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Different Seed Priming Techniques in Vegetables Crops : A Review

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ABSTRACT

Vegetables comprise major parts of the agriculture and provide vitamins and minerals which are essential for human health. The per capita requirement of vegetables is 310 gram. To fullfill this minimum requirement there is need to increase the production of the vegetables crop. The major constraints in vegetables production is non-availability of the quality seeds so that production is very low. In recent years due to advancement in modern technology, high yielding varieties the production is increased. Seed priming is one of the techniques used to treat the seed before sowing in the field so that quality of the seed is increased. Seed priming is a process of regulating the germination process by managing the temperature and seed moisture content, the seed is taken through the first biochemical processes within the initial stages of germination. Seed priming enhances the emergence, enables the seed to germinate under adverse environment conditions, improve the vigour and yield potential of the crops. There are different priming techniques are used i.e., hydropriming, osmopriming, hormonal priming, magneto priming. In this review article we study the effect of different priming techniques on the vegetables crops.

Keywords Vegetable, Seed priming, Germination, Vigour, Yield.

INTRODUCTION

In terms of food and nutritional security, vegetables play a significant role in Indian agriculture. Due to the introduction of high yielding varieties and innovative technologies, Indian agriculture has seen great growth in vegetable output in recent years. Vegetables are rich in minerals, vitamins, and Other compounds that have medicinal and therapeutic properties. Vegetables must be consumed on a regular basis to ensure the household's nutritional security. The yield and productivity of various vegetable crops have improved dramatically in the last two decades as a result of agricultural institutes and private sector's research and development efforts (Behera 2016).

Modern high-tech agriculture, with its modern technologies, requires that each seed material germinate quickly and generate a vigorous seedling to provide a high commercial output. For current mechanized crop production, uniform growth and

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synchronous development are particularly desirable characteristics. As a result, genetically pure and morphologically sound, pathologically disease-free and physiologically healthy seed is capable of improving productivity and ensuring food supply for the future (Maiti and Pramanik 2013).

Seed priming is one of the most important advancements in helping seeds germinate and emerge quickly and uniformly, as well as increasing seed tolerance to harsh climatic conditions (Heydecker *et al.* 1973, Harris *et al.* 1999). Seed priming is a pre-sowing approach for enhancing germination, shortening the period from sowing to emergence, improving emergence uniformity and eventually boosting stand establishment (Brocklehurst and Dearman 1983) and finally to improve stand establishment (Gupta *et al.* 2008). Its a straightforward, low-cost, low-risk strategy for increasing seedling emergence, seedling vigour and yields in a variety of field crops (Maiti and Pramanik 2013). It improves the radical's ability to protrude quickly because the earliest stages of germination are already completed even when the environment is stressful (Ibrahim 2016). Seed priming aids plants in overcoming the negative effects of unfavorable environmental conditions (Ashraf and Foolad 2005, Chen *et al.* 2010). Various seed priming techniques have been developed in different medias : Hydropriming (water), osmopriming (low water potential solutions such as polyethylene glycol – PEG), halo-priming (salt solutions) (Hamidi *et al.* 2013, Chen et al. 2010). The details of the different priming techniques are given below :

Seed priming and its types

Hydropriming

Seeds are steeped in tap water with or without aeration for hydropriming. The seeds are subsequently dried, either with forced air or in the shade, to a weight that is close to their original weight (Afzal *et al.* 2002, Farooq *et al.* 2006a). Hydropriming is a straightforward, cost-effective, and environmentally friendly method. The main drawback of hydropriming is that seed hydration might be uneven, resulting in uneven germination or crop stand (Di Girolamo and Barbanti 2012).

Osmopriming

To manage water imbibition, osmopriming or osmoconditioning involves soaking seeds in aerated, low-osmotic potential solutions (Bray 1995, Lutts *et al.* 2016). Because seeds do not require piercing, polyethylene glycol (PEG) is the most widely utilized substance to diminish water potential because it is non-toxic and has a high molecular size (Thomas *et al.* 2000). KNO_3, KH_2PO_4, $MgSO_4$, $CaCl_2$, KCl, NaCl, K_3PO_4 and mannitol can also be used to produce the same results. When it comes to enhancing cereal germination, osmopriming is the favored method (Moradi and Younesi 2009, Farooq *et al.* 2006b).

Hormonal priming

Seeds are soaked in aerated solutions of several plant growth regulators such as ascorbate, kinetin, and abscisic acid for hormonal priming. Hormonal priming has increased field crop performance on salt-affected soils (Afzal *et al.* 2006, Jafar *et al.* 2012, Iqbal and Ashraf 2013) as well as under low- and high-temperature stress (Bakhtavar *et al.* 2015).

