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Seed Priming in Horticultural Crops

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Introduction

The foundation of a plant's life is germination and seedling establishment. However, delayed germination and non-uniform seedling establishment are important restrictions in several crops. Seed priming has been demonstrated to be beneficial in promoting quick germination, consistent seedling establishment and proper crop growth in order to solve this problem. Heydecker coined the term seed priming in 1973 and he successfully used it to promote seed germination and emergence under demanding conditions (Sivasubramaniam *et al*., 2011). Seed priming is a pre-sowing treatment that induces a physiological state in the seeds that allows them to germinate more quickly. Seed priming is a technique for promoting seedling germination and uniform emergence in the field. It involves imbibition of seeds under controlled condition, followed by drying of seed to its original moisture content.

Phenomenon of Seed Priming

Priming induces seed germination under these stages viz., as imbibition, germination, and cell division and growth. During these stages, seed undergoes various physiological changes. During imbibition stage, water moves inside the seed which promotes synthesis of protein and activate respiratory activities through mRNA. The second stage is germination, where the controlled uptake of water takes place and physiological activities start such as digestion of stored food, protein synthesis, mitochondria synthesis, activation of enzymes and alteration in soluble sugars (Varier *et al*. 2010). Cell division and expansion are the final stages. It is the stage at which the radical emerges from the seed coat and begins to grow. The second stage is the most crucial and vulnerable to poor environmental conditions. Seeds that have passed the second stage of priming may germinate under a variety of stress situations during priming (Come and Thevenot, 1982). Priming has the advantage of shortening the time between seed sowing and radical emergence.

Methods of Seed Priming

The seed priming techniques are divided into - conventional and advanced methods.

A. Conventional Methods

a. Hydro- Priming

It is a simple and cost-effective water-based priming procedure. Hydro-priming involves soaking the seeds in water before sowing them, which may or may not be followed by air drying. Seed germination and seedling emergence may be improved by hydro-priming.

b. Osmo-Priming

This method entails soaking seeds in an osmotic solution with a low water potential for a length of time before air drying them before sowing. The osmotic solution's low water potential allows the seeds to gradually absorb water. Under non-saline or saline circumstances, this approach improves germination. Osmo-Priming boosts seed germination potential and strengthen the antioxidant system, resulting in

greater stress tolerance in germinating seeds (Chen and Arora, 2011). For Osmo-Priming, several osmotic such as NaCl, KNO_3, KH_2PO_4, $MgSO_4$, $CaCl_2$ and $CaSO_4$ are utilized. "Halo-priming" is the process of priming using a salt solution. In salt-affected soil, it enhances seed germination, seedling emergence, seedling establishment and final crop production.

c. Hormonal Priming

Seeds are treated with plant growth hormones such as GA_3, kinetin, ABA, ethylene, polyamines, salicylic acid, NAA and ascorbate, among others, during hormonal priming. This is essentially a pre-soaking therapy that has a direct influence on seed metabolisms and, as a result, enhances seedling growth and development (Ashraf *et al*., 2001).

d. Solid Matrix Priming

The seed hydration is regulated in the solid matrix priming procedure by mixing the solute with water. This is a method of controlled hydration in which seeds are mixed with a wet solid water carrier. Seeds are then extracted from the matrix, cleaned thoroughly and dried. The matrices used in solid matrix priming should have certain qualities, such as low matrix potential, low water solubility, high water holding capacity, zero toxicity to seeds and adhesiveness to the seed surface. In solid matrix priming, vermiculite, peat moss, charcoal, sand, clay and some exceptional solid carriers are employed.

e. Bio- Priming

Bio-priming involves bacterial inoculation of seeds. Some bacteria used for inoculation also act as bio agents, which can protect the seeds against soil and seed borne diseases.

f. Nutrient Priming

The soaking of seed in a certain concentration of nutrition for a specific period of time before sowing is referred to as nutrient priming. Nutrient priming of crop seeds with different macro and micronutrients have positive impact on germination, seedling development and water uptake efficiency.

B. Advanced Methods

a. Priming Through Nano-particles

Nano-priming utilizes nano-particles of less than 100 nm in size. It was also reported that seed priming with calcium-phosphate, SiO_2, ZnO and Ag nanoparticles enhance seed germination and seedling development.

b. Priming Through Physical Agents

The physical agents such as magnetic field, UV radiation, gamma radiation, X-rays and microwaves are involved in priming. These ionizing radiations directly interact with the cellular component and cause certain changes in the hormonal network of cells. It has been reported by many researchers that these physical agents improve germination rate, seed vigor, seedling biomass and tolerance to various environmental stresses.

Advantages of Seed Priming

- Seed priming improves seed germination and seedling vigour by enhancing metabolic and biochemical processes that occur during controlled hydration and subsequent drying to its original moisture content.
- It shortens the time between seed germination and seed sowing.
- It is also responsible for crop establishment that is faster and more uniform.
- It is found to be effective in eliminating or greatly reducing the seed as well as soil borne pathogens.
- Crop can perform better against weed infestation and under stress conditions.

Conclusion

Seed priming is a type of seed planting preparation in which the seed is hydrated and then dehydrated. Seed priming regulates the

Effect of Seed Priming on Horticultural Crops

Crop	Priming Solution	Observations
Okra	Water, calcium chloride and Potassium nitrate	Enhance the synchronous germination and speed of germination in genotypes IC411698 and IC89936.
Pea	Water and mannitol (4%)	Increased the number and biomass of plants knots.
Brinjal	Osmo-priming solution	Increases the number of leaves, plant height, fruit yield, fruit length and days of 50% flowering also minimize.
Bean seeds	Water for 7-14 hr	Improve the plant performance.
Coriander	NaCl at 4 g L^{-1} for 12 hours.	Best germination percentage.
Turmeric	PGPR (Plant Growth Promoting Rhizobacteria) like Azospirillum, Pseudomonas	Increase the germination percentage, root length, shoot length, dry matter production and vigor index.
Coriander	NaCl and $CaCl_2$ solutions	Increase the uniform germination, plant height, shoot fresh weight and shoot dry weight.
Ginger	Salicylic acid (SA-5 m M).	Induce the defense related enzymes like Peroxidase, Polyphenol Oxidase (PPO), Lipoxygenase (LOX) and Phenyl Alanine ammonia lyase (PAL) activities.

metabolic activities that are required for seed germination and seedling establishment within the seed. Both the methods, conventional as well as advanced either directly or indirectly influences seed germination, faster growth, tolerance against biotic and abiotic stress, break dormancy, increases antioxidant capacities and yield.

References

- Ashraf, M. and Rauf, H. 2001. Inducing salt tolerance in maize (*Zea mays L.*) through seed priming with chloride salts: growth and ion transport at early growth stages. *Acta physiol Plant*, 23:407-414.
- Chen, K. and Arora, R. 2013. Priming memory invokes seed stress - tolerance. *Environmental and Experimental Botany,* 94(10):33-45.
- Come, D. and Thevenot, C. 1982. Environmental control of embryo dormancy and germination. *In: The physiology and biochemistry of seed development, dormancy and germination*. 271–298.
- Sivasubramaniam, K., Geetha, R., Sujatha, K., Raja, K., Sripunitha, A. and Selvarani, R. 2011. Seed priming. Triumphs and tribulations. *Madaras Agric. J.,* 98 (7-9):197-209.
- Varier, A., Vari, A.K. and Dadlani, M. 2010. The subcellular basis of seed priming. *Current Science*, 99:450–456.

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