200 seeds following the same procedures.

4. Calculate the mean percentage viability from the results of the two tests and use this as the overall test result.

STEP 8. ENTER THE DATA INTO THE FILES

1. If the standard test for that species in your genebank has been followed exactly, enter the percentage viability into the inventory data file for each accession.

2. If a standard test has not been used, either enter a reference to the full germination data or state the conditions which vary from the standard test.

Notes and Examples

The conditions of the germination test can influence the number of seeds which germinate, especially if seed vigour is low. Optimum conditions allow optimum germination. Therefore, it is important to note the conditions of the test and any deviations from the standard test.

Table of standard germination test regimes for your genebank

Fill in this table for your future reference:

Species	Substrate	Method	Temperature	Light	Test Length	Notes

Practical 21: Seed Sampling

Methods and Types of Sampling

Objectives

1. Sampling is done to get a uniform and representative sample from a seed lot. The size of the submitted sample required for testing is small as compared to the size of the lot, therefore, care must be taken to ensure that the submitted sample represents the lot of the seed to be tested.
2. Hence it is essential that the samples be prepared in accordance to ISTA rules to ensure that the small size sample should represent truly and in the same proportion all constituents of seed lot.

Definition of samples

The seed lots received by laboratory for analysis and testing are given an accession number of each variety for future reference.

A seed lot to be sampled must not be heterogeneous i.e. the primary samples drawn from the lot should be similar in constitution. If there is any evidence of heterogeneity test of the primary samples drawn, as defined by ISTA rules, further sampling and testing from the seed lot should not be continued.

Seed lot: Seed lot is a specified quantity of the seed of one cultivar of known origin as physically identifiable.

Methods of sampling

1. Hand sampling

This is followed for sampling the non free flowing seeds or chaffy and fuzzy seeds such as cotton, tomato, grass seeds etc. In this method, it is very difficult to take samples from the deeper layers of bag. To over come this, bags are emptied completely or partly and then seed samples are taken. While removing the samples from the containers, care should be taken to close the fingers tightly so that no seeds escape.

2. Sampling with triers/Probe

By using appropriate triers, samples can be taken from bags or from bulk. The triers are used for taking free flowing seed samples.

a) Bin samplers

Used for drawing samples from the lots stored in the bins.

b) Nobbe Trier

The name was given after the father of seed testing Fredrick Nobbe. This trier is made in different dimensions to suit various kinds of seeds. It has a pointed tube long enough to reach the centre of the bag with an oval slot near the pointed end. The length is very small. This is suitable for sampling seeds in bag not in bulk.

c) Sleeve type triers or stick triers

It is the most commonly used trier for sampling: There are two types *viz*., 1. With compartments 2. Without compartments. It consists of a hollow brass tube inside with a closely fitting outer sleeve or jacket which has a solid pointed end. Both the inner tube as well as the outer tube have been provided with openings or slots on their walls.

When the inner tube is turned, the slots in the tube and the sleeve are in line. The inner tube may or may not have partitions.

This trier may be used horizontally or vertically. This is diagonally inserted at an angle of 30°C in the closed position till it reaches the centre of the bag. Then the slots are opened by giving a half turn in clockwise direction and gently agitated with inward push and jerk, so that the seeds will fill each compartment through the openings from different layers of the bag, then it is again closed and with drawn and emptied in a plastic bucket.

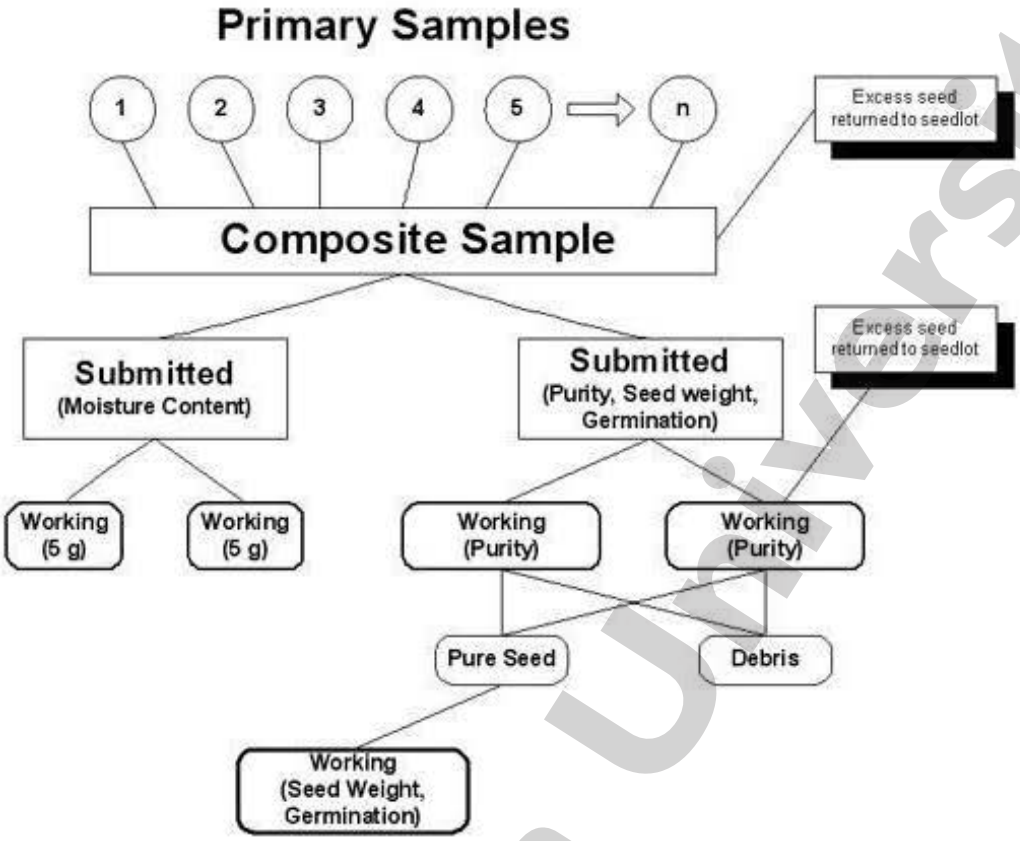
Sleeve type triers

This trier is used for drawing seed samples from the seed lots packed in bags or in containers. Thief trier should not be used because it is not long enough to take representative portion of the sample from the individual container.