Seed biopriming

Seed biopriming combines seed hydration and a biological treatment by inoculating the medium with a living bacterial inoculum (Moeinzadeh *et al*. 2010, Reddy 2012, Mahmood *et al.* 2016). To promote seed germination and vigour, uniform crop stand, plant development and yield qualities, including biotic and abiotic stress tolerance, plant growth promoting rhizobacteria, fungicides and biocontrol agents can be added to priming media. *Azotobacter, Pseudomonas, Azospirillum, Bacillus* and *Agrobacterium* are often employed plant growth-promoting rhizobacteria to boost growth and yield, manage seed or soil diseases, and enhance abiotic stress tolerance, while Trichoderma and Pseudomonas improve biotic stress resistance (Reddy 2012, Mahmood *et al.* 2016).

Magneto-priming

The magnetic field (MF), which was originally ob-

Table 1. Effect of priming treatments on root length (cm) of tomato varieties. Source: Soubhagya Behera (2016).

Priming treatment	Utkal prag-yan	Utkal kumari	Utkal raja	Utkal deepti
GA_3 (1 ppm)	4.55	5.95	6.51	4.75
KNO_3(5%)	3.68	4.58	6.25	4.71
Na_2HPO_4 (2%)	4.39	6.28	6.02	5.57
PEG (10%)	3.39	6.42	7.04	6.04
$ZnSO_4$(1%)	2.06	5.06	6.70	5.28
Ascorbic Acid (50 ppm)	2.88	6.08	6.29	5.20
Deionised H_2O	5.71	5.67	6.59	4.12
Dry seed (Control)	2.54	4.50	4.60	3.77

Table 2. Effect of priming treatments on shoot length (cm) of tomato varieties. Source : Soubhagya Behera (2016).

Priming treatment	Utkal prag-yan	Utkal kumari	Utkal raja	Utkal deepti
GA_3 (1 ppm)	7.59	8.13	7.28	7.48
KNO_3(5%)	7.19	8.82	8.08	8.44
Na_2HPO_4 (2%)	5.60	7.63	8.93	8.35
PEG (10%)	7.21	7.82	7.17	7.25
$ZnSO_{4(}$1%)	5.62	8.68	8.70	7.41
Ascorbic Acid (50 ppm)	5.46	7.42	6.78	7.86
Deionised H_2O	8.05	6.60	7.55	7.70
Dry seed (Control)	6.42	7.32	5.65	4.84

served in plants by Krylov and Tarakanova (1960), has gotten a lot of attention. Seeds that have been magneto-primed have higher germination rates, root development, vigour and seedling biomass than seeds that have not been magneto-primed (Araújo *et al.* 2016). Because of improved amylase and protease activity, plants from magneto-primed seeds are more resistant to abiotic (Anand *et al*. 2012) and biotic (De Souza *et al*. 2006) challenges (Kataria *et al.* 2017). Soybean seedlings that have been magneto-primed produced fewer superoxide radicals (Baby *et al.* 2011). The MF impacts the metabolic pathway by altering the shape and ionic permeability of the cell membrane and stimulating ion transport through ion channels (Labes 1993). This results in enhanced germination and seedling emergence.

Seed priming›s advantages

One of the most important advantages of priming is that it increases the temperature range in which a seed can germinate (Gupta *et al*. 2008).

Phytochrome-induced dormancy must be overcome or alleviated

To reduce the amount of time it takes for seeds to germinate and then emerge

To increase the homogeneity of the stands in order to make production management easier

Effect of different priming techniques on vegetable crops

In this article we study the effect of different priming techniques and there effect on the production of the vegetables crops.

In several vegetable crops, the hydro-priming strategy boosted germination rate and seedling vigour (Harris *et al.* 1999). Maiti *et al.* (2013) used a lab experiment to investigate the influence of seed priming techniques on tomato (*Lycopersicon esculentum* L.) and chilli (*Capsicum annuum* L.) seedlings (4 tomato and 3 chilli varieties). The results showed that priming strategies improved tomato and chilli seedling vigour, growth, and yield. In tomato and chilli, halo-priming increased emergence speed, seedling vigour index, root length, and shoot length when compared to hydropriming. Maiti and Pramanik (2013) investigated the effects of several priming approaches on seedling vigour and agronomic variables such as tomato, chilli, cucumber and cabbage production. Few priming techniques enhanced seedling emergence percentage, seedling vigour and agronomic parameters such as yield of the crop species, though the response of cultivars to different treatments differed.

Behera (2016) treated the four tomato, four brinjal and two chilli varieties with GA_3 (1 ppm), KNO_3 (5%), Na_2HPO_4 (2%), PEG (10%), $ZnSO_4$ (1%), ascorbic acid (50 ppm) and deionised H_2O for 24 hours and then dried to original moisture content under shade. Dried seeds were taken as control. The result showed that there were significantly increased in the root length, shoot length, seedling length, seedling dry weight and seedling vigour index among all the varieties of tomato, brinjal and chilli when treated with priming agents as compared to control. When tomato varieties were treated with different priming treatment the root length was increased by 41.3%, 24.9%, 44.7%, 48.6%, 24.2%, 32.7% and 43.4% when seeds were primed with GA_3, KNO_3, Na_2HPO_4, PEG, $ZnSO_4$, Ascorbic Acid and deionised water respectively as compared to unprimed seeds (Table 1).

