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Effect of Seed Priming on Field Emergence and Yield in Different Bitter Gourd Cultivars (*Momordica charantia* L.) Under Sub-Optimal Temperature

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ABSTRACT: The present investigation was carried at Vegetable Research Farm of Department of Vegetable Science, PAU Ludhiana. The experiment was laid in split plot design with five genotypes (Punjab 14, Punjab Kareli, Jaunpuri Long, Katahi and Green Special Long) in main plot and six treatments along with control (hydration for 24 hours, GA_3 @ 100 ppm for 24 hours, KNO_3 @ 100 ppm for 24 hours, KH_2PO_4 @ 10^{-3} M for 24 hours, hydration for 24 hours and buried in FYM for 1 day, hydration for 24 hours and buried in FYM for 2 days) in sub plot. Seeds were sown in polythene bags during third week of January 2012. The results revealed that pre sowing treatment with GA_3 @ 100 ppm for 24 hours resulted in maximum germination (%), field emergence, speed of emergence, vine length, days to first harvest, number of fruits per plant and yield per plant. Among various genotypes tested, cultivars Katahi, Punjab 14 and Jaunpuri Long responded better to seed priming treatments than other cultivars.

Key words: Bitter Gourd, Vigour, Priming, Genotypes, GA_3

Bitter gourd is a tropical vine which prefers high humidity and warm weather, for optimum growth. For successful seedling emergence, it requires temperature range from 25-28°C. It may fail or take a long time to germinate if the soil temperature is below 20°C and when temperature goes below 15°C, germination ceases. Poor emergence is a common problem in bitter gourd even with the seeds of high germinability, due to thick seed coat. It affects germination by imposing mechanical restriction on embryo growth and seeds sown directly in the open field fail to germinate or germinate late [1] resulting in poor crop stand. Under north Indian conditions cucurbits are generally grown in early winter in polythene bags/plug tray nursery to fetch the premium price of early market, but due to low temperature prevailing during that period (Table 1) it 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. Priming initiates metabolic activities, such as protein, RNA and DNA synthesis, DNA replication and b-tubulin accumulation [2].

Seed priming, one of the techniques to promote germination, advances physiological status of the seeds just up to root extrusion, by controlling water supply or other priming agents. 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 [3]. Application of plant growth regulators induce & cause breakdown of seed reserves in storage tissue and/or increases the activity of enzymes concerning with mobilization, resulting in improved seed germination [2]. For enhancing germination and improving stand establishment,

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seed priming has been suggested]. Priming has shown to increase germination rate and uniformity in several crops [4].

Since the choice of farmers is different for varieties, genotypic response to different seed priming treatments needs to be investigated. Therefore present investigation was planned to assess the response of different bitter gourd varieties to various seed priming treatments and to identify the best seed priming treatment for bitter gourd varieties for improving emergence and vigour under sub optimal conditions.

MATERIALS AND METHODS

The experiment was conducted during summer season of 2012 at the Research Form of the Department of Vegetable Science, Punjab Agricultural University, Ludhiana. The Region is characterized by hot summer and cold winter with semi-arid and sub-tropical climate, which represents the 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 meteorological month wise data during investigation is given in Table 1.

The experiment was laid-out in split plot with five genotypes (Punjab-14, Punjab Kareli, Katahi, Green Special Long, Jaunpuri Long) in the main plots and six priming treatments along with control (hydration for 24 hours, soaking seed in 100 ppm solution of GA_3 for 24 hour, soaking seed in 100 ppm solution of KNO_3, soaking the seed for 24 hours in Potassium dihydrogen phosphate 10^{-3} M, hydration for 24 hours and then buried in FYM for 1 day, hydration for 24 hour and then buried in FYM for 2 days) as sub-plots. Following the treatment, seeds were air dried at room temperature until their original weight had been restored. After drying, the seeds were taken to field immediately for sowing in polythene bags during third week of January 2012.

The observation under field conditions were recorded on field emergence (%), speed of emergence, vine length (cm), days taken for first fruit harvesting, number of fruits per plant and yield per plant (g).

