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# Effect of Seed Priming on Seed Germination and Growth of Kainth

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## Abstract

The experiment was conducted at Horticulture Experimental Area, Nursery, P.G. Department of Agriculture, Khalsa College, Amritsar during 2021-2022 to study the germination and growth parameters of Kainth. The experiment was laid out in Randomized Block Design replicated thrice, comprising ten treatments conc.  $H_2SO_4$  for 5 and 10 minutes,  $KNO_3$  (1 % and 2 %) for 24 hours, Kinetin (0.50 ppm and 0.75 ppm) for 24 hours,  $GA_3$  (500 ppm, 1000 ppm and 1500 ppm) for 24 hours and control (untreated seeds). The results of the present study revealed that the Kainth seeds primed with  $GA_3$  @ 1500 ppm for 24 hours has recorded the minimum days required for initiation of germination (23.66 days), 50 per cent and complete germination (27.66 days and 34.66 days respectively) and maximum germination per cent (42.33 % and 64.33 %) was also recorded with seeds primed with  $GA_3$  @1500 ppm at 30 and 60 DAS respectively, which were statistically at par with the seeds treated with  $GA_3$  @ 1000 ppm for 24 hours.  $GA_3$  @ 1500 ppm treatment has also proved to be superior in the production of vigorous plant height (17.56 cm) with maximum number of shoots (14.00), stem diameter (4.27 mm), leaf number (45.00) and leaf area (39.90 mm<sup>2</sup>) at 30, 60, 90, 120 and 150 DAS.

**Keywords:** Kainth; Seed Germination; Seed priming; Dormancy; Growth; Gibberellic acid

## Introduction

Kainth (*Pyrus pashia* Buck and Ham) is the most widely used rootstock for pears in India, though Shiara (*Pyrus pyrifolia*) and pear root suckers are also used in some areas (Meitei, 1998). Among the rootstocks used for propagating pear cultivars in Northern India, Kainth (*Pyrus pashia* Ham.) has been approved superior for being precocious, free of root suckering, adaptable to variable soil and climatic conditions, higher yield with fruit quality (Sandhu et al., 1995). Kainth has also been reported to be resistant to blight, woolly aphid and drought. It is cheaper and highly nutritious underutilized fruit of sub-tropical region and possesses great therapeutic and medicinal value. With the move towards intensive production systems, desirable rootstocks are those that restrict tree vigour and are precocious and high yielding (Bound, 2021). Rootstocks have a significant impact on the nutrient uptake, growth, longevity, precocity, productivity and fruit quality of cultivars grafted on them (Meitei, 1998).

The Kainth stock is either propagated through seed (seedling) or hardwood cuttings or stooling (clonal) (Sandhu et al., 1995). Seeds of stone fruits do not germinate immediately after harvest and a period of after ripening is essential for certain chemical and other changes to take place in the seed and for dormant embryo to grow (Shah et al., 2013). It has been hypothesised that many fruit species seed coats or testa, contain significant amounts of germination inhibitors such benzoic acid, cinnamic acid, coumarin, naringenin, jasmonate and abscisic acid (ABA) which stop seeds from germinating. To meet the increasing demand for planting material (grafts), nurserymen must produce more rootstocks with graftable sizes in a shorter period of time (Pooja and Honnabyraiah, 2022).



The results of numerous research have demonstrated that applying pre-sowing treatments will enhance seed germination and subsequent seedling growth in a wide range of fruit species (Tania et al., 2020). Therefore, this study was undertaken to keep in mind, halopriming and hormonal priming techniques utilization to examine seed priming for improving seed germination and growth of Kainth seeds.

## Material and Methods

The experiment was conducted in the Horticultural Experimental Area, Nursery, P.G. Department of Agriculture, Khalsa College, Amritsar during the year 2021-2022. The seeds required for the experiment were extracted from the healthy disease-free ripened fruits of Kainth. The experiment was laid out in Randomized Block Design replicated thrice, comprising ten treatments conc.  $H_2SO_4$  for 5 and 10 minutes,  $KNO_3$  (1 % and 2 %) for 24 hours, Kinetin (0.50 ppm and 0.75 ppm) for 24 hours,  $GA_3$  (500 ppm, 1000 ppm and 1500 ppm) for 24 hours and control (untreated seeds).

