Effect of Seed Priming on Seedling Vigour and Yield of Tomato and Chilli

Ratikanta Maiti[1*], Dasari Rajkumar[1], Mangalarapu Jagan[1], K. Pramanik[2] and P. Vidyasagar[1]

[1]Honorary Professor, Universidad de las Americas, Departamento de Quimica y Biologia, Santa Catarina Martir, C.P., Puebla (72820), Mexico

[2]Department of ASEPAN, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal (731 236), India

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Correspondence to

E-mail: ratikanta.maiti@gmail.com

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Abstract

Seed priming increases seedling vigour of several vegetable crops. Tomato (*Lycopersicon esculentum*m L.) and chilli (*Capsicum annuum* L.) were tested for seed priming at seedling stage (4 tomato and 3 chilli varieties) under lab and vegetative and reproductive sate at field conditions (2 tomato and 2 chilli varieties). The priming techniques improved seedling vigour, growth and yield of tomato and chilli although varieties showed variation in response to different treatments. Especially halopriming increased speed of emergence, seedling vigour index, root length and shoot length over hydropriming in tomato and chilli. At field level halo priming showed better performance than control and hydropriming. Halo priming caused early flowering in tomato (8149, 8152) and chilli (9357). Increased plant height is also noticed in halopriming with respect to tomato and chilli (8149, 8152, 9357 and 9366). Mostly importantly halopriming increased total yield 20 plants^{-1} in tomato and chilli. This is the first observation in the aspect of increased yield under field condition with respect to seed priming in vegetable crops.

1. Introduction

Poor seedling emergence and seedling vigour 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 vigour (Taylor, 1998). Priming of seeds of different crops alleviates the adverse effects of salinity stress and enhance crop yield (Ahmed, 1998; Hedegree et al., 2000; Harris et al., 1999; Pill and Kilan, 2000). Seed pre-soaking causes hydration of membrane proteins and initiation of several metabolic processes and re-drying of seeds arrest the process (Beweley, 1982). On the other hand osmopriming of seeds with NaCl nullify the adverse effects of salt stress (Watkinson and Pill, 1998). Curiously under salt stress, the seedling of tomato emerges earlier in NaCl-primed seeds than the non-primed seeds.

Similarly hydro-priming improved germination and later growth of different crops species such as in maize, rice, chickpea (Harris et al., 1999). This technique has been employed to increase germination rate and seedling vigour in several vegetable crops. On the other hand, there is a general consensus that priming decreases longevity (Taylor et al., 1998).

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^{0}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 vigour 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 hydropriming, halopriming, and osmopriming. It is observed that few priming technique improved seedling emergence, seedling vigour 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 concentrated to study the effect of priming of tomato and chilli crops during the rainy season of 2012 at Hyderabad, Andhra Pradesh, India.

2. Material and Methods

2.1. Laboratory experiment:

The four varieties of tomato (8149, 8152, 8159 and 8161) and

three varieties of chilli (9357, 9360 and 9366) were used for experiment purpose. In this study, two priming techniques viz., halopriming and hydropriming were applied on both the crop varieties. For halopriming of the tomato and chilli seeds were primed by soaking of seeds in 3% KNO_3 solution for 30 and 40 hours at normal room temperature, respectively. Non-primed and hydro primed seeds were included the experiment for comparisons. For hydro priming purpose, seeds of bvvvbbzoth crops were primed by soaking of seeds in water for 30 hours (tomato) and 40 hours (chilli) at normal room temperature. After priming, seeds were air dried in shade for 4-5 days to remove the surface moisture at an ambient temperature. After dried, 20 numbers of primed and non-primed seeds were sown in each plastic pots (15 cm height and 10 cm dameter). The experiment was a factorial with two factors (varieties and priming) on the basis of a complete randomized block design with three replications. Experiment was terminated at 18 days form the dates of sowing. Emergence (%), speed of emergence (emergence index), shoot length, root length, and seedling vigour index were calculated. The seedling vigor was determined following the formula of Baki and Andersen (1972) as shown below:

Vigor index=(Mean of root length+Mean of Shoot length)×Percentage of Seed germination (Emergence).

