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EFFECTS OF NUTRIPRIMING ON GERMINATION AND SEEDLING GROWTH OF COLE VEGETABLES

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Abstract

A pot experiment was conducted to observe the efficacy of seed priming on germination and seedling growth of the cole vegetables. Seeds of two different cole vegetables *viz.,* cauliflower and cabbage were soaked in 0.01, 0.05, 0.5 and 1.0% boron solution (w/v) for 18 hrs. Seeds were also soaked in water (hydropriming) and unprimed seeds were taken as control. The results exhibited that most of the germination and growth related attributes of the seedlings decreased with increasing concentration of boron. The best results obtained where boron was used at the lowest concentration of 0.01% with minimum mean germination time (2.84 days), maximum germination index (7.41), seedling vigour index (1596.7), chlorophyll content of leaf (3.62 mg/ml), shoot length (6.02 cm), root length (9.95 cm), fresh weight of the shoot (11.39 g) and root (1.79 g). The leakage of the electrolytes was not significantly influenced by seed priming treatments.

Introduction

Cole crops are a group of related vegetable crops of the mustard family, Brassicaceae. All cole vegetable crops are the varieties of the species *Brassica oleracea* L. Cole vegetable crops are hardy and cool season vegetables that grow best at temperatures between 15.5 and 20^0C. Brassica vegetables have high nutritional value. They provide high amounts of vitamin C and soluble fiber and contain phosphorus, iron and magnesium with potent anticancer properties (Diniz *et al*. 2009).

Better germination and vigorous seedlings are the basic foundations for the success of stand establishment of any crop plant. Pre-treatment of the seeds is one of the valuable reasons that may possibly improve germination and maintain uniformity and stability of the seedlings. Various seed treatment technologies including priming, coating and conditioning of the seeds are applied to improve germination and emergence in seeds of many crops (Arif *et al*. 2008).

Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly seeds of vegetables and small seeded grasses (Raj *et al.* 2013, Rastin *et al.* 2013). Seed priming with macro- or micronutrient (nutripriming) application has been recently done on various agronomic crops including dill (Mirshekari 2012), rice (Johnson *et al*. 2005), maize (Harris *et al*. 2007) and wheat (Iqbal *et al*. 2012). Rare work has been reported on nutrient seed priming related with vegetables as reported in summer squash (Atta 1998), mungbean (Shah *et al*. 2012), broccoli (Memon *et al.* 2013) and carrot (Munwar *et al.* 2013). Most commonly, the nutrients are delivered as soil application, fertigation or foliar spray (Robert 2008). Applying nutrients as seed treatment, through seed coating and seed priming, is another option which avoids aforementioned risks.

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Deficiency of boron causes severe reduction in crop yield, which is due to disturbance in metabolic events involving boron (Brown *et al*. 2002). Realizing the role of boron for plant growth and development, the present study was designed to observe the efficacy of seed priming on germination and seedling related attributes of the two cole vegetable crops *viz.*, cauliflower and cabbage.

Materials and Methods

The experiment was carried out at Horticulture Garden, Department of Horticulture, Sindh Agriculture University, Tandojam, Pakistan located at 25° 25'60'N 68°31' 60E, altitude 19.5 m above sea level. Seeds of two different cole vegetable crops *viz.* cauliflower (var. White Corona) and cabbage (var. Charmant) of SAKATA seed company, Japan were used in the present study to observe the efficacy of seed priming with boron on germination and growth attributes of seedlings. Twenty seeds of each cole vegetable crops were soaked in boric acid solution (w/v) at the concentration of 0.01, 0.05, 0.5 and 1% for 18 hrs. Seeds were also soaked in distilled water (hydropriming) and unprimed seeds were taken as control. The seeds were surface washed thrice with distilled water and dried at room temperature. All primed and unprimed seeds were planted in earthen pots containing soil. This soil samples was analyzed for soil texture, pH, EC, organic matter, total nitrogen and available phosphorus. The soil was sandy clay loam, non-saline in nature with EC 0.74 dS/m and slightly alkaline in reaction with pH 7.8. The soil was also low in organic matter (0.71%), total nitrogen content (0.06%), available phosphorus 3.6 mg/kg, exchangeable potassium 168 mg/kg and Boron 0.48 ppm.

