Seed Priming Improves Seedling Vigor and Yield of few Vegetable Crops

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Abstract

Seed priming is a useful technique for enhancing seed vigor, and thereby, improving overall germination and seedling development in crop species. In tomato variety Gem, germination percentage, early flowering, plant height and leaf length were increased in response to hydro-priming-2 treatment. In okra and onion, seedling vigor was increased in osmo-priming. In case of watermelon, halo-priming and osmo-priming increased seedling vigor. In case of chilli, halo-priming increased seedling vigor. With respect to sponge gourd, osmo-priming increased seedling vigor. In case of ridge gourd, halo-priming increased seedling vigor. In general it is observed that the yield is increased in case tomato, chilli, and okra apart from seedling vigor. Most of the cop's primed seeds have longevity up to 3 months from the dated of priming. The results suggest that primed seeds can be store up to 3 months only after which germination percentage decreases sharply. As the longevity of primed seeds is short, the priming technique may be used in increasing seed production of foundation seeds and breeders seeds. In addition, seed priming could improve seedling vigor in seedling nursery.

1. Introduction

Poor seedling emergence and seedling vigor cause poor establishment in crops. For which different seed treatment practices have been adopted in different crops. Post-harvest seed enhancement treatments improve germination and seedling vigor. Priming of seeds of different crops alleviates the adverse effects of salinity stress and enhance crop yield (Ahmed, 1998; Harris et al., 1999; Hedegree et al., 2000; Pill and Khan, 2000). Seed pre-soaking causes hydration of membrane proteins and initiation of several metabolic processes and re-drying of seeds arrest the process (Bewelley, 1982). On the other hand osmo-priming of seeds with NaCl nullify the adverse effects of salt stress (Watkinson and Pill, 1998). Interesting, under salt stress, the seedling of tomato emerges earlier in NaCl-primed seeds than the non-primed seeds (Cayuella, 1996). Similarly, hydro-priming improved germination and later growth of different crops species such as maize, rice, and chickpea (Harris, 1999). This technique has been employed to increase germination rate and seedling vigor in several vegetable crops. Conversely, there is a general consensus that priming decreases longevity.

Priming of seeds is a well established technology to improve seed emergence and seedling vigor. Gupta et al. (2008) made a review on seed priming. Molecular markers have been identified for priming of seeds in chilli (Lanteri et al., 2000). It is reported that aerated hydration treatment of pepper at 25°C followed by drying increased germination percentage (Demir and Okcu, 2004). Different seed enhancement and priming techniques have been documented by Maiti et al. (2006). Maiti et al. (2009) studied the effect of priming on seedling vigor and productivity of tomato, chilli, cucumber and cabbage during post-rainy seasons, demonstrating that priming improved germination and seedling development and yield of these vegetable species. They used hydro-priming, halo-priming, and osmo-priming treatments. It is observed that few priming technique improved seedling emergence, seedling vigor as well as agronomic traits including yield of the crop species. These findings clearly demonstrated that in all the crops studied, the priming technique improved growth and yield of all the crops showing variations among treatments. The present work is concentrated to study the effect of priming of few vegetable crops during rainy-season of 2010 at Hyderabad, Andhra Pradesh, India.

2. Material and Methods

Effect of priming on seedling vigor and yield in vegetable crops

during the rainy season, 2010. In an earlier study carried out during rabi season, different priming techniques were adopted. It was reported that primed seeds of tomato, chilli, okra, watermelon, cabbage and cucumber showed higher seedling vigor and yield compared to control. To confirm this, experiments were conducted during last rainy season in few vegetable crops, though due to heavy rain the response was lower as mentioned below.

The technology is described in the following. There are several seed priming methods such as hydro-priming, osmotic priming and halo-priming. Seeds are soaked in three different methods viz. water for hydro-priming, KNO_3 (3%) for halo-priming and polyethylene glycol (PEG) -1.0 MPa for osmotic priming. Therafter, the treated seeds are allowed to shade dry for 4-5 days. In this study, different priming techniques were applied on hybrids of eight vegetable crops such as tomato, okra, chilli, Bottle gourd, ridge gourd, spong gourd, onion and cucumber. The time required for treatment is standardized in previous experiments. For example, in the case of hydro-priming it was noted first the time required for each species to initiate germination. On the basis of that, two times were selected; suboptimum near to the initiation of germination for example 20 hours and another half of this viz. 10 hours in the case of tomato. The selection of time varies according to the species and cultivars. Two replications for each treatment of each species were employed.