2.2. Field experiment

After laboratory experiment, two varieties of tomato (8149 and 8152) and two varieties of chilli (9357 and 9366) were selected for field study. The same primed treatment process was followed. Seedlings were raised in big size plastic pots (40 cm height and 35 cm) under net-house. After 35 days after sowing, seedlings were transplanted in field. Transplanting was done in June-July, 2012. Recommended spacing was adopted. Fertilizers were applied according to the soil test recommendation. Irrigation was carried out according to the crops need. 20 plants per each replication were taken for the study. 10 plants from each plot were randomly selected for plant height. Days to 50% flowering and total yield from 20 plants were also recorded. Data analysis was carried out by the using of M Stat C.

3. Result and Discussion

3.1. Laboratory experiment of tomato

The result showed that the tomato varieties were different significantly in respect of speed of emergence (Figure 2), emergence (%) (Figure 1), shoot (Figure 4) and root length (Figure 5) and seedling vigour index (Table 1). The highest speed of emergence (37.14), emergence (94.44%) and seedling vigour index (1162) were recorded with variety (8152) but it was at par with the variety, 8149. The lowest speed of emergence (25.21), emergence (74.44%) and seedling vigour index (791) were recorded with variety (8161) but it was at par with the variety, 8159 except the seedling vigour index (Figure 3). The seedling vigour index increased by 8152 was 59.83% over the variety (8161). The second best variety was 8149 in respect of speed of emergence (32.45), emergence (92.22%) and seedling vigour index (1080).The longest shoot length (8.47 cm) and root length (4.30 cm) were recorded with the variety, 8152 and 8159, respectively (Figure 9). The shortest shoot length (6.45 cm) and root length (3.20 cm) were recorded with the variety, 8161. Speed of emergence, emergence (%), shoot length, root length and seedling vigour index also varied significantly due to seed priming (Table 1). The highest speed of emergence (33.67), emergence (89.16%) and seedling vigour index (1069) were recorded in tomato receiving halo priming treatments. The longest shoot length (7.89 cm) and root length (4.05 cm) were recorded from halo priming treated variety. The shortest root length (3.66 cm) was recorded with hydropriming treated plant. There was no significant different among priming treatment in respect of emergence (%) and root length. Similar types of results were reported by Taylor, (1998).

3.2. Laboratory experiment of chilli

In case of chilli, the result showed that the varieties were different significantly in respect of root length (Figure 5) and seedling vigour index (Table 2). The highest seedling vigour index (1146) was recorded with variety (9366) but it was at par with the variety, 9360. The lowest seedling vigour index (933) was recorded from the variety (933) but it was at par with the

Table 1: Effect of variety and priming techniques on speed of emergence, emergence (%), shoot length, root length and seedling vigour index of tomato

Treatments	Speed of emergence	Emergence (%)	Shoot length (cm)	Root length (cm)	Seedling vigour index
Variety					
8152	37.14	94.44	8.47	3.83	1162
8159	26.02	76.66	7.15	4.47	893
8149	32.45	92.22	7.91	3.77	1080
8161	25.21	78.88	6.67	3.31	791
SEm±	1.81	3.92	0.17	0.18	46
CD (p=0.05)	5.28	11.44	0.50	0.53	134
Seed priming					
Control	28.85	88.33	7.38	3.83	997
Halopriming	33.67	89.16	7.89	4.05	1069
Hydropriming	28.12	79.16	7.39	3.66	879
SEm±	1.57	3.40	0.14	0.16	40
CD (p=0.05)	4.58	NS	0.41	NS	116

Table 2: Effect of variety and priming techniques on speed of emergence, emergence (%), shoot length, root length and seedling vigour index of chilli.

