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Seed Priming for Improving Seed Germination and Growth of Peach cv. Sharbati

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Abstract

The experiment entitled "Seed priming for improving seed germination and growth of peach cv. Sharbati" was carried out in Horticultural Experimental Area, Nursery, P.G. Department of Agriculture, Khalsa College, Amritsar during the year 2021-22. In this study, peach seeds were treated with different pre-sowing treatments and planted in polythene bags having size 7×7 inches. The experiment was performed in Randomized Block Design with three replications and was assessed to know the effect of different treatments on seed germination and growth. Ten treatments comprised soaking of peach seeds in H_2SO_4 for 5 and 10 minutes, KNO_3 (1% and 2%) for 24 hours, kinetin (0.50 ppm) and kinetin (0.75 ppm) for 24 hours, GA_3 @ 500, 1000 and 1500 ppm for 24 hours and control (untreated seeds). The result obtained in the present studies showed that among different treatments, seeds treated with GA_3 @ 1500 ppm for 24 hours recorded the minimum days (22.00 days) required for initiation of germination, 50 per cent germination (28.66 days), complete germination (35.66 days) and maximum germination (46.66 % and 66.66 %) which was at par with the application of GA_3 @ 1000 ppm for 24 hours while the maximum days (39.66 days) taken for germination were recorded with control (without soaking). Application of GA_3 @ 1500 ppm also proved to be superior in the production of maximum plant height, number of leaves, leaf area, stem diameter at 30, 60, 90, 120 and 150 DAS.

Keywords: Peach; Seed Germination; Seed priming; Dormancy; Vigour index; Seedling survival

Introduction

Peach (*Prunus persica* L. Batsch) belongs to the family Rosaceae and sub-family Prunoideae. It is an important stone fruit, their flesh surrounds one large middle seed, and has been extensively consumed worldwide due to its delicious taste, unique flavor and high nutritional value (Ali and Hama, 2014). The peach is largely self-fertile (Chaurasiya and Mishra, 2017). There are at least 77 wild species of Prunus and most of them are found in central Asia, while polyploidy is common in the genus Prunus, the cultivated peach is diploid and has a chromosome number of 2n = 2x = 16 (Hancock et al., 2008). Peaches have a good position among stone fruits and are rated as the third most important temperate fruit next to apple and pear (Wang, 1998). Peach is a quite hardy fruit preferring cold winter and sunny dry spring and its chilling requirement is below 7 °C temperature for 650-1100 hrs. The sub-tropical peaches have come out as a promising fruit crop in North Western plains due to the availability of required chilling hours (Gangwar et al., 2005). Peach thrives well on light sandy soils (Kant et al., 2018). Fruits are rich source of minerals, vitamins and contain a good amount of sugars. This fruit is also a potential source of bioactive compounds, carrying medicinal benefits like a potential protection against various chronic diseases (Kim, 2014). Seeds of stone fruits do not germinate immediately and they show dormancy when the peaches are freshly harvested and need two to three months of stratification for better seed germination and seedling growth.

The germination inhibitors exist at different concentrations in different parts of the seed such as seed coat, pericarp, cotyledons and embryo (Martinez and Dicenta, 2001). Various methods have been tried to overcome the dormancy of stone fruits. Priming is a method that can improve seed performance under the stress conditions such as drought or freshly harvested or aged seeds that might fail to germinate (Binang et al., 2012). Seed priming has been commonly used to reduce the time between seed sowing to seedling emergence (Parera and Cantliffe, 1994).

Material and methods

The experiment was conducted at the P.G. Department of Fruit Science of Agriculture, Khalsa College, Amritsar. The trial was conducted during the winter season. The experiment was laid out in Randomized Block Design with three replications having fifty seeds in each replication, seeds are planted in polythene bags having size 7×7 inches. The experiment was performed in ten treatments which include seeds treated with T_1 and T_2 (H_2SO_4 concentrated for 5 minutes and 10 minutes), T_3 and T_4 (KNO_3 1% and 2% for 24 hours), T_5 and T_6 (Kinetin 0.50 ppm and 0.75 ppm), T_7, T_8 and T_9 (GA_3 500 ppm, 1000 ppm and 1500 ppm) and T_{10} (control).