It was conducted one experiment in all the species mentioned above. Seeds were soaked in 3 different ways: water for hydro-priming, 3 % KNO_3 solution for halo-priming and polyethylene glycol (-1.0 MPa) solution. The priming technique and treatments remaining same as in the case of laboratory experiments. The experiment was conducted in big size pots (pot culture) in polyhouse areas. Seeds were treated and shade dried for 4-5 days. After the shade dry, 10 seeds were sown in each pot. Emergence (%), plant height, days to flowering, number of fruits and total yield were taken for statistical analysis. Seeds of four tomato hybrids were used for priming. The experiment was conducted in big size plastic pots, and five treatments were applied for each hybrid. Each treatment having 2 replications. Seeds were soaked in four different ways: control (no treated seeds at all; treatment 1), water for hydro-priming for 20 h (treatment 2), 3% KNO_3 solution during 10 h (treatment 3) or 20 h (treatment 4) for halo-priming and polyethylene glycol (-1.0 MPa) solution during 7 days (treatment 5).

Statistical analyses

Data were statistically analyzed using one-way analysis of variance with a factorial arrangement being hybrids and priming treatments the factors. Where the F-test was significant (p<0.05), differences were validated using the Tukey´s honestly significant difference. Assumptions of normality of data were tested using the Kolmogorov-Smirnov test (Steel and Torrie, 1980). All applied statistical methods were computed according to the SPSS® (Statistical Package for the Social Sciences) software package (standard released version 13.0 for Windows, SPSS Inc., Chicago, IL).

3. Results and Discussions

Calculated mean squares (MS) and F values from the statistical analysis corresponding to data of four tomato hybrids subjected to hydropriming, halopriming and osmopriming are shown in Table 1. Mean, adjusted coefficient of determination (r^2), and coefficient of variation (CV, %) values are also provided. It was observed that highly significant differences were observed in the interaction hbrids*priming treatments interactions for studied variables such as emergence (%), days to flowering, and plant height and yield. In all cases, high r^2 and low CV values are indicating the reliability of the technique.

The responses of few tomato hybrids to this treatment are shown below.

It is observed that in case of total yield, jewel showed high increase in halopriming followed by osmopriming.

Table 1: Mean squares (MS), F and P values of the analysis of variance of different variables measured in four tomato hybrids treated with different priming techniques

Source of Variation	Variable											
	Emergence (%)			Days to flowering			Plant height			Fruit weight		
	MS	F	P	MS	F	P	MS	F	P	MS	F	P
Hybrid (H)	409.167	4.68	0.012	81.092	3243.67	<0.001	15.318	4.01	0.025	3302.254	1.167	0.347
Treatment (T)	981.250	11.21	<0.001	12.225	489.00	<0.001	3.364	0.88	0.496	3390.081	1.198	0.342
H*T	302.917	3.46	0.007	6.425	257.00	<0.001	12.749	3.34	0.013	9434.728	3.333	0.009
Error	87.500			0.025			3.821			2830.318		
Mean	76.25			45.5			9.78			183.3		
r^2	0.676			0.997			0.503			0.429		
CV (%)	12.26			0.34			18.66			1.00		