Treatments	Speed of emergence	Emergence (%)	Shoot length (cm)	Root length (cm)	Seedling vigour index
Variety					
9360	29.18	92.22	6.27	4.97	1041
9366	25.92	97.77	5.96	5.74	1146
9357	28.37	90.00	5.82	4.57	933
SEm±	1.16	3.33	0.15	0.21	47
CD (p=0.05)	NS	NS	NS	0.62	139
Seed priming					
Control	23.13	96.66	6.22	4.65	1055
Halopriming	34.85	87.77	5.75	5.36	979
Hydropriming	25.49	95.55	6.08	5.27	1088
SEm±	1.16	3.33	0.15	0.21	47
CD (p=0.05)	3.45	NS	NS	0.62	NS

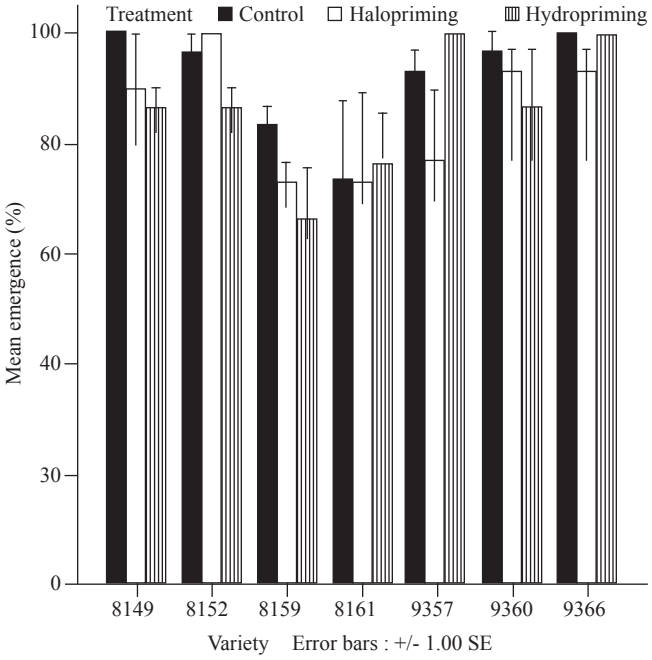

Figure 1: Emergence (%) as influenced by variety (tomato and chilli) and priming techniques

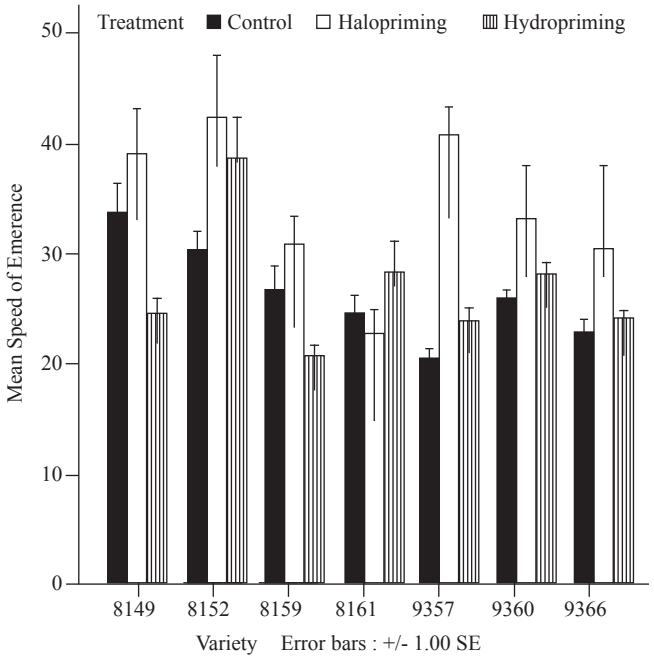

Figure 2: Speed of emergence as influenced by variety (tomato and chilli) and priming techniques