To determine field emergence, 100 seeds per replication for each priming treatment were sown in polythene bag. The number of seeds that emerged and developed into seedlings after 24 days was counted. Speed of emergence was computed by recording daily observations on 100 seeds sown in polythene bags until the final count day (24 days). The speed of emergence was calculated as total number of seeds emerged on day basis, and the mean was calculated [5]. Vine length was measured at the time of last picking of five tagged plants. For determining number of days taken for first fruit harvest, five plants

Table 1: Mean monthly meteorological data during the crop growth period of bitter gourd (2012)

Month	Air temperature (°C)			Relative humidity (%)			Soil temperature at 5cm depth (°C)			Rainfall (mm)
	Max	Min	Mean	Morning	Evening	Mean	Morning	Evening	Mean	Total
January	16.9	5.6	11.3	96	61	79	7.0	16.6	12.0	52.6
February	19.9	6.7	13.2	91	48	67	8.7	22.6	15.7	4.6
March	27.3	11.6	19.5	88	37	60.6	15.3	30.9	22.9	0.0
April	33.8	18.1	26.0	75	32	51	22.0	37.8	29.5	38.6
May	39.6	22.6	31.1	47	18	31.8	27.9	44.9	35.7	1.6
June	40.6	27.2	33.9	57	32	43	33.3	46.9	39.4	3.5

per replication in the plot were tagged and the number of days from date of sowing was calculated and average was taken out. Total number of fruits harvested from all picking of five tagged plants in each replication was recorded and average was calculated as number of fruit per plant. Total weight of fruits harvested from all picking of five randomly tagged plants in each replication was recorded and average was calculated as yield per plant. The statistical analysis was done as a split plot design analysis which was described by Steel and Torrie [7].

RESULTS AND DISCUSSION

The highest field emergence was observed in cultivar Katahi followed by Jaunpuri Long and Green Special Long with GA_3 treatment and these were significantly better than control (Table 2). The minimum field emergence was recorded in cultivar Punjab Kareli without seed treatment. The variation in field emergence among genotypes might be due to their genetic makeup. This GA_3 might have increased the á-amylase activity for breaking starch stored in seeds during imbibitions, thereby increasing germination enhancing metabolites and building up osmotic adjustments [2]. Primed seeds exhibited a rapid, greater and uniform emergence. Pre-sowing hydration might have softened the seed coat that allowed the leakage of germination inhibitors in the seed and this might have contributed to the enhancement of seed emergence [2]. Lin and Sung [8] 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 Islam *et al.* [9] in bitter gourd.

The cultivar Katahi recorded maximum speed of emergence (Table 3) when seeds were primed with GA_3 followed by cultivar Punjab 14 and Jaunpuri Long with same treatment. The minimum speed of emergence was recorded in cultivar Punjab Kareli. 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 [8] 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 Islam *et al* [9] in bittergourd.

Table 2. Effect of seed priming on field emergence (%) of different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	66.00	63.33	69.00	71.66	70.33	68.06
Hydration	71.00	69.00	74.00	76.00	74.00	72.80
GA_3	75.66	72.66	76.00	79.00	76.66	76.00
KNO_3	76.33	72.00	77.33	76.00	76.00	75.53
KH_2PO_4	76.66	72.00	77.00	77.00	75.66	75.66
Hydration + FYM for 1 day	75.33	71.66	77.66	76.66	75.66	75.40
Hydration + FYM for 2 days	75.33	71.66	75.33	76.33	75.33	74.80
Mean	73.76	70.33	75.19	76.09	74.80	
CD at 5%	Varieties: 0.77 Treatments: 0.93 Genotype x treatment: 2.08					

Table 3. Effect of seed priming on speed of emergence (%) of different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	3.24	3.14	3.37	3.72	3.64	3.42
Hydration	4.15	3.79	4.16	4.63	4.41	4.23
GA_3	4.69	4.41	4.72	5.10	4.88	4.76
KNO_3	4.43	4.04	4.46	4.69	4.42	4.41
KH_2PO_4	4.49	4.38	4.42	4.76	4.51	4.51
Hydration + FYM for 1 day	4.36	4.14	4.63	4.54	4.53	4.44
Hydration + FYM for 2 days	4.34	4.03	4.57	4.56	4.44	4.39
Mean	4.24	3.99	4.33	4.57	4.41	
CD at 5%	Varieties: 0.036 Treatments: 0.043 Genotype x treatment: 0.095					

The vine length was significantly influence by the seed priming treatment. As evident from (Table 4), it showed that maximum vine length was in cultivar Punjab Kareli when seeds were primed with GA_3 treatment followed by KNO_3 in same cultivar. The minimum vine length was

Table 4. Effect of seed priming on vine length in different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	125.00	171.67	139.00	134.67	157.67	145.60
Hydration	132.00	203.67	144.27	136.00	164.33	156.05
GA_3	153.33	207.33	153.00	144.33	168.67	165.33
KNO_3	131.33	191.00	142.33	145.00	157.33	153.40
KH_2PO_4	137.33	195.00	139.00	140.33	156.33	153.60
Hydration + FYM for 1 day	141.00	193.00	140.33	140.67	155.67	154.13
Hydration + FYM for 2 days	143.33	191.67	135.33	139.67	154.67	152.93
Mean	137.62	193.33	141.90	140.10	159.24	
CD at 5%	Varieties: 5.27 Treatments: 4.64 Genotype x treatment: 10.37					

observed in cultivar Punjab 14 with untreated seeds. The beneficial effects in

respect to vine length of the plant can be attribute to cell elongation and enlargement as well as quick cell multiplication in cambium tissue caused by GA_3 priming treatment. Moreover the variation in vine length among various genotypes may be due to the genetic makeup of these cultivars.