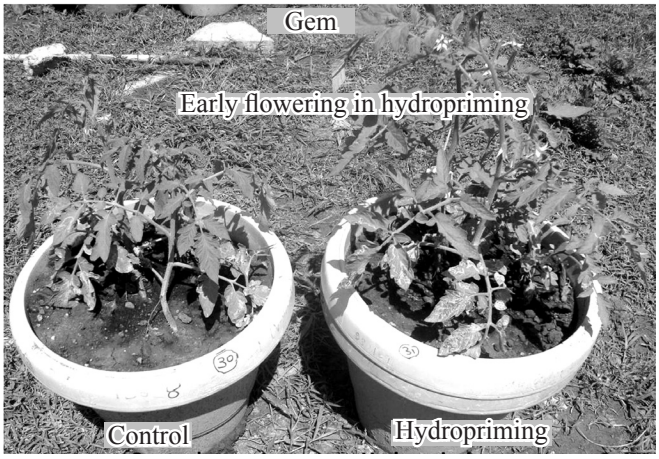


Table 2: Percentage of increased yield in 3 tomato hybrids over control (per four plants)		
Hybrid	Treatment	Increased yield (%)/ four plants
Gem	Hydropriming	24.4
Euro	Halopriming-2	13.5
Jewel	Halopriming-1	80.3
Jewel	Osmopriming	69.6

2. Okra

It is observed that 2 varieties treated with osmopriming showed high increase in plant height followed by hydropriming-2. It is observed that variety sleek showing 30% increased yield

Table 3: Different priming treatments of okra	
Priming technique - Okra	
Hybrids: 2, Replication: 2	
Trts: 4	1. Control
	2. Hydropriming-2 = Soaking of Seeds in Water For 20 Hours
	3. Halopriming-1 = Soaking of Seeds in 3 % KNO_3 Solution for 10 Hours
	4. Osmopriming = Soaking of Seeds in poly ethylene glycol (-1 MPa) Solution for 7 Days

Table 4: Mean values of Plant height of 2 okra varieties exposed to different are given in below table				
	Plant Height (cm)			
Cultivar	Control	Hydroprim-ing-2	Haloprim-ing-1	Os-mopriming
Slender	67.5	82	72.5	85
Sleek	81	80	75	102.5

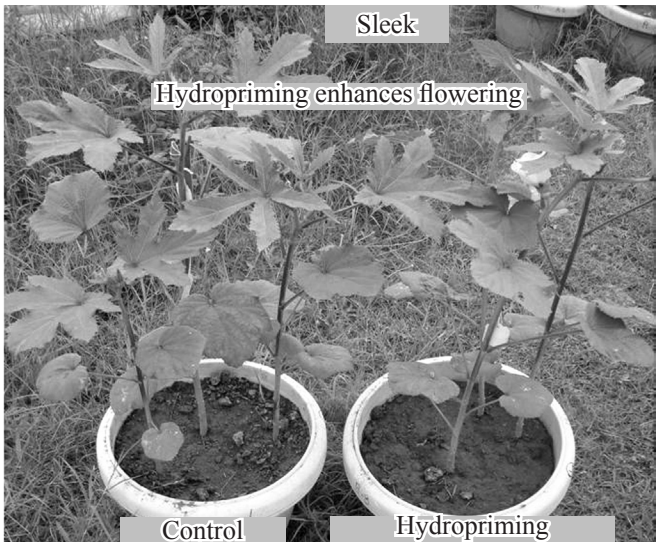


Table 6: Mean values of percentage of increased yield over control per four plants are given below table		
Hybrid	Treatment	Increased yield (%)
Slender	Hydropriming-2	12.8
Sleek	Osmopriming	30.8

over control treated with osmopriming. Variety slender showed 12.8% increased yield over control hydropriming-2.

3. Onion

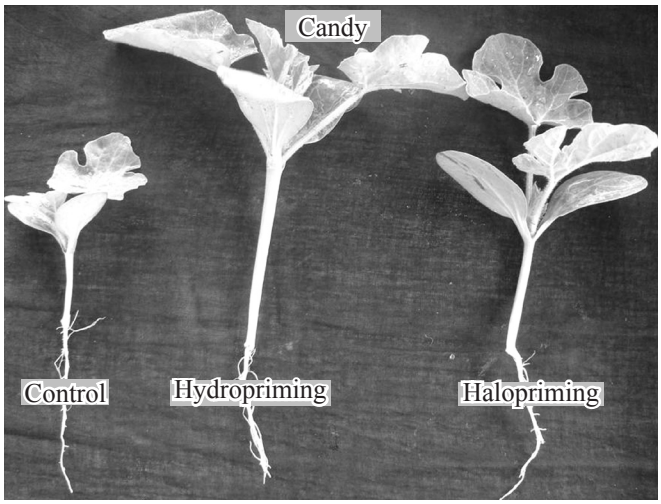
Table 5: Different priming treatments of okra
Priming technique - Okra
Hybrids: 1, Replication: 2; Rest of the details is same as for Okra

