

POST HARVEST PHYSIOLOGY
SEED DORMANCY

Seeds harvested at physiological maturity are known to possess maximum viability and vigor. The ability of these seeds to germinate depends on the internal and external environment of the seeds. Any disturbance in external or internal condition leads to failure of germination in seeds.

31.1 Definition: Dormancy is defined as physical or physiological condition of the seed that prevents germination in the presence of otherwise favorable conditions for germination.

Dormancy may occur with in the embryo (Ground nut) or in the seed coat (Sunflower). The period of dormancy varies from a few days to several months depending on the plant species

After-ripening: The period of rest after harvest that is necessary for germination is sometimes referred to as **after – ripening period** and the changes that take place during the rest are described as **after – ripening**.

Quiscence: is the phenomenon in which the seeds fail to germinate for want of a particular environmental factor.

31.2 TYPES OF DORMANCY:

A. Primary dormancy: This is otherwise called as innate dormancy. These seeds enter in to dormancy much before they are harvested i.e when they are still on their mother plant itself.

e.g; 2-3 months in Virginia runners of Ground nut

Up to 40 days after the seed is formed in sunflower.

B. Secondary dormancy: This is called as induced dormancy. These seeds are non dormant when they are harvested from the mother plant. How ever when they are exposed to brief periods of un favorable environmental condition they show dormancy.

e.g: Mustard seed exposed to high concentration of CO₂

Wheat stored in high moisture content in air tight containers at 50⁰ C

31.3 ADVANTAGES AND DISADVANTAGES OF DORMANCY

The survival of natural populations depends mainly on their ability to exploit the favorable and avoid the unfavorable weather conditions to which they are cyclically exposed in their natural habitats. The state of dormancy equips organisms

to escape the detrimental effects of adverse natural environments, thereby enhancing their chances of survival.

Plants with a long history of domestication generally show much less seed dormancy than wild or recently domesticated species. Thus crop domestication has promoted rapid seed germinability. This may often result in **premature germination** of seeds within ears/pods (**vivipary**) when the crops are exposed to a wet weather favorable for germination just before harvest. In such cases, a pre-harvest rain leads to deterioration in the quality of crop produce, e.g., in wheat, it reduces seed quality and vigor, milling and baking quality, and even grain yield. Therefore, a certain degree of seed dormancy is often deliberately selected for in order to prevent pre-harvest sprouting in cereals. A brief period of dormancy provides adequate time to farmers to harvest, thresh and store the seeds, thereby avoiding considerable losses.

Disadvantage: The seeds with dormancy cannot be used immediately after harvest for seed purpose.

31.3 CAUSES FOR DORMANCY:

31.3.1 Seed coat factors

- (a) Seed coat **impermeable to water**: Common in seeds of Leguminaceae, Malvaceae, convolvulaceae and chenopodiaceae. Seed coat with thick waxy cuticle, lignin and suberin barriers makes seeds impermeable to water.
- (b) Seed coat **impermeable to oxygen**: Any disturbance to the entry of oxygen and exit of CO₂ decreases respiration and there by remains in dormant condition.
- (c) **Mechanically resistant** seed coat: Hard seed coats of nuts make it difficult for embryo to germinate and break the seed coat. High salt concentration in water also aids to cause mechanical resistance to germination.

31.3.2 Embryo Factors

- (a) **Immature/redimentary embryo** : found in *Ranunculus plantago* . These embryos require after ripening though their growth is completed morphologically. This is also called as *physiological dormancy*.

31.3.3 Inhibitory Factors

The inhibitors (e.g : coumarin, caffeic acid , ferulic acid and ABA) may present in the embryo, endosperm or seed coat or pericarp. These inhibitors deactivate enzymes like Amylase, protease and phytase. This will limit the supply of simple substances like sugars, fatty acids and P necessary for

germination. If the ratio of these inhibitors is higher than the that of endogenous hormones especially GA the seeds remain dormant till a balance between them is reached in favor of growth promoters.

31.4 REMEDIAL MESURES / METHODS TO BREAK DORMANCY:

A number of methods of overcoming dormancy have been developed; these methods are either aim at breaking/softening of seed coats or at promoting seed germination through stimulation of embryo. The various treatments for overcoming dormancy may be divided into the following three groups: (I) seed coat treatments, (II) Embryo treatments and (III) miscellaneous approaches.

31.4.1 Seed Coat Treatments:

These treatments are either physical or chemical in nature, and aim at making hard seed coats permeable to water and / or gases by either cracking or softening them; the process is usually referred to as **scarification**.

a) Mechanical scarification:

- Rotating the seeds in machines having drums with abrasive surfaces.
- rubbing the seed against abrasive surfaces manually . Eg. Coriander

b) Chemical scarification: This is achieved by the use of sulphuric acid, Hcl, NaOH, alcohol, acetone, oxidizing agents etc.

- Treating in 3% nitric acid solution for 6-8 hrs can relieve the seed dormancy in Rice.

Among the several methods available the most suitable method to break seed dormancy at farmers level is nitric acid treatment. - Soaking the seed in 0.1 N nitric acid i.e., 6.3 ml per lit. of water for 12 to 24 hours effectively breaks the seed dormancy in less or moderately dormant varieties. However, the varieties like **MTU-1001 (VIJETHA)** which is having 8 weeks and above dormancy duration should be treated with higher nitric acid concentration i.e., 10ml per lit. of water. The seeds can be utilized for sowing immediately after the treatment or they can be dried thoroughly and can be utilized later for sowing.

Scarifications must be done with caution and care; otherwise it may damage the seeds. It may be done in one of the following ways.

- ✓ Scarification may be achieved by rubbing the seeds on a sand paper manually or by using a mechanical scarifier; care should be taken to avoid damage to the embryonic axis. This treatment is effective in species like 'subabool', green gram etc.