Method of preparing composite samples

- When the primary samples appear uniform they are combined and thoroughly mixed to form the composite sample.
- From composite sample, submitted sample of requisite weight or more is obtained either by repeated halving or by abstracting and subsequently combining small random portions.

Types of sampling



1. Primary sample

Each probe or handful of sample taken either in bag or in bulk is called primary sample.

2. Composite sample

All the primary samples drawn are combined together in suitable container to form a composite sample.

3. Submitted sample

When the composite sample is properly reduced to the required size that to be submitted to the seed testing laboratory, it is called submitted sample. Submitted sample of requisite weight or more is obtained by repeated halving or by abstracting and subsequently combining small random portions.

4. Working sample

It is the reduced sample with required weight obtained from the submitted sample after repeated mixing and dividing with which the seed quality tests are conducted in seed testing laboratory.

Sampling intensity

Seed	Size		Maximum	quantity	per	lot
Larger	than	wheat	and	paddy	20,000	kg

Smaller than wheat and paddy 10,000 kg
Maize 40,000 kg

Sampling intensity

The intensity of sampling should be maintained in accordance to the rules described by ISTA. When seeds are stored in bags or other containers of similar capacity that are uniform in size.

a. For seed lots in bags (or container of similar capacity that are uniform in size)

up to 5 containers	Sample each container but never < 5 Primary Sample (PS)
6-30 containers	Sample atleast one in every 3 containers but never> than 5 Primary Sample
31-400 containers	Sample atleast one in every 5 containers but never < 10 Primary Sample Sample
401 or more	Sample atleast one in every 7 containers but never < 80 Primary Sample

When the seed is in small containers such as tins, cartons or packets a 100 kg weight is taken as the basic unit and small containers are combined to form sampling units not exceeding this weight e.g. 20 containers of 5 kg each. For sampling purpose each unit is regarded as one container.

b. For seeds in bulk

Up to - 500 kg	Atleast 5 Primary samples
501 - 3000 Kg	One primary sample for each 300 kg but not less than 5 primary samples
3001-20,000 Kg	One primary sample for each 500 kg but not less than 10 primary samples
20,001 and above	One primary sample for each 700 kg but not less than 40 primary samples

Instructions for sending samples

Pre-requisite in sampling is that the seed lot received in containers / bags must be properly sealed and marked for identification with a single lot designation.

At the time of sampling, all the samples drawn must bear identification corresponding to that of the lot certificate.

The sampler should seal or supervise the sealing of the sample container / bags after drawing sample.

After taking samples which may be more than required for seed testing purpose, a through mixing of the samples is to be done.

Divide it using a seed divider and then the required amount should be submitted to the seed testing laboratory after putting proper identification mark.

If mechanical divider is not available at the spot, a representative sample should be obtained by putting the entire quantity of seed on a clean floor, mixing properly and halving the sample until the desired quantity is obtained.

For moisture determination, 100g of seeds for species which need grinding and 50g for all other species. Sample should be submitted in an air-tight container, like polythene bags of 700 guage or glass bottle with tight cap to the laboratory.

Quantity and despatch of sample for testing

Weight of submitted sample

The minimum weight for submitted samples for various tests are as follows.

1. Moisture test

100 g for those species that have to be ground and 50 g for all other species.

2. For verification of species and cultivar

Crop	Lab only (g)	Field plot & Lab (g)
Peas, beans, maize, soybean and crop seeds of similar size	1000	2000
Barley, oats, wheat and crop seeds of similar size	500	1000
Beet root and seeds of similar size	200	500
All other genera	100	250

Despatch of submitted sample

1. Each submitted sample should be sealed and marked
2. The label should contain all the necessary details such as variety, class of seed, quantity in the lot, to whom it belongs, name of the producer, seed treatment, date of harvesting and threshing if known, sampled by, date of sampling and the kind of tests required.
3. After marking the sample, it should be packed so as to prevent damage during transit. For germination test sample should be packed preferably in cloth bag, for moisture content determination, sample should be packed separately in moisture proof containers.
4. Samples should be despatched by the sampler to the seed testing laboratory without delay.

Types of sample used in Seed Testing Laboratory (STL)

Service sample: Sample received from other than seed certification agencies and seed inspectors **Certified sample:** Sample received from certification agencies or officers
Official sample: Sample received from the seed inspectors.

Practical 22: Physical purity

Physical Purity

Purity analysis

The purity analysis of a seed sample in the seed testing laboratory refers to the determination of the different components of the purity *viz*., pure seeds, other crop seeds, weed seeds and inert matter.

Objective

The objective of the purity analysis is to determine whether the submitted sample conforms to the prescribed physical quality standards with regard to physical components.

Method

The working sample

The purity analysis is done on the working sample of prescribed weight drawn from submitted sample. The analysis may be made on one working sample of the prescribed weight or on two sub-samples of atleast half of this weight, each independently drawn.

Weighing the working sample

The number of decimal places to which the working sample and the componenets of the working sample should be weighed is given below.