The data were recorded on various germination parameters namely days taken to initiation of germination, days taken to 50 per cent and complete germination, germination percentage at 30 and 60 days after sowing and growth parameters which include plant height, stem diameter, number of leaves per seedling and leaf area at 30, 60, 90, 120 and 150 days after sowing. The mean data was separated using LSD test. Difference was considered significant at the level $p \leq 0.05$ using statistical analysis system software Statistix 10.

Result and Discussion

Days taken to initiation of germination

Minimum number of days taken (22 days) for initiation of germination was recorded in the seeds treated with GA_3 @ 1500 ppm for 24 hours which was statistically at par with seeds treated with GA_3 @ 1000 ppm for 24 hours followed by 0.75 ppm kinetin for 24 hours (25.33 days). The highest number of days (39.66 days) taken for initiation of germination was recorded in control. GA_3 upsurges the growth potential of the embryo and indorses germination, it is also required to overcome the mechanical restraint conferred by the seed covering layers by weakening the tissues surrounding the radical (Shah et al., 2013). The above result is in conformity with Barche et al. (2010), Anburani and Shakila (2010) and Dhinesh et al. (2010) and Babu et al. (2010) in papaya, who recorded the least number of days occupied to initiate germination in GA_3.

Days taken to 50 per cent and complete germination

Seed priming with GA_3 @ 1500 ppm for 24 hours registered to take minimum days (28.66 days) for 50 per cent germination which was at par with GA_3 @ 1000 ppm for 24 hours and 0.75 ppm kinetin for 24 hours followed by concentrated H_2SO_4 treatment for 10 minutes. The highest number of days (49.66 days) taken to reach 50 per cent germination were noted in control. The findings are supported by Ynoue et al. (1999) who reported that the GA_3 @ 1500 ppm reduced the average time of germination on kiwi fruit seeds, this might be due to the stimulating effect of imbibition on seed germination caused by improved water absorbing capacity (Cho and Lee, 2018). The minimum number of days (35.66 days) required for complete germination was observed in seeds treated with GA_3 @ 1500 ppm for 24 hours followed by GA_3 @ 1000 ppm for 24 hours i.e. (37.66 days). The maximum number of days (54.33 days) taken for complete germination was found in control. The present findings are in agreement with the findings of Bagal (2004), who observed better 50 per cent germination with GA_3 treatment in aonla. The present findings are also corroborating with the research findings of Vasantha et al. (2014) in tamarind.

Germination per cent at 30 and 60 days after sowing

Maximum seed germination (46.66 %) at 30 DAS was recorded in seeds treated with GA_3 @ 1500 ppm for 24 hours which was statistically at par with GA_3 @ 1000 ppm for 24 hours followed by seeds treated with concentrated H_2SO_4 for 10 minutes and 5 minutes (36.33 % and 33.33 %).

However, no seed germination initiated up to 30 DAS in control. At 60 DAS, the seeds treated with GA_3 @ 1500 ppm for 24 hours recorded the maximum germination (66.66 %) which was followed by GA_3 @ 1000 ppm for 24 hours (63.66 %). The minimum germination percentage at 60 days was in control (27.66 %). High per cent of germination was recorded when seed soaked in GA_3 might be due to the fact that GA_3 helps in the synthesis of α-amylase enzyme which changes the starch into simple sugars during the process of germination. Gibberellic acid also boosts cell elongation, so the radical can push through the endosperm and seed coat that limit its growth (Hartman and Kester 1979). The results are in conformity with the findings reported by Anburani and Shakila (2010) and Deb et al. (2010) in papaya.

