

University of Salahaddin
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Seed Germination and vigor tests

Second Lecture /3rd. stage

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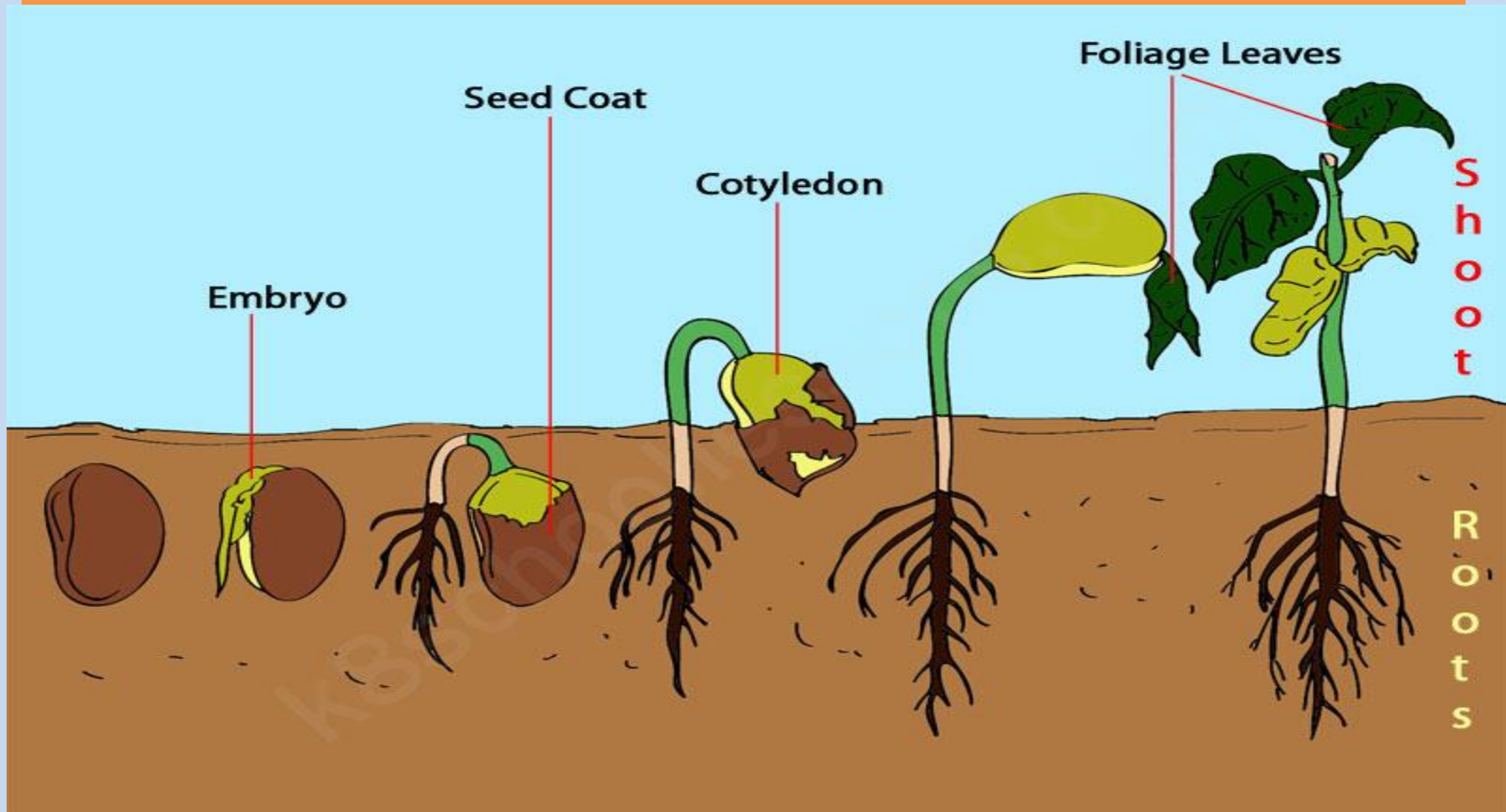
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Seed Borne Pathogen

Seed Germination

Is a process by which the embryo in the seed becomes activated and begins to grow into a new seedling.



Objective of seed germination

- Sowing purposes, with a view to decide the seed rate to achieve desired field establishment.
- Labeling purposes.
- Seed certification purposes.
- Seed Act and Law Enforcement purposes.

Factors affecting seed germination

External factors:

1- Water: Water is a basic requirement for germination.