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

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

It refers to the seeds of crops other than the kind being examined.

Weed Seed

It includes seeds of those species normally recognized as weeds or specified under Seed Act as a noxious weed.

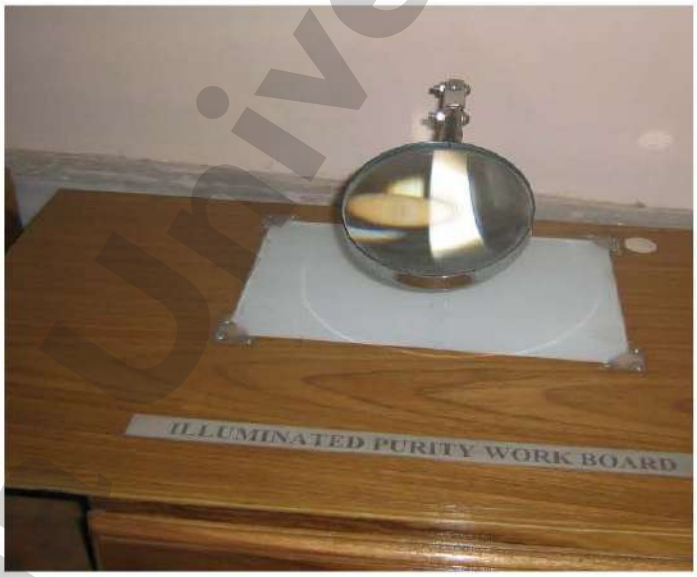
Inert matter

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.

Seed Blower



Purity Work Board

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.

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.

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

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

Practical 23: Germination test

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 favourable 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 favourable conditions of moisture, temperature, suitable substratum and light if necessary. No pretreatment to the seed is given except for those recommended by ISTA.

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.

Germination tray

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

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.

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.

Petriplate method

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.

Germination paper

Seeds germinated on paper

Roll towel method

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	-

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.

Seed germinator

Plant Growth Chamber

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

Vacuum seed counter

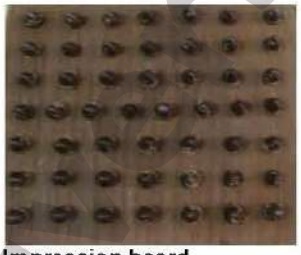
Consists of a head, pipe and wall. There are plates of 50 or 100 holes which can be fitted to the head.

When vacuum is created the plate absorbs seeds and once the vacuum is released the seeds fall on the substrate.

Vacuum seed counter

Impression board

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.



Impression board

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 favourable conditions of soil, water, temperature and light.

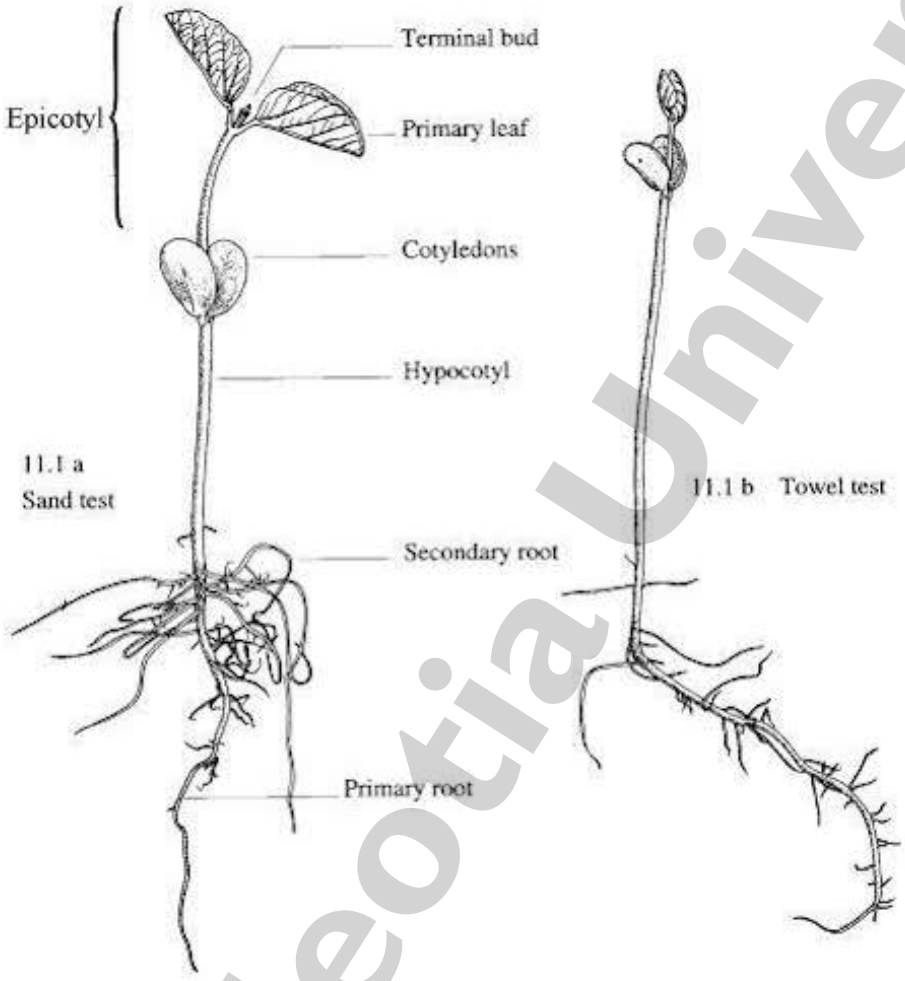
Characters of normal seedlings

- 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 in 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.

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.