Table 1. Effect of seed priming on germination attributes of peach cv. Sharbati

Treatments	Initiation of germination (days)	50 per cent germination (days)	Complete germination (days)	Germination % at 30 DAS	Germination % at 60 DAS
H_2SO_4 Conc. 5 min	26.33 ± 0.72^{cd}	35.00 ± 0.47^{bcd}	38.00 ± 0.47^{de}	33.33 ± 0.98^{b}	$43.33 \pm 1.51^{cde.}$
H_2SO_4 Conc. 10 min	27.33 ± 0.98^{bcd}	33.00 ± 0.94^{def}	41.33 ± 0.72^{c}	36.33 ± 0.72^{b}	46.33 ± 1.44^{bc}
KNO_3 (1%)	29.66 ± 0.72^{b}	37.33 ± 0.72^{b}	46.33 ± 0.72^{b}	30.33 ± 0.47^{cd}	41.66 ± 1.18^{e}
KNO_3 (2%)	27.00 ± 0.47^{bcd}	36.66 ± 0.72^{bc}	40.00 ± 0.47^{cd}	26.66 ± 0.72^{cd}	45.33 ± 1.65^{bcd}
Kinetin (0.50 ppm)	26.00 ± 0.47^{cd}	37.00 ± 0.47^{b}	41.00 ± 0.47^{c}	35.00 ± 0.72^{e}	43.00 ± 1.41^{de}
Kinetin (0.75 ppm)	25.33 ± 1.18^{d}	31.00 ± 0.98^{efg}	38.33 ± 0.98^{de}	29.00 ± 0.47^{c}	47.00 ± 1.24^{b}
GA_3 (500 ppm)	28.66 ± 1.65^{bc}	34.00 ± 0.47^{cde}	39.33 ± 0.72^{cde}	25.66 ± 0.98^{de}	30.66 ± 1.90^{f}
GA_3 (1000 ppm)	24.66 ± 0.72^{de}	30.33 ± 0.47^{fg}	37.66 ± 0.72^{ef}	44.66 ± 1.44^{a}	63.66 ± 0.72^{a}
GA_3 (1500 ppm)	22.00 ± 0.47^{e}	28.66 ± 0.72^{g}	35.66 ± 1.18^{f}	46.66 ± 0.72^{a}	66.66 ± 1.18^{a}
Control	39.66 ± 0.72^{a}	49.66 ± 0.98^{a}	54.33 ± 0.72^{a}	0.00 ± 0^{f}	27.66 ± 0.72^{f}
CD($p \leq 0.05$)	2.938	2.898	2.260	3.091	3.256

Plant height

Soaking the seeds in GA_3 @ 1500 ppm solution for 24 hours recorded the maximum plant height (4.83 cm, 15. 33 cm, 33.70 cm, 46.80 cm and 56.13 cm) on 30, 60, 90, 120 and 150 DAS respectively. The minimum plant height (2.86 cm) was observed in seeds soaked with 0.75 ppm of kinetin for 24 hours. However, no seed germination initiated up to 30 DAS in control. The control (untreated seeds) registered the minimum plant height (6.20 cm, 16.56 cm, 26.66 cm and 37.06 cm) at 60, 90, 120 and 150 DAS respectively. The maximum plant height in GA_3 treated seeds might be credited to the fact that this hormone improved osmotic uptake of nutrients, triggering cell multiplication and elongation in the cambium tissue of the internodal region leading to rise in height of the plant because GA_3 seemingly triggers the metabolic processes or nullifies the consequence of growth inhibitors (Barathkumar, 2019). The results are in accordance with the findings of Harshavardhan and Rajasekhar (2012) in jackfruit.