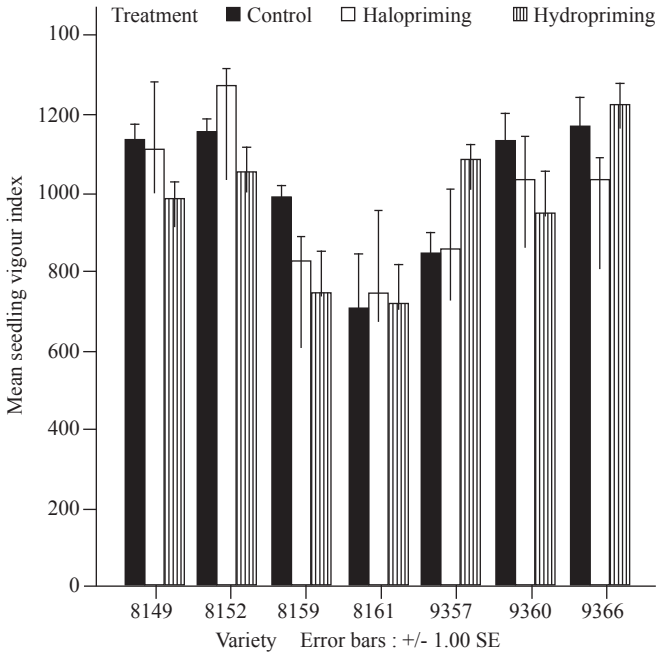

Figure 3: Seedling vigour index as influenced by variety (tomato and chilli) and priming techniques

variety, 9360 (Figure 3). The seedling vigour index increased by 9366 was 22.82% over the variety (9357). The longest root length (5.74 cm) was recorded with the variety, 9366 (Figure 10). The shortest root length (4.57 cm) was recorded with the variety, 9357. The numerically maximum value of emergence (%) (Figure 1) and shoot length (Figure 4) were recorded with the variety of 9366. Speed of emergence (Figure 2) and root length (Figure 5) also varied significantly due to seed priming (Table 1). The maximum speed of emergence (34.85) and longest root length (5.36 cm) was recorded in chilli receiving halo priming treatments. The minimum speed of germination (23.13) and the shortest root length (4.65 cm) was recorded with non primed (control) treated plant. There was no significant different among priming treatment in respect of emergence (%), shoot length and seedling vigour index.

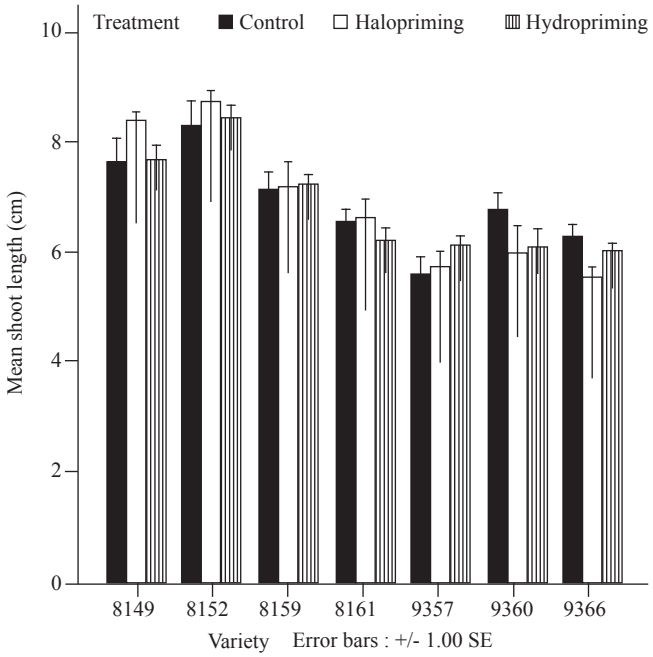

Figure 4: Shoot length as influenced by variety (tomato and chilli) and priming techniques