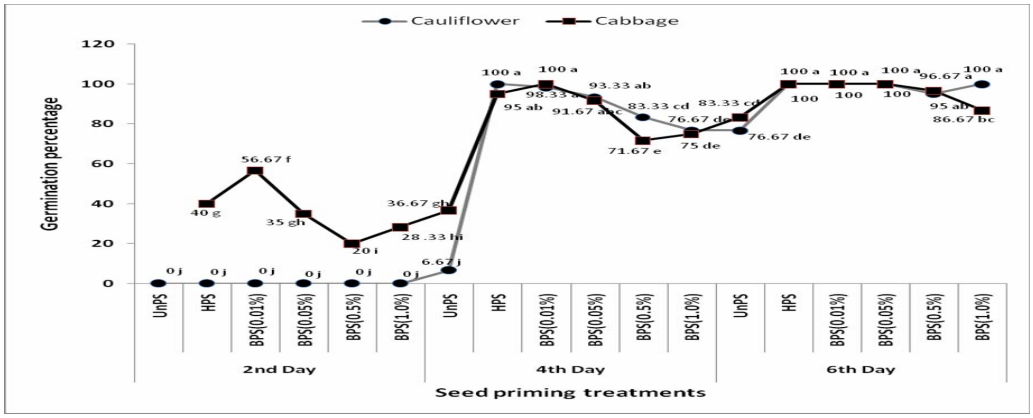
The data were recorded for germination percentage (GP), mean germination time (MGT), germination index (GI), seedling vigorous index (SVI), length and fresh weight of shoot and root, electrolyte leakage of leaf and chlorophyll content of cauliflower and cabbage. Completely randomized design - factorial was established with three replications per treatment. The collected data will be subjected to statistical analysis using Statistix 8.1 computer software (Statistix, 2006). The LSD test was applied to compare treatments superiority.

Results and Discussion

Germination of both the cole vegetables was significantly influenced by nutripriming and with the increase in number of days. No germination was observed from cauliflower seeds on 2nd day of plantation (Fig. 1). While more than 50% of germination (56.67) was observed from the cabbage seeds primed with boron solution at a concentration of 0.01%. On 4th day of plantation, germination was observed more than 70% in all primed treatments as compared to non-primed seeds. However complete (100%) germination was also observed on the same 4th day of plantation from both cauliflower and cabbage seeds, primed with water and boron solution at concentration of 0.01%, respectively. Hydro and all boron primed seeds exhibited statistically non-significant results with each other on 6th day of plantation.

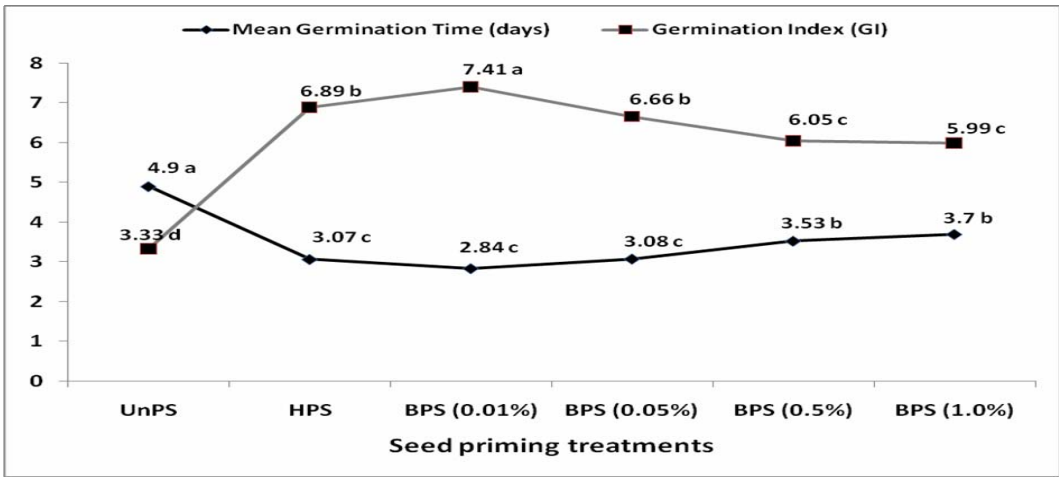
Fig. 2 depicts that germination index (GI) was increased with decreased mean germination time (MGT). MGT (4.9 days) was observed from non-primed seeds with minimum GI of 3.33. However, maximum GI (7.41) and minimum MGT (2.84 days) were observed from the seeds primed with boron solution at concentration of 0.01%. These results of MGT are at par with the results obtained from hydro (3.07 days) and boron (3.08 days) primed seeds at concentration of 0.05%. The seedling vigor index (SVI) was significantly influenced by priming treatments producing the highest mean SVI (1596.7) from priming solution had boron at concentration of 0.01% (Table 1). Hydro and nutriprimed seeds at boron concentration of 0.05% exhibited statistically similar results for mean SVI i.e., 1126.7 and 1151.7, respectively. Priming enhanced

seed performances are related to the repair and the buildup of nucleic acid, enhanced synthesis of protein, repair of membranes and improves antioxidant system (Hsu *et al.* 2003, Mirshekari 2012 and Rehman *et al.* 2012).