Table 2. Effect of seed priming on plant height (cm) of peach cv. Sharbati

Treatments	30 Days	60 Days	90 Days	120 Days	150 Days
H_2SO_4 Conc. 5 min	3.26 ± 0.07^{b}	7.16 ± 0.36^{e}	23.83 ± 0.17^{d}	36.56 ± 0.65^{c}	45.20 ± 0.87^{d}
H_2SO_4 Conc. 10 min	3.00 ± 0.04^{b}	7.80 ± 0.38^{de}	20.60 ± 0.43^{e}	31.56 ± 0.62^{d}	47.96 ± 0.81^{c}
KNO_3 (1%)	2.90 ± 0.04^{b}	8.50 ± 0.23^{d}	17.90 ± 0.62^{f}	28.60 ± 0.43^{ef}	42.50 ± 0.82^{e}
KNO_3 (2%)	3.10 ± 0.14^{b}	8.03 ± 0.02^{d}	17.40 ± 0.52^{f}	30.36 ± 0.73^{de}	45.06 ± 0.09^{d}
Kinetin (0.50 ppm)	3.23 ± 0.19^{b}	12.03 ± 0.19^{b}	29.73 ± 0.42^{b}	37.76 ± 0.77^{c}	45.00 ± 0.68^{de}
Kinetin (0.75 ppm)	2.86 ± 0.21^{b}	10.03 ± 0.19^{c}	26.86 ± 0.50^{c}	32.16 ± 0.43^{d}	47.00 ± 1.29^{cd}
GA_3 (500 ppm)	3.03 ± 0.07^{b}	7.32 ± 0.27^{e}	24.03 ± 0.28^{d}	36.63 ± 0.78^{c}	50.93 ± 0.73^{b}
GA_3 (1000 ppm)	4.56 ± 0.23^{a}	14.40 ± 0.04^{a}	31.76 ± 0.40^{ab}	45.26 ± 0.36^{a}	52.90 ± 0.53^{b}
GA_3 (1500 ppm)	4.83 ± 0.07^{a}	15.33 ± 0.23^{a}	33.70 ± 1.00^{a}	46.80 ± 0.61^{a}	56.13 ± 0.52^{a}
Control	0.00 ± 0^{c}	6.20 ± 0.12^{f}	16.56 ± 0.61^{f}	26.66 ± 0.43^{f}	37.06 ± 0.14^{f}
CD ($p \leq 0.05$)	0.491	0.792	2.062	1.942	2.537

Stem diameter

Seeds soaking in GA_3 @ 1500 ppm for 24 hours recorded the maximum stem diameter (1.07 mm) at 30 DAS which was at par with GA_3 @ 1000 ppm for 24 hours and KNO_3 @ 1 % for 24 hours followed by concentrated H_2SO_4 for 10 minutes (0.87 mm). There were no seed germination takes place in control on 30 days after sowing. At 60, 90, 120 and 150 DAS, seeds treated with GA_3 @ 1500 ppm for 24 hours showed significantly higher stem diameter (2.02 mm, 3.11 mm, 4.58 mm and 5.51 mm). The minimum stem diameter was recorded in control (0.21 mm, 1.62 mm, 1.63 mm and 3.42 mm). The increase in the stem diameter by the treatment of gibberellic acid may be due to the fact that it caused the stimulation of cambium cells and immediate cell progeny by cell multiplication process (Dhankhar and Singh, 1996). Our results are in agreement with Kumar and Shahnaz (2013), who visualized an increased seedling diameter in the wild apricot seeds soaked in different concentrations of gibberellic acid.

Table 3: Effect of seed priming on stem diameter (mm) of peach cv, sharbati

Treatments	30 Days	60 Days	90 Days	120 Days	150 Days
H_2SO_4 Conc. 5 min	0.73 ± 0.09^{bc}	1.42 ± 0.07^{bcd}	2.56 ± 0.06^{bcd}	3.42 ± 0.09^{cd}	4.56 ± 0.06^{bc}
H_2SO_4 Conc. 10 min	0.87 ± 0.09^{ab}	1.61 ± 0.04^{bc}	2.67 ± 0.02^{bc}	3.57 ± 0.06^{cd}	4.49 ± 0.04^{bc}
KNO_3 (1%)	1.02 ± 0.01^{a}	1.63 ± 0.14^{b}	2.87 ± 0.03^{ab}	4.18 ± 0.02^{b}	4.65 ± 0.05^{b}
KNO_3 (2%)	0.52 ± 0.08^{c}	1.28 ± 0.13^{d}	2.33 ± 0.13^{d}	3.32 ± 0.05^{d}	3.69 ± 0.08^{d}
Kinetin (0.50 ppm)	0.60 ± 0.08^{c}	1.33 ± 0.12^{cd}	2.42 ± 0.12^{cd}	3.51 ± 0.05^{cd}	4.39 ± 0.06^{c}
Kinetin (0.75 ppm)	0.65 ± 0.10^{bc}	1.46 ± 0.06^{bcd}	2.47 ± 0.06^{cd}	3.50 ± 0.09^{cd}	4.40 ± 0.06^{c}
GA_3 (500 ppm)	0.73 ± 0.09^{bc}	1.42 ± 0.07^{bcd}	2.64 ± 0.03^{bcd}	3.43 ± 0.10^{cd}	4.37 ± 0.11^{c}
GA_3 (1000 ppm)	1.03 ± 0.03^{a}	2.01 ± 0.01^{a}	3.09 ± 0.05^{a}	3.63 ± 0.11^{c}	5.12 ± 0.007^{a}
GA_3 (1500 ppm)	1.07 ± 0.007^{a}	2.02 ± 0.01^{a}	3.11 ± 0.04^{a}	4.58 ± 0.01^{a}	5.51 ± 0.08^{a}
Control	0.00 ± 0^{d}	0.21 ± 0.002^{e}	1.62 ± 0.15^{e}	1.63 ± 0.14^{e}	3.42 ± 0.10^{e}
CD ($p \leq 0.05$)	0.232	0.305	0.320	0.310	0.234

