

**M.Sc. Ag. IV semester**

**Course:** Principles & Practices of Seed Production

**Chapter:** 06 (Seed Testing)

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### **Topic: Seed priming**

Seed priming was first proposed by Heydecker (1973). Seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield. It is a simple and low cost hydration technique in which seeds are partially hydrated to a point where pre-germination metabolic activities start without actual germination, and then re-dried until close to the original dry weight. Seed priming is employed for better crop stand and higher yields in a range of crops.

Seed priming is a pre-sowing treatment that offers the possibility to improve post-harvest seed quality and allow the release of dormancy leading to increased final germination as well as germination speed and uniformity. The technique involves the initiation of germination metabolism by controlling the hydration of seeds and activating various metabolic processes without allowing radical protrusion.

#### **Seed priming techniques:**

1. Hydro-priming,
2. Halo-priming,
3. Osmo-priming
4. Hormonal priming
5. Solid Matrix priming
6. Bio-priming

**1.Hydro-priming:** soaking the seeds in water before sowing and may or may not be followed by air drying of the seeds. Hydropriming is the simplest method of seed priming, which relies on seed soaking in pure water and re-drying to original moisture content prior to sowing. No use of additional chemical substances as a priming agent makes this method a low-cost and environmentally friendly. Hydro-priming may enhance seed germination and seedling emergence under saline and non- saline conditions. Hydro-priming plays an

important role in the seed germination, radical and plumule emergence in different crop species. Similar to other priming techniques, hydro-priming generally enhance seed germination and seedling emergence under saline and non-saline conditions and also have beneficial effect on enzyme activity required for rapid germination.

The main disadvantage of hydro-priming is uncontrolled water uptake by seeds. This is a consequence of free water availability to seeds during hydropriming, so that the rate of water uptake depends only on seed tissue affinity to water. Moreover, this technique may result in unequal degree of seeds hydration thus leading to lack of simultaneous metabolic activation within seeds followed by unsynchronized emergence

**2. Halo-priming:** refers to soaking of seeds in solution of inorganic salts i.e NaCl, KNO<sub>3</sub>, CaCl<sub>2</sub> and CaSO<sub>4</sub> etc. A number of studies have shown a significant improvement in seed germination, seedling emergence and establishment and final crop yield in salt affected soil in response to halo-priming. Priming with NaCl and KCl was helpful in removing the deleterious effects of salts.

**3. Osmo-priming:** Osmo-priming involves soaking seeds in osmotic solution with low water potential instead of pure water. Due to low water potential of osmotic solutions, water enters seed slowly which allows gradual seed imbibition and activation of early phases of germination but prevents radical protrusion. Different compounds are used in osmo-priming procedure including polyethylene glycol (PEG), mannitol, sorbitol, glycerol, and inorganic salts such as NaCl, KCl, KNO<sub>3</sub>, K<sub>3</sub>PO<sub>4</sub>, KH<sub>2</sub>PO<sub>4</sub>, MgSO<sub>4</sub>, and CaCl<sub>2</sub>. ***Priming with salt solutions is often referred as "halo-priming"***. Most common chemical employed in osmo-priming treatment is PEG, mainly owing to its specific characteristic. Large molecular size of PEG prevents its penetration into the seed thus avoiding induction of potential cytotoxic effect and reduction of osmotic potential within seed. Nevertheless, PEG exhibits some undesirable features including high viscosity, which restrict diffusion of oxygen in the solution so in PEG priming aeration system is preferred. Seed priming with PEG has been shown as an effective method to improve seed germination, seedling emergence, and stress tolerance of several crop plants under unfavorable conditions.

**4. Hormonal priming:** is the pre - seed treatment with different hormones like GA<sub>3</sub>, kinetin, ascorbate etc., which promotes the growth and development of the seedlings. During hormonal-priming, seeds imbibitions occur in the presence of plant growth regulators, which can have direct impact on seed metabolism. The following regulators are commonly used for hormo-priming: abscisic acid, auxins, gibberellins, kinetin, ethylene, polyamines, and salicylic acid (SA). Gibberellic acid (GA<sub>3</sub>). With the proper treatment of seeds they are able to germinate and emerge better as the inorganic salts improve germination and growth parameters of the treated seed; KNO<sub>3</sub> increases yield, fruit size and improves quality in field and vegetables crops and seed priming with GA<sub>3</sub> enhance emergence and germination rate of soybean. Cytokinins can also be used as priming agent as they are mainly involved in the breakdown of dormancy of some seeds .

**5. Solid Matrix priming:** Solid matrix priming (SMP, matrix conditioning), in which water uptake by seeds is controlled, has been developed as an alternative method to osmopriming because of high cost of osmotic agents and technical problems with aeration. During solid matrix priming, seeds are mixed and incubated with wet solid water carrier for a certain period. Afterward, seeds are separated from matrix, rinsed, and back-dried. The use of solid medium allows seeds to hydrate slowly and simulates natural imbibition process occurring in the soil.

To successfully accomplish SMP, materials utilized as matrices should possess specific physical and chemical features such as low matrix potential, minimal water solubility, high water holding capacity and surface area, no toxicity to seeds, and ability to adhere to seed surface. In fact, vermiculite, peat moss, charcoal, sand, clay, and some commercially offered substrate such as Celie or Micro Cell are exemplary solid carriers applied in solid matrix priming.

**6. Bio-priming:** Bio-priming involves seed imbibition together with bacterial inoculation of seed, this treatment increases rate and uniformity of germination, but additionally protects seeds against the soil and seed-borne pathogens. Hydration of seeds infected with pathogens during priming can result in a stronger microbial growth and consequently impairment of plant health. However, applying antagonistic microorganisms during priming is an ecological approach to overcome this problem. Moreover, some bacteria used as biocontrol agents are able to colonize rhizosphere and support plant in both direct and indirect way after germination stage. It was found that biopriming is a much more effective approach to disease management than other techniques such as pelleting and film coating.

## Advantages

- Enhances the germination percentage
- Enhances the speed and uniformity of germination
- Improves the resistance towards water and temperature stress
- Increases the shelf life of seed
- Highly suitable for small seeds
- Enhances the yield

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