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.

Types of abnormal seedlings

Damaged seedlings

Seedligs 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.

Damaged seedlings

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.

Twisted coleoptiles

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.

Decayed Seedlings

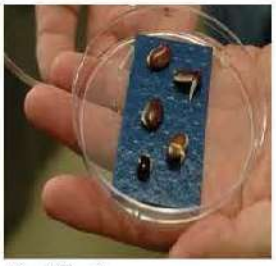
Hard seeds

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

Hard Seeds

Fresh and ungerminated seeds

Seeds which are neither hard nor have germinated but remain firm and apparently viable at the end of the test period.



Dead Seeds

Seeds 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.

Dead seeds

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.

1. Replicates performance is out of tolerance
2. Results being inaccurate due to wrong evaluating of seedlings or counting or errors in test conditions
3. Dormancy persistence or phytotoxicity or spread of fungi or bacteria. The average of the two test shall be reported.

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'.

Practical 24: Seed Vigour Test

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.

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.

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.

Grinding mill

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.

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

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.

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.

Practical 25: Grow - Out Test

Objective

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.

Field of applicability

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. According to the official regulations in India, it is pre-requisite for seed certification of hybrids of certain species such as **cotton, castor, musk melon and brinjal**.

The test is required to be conducted for checking the sellers label with respect to genetic purity status of the seed lot **under the provisions of the seeds Act 1966**. In addition grow-out test can also be used as a measure to judge the efficacy of the certification agency or the inspector.

Sampling

The samples for 'Grow-out test shall be drawn simultaneously with the samples for other seed quality tests in accordance with the prescribed sampling procedures. **Size of submitted sample**

The size of submitted samples shall vary according to the species as exemplified in this Table.

Recommended size of submitted sample for Grow-out Test

1,000 g	-	for maize, cotton, groundnut, soyabean and species of other genera with seeds of similar size;
500 g	-	For sorghum, wheat, paddy and species of other genera with seeds of similar size;
250 g	-	Beta and species of other genera with seeds of similar size;
100 g	-	For bajra, jute and species of all other genera;
250 tubers / planting stakes / roots/ corms	-	Seed potato, sweet potato and other vegetatively propagating crops.

Size of working sample

The working sample for grow out test shall be obtained through subsequent mixing and dividing of the submitted sample in accordance with the prescribed procedure for seed sampling. The minimum population required for taking the observations shall be 400 plants; however, it will also depend on the maximum permissible off-type plants prescribed for the species under consideration in the Indian Minimum seed Certification standards The number of seeds required for raising the crop to obtain the required number of plants shall depend on the germination percentage of the seed sample and hence seed rate should be adjusted accordingly.

Number of plants required per sample for grow out test

Maximum permissible off types (%)	Minimum genetic Purity (%)	Number of plants required per sample
0.10	99.9	4,000
0.20	99.8	2,000
0.30	99.7	1,350
0.50	99.5	800
1.00 and above	99.0 and below	400

Procedures

To achieve the accuracy and reproducibility of the grow out test results, the procedures provided hereunder must be followed:

Location of the grow out test

The grow out test shall be conducted in specified areas recommended for the cultivar / hybrid or in off-season nurseries.

Standard sample

The standard sample of a cultivar (control) is the official standard against which all other samples of the seed of the cultivar will be judged. The standard sample must not differ significantly in any character and be obtained from the originating plant breeder / breeding institute and be stored under controlled temperature and humidity conditions so as to use it each year to sow control plots for cultivars under test. Further quantities of sample must be obtained from the originating plant breeder as and when required. A comparison must be made between the two lots of the standard sample before changing from one standard sample to other.

Method of raising the crop

Standard and recommended agronomic / cultural practices such as field preparation, size of the plot, row length, distance between the rows, distance between the plants, irrigation and fertilization, etc., in respect of the specific crop shall be followed both for the sample in question and its control (standard sample).
The germination percentage of the sample (s) in question and the standard sample must be determined to adjust the seed rate. The sowing should be done by dibbling or small plot drill. Seed drill must be carefully checked to ensure its cleanliness. Subsequent thinnings is not recommended. The samples of the same cultivars must be sown in succession and the standard samples are sown at suitable intervals. (one standard sample for every ten sample to be tested). The size of the plot, row length and spacing shall differ according to the crop. Recommended specification for the above variables are provided in Table mentioned below which can suitably be modified if considered essential.

Recommended row length, distances, spacing for some important crops

S. No.	Crop	Row length (m)	Plant to plant distance (cm)	Space between rows (cm)	Space between plots (cm)
1.	Wheat, barley oats	6	2	25	50
2.	Pea, Cowpea	6	10	45	90
3.	Chickpea, green gram black gram	6	10	30	60
4.	Maize	10	25	60	90
5.	Hybrid cotton	5	10	45	45
6.	Paddy: • Very early to medium • Late and very late	 6 6	 15 25	 20 30	 45 60
7.	Pearl millet	6	10	60	90
8.	Sorghum	6	10	45	60

The field plots should be grown in two replicates to guard against failure in one part of the field and to reduce environmental and soil fertility variations.

Methods for taking observations

Grow-out test plots must be examined throughout the growing season with emphasis on the period from the flowering to ripening. All plants must be examined keeping in view the distinguishing characters described for the cultivars both in the test crop as well as the control. While taking the observation, the plants showing deviations in characters against the control should be tagged and examined carefully at a later stage to confirm whether they are off- types or not. The number of the total plants and the off-type plants found should berecorded.

Calculation and interpretation of the results

Percentage of other cultivars, species or aberrants found must be calculated upto first decimal place. While interpreting the results, tolerances should be applied by using the reject number for prescribed standards with reference to sample size as provided in Table.

