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SEED PRIMING – A SUSTAINABLE APPROACH FOR FARMING

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Seed enhancement technique is a range of techniques performed post harvesting and conditioning before sowing like priming, pelleting, pre-germination, resulting in improved germination and physiological performance.

Objectives

- Improved germination/seedling growth.
- Facilitate seed planting.
- Deliver specific materials needed at the time of sowing (e.g., Nutrients and inoculants).
- Remove weak or dead seeds.
- Tagging of seeds with visible pigments or other materials/markers.

History of Seed Priming

Evenari (1984) reported that the efforts for improving seed germination and growth are dated back to ancient Greeks. Theophrastus (371–287 B.C.), during an investigation, observed that cucumber seeds, when soaked in water, end in faster and uniform germination as compared to un-primed seeds (Theophrastus, Enquiry into Plants, Book VII, I.6). Likewise, the Roman naturalist Gaius Plinius Secundus (23–79 A.D.) reported the positive effects of pre-soaking of cucumber seeds in honey and water for seed germination (Gaius 1949–1954). Afterward, in 1539–1619, the French botanist Oliver de Serres reported the seed soaked in manure water for two days then dried before sowing as an efficient way of seed treatment for better crop growth. Darwin tested osmo-priming on lettuce and cress seeds in seawater and observed high germination within the treated seeds as compared to non-primed seeds (Darwin 1855). And this fashionable concept of seed priming was presented by Ells (1963), who highlighted the critical parameters associated with a seed treatment. He observed high germination rates when seeds were treated with a selected nutrient solution. Koehler

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(1967) reported that treatment with salt solution promotes RNA accumulation that, in turn, enhances other physiological processes and leads to high seed emergence. May *et al*. (1962) stated that seed drying surely time at a specific level after priming exerts beneficial effect and results in fast germination under normal also as stressful conditions (Berrie and Drennan 1971). Heydecker*et al.* (1973) used organic chemical polyethylene glycol (PEG) H–(O–CH_2–CH_2)n–OH, a high molecular weight compound, for seed pre-treatment to spice up germination and avoid several problems related to salts treatment like hardening. Hence, various seed treatment techniques were introduced and examined for uniform germination under different environmental conditions.

Seed Priming

Seed priming is a method in which seeds are hydrated (control hydration or uncontrolled hydration) and dried to original moisture content, but the actual emergence of the radicle is prevented.

Phenomenon of Seed Priming

After sowing, seeds remain within the soil for a particular duration to soak up water and a few essential nutrients for his or her growth. Seed priming reduces this point and makes the germination quick and uniform. Additionally to hydration, priming also reduces the sensitivity of seeds to external environmental factors (Afzal *et al.*, 2016). Priming promotes seed germination under three stages like imbibition, germination, and growth. During the imbibition stage, the water uptake promotes protein synthesis and respiratory activities through messenger RNA (mRNA). The second stage is said to the initiation of various physiological activities associated with germination like protein synthesis, mitochondria synthesis, and alteration in soluble sugars (Varier*et al*. 2010). The critical factor during seed priming is that the controlled water uptake during the second stage, before the emergence and growth of radical from the testa during the last stage. The second stage (germination) is far sensitive to environmental factors than the third stage (Côme and Thévenot 1982). Therefore, during priming, the seeds that have skilled the second stage could germinate under variant environmental conditions as compared to un-primed seeds (Corbineau and Côme2006).

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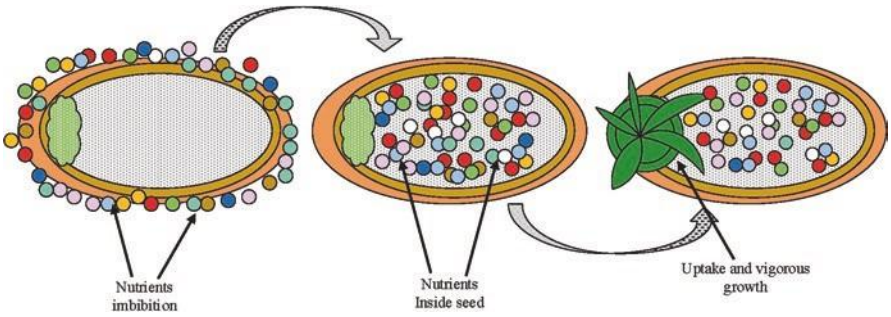

Fig. 1: General phenomenon of seed priming. (M. Waqas *et al.*, 2019)

Methods of Seed Priming

A. Conventional methods of seed priming.

- ***Hydro-priming***: It is a seed priming method that involves priming of seed in pure water to initiate pre-germinative physiological activity of seed, but without radicle emergence, seeds are dried to original moisture content before sowing.
- ***Osmo-priming***: Osmo-priming is one among the sort of seed priming during which seeds are mixed with osmotic agents of high relative molecular mass (Poly Ethylene Elycol) with different osmotic potential and have control on the level of hydration i.e. controlled hydration. Commonly used osmotic agents are PEG 6000 and PEG 8000.
- ***Chemo priming***: Chemo-priming involves the use of various chemicals to in-vigor the seeds.
- ***Halo priming***: Seeds are dipped in various salt solutions e.g. NaCl.
- ***Solid matrix priming***: Solid matrix priming is a type of seed priming in which seeds are mixed with solid materials and water.
- ***Bio-priming***: Bio-priming is also a type of priming in which seeds are primed in a solution containing bio-control agents (bacteria).
- ***Priming with plant growth regulators*** - Seed treatment with plant growth regulators (PGR) is known to mitigate the harmful effects of several environmental stresses (Jisha*et al*. 2013).
- ***Priming with Plant Extract***–Allelochemicals such as phenolic compounds, terpenoids, flavonoids, saponins, alkaloids, and steroids may inhibit or stimulate

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plant growth (Narwal 1994). Saponins can accelerate nutrient absorption as they are readily soluble in water. Alkaloids, saponins, and phenolic compounds present in the leaves of various plants are involved in the production of antioxidant activities and protect the plants against pathogens (Satish *et al*. 2007).

B. Advanced method of seed priming

- ***Seed Priming through Nanoparticles***- Nanotechnology utilizes nanoparticles less than 100 nm in size, and it has a promising role in transforming food production and agriculture (Fraceto *et al*. 2016).

- ***Seed Priming through Physical Agents***- The magnetic field, UV radiation, gamma radiation, X-rays, and microwaves are some of the physical agents used for seed priming (Bilalis *et al*. 2012). Priming with magnetic field found to improve germination rate, vigor, and seedling biomass as well as tolerance to various environmental stresses.

Factors affecting seed priming

Seed priming is highly affected by various biotic and abiotic factors such as

1. Aeration
2. Temperature.
3. Time.
4. Seed quality.

Conclusion

Seed priming is the need of prime importance in agriculture as it not only helps to influence germination but also has multiple attributing benefits. Their role in increasing nutrient content in food and seed is much valuable. Seed priming facilitates plant growth promotion and influences yield. Despite these factors, they also positively impact decreasing fertilizer rate, influencing nutrient uptake, maintaining plant growth vigor, and tolerance to different biotic and abiotic stress.

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