UnPS = Non-primed seeds, HPS = Hydroprimed seeds, BPS = Boron primed seeds.

Fig. 1. Germination percentage of cauliflower and cabbage seeds as influenced by priming and in relation to number of days.



UnPS = Non-primed seeds, HPS = Hydroprimed seeds, BPS = Boron primed seeds.

Fig. 2. Mean germination time (MGT) and germination index (GI) as influenced by various priming treatments.

Chlorophyll content of leaf was also significantly influenced by nutripriming treatments producing the highest mean chlorophyll content of 3.62 mg/ml from the priming treatment where boron was used at concentration of 0.01% (Table 1). The minimum chlorophyll content (2.64 mg/l) of leaf was observed from the seedling sprouts where boron was used at concentration of 0.5% followed by the control (3.10 mg/l).

Table 2 that root and shoot related attributes were significantly influenced by nutripirming treatments producing the highest average length of the root (9.95 cm) and shoot (6.02 cm) in response to the treatment where boron was used at its lowest concentration of 0.01%. While hydroprimed seeds produced better mean results of shoot (4.05 cm) and root (7.22 cm) length as compared to the treatments where boron was used from concentration of 0.05 to 0.5%. Interaction results showed maximum values at the concentration of 0.01% in both the cole vegetables *viz.*, cauliflower and cabbage.

Table 1. Seedling vigour index and chlorophyll content of cauliflower and cabbage as influenced by seed priming treatments.

SPT	SVI		Mean	Cc (mg/ml)		Mean
	C_1	C_2		C_1	C_2	
Unprimed seeds (control)	645.00	634.20	639.6 D	3.63	2.56	3.10 B
Seeds primed with distilled water	1113.30	1140.00	1126.7 B	3.44	3.30	3.37 AB
Seeds primed with B @ 0.01%	1660.00	1533.30	1596.7 A	3.64	3.61	3.62 A
Seeds primed with B @ 0.05%	1026.70	1276.70	1151.7 B	3.78	3.39	3.59 A
Seeds primed with B @ 0.5%	861.00	915.70	888.3 C	3.03	2.26	2.64 C
Seeds primed with B @ 1.0%	843.30	773.50	808.4 C	3.57	3.16	3.36 AB
	1024.90	1045.60		3.51	3.05	

SPT = Seed priming treatments, SVI = Seedling vigor index, Cc = Chlorophyll content, C_1 = Cauliflower, C_2 = Cabbage.

Table 2. Shoot and root length (cm) of the seedling sprouts of cauliflower and cabbage as influenced by seed priming treatments.

SPT	SL (cm)		Mean	RL (cm)		Mean
	C_1	C_2		C_1	C_2	
Unprimed seeds (control)	3.50 cd	3.13 de	3.32 CD	4.87 d	4.50 d	4.68 D
Seeds primed with distilled water	4.10 c	4.00 c	4.05 B	7.03 bc	7.40 bc	7.22 B
Seeds primed with B @ 0.01%	6.76 a	5.27 b	6.02 A	9.83 a	10.07 a	9.95 A
Seeds primed with B @ 0.05%	3.33 cde	4.07 c	3.70 BC	6.93 c	8.70 ab	7.82 B
Seeds primed with B @ 0.5%	3.07 de	3.53 cd	3.30 CD	5.93 cd	5.93 cd	5.93 C
Seeds primed with B @ 1.0%	2.60 e	2.97 de	2.78 D	5.83 cd	5.93 cd	5.88 C
	3.89	3.82		6.74	7.09	

SPT = Seed priming treatments, SL = Shoot length, RL= Root length, C_1 = Cauliflower, C_2 = Cabbage.

