Research Article

Effect of Seed Priming Techniques on Filed Performance of Bitter Gourd (*Momordica Charantia* L.)

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Abstract

The present investigation was set to evaluate the effect of seed priming techniques on filed performance of bitter gourd (*Momordica charantia* L.). Bitter gourd is having hard seed coat. So, it needs a pre sowing treatment as it reduces the germination time, enhances the seedling emergence, germination percentage (%) and uniformity under normal as well as adverse climatic conditions. By keeping this in view, seeds of bitter gourd variety Kahalgaon Local were subjected to various seed priming treatments viz., hydro priming with dist. water, osmo priming with PEG, halo priming with KNO_3 and hormonal treatments with GA_3at various concentrations i.e 2% and 4% with different soaking duration's viz., 12 hrs and 18 hrs keeping unprimed seeds as control. Among various seed priming treatments evaluated, significantly higher speed of emergence, field emergence index, relative growth rate, seedling vigour and average fruit yield per plant of bitter gourd was recorded in GA_3 @ 500 ppm solution for 18 hrs soaking period compared to all other treatments. From this present investigation, it can be defined that pre-treatment of bitter gourd seeds with hormonal treatment i.e., GA_3 @ 500 ppm for 18 hrs soaking duration enhanced field performance of bitter gourd.

Keywords: Seed priming, Bitter gourd, Field performance

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Introduction

Bitter gourd (*Momordica charantia* L.) prefers warm season for its growth and development. It is a viny vegetable crop comes under cucurbitaceae family. It is monoecious in nature and native to South Asia [1]. Fruit juice of bitter gourd has anti-diabetic properties which aid in retaining sugar levels in human body [2]. In India, the area under bitter gourd is 1,07,000 hectares with the production of 12,92,000 MT [3] whereas Bihar constitute an area of 10,002 hectares with the production of 83, 444 MT [4]. The productivity of bitter gourd when compared with national average (12.07 t/ha) is low at Bihar (8.34 t/ha). Generally, the bitter gourd seed germination is disturbed at suboptimal temperatures i.e. below 18°C and one more reason for slow rising of bitter gourd seedlings is thick seed coat enclosing embryo. Hence, the thicker seed coat affects the germination by striking the mechanical strength on embryo growth. This problem of slow or poor germination of bitter gourd seeds can be overcome by plenty of practices and one of them is seed priming [5]. Seed priming is a skillful hydration method in which seeds are dipped in water or low osmotic potential solution to a point where germination linked metabolic events initiate in the seeds but radical emergence does not occur [6]. Seed priming has its great importance in regions where the low temperatures affect the seedling germination and its uniformity. It reduces the germination time, enhances the seedling emergence, germination percentage (%) and uniformity under normal as well as adverse climatic conditions. Seed priming can be achieved in several ways namely; imbibition in distilled water (Hydropriming), imbibition in osmotic solution (Osmopriming), imbibition in salt solution (Halopriming) and imbibitions in hormonal solution (Hormonal treatment). The key process involved in seed priming are, quick start of RNA synthesis, protein synthesis and finally polyribosome formation [7]. Enzymes present in storage reserves are triggered. During the process of seed priming, the water percent of the seed enhances up to 35 to 45% of its weight, it is adequate to trigger the biological actions and progressing seed germination process without radicle emergence. The result of these fluctuations persistent and subsequent desiccation and are available re-imbibition of water during seed sowing, it leads to accomplishment of seed germination speedily and uniformly with synchronized flowering/fruiting in filed.

Material and Methods

Location of experiment

The present investigation was carried out in BAU, Sabour. This place is situated in North Eastern India with the coordinates of longitude of 87° 2' 42" East and latitude of 25° 15' 40'' North and is situated at an altitude of 45.57 m above mean sea level. The prevalent soil type is sandy loam.

Genotypic background the bitter gourd cultivar Kahalgaon Local

Kahalgaon Local is the race/germplasm collected from the farmer's field of Kahalgaon region in Bhagalpur district of Bihar during 2012. Through pure line selection homozygous inbred lines has been developed by department of Horticulture (Vegetable and Floriculture), Bihar Agricultural College, Bihar Agricultural University, Sabour in the year 2018. Now it is very popular among bitter gourd farmers in Bhagalpur district of Bihar.

Experimental details

Experiment was done by using bitter gourd variety Kahalgaon Local. Experiment was laid out in randomized block design with three replications and fifteen treatments including control as shown in **Table 1**. Experiment was conducted during the summer season i.e in the month of March, 2021.