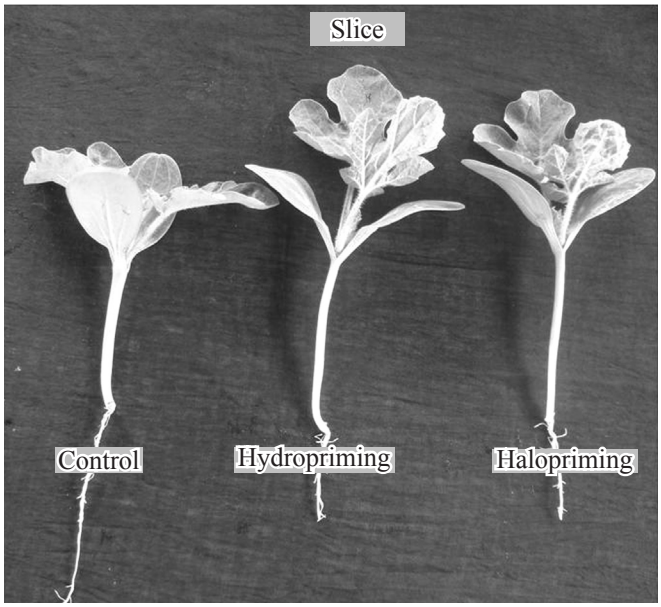
Plant height was increased in osmopriming.

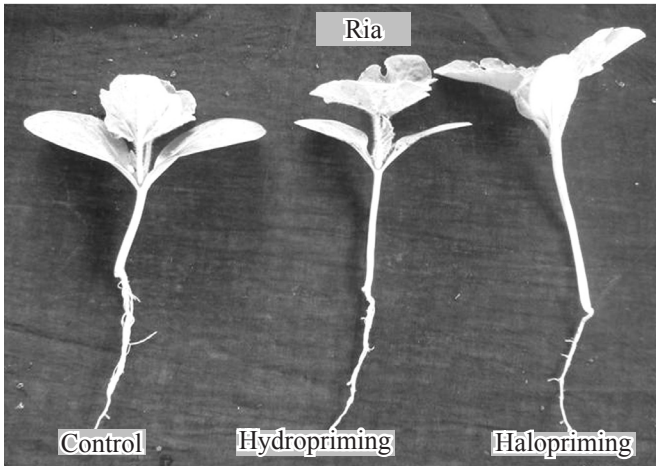
Table 6: Mean values of plant height				
Items	Control	Hydroprim-ing-2	Haloprim-ing-1	Os-moprim-ing
Pt ht (cm)	46	63.5	59	60.5
Leaves no.	12.5	9.5	6	6.5

4. Water melon

3 Varieties are taken i.e., Candy, Slice and Riafor study. Incase seedling vigour was observed in case of hydropriming and halopriming.