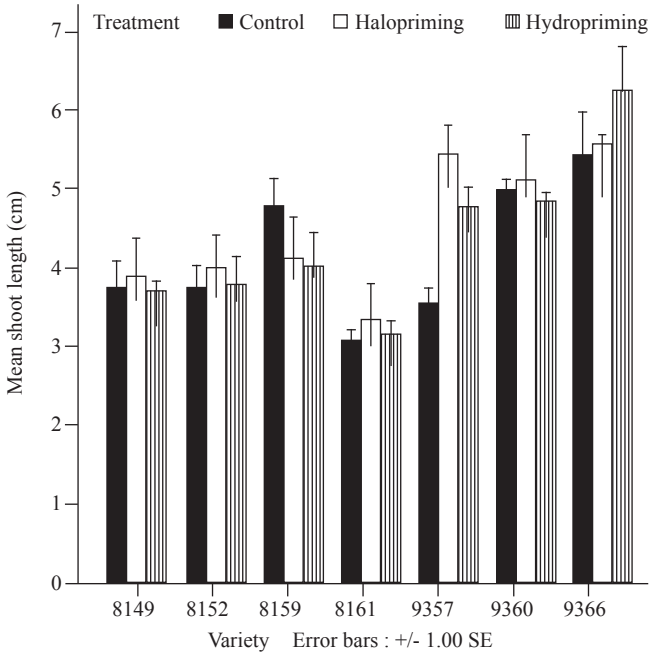

Figure 5: Root Length as influenced by variety (tomato and chilli) and priming techniques

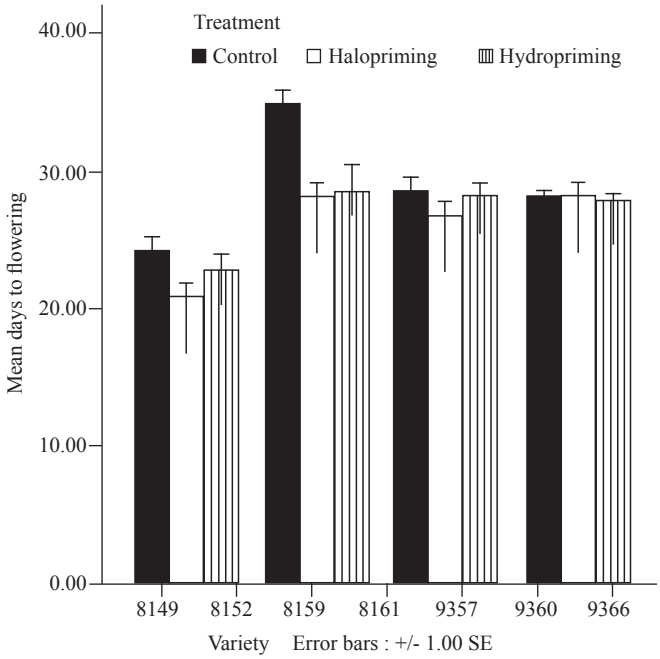

Figure 6: Days to Flowering as influenced by variety (tomato and chilli) and priming techniques

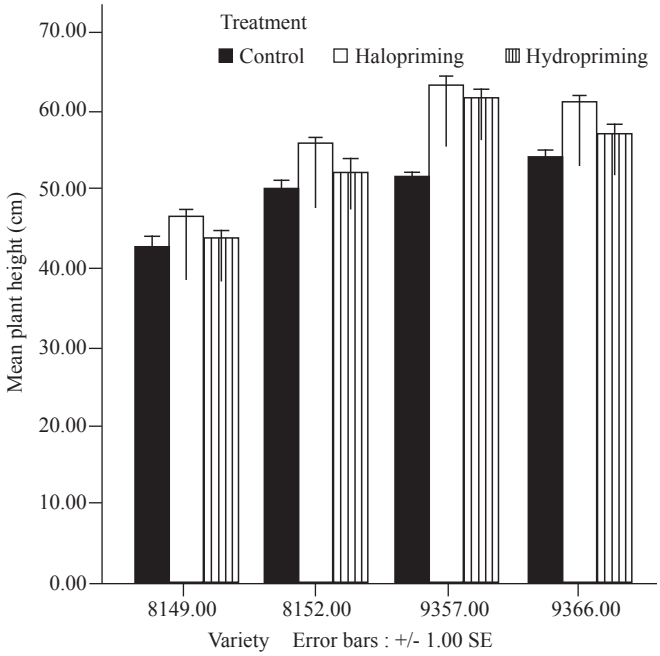

Figure 7: Plant height as influenced by variety (tomato and chilli) and priming techniques

