Seed Priming – A Tool for Sustainable Agriculture

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Introduction

Effective germination of seed is crucial for agriculture. The emergence and growth of plant species are initially based on the seed quality. A good quality seed, in a good soil yield higher. The use of other inputs such as manures, pesticides, fertilizers etc. are based upon the seed quality used. Seed forms a key tool in ensuring food security and act as a carrier in technology adoption. Quality seed must possess some important traits including high physical and genetic purity, higher germination percentage, increased vigour and free from pest and diseases. Many adverse conditions including climate change may lead to failure of the crop. Some effective strategy must therefore be adopted for successful crop growth. Among them seed priming is a vital technique aiding the successful establishment of crop growth. Seed priming is a physical technique where the seeds are subjected to controlled hydration and drying for enhancing the sufficient pre-germination metabolic process for quick and rapid germination. The seeds are partially hydrated and retained under a specified temperature, moisture and aerated condition for a particular time period. Priming forms feasible and economic technique for uniform germination and growth (Pawar *et al.,* 2018)**.**

Benefits of Seed Priming

- Faster and uniform seed germination
- Helps to overcome thermo dormancy
- Alleviate diverse effects caused by various stresses
- Aids to overcome the chromosome damages induced by aging
- It minimizes soil borne diseases
- Increases the viability of low vigor seed
- Overall enhances the growth and yield of the crop

Seed Priming Phenomena

After sowing, usually the seeds remain in soil for some time for absorbing water and nutrients required for their growth. In seed priming technique this time is reduced and the seed germinate quickly and uniformly. Added to the hydration, the priming also decreases the seed sensitivity to the external environmental factors. Priming regulate the seed germination under 3 stages *viz.,* imbibition, germination and the growth (Fig 1). During imbibition stage, water uptake promotes the respiratory activities and protein synthesis through mRNA. The

second stage is the initiation of various physiological process like mitochondrial synthesis, protein synthesis and alternation in the soluble sugars related to germination. The crucial factor during priming are the controlled uptake of water during second stage before emergence and the growth of the radical from seed coat in the last stage. The second stage are much sensitive for the environmental factors than the last stage. Therefore, during seed priming seeds that had passed through second stage can germinate under varied environmental conditions.

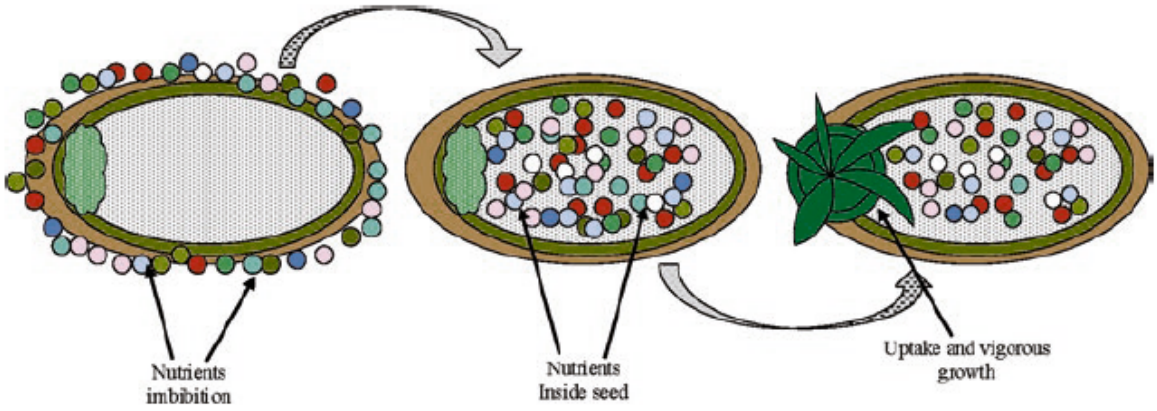

Fig 1: Seed Priming Phenomena (Waqas *et al.,* 2019).

Methods of Seed Primining:

There are several priming techniques that are been practiced (Raj *et al.,* 2019). Some of the priming techniques are as follows:

1) *Hydropriming*

In this, the seeds are soaked in the water for some specific duration. This technique is mostly used in dry farming areas. Here the water entering the seeds is influenced by the seed tissue affinity for water. Hydropriming are cheap and ecofriendly in nature. The key factors in hydropriming are water soaking duration, volume of water and the temperature at which the priming is performed

2) Halopriming

The seeds are soaked in the inorganic salt solutions (NaCl, KCl, etc,) during halopriming. These salts might exert some direct or indirect effects on nutrition. It promotes uniform and better performance of the crop even under some adverse conditions. Added it also tolerates salinity through enhanced Ca^{2+} and K^{+} accumulation, reduced Na^{+} accumulation and increased osmosis by proline accumulation

3) O*smopriming*

Osmopriming also termed as osmoconditioning involves the soaking of seeds in osmotic solution like polyethylene glycol, mannitol, glycerol, sorbitol etc. Seeds uptake the water slowly due to the lower water potential in the osmotic solution permitting the seed imbibition. Generally osmotic potential of priming solution ranges from – 1 to -2 MPa but differs with duration and species in the priming solution.

4) Solid matrix priming

In this method the seeds are incubated in solid insoluble matrix such as peat moss, vermiculite, diatomaceous earth, sand, charcoal and clay with limited water quantity conferring slow imbibition. The materials that are used as matrices should have low matrix potential, low water holding capacity, should stick to bed surface and non-toxic to the seeds

5) Biopriming

Biopriming combines the seed inoculation with the beneficial microorganisms and regulate the hydration of seeds for the biotic and abiotic stress management. During biopriming microorganism proliferates, colonize and produces PGRs (Plant Growth Regulators). Biopriming also favors seed germination and safeguards from seed and soil borne diseases. The beneficial microorganisms can colonize and proliferate in the rhizosphere and supports the plant both directly and indirectly.

6) Hormonal priming

Hormopriming or hormonal priming involves the treating of the seeds with various hormones that increases growth and development of seedlings. Hormones that are commonly used includes auxin, abscisic acid, kinetin, gibberellins, ethylene, salicylic acid and polyamines

7) Nutripriming

Here the seeds are primed with nutrient solution to improve the seed quality by enhancing the seed nutrient content. Micronutrients are vital for the plant growth as it involves in 2 key process namely photosynthesis and the respiration that aid in overall growth of the plant.

8) Nano priming

It is a new seed priming method with the nanoparticles like iron oxide, zinc oxide, silver nanoparticle, titanium dioxide etc. Nutrient or fertilizer applied to the plants are not taken up by them as they get drained off or broken down by the exposure to water and light. Nanoparticulate nutrient/material deliver to the plants provides restricted and adequate nutrient use at the specific site required for the plant growth.

Conclusion

The technique of seed priming is considered as the best solution for problems related to germination that too when the seeds are under favourable condition. Over last few decades, priming seeds offers effective, realistic and smart option for an effective plant growth. It is environmentally safe and can be easily adapted by farmers and are beneficial in numerous ways. Added, all the priming protocols would not lead to significant germination and growth where some inappropriate techniques can cause protective protein degradation. Hence, there must be an extensive research for selecting a specific priming protocol for different species in relation to germination and growth in various environmental conditions.

Reference

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