It is essential for enzyme activation, breakdown, translocation and use of reserve storage materials.

The poor or additional supply of water affects seed germination.

2- Oxygen: Aeration of the soil is absolutely necessary for the germination of seed because oxygen is necessary for the aerobic respiration by which the seeds get the requisite energy for the growth of the embryo.

3-Temperature

Seed germination is a complex process involving many individual reactions and phases, each of which is affected by temperature. The optimum temperature for most of the seeds is between 15 to 30 0C.

4- Soil factor

Soil structure, soil texture and soil temperature influences on seed

5- light

Some seed species required light for germination. Both light intensity (lux) and light quality (colour and wavelength) influence seed germination

Internal factors:

Dormancy:

Seeds become dormant due to various reasons like the presence of hard, tough and impermeable seed coats, and the deficiency amounts of food, minerals and enzymes, etc.

Rolled Paper towel seed germination test

Procedure:

- 1-** Place 4 replicate of 100 seeds each uniformly on the upper halves of moist filter or blotter paper towels.
- 2-** fold towels in the middle and cover seeds completely with the lower half folded upwards.
- 3-** roll towels and place 4 replicates in a plastic bag open at the top.
- 4-** place the plastic bag upright in an incubator for 8 days.

Rolled paper towel



On the top of the paper towel

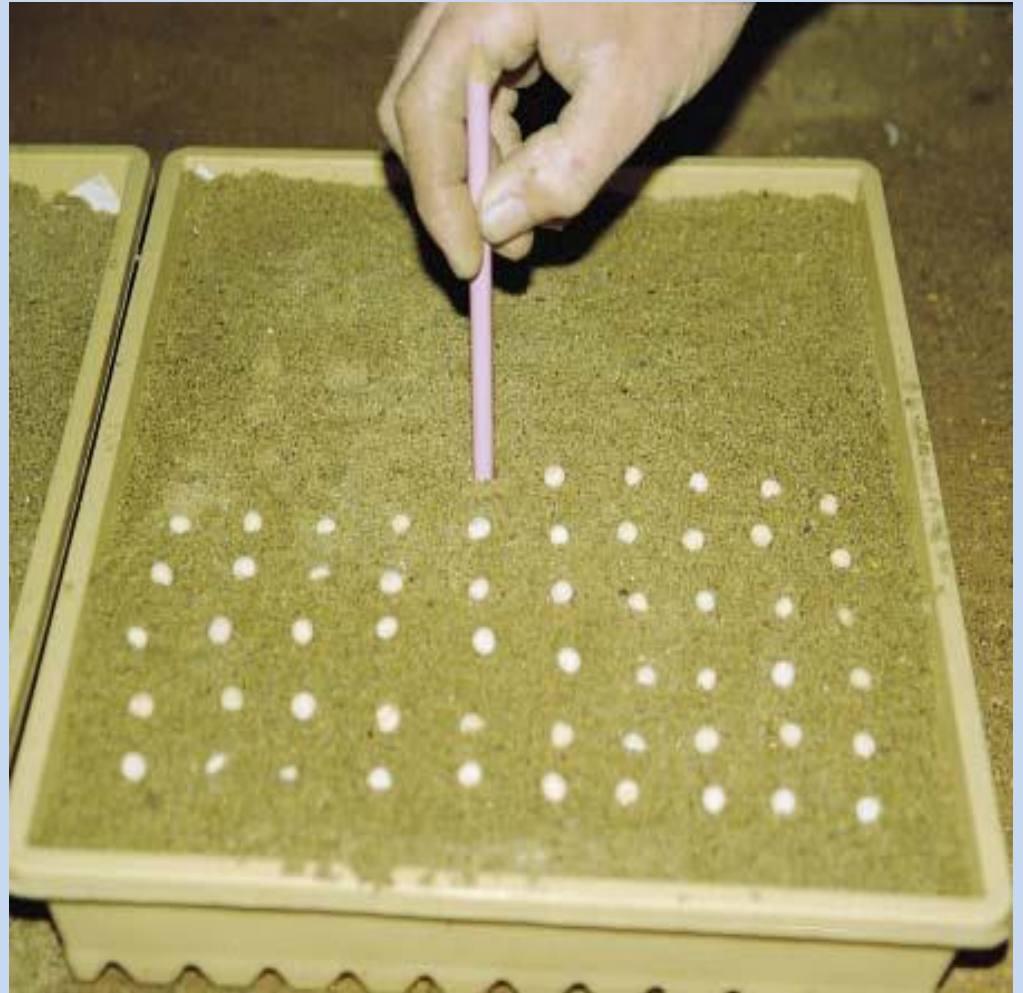
Procedure:

Seeds are placed on one or more layers of moist filter paper in petriplates. These petriplates are placed inside the germination cabinet. This is suitable for those seeds which require light.