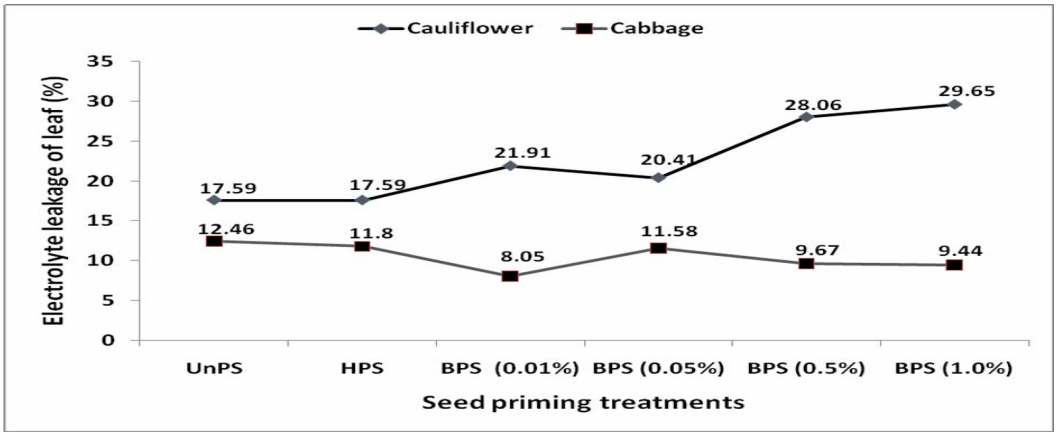
More or less similar results were observed for fresh weight of shoot and root (Table 3). On the basis of interaction of vegetables and priming treatments, maximum mean fresh weight of shoot (11.40 g) and root (1.79 g) were observed from the treatment where boron was used at its lowest concentration of 0.01% in cabbage and cauliflower, respectively. However, mean fresh weight of root was significantly influenced by vegetables producing the highest weight of root 1.30 g in cabbage as compared to cauliflower (0.97 g). The mean boron primed treatments with concentration of 0.01 and 0.05% exhibited statistically similar results for fresh weight of shoot and root. The low concentration of boron has been reported to activate key enzymes including phosphorylase, α-amylase etc. involved in starch metabolism. In present study, germination was

observed decreased with increased doses of boron i.e. from 0.5 to 1% (Rehman *et al*. 2012) reported no germination from rice seeds primed with boron at 0.5%.

Table 3. Fresh weight of shoot and root (g) of the seedlings of cauliflower and cabbage as influenced by seed priming treatments.

SPT	FWS (g)		Mean	FWR (g)		Mean
	C_1	C_2		C_1	C_2	
Unprimed seeds (control)	6.27 def	7.00 cde	6.63 C	0.74 efg	0.95 de	0.84 C
Seeds primed with distilled water	8.95 bc	8.21 cd	8.58 B	1.05 cde	1.43 abc	1.24 B
Seeds primed with B @ 0.01%	11.38 a	11.40 a	11.39A	1.87 a	1.72 ab	1.79 A
Seeds primed with B @ 0.05%	10.73 ab	11.00 ab	10.87 A	1.33 bcd	1.79 ab	1.56 AB
Seeds primed with B @ 0.5%	4.91 ef	5.40 ef	5.15 CD	0.46 fg	1.02 cde	0.74 C
Seeds primed with B @ 1.0%	4.14 f	5.11 ef	4.62 D	0.37 g	0.88 def	0.62 C
	7.73	8.02		0.97 B	1.30 A	

SPT = Seed priming treatments, FWS = Fresh weight of shoot, FWR = Fresh weight of root,
C_1 = Cauliflower, C_2 = Cabbage.



UnPS = Non-primed seeds, HPS = Hydroprimed seeds, BPS = Boron primed seeds.

Fig. 3. Electrolyte leakage of leaf (%) recorded in response to the various seed priming treatments.

The data concerning electrolyte leakage of leaf (%) presented in Fig. 3 and depicted that there is no effect of seed priming on the leakage of the leaf. Cauliflower exhibited more leakage of electrolytes (29.65%) in response to the treatment where boron was used at 1.0% as compared to rest of the priming treatments and control. Cabbage exhibited less leakage of electrolytes as compared to cauliflower producing the highest 12.46% from unprimed seeds. Munawar *et al*. (2013) reported no germination from the carrot seeds when primed with boron at concentration of 1, 1.5 and 2%. The higher doses of micronutrients in soil solution may also slow the establishment of the seedlings as reported by Mershikari (2012). Kumar *et al*. (2008) reported increased plant height of pea when seeds were primed with boron at 0.5%. This variation in results may be of different genotypes, boron application method, and other soil and environment related. Lowest concentration (0.01%) of boron maximized germination and growth traits in cabbage and cauliflower, respectively.

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