Number of leaves per seedling

Seeds treated with GA_3 @ 1500 ppm for 24 hours recorded the maximum number of leaves per seedling (4.66) on 30 DAS which was statistically at par with GA_3 @ 1000 ppm solution for 24 hours. However, no seed germination takes place in control at 30 days after sowing. At 60, 90, 120 and 150 DAS, seeds treated with GA_3 @ 1500 ppm for 24 hours showed significantly higher number of leaves (21.66, 36.33, 43.66 and 48.33) respectively. The minimum number of leaves was recorded in control (5.00, 14.33, 16.33 and 31.00). Plant height is directly correlated to the number of leaves, which means more height, more will be the number of leaves and hence additional photosynthetic area which ultimately leads to more yield and productivity (Kaushal, 2016). Our findings are in consonance with the studies of Al-Hawezy (2013), who also found that the seed treatment of GA_3 resulted into increased number of leaves, while studying the effect of different concentration of gibberellins on germination and seedling growth in loquat.

Leaf area

Maximum leaf area (15.76 mm^2) was recorded in seedling raised from seeds treated with GA_3 @ 1500 ppm for 24 hours at 30 DAS followed by GA_3 @ 1000 ppm for 24 hours (13.43 mm^2). However, no seed germination initiated up to 30 days after sowing in control. At 60, 90, 120 and 150 DAS, seeds treated with GA_3 @ 1500 ppm for 24 hours showed significantly higher leaf area (25.00 mm^2, 32.60 mm^2, 38.50 mm^2 and 44.56 mm^2) respectively. The minimum leaf area was recorded in control (10.03 mm^2, 15.60 mm^2, 18.40 mm^2 and 24.30 mm^2) respectively. The increase in leaf area with seed coat removal may be due to the reason that early germination ultimately increased the seedling vigour. Hence, the better leaf area was correlated with vigorous plants. These results are in line with Muralidhara et al. (2016), who studied the effect of seed coat removal on seed germination and seedling vigour in mango and found that the elimination of seed coat caused maximum leaf area. The present results are in conformism with the conclusions of Anjanawe et al. (2013) who also spotted the maximum leaf area in papaya seedlings with GA_3 application.