The effects of GA_3, KNO_3 and PEG on the germination of two and five year old eggplant seeds were investigated by Demir *et al.* (1994). They discovered that GA_3 and KNO_3 in particular, in contrast to the control, had a considerable impact on germination % and rate. Farooq *et al.* (2005) investigated the effect of priming on fresh seeds of four tomato cultivars and found that KNO_3 (3%) had the greatest impact on seed germination across all cultivars.

Table 2 showed that the different priming techniques were significantly increased the shoot length of all cultivars of tomato varieties as compared to unprimed seeds.

Priming in water or KNO_3 increased brinjal germination, according to Reis *et al.* (2013). Seed priming methods, as well as seed biopriming procedures, improve seed germination, emergence, and seedling vigour in tomatoes, both in greenhouse and field environments, under normal and/or stress circumstances (Delian *et al.* 2017). Patel and Rai (2018) tested four replications of two tomato varieties (Navodya and S-22) with Distilled Water @100 ml, Sodium Chloride, and Potassium Nitrate @ 1% solution (Halo-priming) at different time intervals, i.e., at 12 hs, 24 hs and 36 hs. S-22 was determined to be the best in terms of seed quality and vigour, whereas Navodya was found to be the best in terms of germination percentage.

Saini *et al.* (2017) examined the effects of various priming treatments on bitter guard seeds, including hydro-priming, halo-priming and osmo-priming. T_0 - Unprimed Control, T1-2 - Distilled water hydration (for 6 and 12 hs), T3-4 NaCl (for 6 and 12 hs), and T5-6 PEG were the durations and concentrations tested on bitter guard seeds (for 6 and 12 hrs). When compared to other treatments and unprimed, the Osmo-priming 12 hr of Bitter Guard exhibited a substantial increase in seed germination, seedling length, fresh weight, dry weight, speed of germination and vigour.

Islam *et al.* (2006) explore the effects of GA_3 and GABA on brinjal, tomato, and chilli seed germination and seedling growth. GA_3 concentrations were 25 mlL^{-1}, 50 mlL^{-1} and 100 mlL^{-1}, respectively, whereas GABA concentrations were 0.16 mlL^{-1}, 0.33 mlL^{-1}, 0.66 mlL^{-1} and water, respectively. Seeds were treated by soaking for 12 hs prior to sowing on saturated tissue paper in petri-dishes. At 100 mlL^{-1} of GA_3, seed germination was significantly increased in brinal, tomato, and chilli plants. At 25 mlL^{-1}, 100 mlL^{-1} and 0.33 mlL^{-1} of GA_3, seedling growth (shoot length and root length) increased.

Moaaz Ali *et al.* (2020) experimented with potassium nitrate (KNO_3) as a seed priming agent to improve the quality of tomato seeds. Before testing, seeds were soaked in 0.25, 0.50, 0.75, 1.0 and 1.25 KNO_3 (weight/volume) for 24 hs and then dried. When compared to other concentrations and the nonprimed control, tomato seeds primed with 0.75% KNO_3 performed better.

Two hot pepper cultivars were treated to natural ageing (at room temperature for 12 months), controlled ageing (in the refrigerator for 12 months), and accelerated ageing (at room temperature for 12 months) (3, 6, 9 and 12 days). For 12 and 24 hs, stored seeds were primed in Ascorbic acid (2% and 2.5%), PEG (25% and 30%), GA_3 (30ppm and 50 ppm), and KNO_3 (1% and 2%) solutions. All priming treatments significantly increased germination percentage, seedling growth, moisture content, and electrolytic leakage (Hagroo and Johal 2019).

Araby and Hegazi (2004) investigated the osmo-priming impact of PEG on tomato seedlings and found that a 7 day priming period and direct sowing yielded the best results. PEG had a favorable impact on root length in all cultivars, according to Farooq *et al.* (2005).

Pooja (2013) conducted an experiment on primed seeds of two varieties of brinjal and observed that seed artificially aged for 3 days recorded higher germination percentage, field emergence, speed of germination and seedling vigor indices and least was recorded in 13 days artificially aged seeds in both the varieties. The seed primed with sand matrix (80%WI-IC) resulted in best performance for all the physiological and biochemical parameters followed by hydropriming.

Sharma *et al.* (2013) used four distinct priming methods, including hydropriming, osmopriming, halo-priming and solid matrix priming, as well as a control condition. Seed germination, seedling vigour, mean germination time, and marketable fruit production were all considerably improved using the hydro-priming technique for 12 hs and solid matrix priming with calcium aluminium silicate for 24 hs. In okra, seed priming improves seed germination, seedling vigour, and fruit yield.

CONCLUSION

It can be concluded from this review article that seed priming in very helpful techniques to increase the production of vegetables crops. Seed priming increase the germination percentage, seed vigour, uniformity for harvest and yield of the crops. The response of different cultivars is different for different priming techniques. The varieties responded differently according to the concentrations of the priming agents.

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