Reject number for prescribed standards and sample size

	Reject numbers for sample size of	
	800	400
99.5 (1 in 200)	8	*
99.0 (1 in 100)	16	8
95.0 (5 in 100)	48	24
90.0 (10 in 100)	88	44
85.0 (15 in 100)	128	64

** indicates that the sample size is too small for a valid test.*

Reporting of results

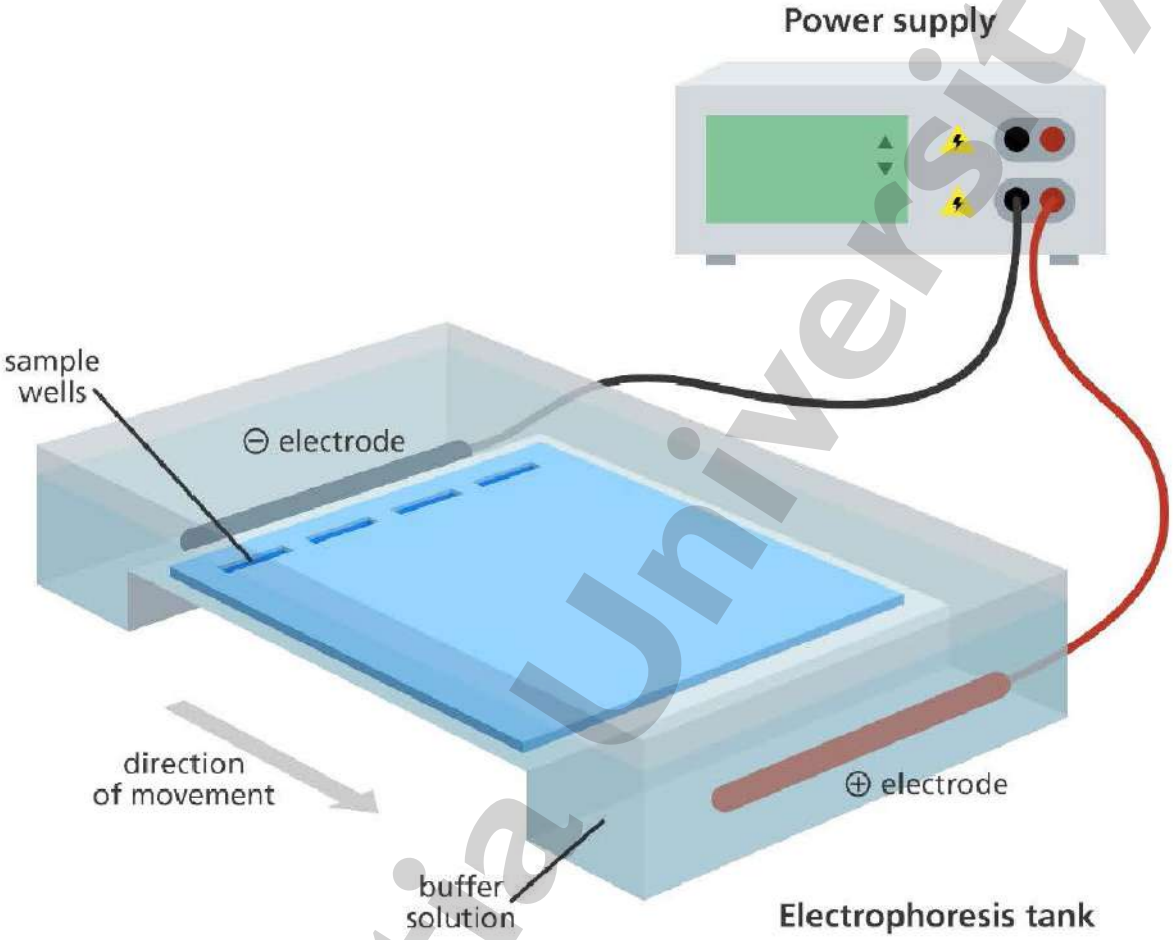
- The results of the grow-out test shall be reported as percentage of other species, cultivars or off-type plants.
- If the sample is found to be a cultivar other than stated by the sender, the results shall be reported as such.
- If plants of other cultivars are more than 15 per cent, the report shall state that the sample consists of mixture of different cultivars.
- If nothing worthy of special comments is found, the report shall state that the results of the grow-out test of the sample in question revealed nothing to indicate that the name of the cultivar or species stated by the sender is incorrect.

Practical 26: Electrophoresis

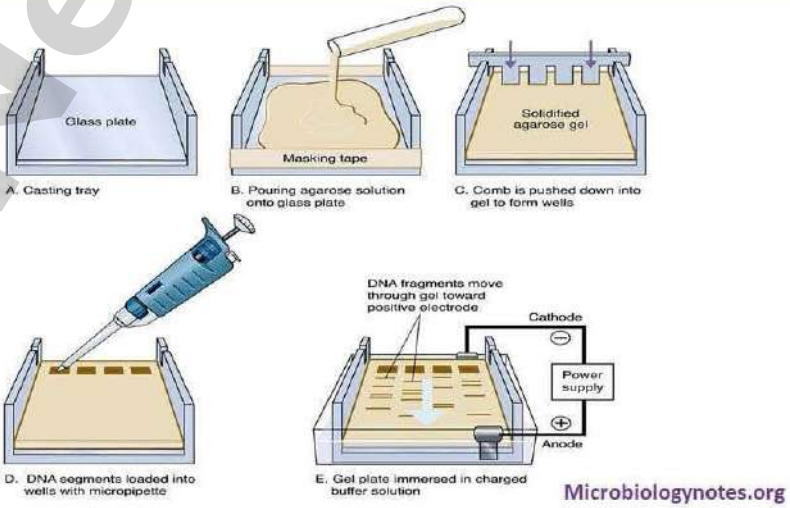
It is the latest method of cultivar identification based on protein banding and isoenzyme activity. Here single seeds are defatted and extracted for protein and esterases. The extracted proteins or esterases are separated by polyacrylamide gel electrophoresis. Based on the banding pattern of protein and esterase's the varieties can