- ✓ The seed coat may be pierced by a needle or a small incision may be made in it at the abaxial end of the seed, e.g., in bitter melon (*Momordica charantia*).
- ✓ In some cases, the seed coat may be completely removed by breaking e.g., in rubber (*Hevea Spp*). In this technique, each seed has to be handled individually, which makes the treatment slow, time taking and tedious.
- ✓ The seed may be soaked in a concentrated or dilute solution of sulphuric acid for 1 to 60 minutes, followed by thorough washing with tap water to remove all traces of acid e.g., in cotton (*Gossypium spp*)
- ✓ In some species e.g. lentil, Bengal gram etc. soaking the seeds in hot water (80°C) for 1-5 minutes effectively softens their seed coats. But seeds of some species may be highly sensitive to this treatment e.g. a treatment of more than 1 minute reduces the germinability of Bengal gram seeds

Mechanical scarification, especially, manual scarification, is the most commonly used technique and is relatively safer but, quite often tedious.

31.4.2 Embryo treatments

When dormancy is due to factors located within the embryo such treatments have to be applied that are capable of inducing the embryo to resume growth. Some of the common treatments are briefly described below

- A. Stratification :** stratification is the incubation of seeds at a suitable low temperature (usually, 0-5°C) over a moist substratum before transferring them to a temperature optimum for germination; it is a common embryo treatment designed to overcome dormancy. It is commonly used in crops like cherry (*Prunus cerasus*), mustard (*Brassica campestris*) species of family Rosaceae (2-6 months at 5-10°C) etc.
- B. High temperature treatment:** In some plants incubation at 40-50°C for few hours to 1-5 days may be effective in overcoming dormancy. Care should be taken that the moisture content of seeds should be less than 15% For example rice (*Oryza sativa*) seeds having less than 15% moisture are incubated at 40-50°C for 4-5 days for overcoming dormancy.
- C. Chemical / Hormonal treatments:** The growth regulators most commonly used for this purpose are **GA**, (100ppm is the most commonly used concentration) and **kinetin** (concentration range, usually 10-15ppm). Benzyl adenine at 2 ppm and ethrel at 250ppm are effective in breaking seed dormancy of sunflower. Ethrel 75ppm and GA at 60 – 75 ppm are effective in controlling seed dormancy in groundnut.

Other widely used chemicals are **potassium nitrate** (0.2%) and thiourea (0.5 to 3%) Potassium nitrate breaks the dormancy of seeds requiring light and allows them to germinate in dark e.g. in case of oats, barley

tomato, etc. **Thiourea** breaks the dormancy of seeds requiring light and / or chilling e.g.in lettuce, Gladiolus etc.

31.4.3 Miscellaneous Treatments

Exposing the seeds of many species to red or white Light leads to a termination of dormancy For example lettuce seeds exposed to red light at 660nm or to white light are induced to germinate. Generally seeds are placed initially in red light, and they are subsequently transferred to dark or white light for germination.

31.5 OPTIMUM SEED STORAGE CONDITIONS

Seeds that can be stored in a state of low moisture content are called “**Orthodox**” seeds (Rice, Mung, sorghum, cotton etc.)The seeds that can be stored in a state of high moisture content are called as **recalcitrant seeds** (Cacao, Rubber,Tea etc.). Their viability depends on storage conditions and follows some general rules: (Harrington thumb rules) (ISTA rules) (International Seed Testing Association).

- a) For each 1% decrease in seed moisture content, the storage life of the seeds is doubled.
- b) For each 10⁰F (5.6⁰C) decrease in seed storage temperature, the storage life of seed is doubled.
- c) The arithmetic sum of storage temperature in degrees F and the percent relative humidity should not exceed 100, with no more than half the sum contributed by the temperature.

These “rules of thumb” clearly indicate that temperature and moisture content of the seed are major factors in determining the viability of seed.

31.6 FACTORS AFFECTING SEED VIABILITY DURING STORAGE:

31.6.1. Seed Moisture:

- a) > 30% : Non dormant seeds may germinate
- b) 18-30% : Rapid deterioration by microorganisms
- c) 8-20% : Seeds respire rapidly and in poor ventilation, the generated heat will kill them.
- d) <8-9% : There is little or no insect activity
- e) <4-5% : Immune from attack by insects and storage fungi, but they may deteriorate faster than those maintained at a slightly higher moisture content.

31.6.2 Temperature:

Cold storage of seeds at 0-5°C is generally desirable if they are dried to safe moisture limits and sealed in moisture proof containers.

31.6.3 Relative humidity

The activities of seed storage fungi are more influenced by the RH of the inter seed atmosphere than by the moisture content of seeds. Oil seeds may differ in their moisture content from starchy seeds even though both are at same atmospheric RH. At 45% RH starchy seed have 11% moisture and oil seeds have 4-6% moisture.

31.6.4 Cultivar and harvest variability

Different cultivars and harvests of a particular species may show different viability characteristics under the same storage conditions.

31.6.5 Pre and post harvest conditions

Environmental variation during seed development usually has little effect on the viability of seeds, unless the ripening process is interrupted by premature harvesting. Weathering of matured seeds in field particularly in excess moisture or freezing temperatures, results in inferior storage potential. Mechanical damage during harvesting severely reduces the viability of some seeds.

31.6.6 Oxygen pressure during storage:

If seeds are not maintained in hermetic storage at low moisture contents, even under constant temperature and moisture, the gaseous environment may change as a result of respiratory activity of the seeds and associated micro flora.

31.6.7 Fluctuating storage conditions:

Onion and Dandelion seeds stored under conditions of alternating high and low RH lose viability proportionately to the length of time that the seeds are subjected to the high RH.
