Agronomic Spotlight

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Vegetable Seed Priming

- Priming vegetable seeds can help increase vegetable seed germination rates, percentages, and uniformity.
- Priming initiates the processes of germination but stops them before radicle emergence.
- Several different methods are used to prime vegetable seeds.

Seed germination takes place in several steps, the first being the imbibition (absorption) of water into the seed, followed by the activation of metabolic systems that enables the final phase of cell elongation and the emergence of the radical (young root) from the seed. Seed priming is used to initiate the early phases of germination, including activating metabolic and physiological processes.[1] However, the process is halted before the final stage of radicle emergence. Priming is used to increase the uniformity and rate of germination, especially under suboptimal or stressful conditions (seed vigor).[1,2]

The advantages of seed priming can include producing seeds that germinate more quickly (rate of germination), more synchronous germination leading to greater stand uniformity, and more vigorous, faster-growing seedings. One description of seed priming is that it allows slower seeds to catch up with faster-germinating seeds, resulting in more rapid and uniform germination of the seed lot.[3] In some cases, seed priming reduces photo- and thermos-dormancy-based inhibition of germination and may increase the range of temperatures in which germination can occur.[2] Other benefits of seed priming can include improved drought and salt tolerance, reduced frequency of abnormal seedlings, and increased yield potential and harvesting efficiency.[4] Vegetable seeds that are often primed include carrot, leek, onion, celery, lettuce, endive, pepper, tomato, and seedless watermelon.[2]

Priming Methods

Several methods are used to prime seeds; many involve soaking seeds in water or water-based solutions. Crop species respond differently to the various methods and variations of seed priming. Therefore, it is important to select the appropriate method and procedure for the particular type of seed. Water-based seed priming involves the controlled rehydration of seeds to the point where the metabolic processes of early germination are triggered but stopped before the phase of radicle elongation.[2]

Hydropriming: This method involves soaking seeds in normal water and drying them near their original moisture content. This is usually done at temperatures between 40° and 68°F (5° and 20°C), with or without aeration. This results in the non-controlled uptake of water resulting in non-homogenous seed hydration and uneven germination. However, the method is relatively simple and inexpensive.[2,4]

Drum priming: A variation of hydropriming where water vapor is injected into a rotating drum containing seeds. Measured amounts of water can be added, resulting in more even seed hydration.

Osmopriming: Seeds are soaked in solutions with low osmotic water potential resulting in the controlled imbibition of water by the seeds. The slower uptake of water may result in less injury to seeds and more even hydration and germination. Solutions of polyethylene glycol (PEG, 6000 to 8000 Daltons), glycerol or mannitol are often used. PEG can be expensive, and the high viscosity of the solutions limits the oxygenation of the seed, which aeration can help overcome. PEG is non-toxic and does not enter the seed, so it does not affect cellular processes.[1,2]

Halopriming: Halopriming is a variation of osmopriming using inorganic salt solutions such as KH_2PO_4, KNO_3, $CaCl_2$, $MgSO_4$, NaCl, and KCl. Halopriming can improve germination rates and percentages and increase the salinity tolerance of seeds and seedlings. The osmotic agent (salt) should be chosen based on the permeability of the membrane between the seed coat and pericarp, which varies by crop species, as the salt ions can penetrate the membrane and disrupt the internal osmotic equilibrium of the seed.[1,2,4]

Solid matrix priming: The hydration of the seed is controlled by matrix water potential (think of a sponge holding onto water) rather than osmotic water potential (think of salt pulling water out of a substance). Water is added to non-toxic, inert materials (sawdust, vermiculite, charcoal), and the seeds are mixed into the wetted material. The method is often less expensive than seed priming with PEG, and aeration of seeds is not a problem. The process simulates seed in a soil environment.[2]

Biological priming: The priming solutions contain beneficial microorganisms such as biocontrol agents or plant growth-promoting bacteria. These treatments can help protect seed and seedlings from pathogens and improve seedling vigor.[1,2]

(Continued on page 2)

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Nutripriming: Priming solutions include nutrients, such as nitrogen, calcium, manganese, zinc, and boron, which can help enhance seedling growth and prevent nutrient deficiencies.

Thermopriming: This method uses heat treatment to help seeds tolerate adverse conditions, such as soil temperatures outside the optimal germination range.[2] Thermopriming can also help seeds overcome thermo-inhibition issues.

Factors and Disadvantages

The primary disadvantage observed with primed seeds is that the rapid redrying procedure can reduce longevity, so the storage life of primed seeds can be shorter than that of non-primed seeds. Therefore, growers should use primed seeds in the first growing season and not carry them over. Priming may also result in a loss of tolerance to seed desiccation, and there can be inconsistencies in the germination performance. Growers may need to change certain practices in response to the faster emergence of primed seed. For example, pre-emergence herbicides may have to be applied earlier on plantings of primed seed compared to non-primed seed.