Table 4: Effect of seed priming on number of leaves of peach cv. Sharbati

Treatments	30 Days	60 Days	90 Days	120 Days	150 Days
H_2SO_4 Conc. 5 min	9.13 ± 0.16^{e}	12.80 ± 0.14^{ef}	17.16 ± 0.19^{d}	21.83 ± 0.39^{e}	27.83 ± 0.38^{e}
H_2SO_4 Conc. 10 min	10.90 ± 0.54^{cde}	17.83 ± 0.82^{bc}	21.73 ± 1.39^{b}	27.56 ± 0.87^{bcd}	33.56 ± 0.43^{bcd}
KNO_3 (1%)	10.06 ± 0.68^{de}	14.53 ± 0.89^{cde}	20.03 ± 0.34^{bc}	25.63 ± 0.89^{d}	31.70 ± 0.47^{d}
KNO_3 (2%)	10.53 ± 0.61^{cde}	16.80 ± 0.96^{bcd}	20.93 ± 0.27^{b}	26.53 ± 0.44^{cd}	32.46 ± 0.43^{cd}
Kinetin (0.50 ppm)	11.66 ± 0.89^{bcd}	17.40 ± 0.53^{bcd}	22.00 ± 0.63^{b}	28.63 ± 0.42^{bc}	34.63 ± 0.53^{bc}
Kinetin (0.75 ppm)	12.46 ± 0.40^{bc}	18.40 ± 2.10^{b}	22.66 ± 0.97^{b}	29.56 ± 1.36^{b}	35.53 ± 1.03^{b}
GA_3 (500 ppm)	9.90 ± 0.66^{de}	13.90 ± 0.66^{de}	17.90 ± 0.70^{cd}	22.16 ± 0.28^{e}	28.23 ± 0.28^{e}
GA_3 (1000 ppm)	13.43 ± 0.28^{b}	23.16 ± 1.08^{a}	31.50 ± 0.51^{a}	37.50 ± 0.46^{a}	43.60 ± 0.38^{a}
GA_3 (1500 ppm)	15.76 ± 1.01^{a}	25.00 ± 1.48^{a}	32.60 ± 0.90^{a}	38.50 ± 0.82^{a}	44.56 ± 1.10^{a}
Control	0.00 ± 0^{f}	10.03 ± 0.43^{f}	15.60 ± 0.43^{d}	18.40 ± 0.77^{f}	24.30 ± 0.71^{f}
CD ($p \leq 0.05$)	2.077	3.827	2.680	2.643	2.354

Table 5: Effect of seed priming on leaf area (mm^2) of peach cv. Sharbati

Treatments	30 Days	60 Days	90 Days	120 Days	150 Days
H_2SO_4 Conc. 5 min	3.33 ± 0.54^{abcd}	13.33 ± 0.72^{cd}	25.33 ± 1.44^{bcd}	33.00 ± 0.47^{cd}	43.33 ± 0.72^{def}
H_2SO_4 Conc. 10 min	2.66 ± 0.27^{cde}	12.00 ± 0.94^{cde}	26.33 ± 0.98^{bc}	34.00 ± 0.47^{bc}	44.00 ± 0.47^{cde}
KNO_3 (1%)	1.33 ± 0.27^{ef}	10.33 ± 0.72^{e}	24.00 ± 0.47^{cd}	32.66 ± 0.72^{cd}	42.33 ± 0.72^{ef}
KNO_3 (2%)	3.00 ± 0.00^{bcd}	11.00 ± 0.47^{de}	23.33 ± 0.72^{cd}	33.66 ± 0.72^{bcd}	41.00 ± 0.94^{f}
Kinetin (0.50 ppm)	2.00 ± 0.47^{de}	12.66 ± 1.18^{cde}	27.66 ± 0.72^{b}	31.00 ± 0.94^{d}	44.66 ± 0.72^{bcde}
Kinetin (0.75 ppm)	3.66 ± 0.54^{abc}	17.66 ± 0.72^{b}	28.00 ± 0.47^{b}	35.00 ± 0.94^{bc}	45.00 ± 0.47^{bcd}
GA_3 (500 ppm)	2.33 ± 0.54^{cde}	14.00 ± 0.94^{c}	22.33 ± 0.72^{d}	36.33 ± 0.72^{b}	46.00 ± 0.47^{abc}
GA_3 (1000 ppm)	4.33 ± 0.27^{ab}	20.66 ± 0.72^{a}	35.00 ± 0.47^{a}	42.00 ± 0.94^{a}	47.00 ± 0.47^{ab}
GA_3 (1500 ppm)	4.66 ± 0.27^{a}	21.66 ± 0.72^{a}	36.33 ± 0.98^{a}	43.66 ± 0.72^{a}	48.33 ± 0.72^{a}
Control	0.00 ± 0^{f}	5.00 ± 0.47^{f}	14.33 ± 1.96^{e}	13.33 ± 0.72^{e}	31.00 ± 0.94^{g}
CD ($p \leq 0.05$)	1.435	2.740	3.510	2.928	2.614

Conclusion

On the basis of study, it was concluded that GA_3 @ 1500 ppm and GA_3 @ 1000 ppm for 24 hours proved to be an effective seed treatment for better seed germination and seedling growth of peach cv. Sharbati.

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GK, VS, MS and MK conceived the concept, wrote and approved the manuscript.

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