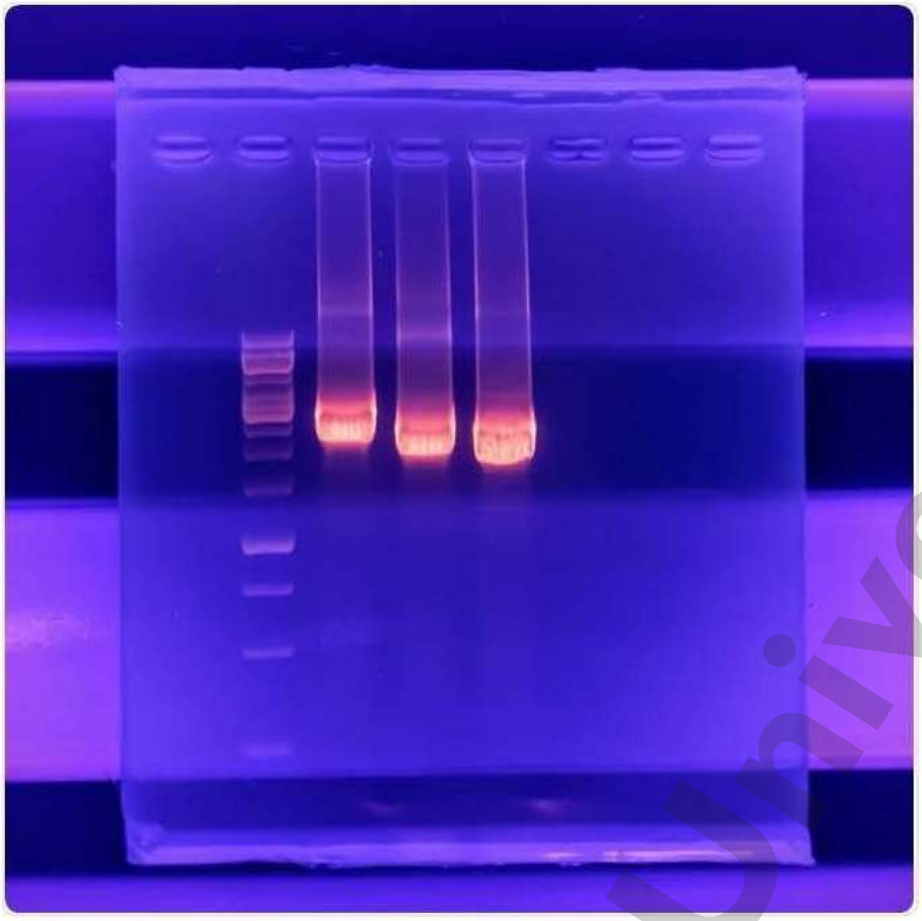
be differentiated and identified.

Electrophoresis for proteins and enzymes: Seeds, seedlings or mature leaves etc. of a crop plant have a specific mix of proteins which are not only crop specific but also variety specific (genotype specific). The electrophoresis in a suitable medium separates the mixture of proteins extracted from seeds, seedlings or mature leaves into distinct bands. Each variety (or genotype) thus has a specific "banding pattern" on the basis of which admixtures of other varieties, differing in "banding pattern" could be detected. This is done by comparing the banding pattern of analysed sample with the standard banding pattern of that variety. The electrophoresis is now being increasingly used for determining the genetic purity of seed samples.



Gel electrophoresis: Types, Principle, Instrumentation and Applications





Principle: The term 'electrophoresis' refers to the migration of a charged particle under the influence of an electric field. The movement of ions takes place in a suitable medium, such as, polyacrylamide gel, which acts as a molecular sieve and cut down convection currents and diffusion, so that the separated components remain as sharp zones with maximum resolution. The separation into distinct bands is due to,
1. differences in the size of molecules (molecular weight) of various proteins. Particles with smaller molecular weights migrate faster than those with higher weights, and
2. differences in charge. The molecules with the higher charge migrate faster than those with a lower charge.
Since proteins carry a net charge at any pH other than their isoelectric point, they migrate in an electric field, the rate of which depends on the charge density (that is, the rate of charge to mass of the molecule). Proteins with higher charge density will migrate faster, thus resulting in differential rates of movement of proteins when a mixture of different proteins is subjected to an electric field. By altering the gel pore size (using polymers at different concentrations) and the charge on the protein molecule (by changing the pH of the system) a high degree of resolution can be achieved for separation of protein molecules in a mixture.

Exercise: Draw a gel showing Bands.

Practical 27: SEED CERTIFICATION PART1

Definition: Seed certification is a legally sanctioned system for quality control of seed multiplication and production.

Purpose of seed certification

The purpose of seed certification is to maintain and make available to the public, through certification, high quality seeds and propagating materials of notified kind and varieties so grown and distributed as to ensure genetic identity and genetic purity.

IMPORTANCE OF CERTIFIED SEED

Certified seed is the starting point to a successful crop as well as an important risk management tool.

Here are the top 10 reasons to use certified seed:

You're getting clean seed

Certified seed is grown under stringent production requirements and has minimal weed seeds or other matter.