3.3 Field experiment of tomato

The result showed that plant height (Figure 7), days to flowering (Figure 6) and yield (Figure 8) were significantly varied due to variety. (Table 3).The tallest plant height (52.58 cm) was recorded from the variety of 8152 where dwarf plant height (44.48 cm) with the variety of 8149. The variety, 8149 required less days (7.90) to flowering than the variety, 8152. The highest yield (3755 g) was recorded with the variety of 8149 whereas lowest yield (3528 g) was recorded with the variety of 8152. The percentage of yield increased due to to 8149 was 6.43% over the variety of 8152. The result showed that priming had a significant affect on plant height, days to flowering and yield. Halo priming showed better performance than control and hydropriming. Increased plant height also noticed in halopriming. The tallest plant height (51.26 cm) was recorded with halo priming treated plot whereas shortest height (46.47

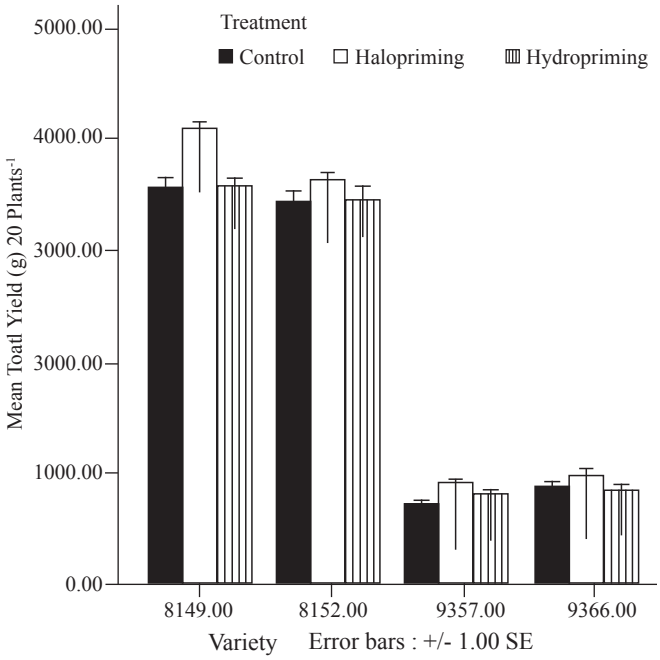

Figure 8: Total yield as influenced by variety (tomato and chilli) and priming techniques

cm) was recorded from the control plot. Earliness of flowering was recorded from the halo primed treated plant. The maximum yield (3872 g) was recorded in crop receiving halo priming treatment whereas minimum yield (3516 g) was recorded from the control plot (non primed plot). The percentage of yield increased due to halo priming was 10.10% over the control plot. The maximum yield (4098 g) was obtained at the combination of variety of 8149 and halo priming (Table 4) and was followed by the crop variety of 8152 with halo priming (3646 g). The minimum yield (3453 g) was obtained from the combination of variety of 8152 and control plot (Table 4).

