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Methods of Seed Priming and their Importance in Seed Industry

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Seed priming is the controlled hydration of seeds in water or a solution of low osmotic potential to initiate the germination metabolism without radical protrusion. Many studies have reported that seed priming improves the stand establishment and productivity of field crops. There are several types of seed priming including hydropriming, halopriming, osmopriming, solid matrix priming, biopriming, nutripriming, and seed priming with hormones, plant growth regulators, and other organic sources.

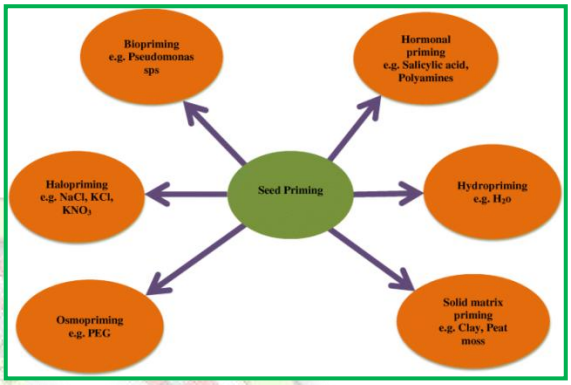

Fig: Types of Seed Priming

Seed priming was first proposed by Heydecker in 1973, it 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.

Methods of Seed Priming

Hydropriming: 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

Halopriming: Halo-priming refers to soaking of seeds in solution of inorganic salts i.e NaCl, KNO3, CaCl2 and CaSO4 etc. A numbe rof 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.

Osmopriming: Osmo-priming involves soaking of 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 osmopriming procedure including polyethylene glycol (PEG), mannitol, sorbitol, glycerol, and inorganic salts such as NaCl, KCl, KNO3, K3PO4, KH2PO4, MgSO4, and CaCl2 . ***Priming with salt solutions is often referred as "halo-priming"***. Most common chemical employed in osmopriming 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.

Solid Matrix Priming: Solid matrix priming 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 imbibitions 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 carries applied in solid matrix priming.

Biopriming: 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

Nutripriming: Recently, the priming of seeds in different micronutrient soltutions is getting momentum in order to improve the micronutrient availability into plants and their final assimilation in the seed (biofortification) to reduce the malnutrition. Many studies have reported that seed priming with zinc, boron (B), and magnesium at preoptimized rates improved the performance of different field crops owing to an improvement in seed germination, growth, and yield parameters. In conclusion, nutripriming improves stand establishment, growth, productivity, and grain biofortification of field crops.

Seed Priming with Plant Growth Regulators, Hormones, and Other Organic Sources: Hormonal priming is the pre - seed treatment with different hormones like GA3, 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 (GA3) .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; KNO3 increases yield, fruit size and improves quality in field and vegetables crops and seed priming with GA3 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.

Importance of seed priming

1. Enhances the speed of emergence and uniformity of germination.
2. Improves the resistance towards water and temperature stress.
3. Increases the shelf life of seed.
4. Highly suitable for small seeds.
5. Enhances the yield.
6. It reduces chemical input requirements of the crop by increasing efficiency which helps in enhancing the B: C ratio.
7. In plant defense, priming is used as a physiological process by which a plant prepares to respond to imminent a biotic stress more quickly or aggressively.
8. It has better adaptive strategies for dispersal to new habitats for better survival.

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