You're getting varietal purity

Certified seed uses systems to maximize genetic purity Off-types, other crop seeds, and weeds are guaranteed to be minimized

You're getting guaranteed quality assurance

Third party inspections in the field and at the processing plant ensure that all quality assurance requirements have been met. You can rest easy knowing your seed is what you expect it to be and can back up your assurances to others.

You're getting access to new opportunities

Many end-users are requiring specific varieties for their products.Using certified seed can open the door to new opportunities and greater sales by providing proof of varietal identity.

You're getting new genetics

Improved traits like better yield, pest resistance, drought tolerance, herbicide tolerance, and much more are delivered to farmers in certified seed. Years of research and development went into these traits and they can only be reliably accessed through certified seed use.

You're getting substance behind your word

The blue tag is proof that you used certified seed to maintain the value traits of the crop. It's your assurance to grain buyers and others that what you are delivering is what you say it is.

You're getting a better deal on crop insurance

Certified seed use can, in some cases, allow you to get a better deal on crop insurance premiums. Insurers know that certified seed means a crop with reduced risk.

You're getting maximum use of other inputs

You want the best genetics and purest fields to ensure you are making the most of your input dollars. Certified seed means you're not wasting time and other inputs on a crop that won't make grade.

You're getting access to premium markets

Proper inputs make for a good crop, but seed is the only input that can get you more than higher yields. Use of certified seed can be your ticket to premium markets like tofu soybeans or high stability canola and MORE.

You're getting traceability

Food safety and traceability are important considerations in agriculture. You can only be sure of your product if you know its origins. Certified seed is the key to that knowledge: production of this seed is carefully controlled under a quality assurance system right from the very beginning. Using certified seed will allow you to capitalize on a whole history of traceability measures.

Practical 28: SEED CERTIFICATION PART2

Eligibility for certification of crop varieties

Certified seed production can be carried out only in notified varieties(http://www.seedtamilnadu.com/). Information on notification status of various varieties that are intended to be produced can be obtained from the offices of Assistant Directors of Seed Certification and the seed certification officers working under them.

Availability of seeds

To get Breeder seeds, a farmer /seed producer should apply to Seed Association of India for Central released varieties and to Tamil Nadu Agricultural University for state released varieties through Department of Seed Certification.

Foundation seeds may be obtained from state A **Practical 27: SEED CERTIFICATION PART1**

gricultural Department, Quasi Government agencies and private seed producers and sellers.

Phases of seed certification

- Receipt and scrutiny of application
- Verification of seed source
- Field inspection
- Post harvest supervision of seed crops
- Seed sampling and testing
- Labelling, tagging, sealing and grant of certificate

Receipt and scrutiny of application

Any person, who wants to produce certified seed, shall register his name with the concerned Assistant Director of Seed Certification by permitting Rs. 25/- per crop, per season. There are 3 seasons under certification viz., kharif (June-September), rabi (October-January) and summer (February-May).

The applicant shall submit two copies of the application to the Assistant Director of Seed Certification 10 days before the commencement of the season or atleast at the time of registration of sowing report. On the receipt of application, the Assistant Director of Seed Certification will verify the time limit, variety, eligibility and its source, the class mentioned, remittance of fee etc., The application, if accepted will be given an application number. The original application is retained and the duplicate is returned to the applicant.

Sowing report

The seed producer who wants to produce certified seeds shall apply to the Assistant Director of Seed Certification in the prescribed sowing report form in quadruplicate with prescribed certification fees along with other documents such as tags to establish the seed source.

Class of seed	Source of seed
1. Foundation class	Breeder seed
2. Certified class	Foundation seed
3. Foundation class stage II	Foundation class stage I
4. Certified class stage II	certified class stage I

Separate sowing reports are required for different crop varieties, different classes, and different stages and if the seed fields are separated by more than 50meters, separate sowing reports are also required if sowing or planting dates differ by more than 7 days and if the seed farm area exceeds 25 acres. The sowing report shall reach concerned Assistant Director of Seed Certification within 35 days from the date of sowing or 15 days before flowering whichever is earlier. In the case of transplanted crop the sowing report shall be sent 15 days before flowering. The producer shall clearly indicate on the reverse of sowing report, the exact location of the seed farm in a rough sketch with direction, distances marked from a permanent mark like mile stone, building bridge, road, name of the farm if any, crops grown on four sides of the seed farm etc., to facilitate easy identification of the seed farm by the seed certification officer.

The Assistant Director of Seed Certification on receipt of the sowing report, scrutinizes and register the seed farm by giving a seed certification number for each sowing report. Then he will send one copy of the sowing report to the seed certification officer, one to the Deputy Director of Seed Certification and the third to the producer after retaining the fourth copy.

Verification of seed source

During first inspection of seed farm the seed certification officer will verify whether the seed used to raise the crop is from an approved source.

Practical 28: SEED CERTIFICATION PART3

EED QUALITY CONTROL

As per the section 6 (a) of the seeds Act 1966 the minimum limits of germination and purity standards have been notified for different kinds and according to section 6 (b) of the act a mark or label should be attached with the seed container with required particulars.

Under section 7 of the said act the sale of seeds of notified kinds and varieties are regulated. Every person selling seeds should sell seeds

- Which are identifiable to its kind and variety.
- Should posses the minimum required seed standards for germination, physical purity and genetic purity.
- Should affix a mark or label with correct particular to the seed container.
- Should carryout such other instruction given by the State Government as prescribed under rules.

Also under Rule -13 there are some requirements for every dealer to comply with

1. No. person shall keep for sale any seed after the date of its validity
2. The mark of label should not be tampered
3. Every person selling seeds should keep complete lot wise records of seeds for atleast for a period of three year which also include a seed sample from each lot which may be kept for one year.