Table 1 Details of experiment

Cultivar used	Kahalgaon Local
Design	Completely randomized design
Replication	03
Treatments	15
Total degree of freedom	(t-1) × (r-1) = (15-1) × (3-1) = 28
Spacing	0.75 m (between the plants) and 2 m (between the rows)
Date of transplanting	25th March 2021

Preparation of chemical/hormonal solutions

2% Polyethylene Glycol 8000 (PEG) solution is made by adding 4g of PEG 8000 into 200 ml of distilled H_2O and 4% solution is made by adding 8g of PEG 8000 into 200 ml of distilled H_2O.2% Potassium nitrate (KNO_3) solution is made by adding 4g of KNO_3 into 200 ml of distilled H_2O and 4% solution is made by adding 8g of KNO_3 into 200 ml of distilled H_2O.500 ppm solution of gibberellic acid (GA_3) is made by adding 100mg of GA_3 into 200 ml of distilled H_2O and 1000 ppm solution is made by adding 200mg of GA_3 into 200 ml of distilled H_2O.

Methods used

Speed of emergence was computed by using fifty seeds in each priming treatment. Daily observations of emerged seedlings were recorded till the final count day (18 days). The speed of emergence was calculated as per formula [8]. Speed of emergence = n/d, Where n = number of seeds emerged and d = number of days taken for field emergence.

For the calculation of field emergence index (%), fifty seeds for each replication were sown in portrays. The number of seeds emerged into seedlings and appearance of seeding through soil after transplanting of one week was counted.

Days to first male flower and first female flower was counted manually from the date of sowing to the anthesis of first male flower and first female flower respectively

Node number to first male flower and first female flower was counted manually i.e. the node at which the first male flower and first female flower appeared was counted. Days to first fruit harvest was recorded by counting the days taken from sowing to the first harvest of fruit at marketable stage.

Average fruit weight (g) was calculated by weight of the individual fruit produced per vine was weighed and divided with total number of fruits and thus the value was recorded as mean fruit weight in gram. Similarly, average yield per plant/vine (kg) was measured by taking the fresh weight of total number of fruits harvested at different pickings till marketable harvest.

Analysis of variance (ANOVA) for randomized block design (RBD)

The ANOVA for RBD procedure was given by [9]. The significance of variation in treatments average was tested by 'F' test. To test the hypothesis H_0:t_1=$t_{2.....}$tv, the fixed effect model for the ANOVA for RBD is,

$$Y_{ij}=\mu+t_i+b_i+e_{ij}$$

Where, Y_{ij}=Yield of i^{th}entry in the j^{th}replication, μ=GM, t_i=Effect of the i^{th} entry (i=1,2….), b_i=Effect of the j^{th} replication (j=1,2….), e_{ij}= Effect of the environment.

$$\text{SE of mean}=\sqrt{\frac{2MSE}{R}}$$

$$\text{C.D.} = \sqrt{\frac{2MSE}{r}} \text{ x t value at 5\% error d.f.}$$

$$\text{C.V. \%}= \sqrt{\frac{MSE}{GM}} \text{ x 100}$$

Results and Discussion

Effect of various seed priming treatments on speed of emergence and field emergence index of bitter gourd cv. Kahalgaon Local

Among various seed priming treatments evaluated, significantly higher speed of emergence was recorded in GA_3 @ 500 ppm solution for 18 hrs soaking duration and the lowest speed of emergence was recorded in PEG @ 4% solution for 18 hrs soaking duration as shown in **Table 2**. Similarly, in case of field emergence index, significantly higher field emergence index was recorded in GA_3 @ 500 ppm solution for 18 hrs soaking period while it was found lowest in PEG @ 4% solution for 18 hrs soaking period as shown in Table 2. It may be happened due to improved seedling vigour, improved root and shoot length.Similar results were obtained by investigation conducted by [10] and [11]. Results were also similar to the experiment conducted by [12]. They reported that bitter gourd seeds primed with 100 ppm of GA_3 for 24 hours gave better germination, field emergence, speed of emergence, seeding length and vigour index-I over the control.