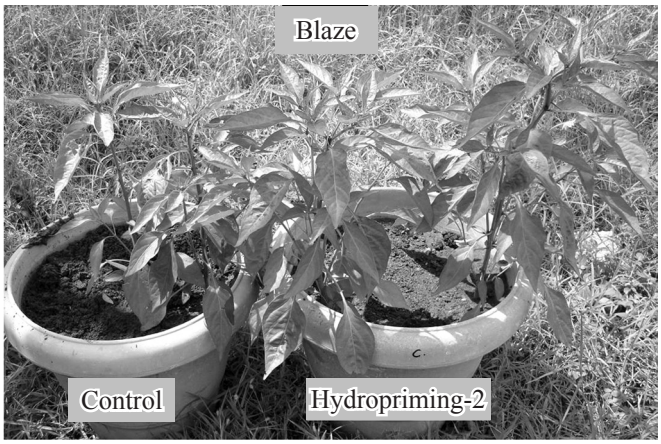


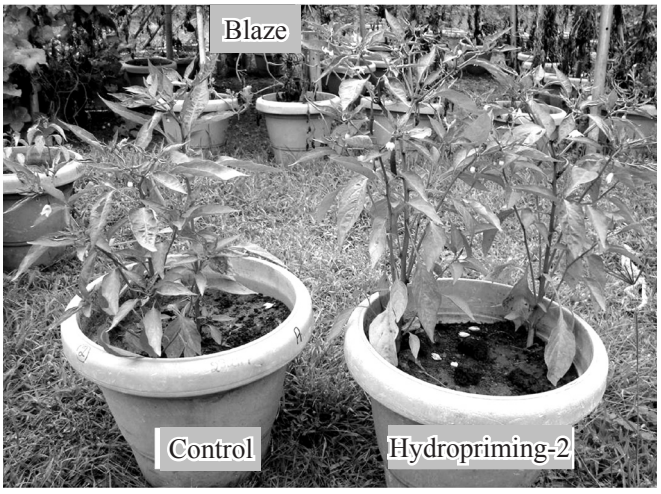




5. Chilli

4 chilli varieties are taken for study. Incase variety of Blaze high seedling vigour was observed in halopriming.





6. Sponge gourd

One variety was taken for study and osmopriming showing high increase in plant height. Early flowering was observed in halopriming.

Mean values of plant height and days to flowering was given in table.

Table 7: Mean values of plant height and days to flowering

Items	Control	Hydroprim-ing-2	Haloprim-ing-1	Os-moprim-ing
Pt ht (cm)	31	34	45	47
Day to flowering	52	54	50	52

7. Ridge gourd

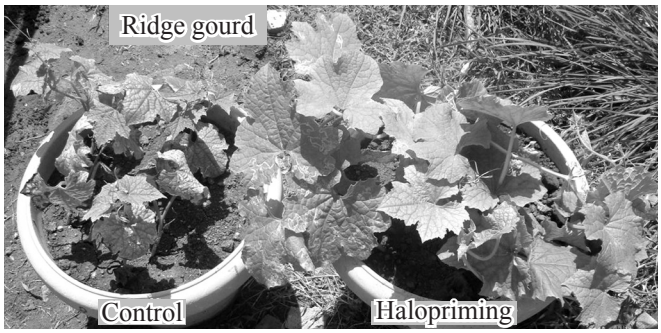
One variety was tken for study. Halopriming showing high plant height, leaf breadth, leaf length and petiole length. Mean values are tabulated below.

In our earlier study during rabi season, we adopted different priming techniques. We have reported primed seeds of tomato, chilli, okra, water melon, cabbage and cucumber showed higher seedling vigour and yield compared to control.

To confirm this we conducted this experiments during last rainy season, 2010 in few vegetable crops, though due to heavy rain the response is lower as mentioned below. It is observed that Tomato hydropriming is giving high seedling vigour and higher yield compared to contro.

Table 8: Mean values of different parameters

Items	Control	Halopriming
Plant height	26.0	49.0
Leaf breadth	9.0	12.2
Leaf length	7.7	9.5
Petiole length	5.0	9.0



In okra hydro & osmopriming is giving high seedling vigour and better yield.

Cucumber halopriming is increased yield & seedling vigour

In casee of bottle gourd, water melon and cucumber we could get yield, but the priming enhances flowering and vigour. We can effectively use selected technique for seed production of fouwndation and commercial seeds. In my opinion this will definitely improve seedling emergence and seedling vigour and to some extent yield which is confirmed in case of tomato and chilli

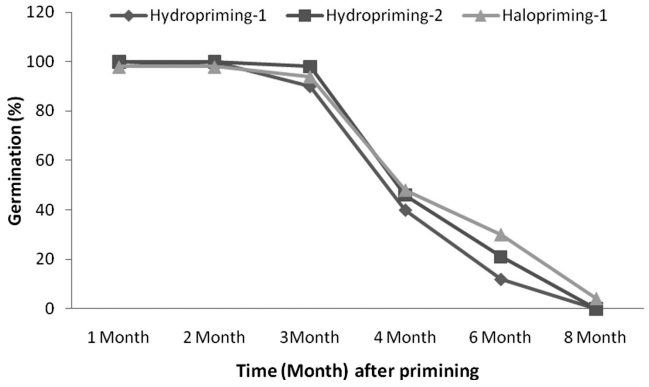
It is assessed that in most of the crop species in general priming techniques increased seedling emergence and seedling vigour which has been reported by different authors in several crops (Khan. 1992, Taylor, 1998). Seed pre-soaking causes hydrolysis of membrane proteins and induce several metabolic process and re-drying arrest this process (Bewley, 1982). Hydropriming improve germination (Harris, 1999). The findings of the present study coincides with the findings of Maiti et al., .2009). In all studies priming improves seedling vigour for maintaining good seedling nursery.

