Concept and Methods of Seed Priming

C. Vanitha[1], M. Kathiravan[2], R. Umarani[3], M. Yuvaraj[4]*, Jaiby Cyric[5] and R. Sathya Priya[6]

[1,3] *Seed Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India*
[2,4] *Agricultural College and Research Institute, Vazhavachanur, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India*
[5] *Department of Botany, Newman College, Thodupuzha-685585, Kerala, India.*
[6] *Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India*

Corresponding Author
M. Yuvaraj
Email: yuvasoil@gmail.com

OPEN ACCESS

Keywords

Seed Priming, Germination, Seedling Growth

How to cite this article:

Vanitha, C., Kathiravan, M., Umarani, R., Yuvaraj, M., Cyric, J. and Priya, R. S. 2023. Concept and Methods of Seed Priming. *Vigyan Varta* 4(5): 86-89.

ABSTRACT

Seed priming is a pre-sowing treatment that involves controlled hydration process in which seeds are dipped in water or any solution for a specific time period to allow the seed to complete its metabolic activities before sowing and then re-dried to original moisture content. Seed priming influences the seedling development by stimulating pre-germination metabolic activities prior to the emergence of radicle and improvementin the germination rate and performance of plant. The most important factors to be considered while priming are seed: solution ratio; duration of soaking, temperature and method of drying. Among the different seed enhancement techniques, hydropriming could be a suitable treatment under salinity stress and drought-prone environments.

INTRODUCTION

Seed is a basic input for secured food supply and also a carrier of new technologies coupled with assured quality and quality seeds only can be expected to respond to fertilizers and other inputs in the expected manner. For any crop, the time from sowing to seedling establishment is crucial, in which the seeds are exposed to wide range of environmental stresses viz., harmful microorganisms, destruction by seed, soil and air borne pathogens; damage by insects, cold, frost, temperature and moisture effects; monsoon failure, severe drought, problem soils, competition from weeds and toxic effects of chemicals present in soil, which pose problems of dormancy, germination and survival. A

judicious and comprehensive package of crop specific seed management technologies starting from dormancy breaking treatments, treatment of seeds with bioactive chemicals assumes importance and is effective in improving the performance of seed under field conditions. Apart from these methods, simple techniques without using any chemicals are also available which are eco-friendly, low-cost and no cost technologies and thus the accomplishment of sustainability in the seed production can be assured besides seed germination and vigour augmenting treatments, seed protection treatments, and finally seed handling and conditioning treatments need to be developed for sustainable good crop growth and productivity.

Physiological basis of seed priming

In orthodox dry seeds which are ready for germination, exhibits a triphasic pattern of water uptake. Phase I is the rapid water uptake phase that is largely a consequence of the matric forces exerted by the seed. During this phase, DNA and mitochondria are repaired and proteins are synthesized using existing messenger ribonucleic acid (mRNA) (McDonald, 2000). Phase II is a lag phase, in which seed water potential is in balance with that of the environment. In this phase the major metabolic changes preparing the embryo for germination occur, including the synthesis of mitochondria and proteins by new mRNA. Thus, phase II is also called activation phase. In phase II the germination process is completed strictosensu; however, only in phase III the radicle emerges and the so called visible germination can be assessed. In phase III, a second rapid uptake of water occurs. Phase I and II represent the most delicate phases for the process of germination and are crucial for successful seed priming.

Seed priming typically involves an extension of phase II, which in turn permits the completion of more repair processes and allows the drying-back, which is necessary for enhancing germination and vigour. Differences in the imbibition phases of a normal germination process compared to priming followed by drying-back and subsequent germination are shown in Fig. 1.