Table 2 Effect of various seed priming treatments on speed of emergence and field emergence index of bitter gourd cv. Kahalgaon Local

Treatments	Speed of emergence	Field emergence index (%)
T_0 (Un primed seed)	9.01	65.98
T_1 (Dist. water for12 h)	10.38	78.64
T_2 (Dist. water for18 h)	14.14	81.30
T_3(2% PEG for 12 h)	10.51	82.69
T_4(2% PEG for 18 h)	9.30	73.33
T_5 (4% PEG for 12 h)	7.96	43.28
T_6 (4% PEG for 18 h)	3.87	38.64
T_7(2% $KNO_3$for 12 h)	8.32	57.38
T_8(2% $KNO_3$for 18 h)	8.95	60.68
T_9 (4% $KNO_3$for 12 h)	11.29	78.35
T_{10} (4% $KNO_3$for 18 h)	12.20	80.00
T_{11} (500 ppm of GA_3 for 12 h)	13.86	84.00
T_{12} (500 ppm of GA_3 for 18 h)	14.93	90.66
T_{13} (1000 ppm of GA_3 for 12 h)	12.88	83.33
T_{14} (1000 ppm of GA_3 for 18 h)	11.59	82.67
C.D. (P=0.05)	0.95	2.22
S.Em±	0.32	0.76

Effect of various seed priming treatments on growth parameters of bitter gourd cv. Kahalgaon Local

Lowest node number to first male and female flower was recorded when seeds were treated with GA_3 @ 500 ppm solution for 18 hrs compared to all other treatments as shown in **Table 3**.

Similarly, the earliest female flowers were recorded when seeds treated withGA_3 @ 500 ppm solution for 18 hrs soaking duration. Whereas, seeds treated with PEG @ 4% solution for 12 hrs soaking duration delayed the appearance of female flowers as shown in Table 3. But there is no significant difference among various treatments in case of days to first male flower as shown in Table 3. It indicated that seed priming treatment cannot influenced the earliness in days to first male flower may be due that particular character is governed but less number of genes. These findings were similar to findings of [13] and [14].

Table 3 Effect of various seed priming treatments on growth parameters of bitter gourd cv. Kahalgaon Local

Treatments	Node to first male flower	Node to first female flower	Days to first male flower	Days to first female flower
T_0 (Un primed seed)	10.67	18.00	45.00	47.00
T_1 (Dist. water for12 h)	11.00	18.00	45.00	49.00
T_2 (Dist. water for18 h)	8.67	20.00	44.00	45.00
T_3(2% PEG for 12 h)	10.67	21.33	43.00	47.00
T_4(2% PEG for 18 h)	11.33	21.00	45.00	49.00
T_5 (4% PEG for 12 h)	12.00	20.00	47.00	53.33
T_6 (4% PEG for 18 h)	14.00	21.00	45.00	49.00
T_7(2% $KNO_3$for 12 h)	10.67	17.00	44.00	49.00
T_8(2% $KNO_3$for 18 h)	10.33	18.67	45.00	49.00
T_9 (4% $KNO_3$for 12 h)	9.33	18.00	44.00	45.67
T_{10} (4% $KNO_3$for 18 h)	10.67	20.00	43.00	51.00
T_{11} (500 ppm of GA_3 for 12 h)	8.00	15.00	45.33	47.00
T_{12} (500 ppm of GA_3 for 18 h)	6.00	12.00	42.00	44.00
T_{13} (1000 ppm of GA_3 for 12 h)	7.00	18.00	45.00	51.00
T_{14} (1000 ppm of GA_3 for 18 h)	10.00	16.33	45.00	47.00
C.D. (P=0.05)	2.43	3.77	N/S	4.04
S.Em±	0.83	1.29	1.43	1.39

Effect of various seed priming treatments on yield parameters of bitter gourd cv. Kahalgaon Local

Results revealed that the effect of various seed priming treatments significantly differed with each other. Lowest number of days to first fruit harvest was recorded in GA_3 @ 500 ppm solution for 18 hrs soaking period which is at par with the treatment GA_3 @ 1000 ppm solution for 18 hrs soaking period and seeds soaked in distilled water for 18 hrsas shown in **Table 4**. The highest number of days taken to first fruit harvest was recorded in the osmo priming treatment with PEG @ 4% solution for 12 hrs soaking period as shown in Table 4. It may be due to the higher speed of emergence of bitter gourd seedlings with higher field emergence.

Among various seed priming treatments evaluated, significantly higher average fruit weight was recorded in GA_3 @ 500 ppm solution for 18 hrs soaking period followed by GA_3 @ 500 ppm solution for 12 hrs soaking period as shown in Table 4. It might have due the higher rate of photosynthesis by the source and translocation, and utilization of food material by the sink [15]. Lowest was recorded in the osmopriming treatment with PEG @ 4% solution for 12 hrs soaking period. It might have due to the induction of heavy osmotic stresses in the bitter gourd seeds leads to disruption of the sprouting processes [16].