3.4. Field experiment of chilli

The result showed that plant height (Figure 7), days to flowering (Figure 6) and yield (Figure 8) were significantly varied due to variety. (Table 3).The tallest plant height (58.94 cm) was recorded from the variety of 9357 where dwarf plant height (57.67 cm) with the variety of 9366. There was no significant difference between days to flowering in respect of variety. The highest yield (906.9 g) was recorded with the variety of 9366 whereas lowest yield (820.9 g) was recorded with the variety of 9357. The percentage of yield increased

Table 3: Effect of variety and priming techniques on plant height, days to flowering and yield of tomato and chilli

Treatments	Tomato			Treatments	Chill		
	Plant height (cm)	Days to flowering	Yield (g 20 plants^{-1}		Plant height (cm)	Days to flowering	Yield (g/20 plants
Variety				Variety			
8149	44.48	22.77	3755	9357	58.94	28.0	820.9
8152	52.58	30.67	3528	9366	57.67	28.2	906.9
SEm±	0.31	0.33	39.4	SEm±	0.23	0.25	9.9
CD (p=0.05)	0.93	0.99	118.7	CD (p=0.05)	0.69	NS	29.8
Seed priming				Seed priming			
Control	46.47	29.6	3516	Control	52.93	28.5	803.1
Halopriming	51.26	24.6	3872	Halopriming	62.35	27.6	951.5
Hydropriming	47.86	25.8	3536	Hydropriming	59.63	28.1	837.1
SEm±	0.38	0.40	48.2	SEm±	0.28	0.32	12.2
CD (p=0.05)	1.15	1.21	145.2	CD (p=0.05)	0.84	NS	36.7

Table 4: Interaction effect of variety and priming techniques on yield of tomato and chilli

Treatments	Tomato			Treatments	Chilli		
	Priming				Priming		
Variety	Control	Halo priming	Hydro priming	Variety	Control	Halo priming	Hydro priming
8149	3578	4098	3589	9357	722	920	820
8152	3453	3646	3484	9366	884	982	854
SEm±		68.2		SEm±		17.2	
CD (p=0.05)		205.5		CD (p=0.05)		51.8	

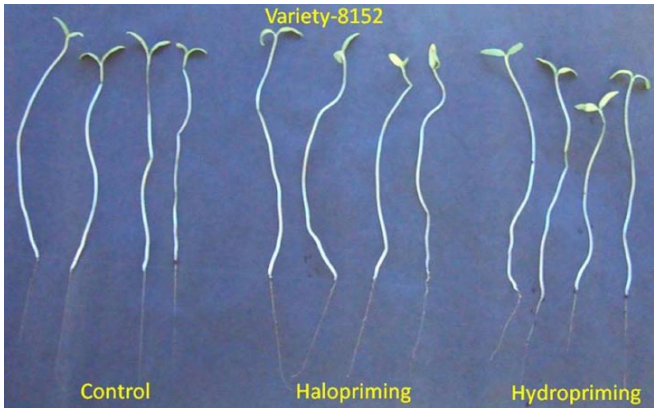

Figure 9: Tomato variety-8152 showing increased root length in halopriming compared to control and hydropriming.

Figure 10: Chilli Variety-9366 showing good seedling vigour in halopriming compared to control and hydropriming

Figure 11: Chilli variety-9366 showing higher plant growth and vigour compared to control

Figure 12: Halopriming showing higher yield compared to control and hydropring in chilli variety-9366

due to 9366 was 10.5% over the variety of 9357. The result showed that priming had a significant affect on plant height (Figure 11) and yield (Figure12). Halo priming showed better performance than control and hydro priming. The tallest plant height (62.35 cm) was recorded with halo priming treated plot whereas shortest height (52.93 cm) was recorded from the control plot. Earliness of flowering was recorded from the halo primed treated plant but was non significant than other primed treatments. The maximum yield (951.5 g) was recorded in crop receiving halo priming treatment whereas minimum yield (803.1 g) was recorded from the control plot (non primed plot). The percentage of yield increased due to halo priming was 18.50% over the control plot. The maximum yield (982 g) was obtained at the combination of variety of 9366 and halo priming (Table 4) and was closely followed by the crop variety of 9357 with halo priming (920 g). The minimum yield (722 g) was obtained from the combination of variety of 9357 and control plot (Table 4).

4. Conclusion

A comparative study on the effects of priming techniques revealed that the priming techniques improved growth and yield of tomato and chilli although 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. This is the first time with reporting that priming showed increased yield under field condition in tomato and chilli.

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