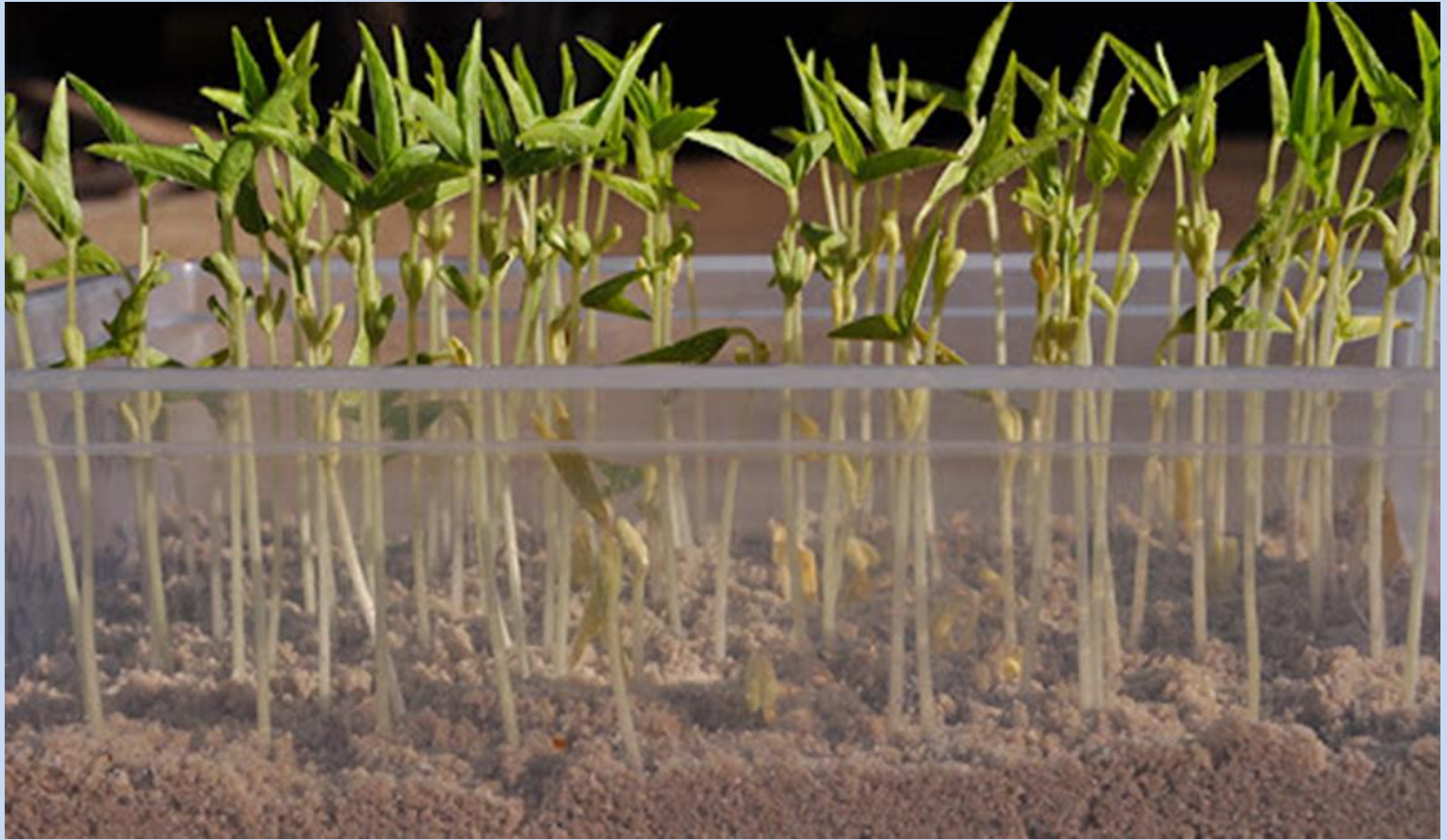


Sand/soil seed germination test

- 1-** Fill 3 trays with 4 cm of soil.
- 2-** place 100 seeds at uniform intervals in each tray.
- 3-** place another 4 cm of soil on the top of the seeds.
- 4-** incubate seed trays at 20°C and evaluate after 7 days.