Among various seed priming treatments evaluated, significantly higher average fruit yield per plant was recorded in the treatment GA_3 @ 500 ppm solution for 18 hrs (4.67 kg) and the lowest average fruit yield per plant was recorded in PEG @ 4% solution for 12 hrs soaking period (2.33 kg) as shown in Table 4. The Higher average fruit yield per plant was due to the higher average fruit weight and more number of fruits per plant. Results were similar to the experiment conducted by [12]. They reported that bitter gourd seeds primed with 100 ppm of GA_3 for 24 hours gave better germination, field emergence, speed of emergence, seeding length and vigour index-I over the control. [10] reported that treating of bottle gourd seeds with 500 ppm of GA_3 gives the significantly maximum seed germination, vigour index-I, vigour index-II and seedling dry weight compared to dry seeds. [17] conducted an experiment to find out the impact of hormonal priming (GA_3) on seed quality parameters of solanaceous vegetables. He concluded that mean effect of GA_3 was more pronounced in increasing dry weight and more positive in increasing SV-II.

Seed priming of bitter gourd seeds with Gibberellic acid (GA_3) might have create a suitable metabolic reaction in the seeds, which enhanced the seed germination percentage and seedling establishment.From this present investigation, it can be defined that pre-treatment of bitter gourd seeds with hormonal treatment *i.e.* GA_3 @ 500 ppm

for 18 hrs soaking duration caused enhanced germination power, relative growth rate, seedling vigour and yield of bitter gourd.

Plant growth is based mainly upon photosynthesis, while its performance is mostly dependent on the opening/closing of stomata, which controls rate of photosynthesis, rate of respiration, and CO_2 index [15]. The results of the present study revealed that the maximum photosynthesis rate, transpiration rate, and CO_2 index was observed in bitter gourd plants grown by seeds primed with 500 ppm of GA_3 for 18 hrs soaking period, compared to all other priming treatments. Our study is in validation with another study in which treating of bottle gourd seeds with 500 ppm of GA_3 gives the significantly maximum seed germination, vigour index I, vigour index II and seedling dry weight compared to dry seeds [10]. The photosynthesis rate of the seedlings has a positive correlation with the growth of seedling [18].

Table 4 Effect of various seed priming treatments on yield parameters of bitter gourd cv. Kahalgaon Local

Treatments	Days to first fruit harvest	Average fruit weight (g)	Average Fruit yield (kg/plant)
T_0 (Un primed seed)	58.00	61.63	3.21
T_1 (Dist. water for12 h)	57.00	52.16	2.92
T_2 (Dist. water for18 h)	55.00	62.21	3.85
T_3(2% PEG for 12 h)	55.33	73.52	3.08
T_4(2% PEG for 18 h)	58.00	66.63	3.39
T_5 (4% PEG for 12 h)	61.33	58.36	2.33
T_6 (4% PEG for 18 h)	58.00	66.02	2.89
T_7(2% $KNO_3$for 12 h)	58.00	73.36	2.34
T_8(2% $KNO_3$for 18 h)	57.00	68.17	2.38
T_9 (4% $KNO_3$for 12 h)	55.00	50.96	3.13
T_{10} (4% $KNO_3$for 18 h)	60.00	51.35	3.00
T_{11} (500 ppm of GA_3 for 12 h)	57.00	76.47	3.91
T_{12} (500 ppm of GA_3 for 18 h)	52.00	77.99	4.67
T_{13} (1000 ppm of GA_3 for 12 h)	60.00	67.95	3.88
T_{14} (1000 ppm of GA_3 for 18 h)	55.00	70.98	3.66
C.D. (P=0.05)	3.08	1.30	0.31
S.Em±	1.06	0.44	0.10

Conclusion

From this investigation it is concluded that, seeds treated with 500 ppm of GA_3 for 18 hrs soaking duration enhanced the field performance of bitter gourd in terms of speed of emergence, earliness, average fruit weight and average fruit yield per plant. It might have happened due to maximum photosynthesis rate, transpiration rate, and CO_2 index. Whereas seeds treated with PEG @ 4% solution for 18 hrs soaking duration gives the poor results in terms of growth and yield parameters of bitter gourd. It may be due to the induction of heavy osmotic stresses in the bitter gourd seeds leads to disruption of the sprouting processes.

Future scope

We optimize the concentration of various chemicals for seed priming treatment of bitter gourd to enhance the germination percentage and uniformity under normal as well as adverse climatic conditions. Farmers may go for the cultivation of bitter gourd through optimized seed priming treatments under unfavorable conditions. It may enhance the field performance of bitter gourd in terms of growth as well as yield parameters.

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