Among various cultivars, the Jaunpuri Long required significantly minimum number of days to first fruit harvesting when seeds were treated with GA_3 followed by treatments KNO_3 and hydration and followed by cultivar Punjab 14 with GA_3 treatment. (Table 5) The maximum number of days taken to first fruit harvesting was recorded in cultivar Punjab Kareli with untreated seeds. The reduction in number of days taken to first fruit harvesting with GA_3 treatment may be attributed to the fact that these treatment had hastened the germination speed, growth of seedling and early flowering, which helped to attained early maturity of the plant, resulting in less number of days to fruit harvesting.

The cultivar Punjab 14 produced highest number of fruits per plant when seeds were treated with GA_3 followed by Katahi with GA_3 seed treatment (Table 6). The cultivar Punjab Kareli produced lowest number of fruits per plant with untreated seeds. The higher number of fruits per plant obtained by GA_3 treatment may be due to the reason that treated plant has produced more flowering and fruiting because they remained physiologically more active to build up significant food reserve, resulting in more number of fruits per plant.

The cultivars Jaunpuri Long recorded significantly higher yield per plant followed by Katahi and Green Special Long when seeds were treated with GA_3 (Table 7). The minimum yield per plant was found in cultivar Punjab 14 with untreated seeds. Increased yield may be due to increase in vine length, duration of crop and number of fruits per plant. The variation among different genotypes for yield may be due to their genetic make up. The increased in yield per plant can be attributed to the fact that GA_3 had increased the vine length and number of fruits per plant. Thus it can be presumed that GA_3 treated plants have more flowering and fruiting resulting in increased yield per plant.

Table 5. Effect of seed priming on number of days to first fruit harvest in different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	15.83	12.73	18.17	19.40	18.00	16.83
Hydration	16.40	12.90	19.13	20.37	18.63	17.49
GA_3	16.90	13.07	19.47	20.70	19.03	17.83
KNO_3	15.93	13.23	18.70	20.30	18.83	17.40
KH_2PO_4	16.40	13.10	19.13	20.67	18.50	17.56
Hydration + FYM for 1 day	16.83	13.27	18.73	20.57	19.00	17.68
Hydration + FYM for 2 days	16.60	12.67	19.00	20.77	19.13	17.63
Mean	16.41	13.00	18.90	20.40	18.73	
CD at 5%	Varieties: 0.48 Treatments: 0.43 Genotype x treatment: NS					

Table 6. Effect of seed priming on number of fruits per plant in different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	15.83	12.73	18.17	19.40	18.00	16.83
Hydration	16.40	12.90	19.13	20.37	18.63	17.49
GA_3	16.90	13.07	19.47	20.70	19.03	17.83
KNO_3	15.93	13.23	18.70	20.30	18.83	17.40
KH_2PO_4	16.40	13.10	19.13	20.67	18.50	17.56
Hydration + FYM for 1 day	16.83	13.27	18.73	20.57	19.00	17.68
Hydration + FYM for 2 days	16.60	12.67	19.00	20.77	19.13	17.63
Mean	16.41	13.00	18.90	20.40	18.73	
CD at 5%	Varieties: 0.48 Treatments: 0.42 Genotype x treatment: NS					

Table 7. Effect of seed priming on yield/plant in different cultivars of bittergourd

Treatment/variety	Punjab 14	Punjab Kareli	Jaunpuri Long	Katahi	Green Special Long	Mean
Control	558.73	629.17	951.27	911.53	905.87	791.31
Hydration	590.87	645.20	994.13	970.40	931.33	826.39
GA_3	608.87	650.03	1012.33	993.30	957.80	844.47
KNO_3	563.00	662.13	972.07	967.47	960.33	825.00
KH_2PO_4	590.20	664.60	1001.13	984.40	925.30	833.13
Hydration + FYM for 1 day	589.50	671.50	968.93	967.47	962.47	831.97
Hydration + FYM for 2 days	591.73	621.13	993.57	990.27	963.43	832.03
Mean	584.70	649.11	984.78	969.26	943.79	
CD at 5%	Varieties: 18.59 Treatments: 31.15 Genotype x treatment: NS					

From the present investigation it may be concluded that the seeds of different bitter gourd genotypes when treated with GA_3 @ 100 ppm for 24 hours under sub optimal conditions improved the germination, field emergence, seed vigour, number of fruits per plant and yield per plant.

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