Sand/soil seed germination test



Seed Germinator

The seed germinators are the essential requirement for germination testing for maintaining the specific conditions of temperature, relative humidity and light.



Evaluation of seed germination test

1- Normal seedling: seedlings showing potential for continued development into satisfactory plants when grown in good quality soil under optimum conditions.

2- abnormal seedling: do not show the potential to develop into a normal plant when grown in good quality under favorable condition.

3- ungerminated seed: seeds which have not germinated by the end of the test period for a standard germination test.

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

5- dead seed: 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.

Calculation of seed germination

Normal seedlings should be counted after 7 to 10 days when the majority of seedlings are up.

$$\text{Germination (\%)} = G/N * 100$$

G= number of **normal germinated seedling**.

N= number of seed sown

Seed vigour definition

the sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence.

Seed vigor test definition:

the ability to emerge seeds in soil under stress conditions

Factors affecting seed vigourity

Several factors (nutrition of mother plant, Weather conditions during seed development and maturation, mechanical damage during harvest or cleaning, inadequate drying, and unsuitable storage conditions. seed weight and size, deterioration and ageing and pathogens) are known to influence seed vigour.

Seed vigour test

1- brick gravel test

2-Cold Test

3- paper piercing test

4- conductivity test

5- Accelerated ageing test

Brick gravel test

the principle is that the weak seedlings are not able to generate enough force to overcome the pressure of brick gravels, so this method can be used to differentiate vigour levels in cereal seeds.

Procedure:

- ✓ The sand is sieved, moistured and filled in the germination box leaving about 3 cm empty at the top. One hundred seeds are 'placed in each box.
- ✓ After this 2-2.5 cm of porous brick gravel is spread over the seeds.
- ✓ The box is kept in the germinator at appropriate temperature.
- ✓ After the period required for germination, the box is removed and the seedlings which have emerged through the brick gravel layer are counted.



Cold Test

This test aims to differentiate between weak and vigorous seed lots by subjecting them to low temperature prior to germination at optimum temperature.

Procedure:

- 1-** After grinding and properly sieving the soil is filled in tray upto 2 cm depth.
- 2-** Fifty seeds are placed over the sand and covered with another 2 cm thick layer of soil.
- 3-** The soil is compacted and enough water is added
- 4-** After watering the trays are covered with polythene bags and placed in the refrigerator maintainance at 10°C for one week.
- 5-** After one week the trays are removed and placed in the germinator at 25°C temperature.
- 6-** The seedlings emerged after 4 days are counted. -

Cold test



Paper piercing test

The principle of this test is high vigour seed lots are expected to produce strong seedlings which can pierce a particular type of paper while seedlings of poor vigour lots may not be able to pierce the paper.

Therefore, the seedlings which emerge by piercing the paper are more vigorous than those which are not able to emerge through the paper.

Paper piercing test

Procedure:

- 1-** The cereal seeds are placed on 2 cm moist sand in a tray or sand box.
- 2-** The seeds are covered with specially selected dry filter paper which is then covered with 2 cm of moist sand.
- 3-** The sand boxes/trays are kept in a germinator maintained at 20°C temperature for 7 days.
- 4-** After 7 days sand boxes/trays are taken out and seedlings emerging above the paper are counted.

seed Viability test

Seed viability: is the ability of embryo of seeds to germinate.

seed viability test measured how many seeds are live and can germinate and grow

Tetrazolium test

The TZ is a biochemical test, which differentiates live seeds from dead seeds based on the activity of the respiration enzymes in seeds.

Tetrazolium (*2,3,5-triphenyl tetrazolium chloride*) in a chemical compound called *formazan*.

Formazan stains living cells (respiring) with a red color while dead cells (not respiring) remain colorless.

Tetrazolium test

- 1- Place 100 seeds in a beaker containing 100 ml of water
- 2- Drain seeds and subsection longitudinally through the embryo.
- 3- The water is decanted and tetrazolium solution is added then incubate in the dark for 2 to 4 hours.
- 4- Examine the seed for a color change in the embryo.



Calculation of seed viability

Seed viability % = $\frac{N \text{ of stained embryo}}{N \text{ of total embryo}} \times 100$

For example:

Number of total embryo = 25

Number of stained embryo = 23

Seed viability % = ?