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Enhancement of Emergence and Vigour of Bottle gourd Seed under Subtropical Conditions

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ABSTRACT: The present investigation was carried at Vegetable Research Farm of Department of Vegetable Science, Punjab Agricultural University, Ludhiana. The experiment was laid in completely randomized design with nine priming treatments along with control. The seeds of bottle gourd were treated with PEG 6000 @ 0.5 Mpa and 1.5 Mpa, disodium hydrogen phosphate @ 10^{-1} M and 10^{-3} M, KH_2PO_4 @ 10^{-1} and M 10^{-3} M, GA_3 @ 100 ppm and 500 ppm, hydration for 24 hours and 48 hours. Seeds were sown in polythene bags during second week of February 2011, 2012 and 2013. The results revealed that pre sowing treatment with KH_2PO_4 @ 10^{-1} M resulted in maximum field emergence (%), speed of emergence, seedling dry weight and vigour index II whereas seedling length and vigour index-I better in treatment GA_3 @ 100 ppm and 500 ppm.

Keywords: Bottle gourd, Emergence, Priming, Vigour

Lagenaria siceraria (Molina) Standl. is an internationally accepted name for bottle gourd, which is an important cucurbitaceous vegetable crop grown for its fleshy fruits in tropical and subtropical regions of world. It is cultivated both in kharif and summer season in subtropical part of India; whereas in tropical regions it is cultivated round the year under mild temperature conditions. For successful seedling emergence, it requires temperature from 25^0C to 28^0C. It may fail or take long time to germinate if the soil temperature is below 20^0C and when temperature goes below 15^0C germination ceases [1]. Poor emergence is a common problem in bottle gourd when the crop is sown in early summer under north Indian conditions due to low temperature and seed sown directly in the open field either fails to germinate or emergence is delayed resulting in poor crop stand [2]. Under north Indian conditions cucurbits are generally grown in early winter in polythene bags/ plug tray nursery to fetch the premium of early market but due to low temperature prevailing during that period slows down or inhibits the germination of costly seeds. In order to improve its emergence, treatment is given to seeds before seeding in the soil. Priming treatments are successfully applied either to poor germinating seed lots or to seeds, which are sown under different stress conditions.

Seed priming, one of the techniques to promote germination, advances physiological status of the seeds just before root extrusion by controlling water supply or other priming agents. Priming initiates metabolic activities, such as protein, RNA and DNA synthesis, DNA replication and b-tubulin accumulation [3]. On the other hand, priming offers an effective means for counteracting sub-optimum temperature induced oxidative injury and raising seed performance in many crop species [4]. Application of plant growth regulators induce and breakdown of seed reserves in storage tissue and/ or increases the activity of enzymes concerning with mobilization, resulting in improved seed germination [5]. For enhancing germination and improved stand establishment, seed priming has been suggested [6]. Priming has shown to increase germination rate and uniformity in several crops [7] and [8]. In light of the above facts, the present research work was conducted in order to study

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the effect of different priming treatments on seeds of bottle gourd.

MATERIALS AND METHODS

The experiment was conducted during summer season of 2011, 2012 and 2013 at Research Farm of Department of Vegetable Science, Punjab Agricultural University, Ludhiana. This region is characterized by hot summer and cold winter with semi-arid and subtropical climate, which represents a typical monsoon conditions prevailing in central districts of Punjab. The mean maximum and minimum temperature show considerable fluctuations during summer, while minimum temperature falls below freezing point accompanied by frosty spells during winter.

The experiment was laid-out in completely randomized design and nine priming treatments along with control. The seeds of bottle gourd variety Punjab Komal were treated with PEG 6000 0.5Mpa, PEG 6000 1.5Mpa, Disodium hydrogen phosphate 10^{-3}M, Disodium hydrogen phosphate 10^{-1}M, Potassium dihydrogen phosphate 10^{-3}M, Potassium dihydrogen phosphate 10^{-1}M, GA_3 100ppm, GA_3 500ppm, Soaking in water for 24 h and 48 h. Following the treatment, seeds were air dried at room temperature until restoration of their original weight. After drying, the seeds were taken to field immediately for sowing in polythene bags during third second week of February. The observation under field conditions were recorded on field emergence (%), mean emergence time, seedling length (cm), seedling dry weight (g), vigour index-I and vigour index-II.