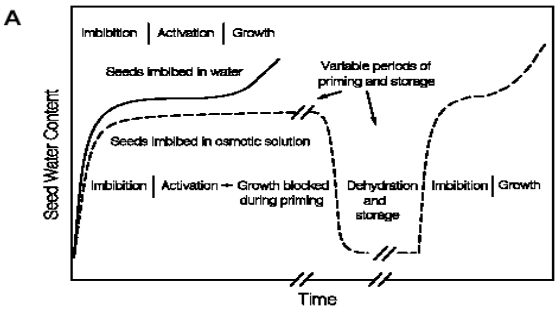

Fig.1. Events associated with seed priming and dehydration

Methods of seed priming

1) **Osmopriming:** Soaking the seeds in osmotic solutions. Polyethylene glycol (PEG) is commonly used as a priming osmoticum. PEG is advantageous because it is chemically inert and does not have adverse effects on the embryo. The large size of the PEG molecules prevents its penetration into seed tissues thus reducing toxic side effects on seeds (Heydecker and Coolbear, 1977).

2) **Hydropriming:** Hydropriming is a controlled hydration process that involves seed soaking in simple

waterand then re-drying to their initial moisture content. Hydropriming as a risk free, simple and cheap technique has become popular among farmers, with promising effects in the context of extensive farming system (Janmohammadi et al., 2008). Hydroprimed seeds produced healthy seedlings, which resulted in uniform crop stand, drought resistance, early maturity and somewhat improved yield.

3) **Halopriming:** Most commonly used salts for halopriming are potassium chloride (KCl), potassium nitrate (KNO3), sodium chloride (NaCl), magnesium sulphate (MgSO4), potassium phosphate (K3PO4), calcium chloride (CaCl2) and potassium dihydrogenphosphate (KH2PO4). All these salts provide nutrient like nitrogen to the germinating seed, which is required for the protein synthesis during the germination process.

4) **Hormonal priming:** Hormones are used for seed priming. Plant-growth hormones or their derivatives contained by several products are indole-3-butyric acid (IBA), an auxin and kinetin type of cytokine in. Cytokines play a vital role in all phases of plant development starting from seed germination up to senescence (Riefler et al., 2006). Gibberellic acid (GA3) is known to break seed dormancy, enhance germination, hypocotyl growth, inter nodal length, and cell division in the cambial zone and increase the size of leaves.

5) **Solid matrix priming:** This consists of mixing seeds with an organic or inorganic carrier and water. The moisture content of the matrix is brought to a level just below what is required for radical protrusion. Seed water potential is regulated by the matrix potential of the seed and during priming, the water is largely held by the carrier.

6) **Biopriming:** Plant-growth-promoting rhizobacteria (PGPR) can influence plant growth either directly or indirectly through fixation of atmospheric nitrogen, solubilization of phosphorus and zinc and producing siderophores, which can solubilize/sequester iron, synthesize phytohormones, including auxins, cytokinins and gibberellins to stimulate plant growth, and synthesize ACC deaminase enzyme by modulation of ethylene level under stress conditions (Nadeem et al., 2015).

CONCLUSION

Seed priming is a viable option to boost the performance of crops under fragile ecosystems. An enhanced understanding of the metabolic events taking place throughout the priming intervention and the subsequent germination should facilitate to use this simple and inexpensive technology for maximizing seed performance in a more resourceful way under varied fragile ecologies.

REFERENCES

Heydecker, W. and Coolbear, P. 1977. Seed treatment for improved performance - survey and

attempted prognosis. Seed Sci. & Technol.,5 : 353-425.

Janmohammadi, M., Moradi Dezfuli, P., Sharifzadeh, F. 2008. Seed invigoration techniques to improve germination and early growth of inbred line of maize under salinity and drought stress. Gen. Appl. Plant Physiol. 34(3-4): 215-226.

Nadeem, S.M., Naveed, M., Ahmad, M. Zahir, Z.A. 2015. Rhizosphere bacteria for biomass production and improvement of stress tolerance: mechanisms of action, applications and future prospects. In: Arora, N.K. (Ed.). Plant Microbe Symbiosis - Applied Facets. Springer, The Netherlands. pp. 1-36.

Riefler, M., Novak, O., Strnad, M., Schmülling, T. 2006. Arabidopsis cytokinin receptor mutants reveal functions in shoot growth, leaf senescence, seed size, germination, rootdevelopment, and cytokinin metabolism. Plant Cell. 18: 40-54.