8. Seed longitivity (viability) of primed seeds

To observe the longitivity (storage capacity) of the primed seeds of different priming techniques we conducted an experiment. Seeds of cucumber (3 varieties), okra (2 varieties) and tomato (4 varieties) are primed using hydropriming , halopriming and osmopriming, and observed for germination % (in between germination paper) at regular intervals of 1, 2 3 4, 6 and 8 months. Most of the crops showing longitivity up to 3 months from the dated of priming. Crop wise germination % in different techniques is given below in graphs:

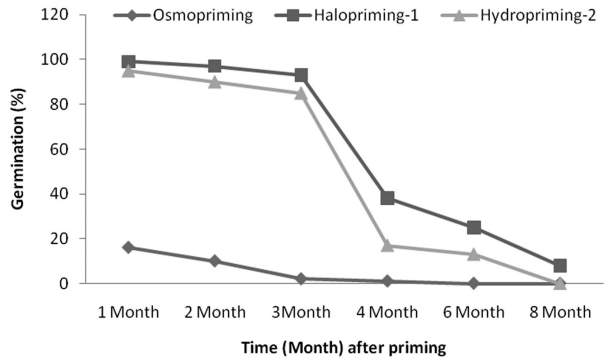
a. Cucumber

3 varieties are tested for longitivity. Techniques used are hydropriming-1 and 2 and halopriming-1. Germination % is constant up to 2 months (100%) from the date of priming and showing little reduction at 3rd month (94%). Drastically reduction was observed after 3rd month to 8th month. So it is concluded the cucumber seeds are have longitivity up to 3 months.



b. Okra

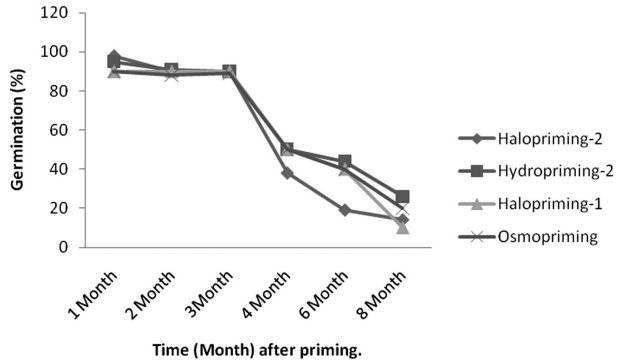
2 varieties are tested for longitivity. Techniques used are halopriming-1, hydropriming -2 and osmopriming. In case of halopriming -1 and hydropriming-2 germination % is constant at 1st month and showing very little reduction up to 3rd month. Germination (%) was drastically reduced after 3rd month to 8th month. In case of osmoprimed seeds germination was completely reduced immediate after priming. So it is concluded that halo and hydro primed okra seeds have longitivity up to 3 months



c. Tomato

3 varieties are tested for longitivity. Techniques used are hydropriming-1, hydropriming -2 halopriming-1, and osmopriming. In case these entire 4 varieties germination % is constant almost constant up to 3 months from the date of priming. Germination (%) was drastically reduced after 3rd month to 8th month. So it is concluded that hydro, halo and osmoprimed tomato seeds have longitivity up to 3 months.

It is reported that priming decreases longevity (Taylor, 1998). The present study reveals that the vegetable species retain viability and stored up to three months after which it deteriorates drastically.



9. Conclusion

A comparative study on the effects of priming techniques revealed that the priming techniques improved growth and yield of all the crops although the varieties showed variation in response to different treatments. The beneficial effect of priming on vegetable crops with respect to growth and yield is rarely documented in the literature. It was also conclude that priming of seeds of different crops could alleviate the adverse effects of salinity stress and increased yield.

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