Factors that may impact the response to seed priming include the composition and concentration of the priming solution, the osmotic or matric potential, the duration of priming and the temperature, and the extent of aeration.[5,6]

Tomato and Pepper

In a 2011 study the effects of hydro-, matric-, halo-, and osmo-priming on the percent and rate of germination of tomato and pepper seeds were rated. The study found that all priming methods enhanced germination compared to non-primed control treatment. The optimal duration of priming varied with the priming method (36 hours for halopriming, 48 hours for hydropriming, 3 days for osmo- and matric-priming).[5] Other studies found that priming increased the rate of germination but had no effect on the final germination percentage of tomato seeds (Figure 1).[7,8] However, some varieties may produce more blind seedlings (loss of growing point) when some priming methods are used.[9]

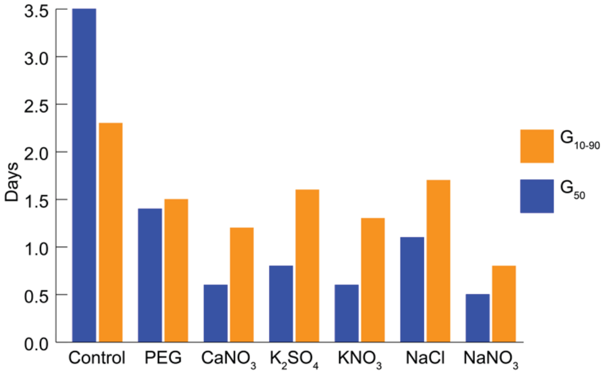

Figure 1. Effect of different priming solitions on on germination rate. and germination percentage of tomato, eggplant, and chilli.[7] G50 indicates the number of days for 50% of the seed to germinate. G10-90 indicates the number of days between 10% and 90% germination.[7]

Melons

In one study, osmopriming (PEG 6000) and halopriming (KNO_3+K_3PO_4, $CaCl_2$, and NaCl) increased the percentage of germinated honeydew melon seeds over that of non-primed seeds. The rate of germination was also faster with the $CaCl_2$ but slower with the PEG and NaCl treatments as compared to the control (Table 1).[10] However, priming did not result in adequate germination at below optimal temperatures. A study with muskmelon found that halopriming resulted in faster germination than osmopriming with PEG or mannitol, but in this case, the percent of germination was lower with halopriming. In this study, priming resulted in some improvement in germination at sub-optimal temperatures.[6]

Table 1. Effects of seed priming treatments on melon seed germination.[9]

Treatment	% Germination	Mean Germination Time (days)
Control (non-primed)	84	4.7
PEG*	98	5.3
KNO_3+K_3PO_4	96	4.5
$CaCl_2$	100	3.7
NaCl	98	6.5

* Three-day duration for all seed priming treatments. The germination was temperature 77°F.

Sources:

[1] Marthandan, V., Geetha, R., Kumutha, K., Renganathan, V. G., Karthikeyan, A., & Ramalingam, J. 2020. Seed Priming: A Feasible Strategy to Enhance Drought Tolerance in Crop Plants. International journal of molecular sciences, 21:8258.
[2] Paparella S., Araújo S., Rossi G., Wijayasinghe M., Carbonera, D., Balestrazzi A., Seed priming: state of the art and new perspectives, Plant Cell Rep., 2015, 34, 1281–1293.
[3] Venkatasubramanian A., Umarani R., Evaluation of seed priming methods to improve seed performance of tomato (Lycopersicon esculentum), egg plant (Solanum melongena) and chilli (Capsicum annum), Seed Sci. Technol., 2007, 35, 487–493.
[4] Yadav, N. and Chandanshive, A. 2017. Seed priming, enhancement, coating and pelleting of vegetable seeds. Biotech Articles. https://www.biotecharticles.com/Applications-Article/Seed-Priming-Enhancement-Coating-and-Pelleting-of-Vegetable-Seeds-3981.html.
[5] Warmund, M. 2011. Enhancing germination with primed seed? Integrated Pest Management, University of Missouri.
[6] Nascimento W. 2003. Muskmelon seed germination and seedling development in response to seed priming, Sci. Agric. 60:71–75.
[7] Frett, J., Pill, W., and Morneau, D. 1991. A comparison of priming agents for tomato and asparagus seeds. HortScience 26:1158-1159.
[8] Argerich, C., and Bradford, K. 1989. The effects of priming and ageing on seed vigour in tomato. Journal of Experimental Botany, 40, 599-607.
[9] Nascimento, W. and Silva, P. 2016. Incidence of blind transplants of processing tomato from primed seeds. In XIV International Symposium on Processing Tomato 1159:87-90.
[10] Castanares, L. and Bouzo, C. 2018. Effect of different priming treatments and priming durations on melon germination behavior under suboptimal conditions. Open Agric. 3:386–392.

Websites verified 05/06/2022

For additional agronomic information, please contact your local seed representative.

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