The seeds were allowed to germinate in controlled laboratory conditions. Three replicates of 100 seeds each were taken for germination (%) in germination paper using 'Between the Papers' (BP) method at 25±1°C and was evaluated after 14 days. To determine field emergence, 100 seeds per replication for each priming treatment were sown in polythene bags. The number of seeds emerged and developed into seedlings after 14 days were counted. Mean germination time was computed by recording daily observations on 100 seeds sown in polythene bags until the final count day (24 d). The mean germination time was calculated as total number of seeds emerged on day basis, and the mean was calculated [8]. For determining seedling length, ten normal seedlings from each replication of lab germination test were taken at random, and seedlings length was measured (cm). Seedlings dry weight was taken after drying ten normal seedlings at 110ºC for 17 hours and mean dry weight was calculated (g). The vigour index-I [germination (%) x seedling length] and vigour index-II [germination (%) x seedling dry weight] were calculated as per the formulae suggested by Abdul Baki and Anderson [9]. The values in percentage were arcsine transformed and data was analysed using method [10].

RESULTS AND DISCUSSION

It is evident from the data present in table 1 that the priming treatments had considerable influence on the emergence of seedling. The highest field emergence (81.11%) was observed when seeds were treated with potassium dihydrogen orthophosphate 10^{-1} M for 24 hours and was significantly better than all other treatments for all the three years under consideration. The minimum emergence was recorded with untreated seeds. The increase in emergence with potassium dihydrogen orthophosphate might be due to increased α-amylase that resulted in breaking of starch stored in seeds during imbibitions by increasing germination enhancing metabolites and build up osmotic adjustments [11]. Primed seeds exhibited a rapid, greater and uniform emergence. Lin and Sung [12] also stated that priming counteracted the low temperature effect by increasing the activity of different enzymes like isocitrate lyase, malate synthase and malate dehydrogenase involved in lipid and sucrose conversion. Similar findings were reported by Kumar *et al.* [13] in okra and Islam *et al.* [14] in bitter gourd.

The minimum emergence time (6.20 days) was observed when seed were treated with GA3 500 ppm for 48 hours and it was at par with priming treatments potassium dihydrogen orthophosphate 10^{-1}M for 24 and 48 hour. The maximum time for emergence (9.62 days) was recorded in untreated seeds. Enhanced speed of emergence due to various priming treatments might be linked with enhanced activity of glutathione peroxidase (free radical and peroxide scavenging enzyme). Lin and Sung [12]

Table 1. Effect of different priming treatments on emergence of bottle gourd seed

Sr. No.	Treatments	Mean emergence time (days)				Field emergence (%)			
		2011	2012	2013	Mean	2011	2012	2013	Mean
1.	PEG 6000 0.5Mpa 24 hour	13.00	6.87	6.80	8.89	72.00 (58.04)*	72.67 (58.46)	74.67 (59.76)	73.11 (58.74)
2.	PEG 6000 0.5Mpa 48 hour	12.33	6.37	6.30	8.33	73.00 (58.71)	72.33 (58.24)	74.67 (59.77)	73.33 (58.90)
3.	PEG 6000 1.5Mpa 24 hour	11.67	5.80	5.70	7.72	74.00 (59.33)	72.00 (58.03)	74.67 (59.78)	73.55 (59.02)
4.	PEG 6000 1.5Mpa 48 hour	12.67	5.37	5.27	7.77	71.00 (57.41)	72.00 (58.03)	74.33 (59.55)	72.45 (58.32)
5.	Disodium hydrogen phosphate 10^{-3}M 24 hour	12.33	4.83	4.73	7.30	74.00 (59.34)	74.67 (59.76)	76.33 (60.89)	75.00 (59.98)
6.	Disodium hydrogen phosphate 10^{-3}M 48 hour	12.00	4.63	4.53	7.06	71.67 (57.84)	78.33 (62.24)	79.33 (62.96)	76.44 (60.96)
7.	Disodium hydrogen phosphate 10^{-1}M 24 hour	12.33	4.60	4.50	7.14	76.67 (61.11)	76.00 (60.64)	77.33 (61.56)	76.67 (61.10)
8.	Disodium hydrogen phosphate 10^{-1}M 48 hour	13.33	4.47	4.37	7.39	78.67 (62.48)	75.00 (59.98)	76.67 (61.10)	76.78 (61.17)
9.	Potassium dihydroge n phosphate 10^{-3}M 24 hour	13.67	4.77	4.67	7.70	73.67 (59.12)	76.67 (61.10)	77.67 (61.80)	76.00 (60.65)
10.	Potassium dihydroge n phosphate 10^{-3}M 48 hour	13.33	4.60	4.50	7.48	76.00 (60.67)	76.67 (61.10)	78.00 (62.02)	76.89 (61.25)
11.	Potassium dihydroge n phosphate 10^{-1}M 24 hour	11.33	4.23	4.17	6.58	81.00 (64.15)	80.67 (63.90)	81.67 (64.65)	81.11 (64.23)
12.	Potassium dihydroge n phosphate 10^{-1}M 48 hour	11.67	4.13	4.10	6.30	78.33 (62.25)	75.67 (60.43)	76.67 (61.11)	76.89 (61.25)
13.	GA_3 100ppm 24 hour	12.00	4.17	4.10	6.76	74.67 (59.77)	77.00 (61.32)	78.33 (62.25)	76.66 (61.09)
14.	GA_3 100ppm 48 hour	10.67	4.10	4.03	6.27	75.67 (60.43)	75.33 (60.20)	76.67 (61.12)	75.89 (60.57)
15.	GA_3 500ppm 24 hour	12.00	4.27	4.17	6.81	73.00 (58.68)	77.00 (61.32)	78.00 (62.03)	76.00 (60.64)
16.	GA_3 500ppm 48 hour	10.33	4.17	4.10	6.20	73.67 (59.12)	77.67 (61.77)	78.67 (62.48)	76.67 (61.10)
17.	Water soaking 24 hour	12.00	5.13	5.03	7.39	73.67 (59.11)	74.67 (59.76)	75.67 (60.43)	74.67 (59.76)
18.	Water soaking 48 hour	11.33	4.77	4.70	6.93	74.33 (59.55)	73.33 (58.89)	74.67 (59.76)	74.11 (59.40)
19.	Control	15.00	6.97	6.90	9.62	65.67 (54.12)	68.67 (55.94)	70.00 (56.77)	68.11 (55.60)
	CD (p=0.05)	1.33	0.27	0.33	0.48	4.11	1.73	3.78	2.17