Notified seed inspectors inspect the seed selling points to verify the quality of the seeds. They also draw seed samples when they suspect the quality of the seeds being sold. Seeds are then, sent to Seed Testing Laboratories for analysis. Legal actions are initiated against the defaulters based on the analytical results.

Seed selling licenses are issued under Seed Control Order 1983. Seed Inspectors also take appropriate action as and when complaints are received from farmers.

Role of farmers in maintaining the quality of seeds

Farmers should purchase the seeds only in the licensed seed selling points. Verify the details furnished in the producers label attached to the seed bag.
The label should possess the following details
SL.No.
Crop
Variety
Lot No.
Date of Test (Date/Month/Year)
Validity period (Date/Month/Year)
Germination %(Minimum)
Physical purity (Minimum)
Genetic purity (Minimum)
Net weight
Chemical used for seed treatment
Name and address of the producer

(Caution in red ink should be furnished for Name of the chemical, and "Do not use for Food, Fodder, or Oil purpose)

Certified seed Tag

When the farmers suspect the quality, they should report the matter to the concerned seed Inspector. Further they should keep with them the tag, label and the container of the seed bag. If the seeds do not germinate properly, the fact should be reported to the seed inspector concerned.

Whenever the farmers purchase seeds they should verify the variety and its performance. They should avoid purchasing un notified varieties.

The farmers should obtain receipt for the purchase of seeds without fail. In the receipt, details on variety, Lot number and validity period should be verified at the time of purchase.

Exercise: Draw the tag of breeder and certified seed.

Practical 29: Field inspection

The objective in conducting field inspection is to verify the factors which can cause irreversible damage to the genetic purity or seed health.

Field Inspection by seed Certification Officer

Crop stages for inspection

The number of field inspections and the stages of crop growth at which the field inspections should be conducted vary from crop to crop. It depends upon duration and nature of pollination of the seed crop.

1. Pre flowering stage
2. Flowering stage
3. Inspection during Post flowering and pre-harvesting stage
4. Inspection during harvest

Assessment of seed crop yield

It is necessary to avoid malpractices at the final stage during harvest operation. The seed certification officer is expected to fix the appropriate seed yield.

Liable for rejection report

If the seed crop fails to meet with any one factor as per the standards, Liable for rejection report I prepared and the signature of the producer is obtained and sent to Deputy Director of Agriculture (Seed Certification) within 24 hours.

Re-inspection

For the factors which can be removed without hampering the seed quality, the producer can

apply for re-inspection to the concerned Deputy Director of Agriculture Seed Certification within 7 days from the date of first inspection order. For re-inspection half of the inspection charge is collected.

Post harvest supervision of seed crop

The post harvest inspection of a seed crop covers the operations carried out at the threshing floor, transport of the raw seed produce to the processing plant, pre-cleaning, grading, seed treatment, bagging and post processing storage of the seed lot.

Exercise: Write a field inspection report.

Practical 30: Visit to Seed Processing Unit

Seed processing unit

Place where seeds harvested from grower's field are processed and graded.

Procedures for approval of seed processing unit

Any one can apply for approval to Director of Seed Certification, Coimbatore through Assistant Director of Seed Certification if he/she has space, machines and equipments for processing. The format of the form for approval of seed processing unit can be obtained from Seed Certification Officers or from the office of Assistant Director of Seed Certification. A fee of Rs. 250/- should be remitted in the office of Assistant Director of Seed Certification and a copy of cash bill of the same should be attached along with application. A fee of Rs. 150/- is collected for the renewal of approval of seed processing unit every year.

Procedures for seed processing

The seed lots in sealed containers from grower/farmers farmers' field should be brought within 3 months from the date of final inspection of Seed Certification Office. The seed lots should be processed and sampled within 3 months from the date of receipt in the processing unit. Seed samples will be sent to Seed Testing Laboratories through Assistant Director of Seed Certification office to ascertain the quality of seeds. A seed testing charges of Rs. 15/- per sample should be remitted in the Assistant Director of Seed Certification Office.

Seed Sampling and testing

Seed samples are also drawn separately from the seed lots of hybrid cotton, hybrid brinjal etc., for the purpose of conducting genetic purity test and sent to Director of Seed Certification from Assistant Director of Seed Certification. A fee of Rs. 200/- is collected in the Office of Assistant Director of Seed Certification for genetic purity test.

Seed lots possessing prescribed minimum seed standards are only tagged. Certification tags can be purchased from the Office of Assistant Director of Seed Certification. White tags are affixed to foundation class of seeds and blue tags for certified class. The cost of white tags is Rs. 3/- and Re. 1/- is the cost of blue tag.

Labelling, tagging, sealing and grant of certificate

Certified seed should be tagged within 2 months from the date of test. A validity period of 9 months is given for the certified seed lots.

If the seed lots are not sold or used within the validity period, then there is a procedure for validation i.e. extension of validity to already certified seeds seed lots.

Validation

It is nothing but extension of validity period to the expired seed lots. For validation of seed lots application should be sent to Deputy Director of Seed Certification in a prescribed Performa. The addresses of Deputy Director of Seed Certification Offices are given separately. Validation fee should be remitted in the office of Assistant Director of Seed Certification after obtaining the permission for the same from the Deputy Director of Seed Certification. Within 10 days from the date of remittance of validation charges, validation work will be commenced by the concerned Seed Certification Officers and samples will be drawn and sent to the Seed Testing Laboratory through Office of the Assistant Director of Seed Certification for the purpose of ascertaining the seed standards. The seed lots possessing prescribed seed standards will be given an extension and validity period for 6 months from the date of test.

Exercise: Visit a processing Unit