*Figures in parentheses are arcsine transformed values

also stated that priming increased the activity of different enzymes like isocitrate lyase, malate synthase and malate dehydrogenase involved in lipid and sucrose conversion. Similar findings were reported by Nascimento [15] in muskmelon and Islam *et al.* [14] in bitter gourd.

As depicted in table 2 and table 3, maximum seedling length and vigour index-I were recorded when seeds were treated GA_3 100 ppm for 24 hour and GA_3 500 ppm for 24 and 48 hour and significantly better than other priming treatments. The minimum seedling length and vigour index I was observed in untreated seeds. The increase in seedling length due to GA_3 might be due to increased enzymatic activities resulting in increased cell division during germination and hence increased the seedling length. Untreated seeds germinated late than treated seeds and this slow growth also caused less seedling length. Similar results have been reported by Kumar [13] and Bassi *et al.* [17] in brinjal and Peyvast *et al.* [18] in cucumber.

As shown in table 2 and 3 the maximum seedling dry weight and vigour index II was observed in when seeds were treated with dihydrogen orthophosphate 10^{-1}M for 24 hour

Table 2. Effect of different priming treatments on seedling length and dry weight of bottle gourd seed

Sr No	Treatments	Seedling length (cm)				Seedling dry weight (g)			
		2011	2012	2013	Mean	2011	2012	2013	Mean
1.	PEG 6000 0.5Mpa 24 hour	13.50	13.37	13.53	13.47	1.18	1.18	1.18	1.18
2.	PEG 6000 0.5Mpa 48 hour	13.80	13.17	13.23	13.40	1.20	1.19	1.19	1.19
3.	PEG 6000 1.5Mpa 24 hour	13.93	14.13	14.20	14.09	1.25	1.25	1.26	1.25
4.	PEG 6000 1.5Mpa 48 hour	13.40	14.03	14.07	13.83	1.16	1.16	1.16	1.16
5.	Disodium hydrogen phosphate 10^{-3}M 24 hour	14.20	15.50	15.57	15.09	1.23	1.26	1.26	1.25
6.	Disodium hydrogen phosphate 10^{-3}M 48 hour	13.83	15.57	15.67	15.02	1.24	1.28	1.28	1.27
7.	Disodium hydrogen phosphate 10^{-1}M 24 hour	13.90	15.57	15.63	15.03	1.23	1.24	1.24	1.24
8.	Disodium hydrogen phosphate 10^{-1}M 48 hour	14.10	15.73	15.77	15.20	1.21	1.22	1.23	1.22
9.	Potassium dihydrogen phosphate 10^{-3}M 24 hour	14.37	14.53	14.53	14.48	1.39	1.39	1.39	1.39
10.	Potassium dihydrogen phosphate 10^{-3}M 48 hour	14.77	15.37	15.43	15.19	1.41	1.42	1.42	1.42
11.	Potassium dihydrogen phosphate 10^{-1}M 24 hour	14.77	14.57	14.60	14.76	1.47	1.43	1.43	1.44
12.	Potassium dihydrogen phosphate 10^{-1}M 48 hour	15.10	14.97	15.03	14.69	1.42	1.42	1.42	1.42
13.	GA_3 100ppm 24 hour	14.07	16.13	16.20	15.37	1.26	1.34	1.34	1.31
14.	GA_3 100ppm 48 hour	13.77	16.47	16.56	15.64	1.29	1.34	1.35	1.32
15.	GA_3 500ppm 24 hour	13.83	16.50	16.57	15.63	1.31	1.33	1.33	1.32
16.	GA_3 500ppm 48 hour	13.87	16.53	16.54	15.62	1.24	1.33	1.34	1.30
17.	Water soaking 24 hour	13.30	14.77	14.80	14.29	1.23	1.23	1.24	1.23
18.	Water soaking 48 hour	13.43	14.53	14.60	14.19	1.23	1.24	1.24	1.24
19.	Control	13.40	13.90	14.03	13.78	1.19	1.17	1.17	1.18
	C.D. (p=0.05)	0.31	0.67	0.82	0.48	0.031	0.032	0.044	0.026

Table 3. Effect of different priming treatments on vigour indices of bottle gourd seed

Sr No	Treatments	Vigour index I				Vigour index II			
		2011	2012	2013	Mean	2011	2012	2013	Mean
1.	PEG 6000 0.5Mpa 24 hour	971.67	971.30	1011.33	984.77	84.22	85.49	89.30	86.33
2.	PEG 6000 0.5Mpa 48 hour	1003.33	952.87	987.60	981.27	87.37	85.83	90.31	87.84
3.	PEG 6000 1.5Mpa 24 hour	1021.00	1017.50	1060.53	1033.01	92.07	90.25	91.57	91.30
4.	PEG 6000 1.5Mpa 48 hour	952.53	1010.73	1046.30	1003.19	85.10	83.29	87.18	85.19
5.	Disodium hydrogen phosphate 10^{-3}M 24 hour	1044.53	1157.33	1188.63	1130.17	91.50	94.33	98.56	94.80
6.	Disodium hydrogen phosphate 10^{-3}M 48 hour	7091.43	1219.03	1242.23	1160.90	89.57	99.09	103.08	97.25
7.	Disodium hydrogen phosphate 10^{-1}M 24 hour	1071.87	1183.07	1209.33	1154.76	95.60	94.50	97.81	95.97
8.	Disodium hydrogen phosphate 10^{-1}M 48 hour	1092.00	1180.00	1208.43	1160.14	94.57	91.49	93.50	93.19
9.	Potassium dihydrogen phosphate 10^{-3}M 24 hour	1072.60	1114.37	1128.50	1105.15	105.17	106.33	107.07	106.19
10.	Potassium dihydrogen phosphate 10^{-3}M 48 hour	1117.87	1178.10	1203.60	1166.52	108.13	108.62	112.67	109.81
11.	Potassium dihydrogen phosphate 10^{-1}M 24 hour	1224.87	1174.83	1191.83	1197.17	119.50	115.34	118.50	117.78
12.	Potassium dihydrogen phosphate 10^{-1}M 48 hour	1105.33	1132.07	1151.80	1129.73	111.50	107.18	106.73	108.47
13.	GA_3 100ppm 24 hour	1035.30	1242.20	1268.53	1182.01	93.60	103.43	103.41	100.15
14.	GA_3 100ppm 48 hour	1051.37	1240.50	1265.17	1185.68	97.67	100.95	101.00	99.87
15.	GA_3 500ppm 24 hour	1046.57	1270.67	1292.93	1203.39	97.20	102.16	102.22	100.53
16.	GA_3 500ppm 48 hour	1030.87	1284.17	1303.70	1206.24	91.97	103.56	107.22	100.92
17.	Water soaking 24 hour	971.87	1107.50	1120.17	1066.51	89.23	92.08	94.22	91.85
18.	Water soaking 48 hour	1004.47	1051.43	1090.37	945.76	91.67	90.69	93.68	92.01
19.	Control	845.60	954.47	982.07	927.38	77.23	80.33	82.51	80.02
	C.D. (p=0.05)	55.68	55.14	86.27	80.78	8.72	3.31	5.28	3.68

which was significantly higher than other treatments. The minimum seedlings dry weight was noted in untreated seeds. The increase in seedling dry weight could be positively correlated with fast emergence of seedlings and mobilization of seed reserve for utilization in growth and biomass accumulation of the seedlings. Similar findings have been reported by Kumar [13] and Bassi *et al.* [17] in brinjal, Peyvast *et al.* [18] in cucumber and Singh [19] in chilli.

From the present investigation it may be concluded that the seeds of bottle gourd when treated with potassium dihydrogen orthophosphate 10^{-1}M for 24 improved the field emergence, seed vigour and taken less time for emergence.

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