Treated seeds were sown in polybags of 7 × 7 inches size and then light irrigation was done. The observations on days taken to initiation of germination, days taken to 50 per cent and complete germination and germination per cent at 30 and 60 DAS were recorded daily. The data pertaining to plant height (cm), shoot number, stem diameter (mm), leaf number and leaf area ( $mm^2$ ) was recorded at 30, 60, 90, 120 and 150 DAS.

## Result and Discussion

### *Days taken to initiation of germination*

The seed priming had marked influence on seeds germination. Among all the treatments, the seeds treated with  $GA_3$  @ 1500 ppm for 24 hours has recorded minimum number of days taken for initiation of germination which were statistically at par with seeds treated with  $GA_3$  @ 1000 ppm for 24 hours. Whereas, the maximum number of days taken to initiate germination were observed in control (35.66 days). Early germination could be attributed to the fact that  $GA_3$  plays an important role in two stages of germination, one during initial enzyme induction and the other during activation of the reserve food mobilising system, both of which aid in germination enhancement (Jha et al., 1997). The result is in agreement with the findings of Suryakanth et al. (2005) in guava, Rana et al. (2020) and Pareb et al. (2017) in papaya cv. Solo.

**Table 1.** Germination parameters

Treatments	Days taken to initiation of germination	Days taken to 50 per cent germination	Days taken to complete germination	Germination per cent at 30 DAS	Germination per cent at 60 DAS
$H_2SO_4$ (Conc. 5 min)	28.33 ± 0.98 <sup>b</sup>	35.00 ± 0.47 <sup>cd</sup>	41.66 ± 0.72 <sup>de</sup>	29.33 ± 0.72 <sup>c</sup>	43.00 ± 0.47 <sup>cd</sup>
$H_2SO_4$ (Conc. 10 min)	29.00 ± 0.47 <sup>b</sup>	36.00 ± 0.94 <sup>bcd</sup>	42.33 ± 0.72 <sup>de</sup>	28.66 ± 0.72 <sup>c</sup>	41.00 ± 0.47 <sup>de</sup>
$KNO_3$ (1 %)	28.00 ± 0.94 <sup>bc</sup>	35.33 ± 0.72 <sup>cd</sup>	43.66 ± 0.72 <sup>cd</sup>	30.00 ± 0.47 <sup>c</sup>	43.00 ± 0.47 <sup>cd</sup>
$KNO_3$ (2 %)	26.00 ± 0.47 <sup>cd</sup>	33.66 ± 0.72 <sup>de</sup>	41.00 ± 0.94 <sup>ef</sup>	34.33 ± 0.72 <sup>b</sup>	45.00 ± 0.47 <sup>c</sup>
Kinetin (0.50 ppm)	27.66 ± 1.18 <sup>bc</sup>	37.33 ± 0.72 <sup>bc</sup>	45.00 ± 0.47 <sup>bc</sup>	25.33 ± 0.72 <sup>d</sup>	55.00 ± 0.94 <sup>b</sup>
Kinetin (0.75 ppm)	27.00 ± 0.94 <sup>bcd</sup>	32.00 ± 0.94 <sup>ef</sup>	39.33 ± 0.72 <sup>f</sup>	27.66 ± 0.72 <sup>cd</sup>	57.33 ± 0.98 <sup>b</sup>
$GA_3$ (500 ppm)	28.66 ± 0.72 <sup>b</sup>	38.33 ± 0.72 <sup>b</sup>	46.66 ± 0.72 <sup>b</sup>	22.33 ± 0.72 <sup>e</sup>	39.33 ± 0.98 <sup>c</sup>
$GA_3$ (1000 ppm)	25.33 ± 0.72 <sup>de</sup>	30.33 ± 0.72 <sup>fg</sup>	35.66 ± 0.72 <sup>g</sup>	40.00 ± 0.72 <sup>a</sup>	63.00 ± 0.94 <sup>a</sup>
$GA_3$ (1500 ppm)	23.66 ± 0.72 <sup>e</sup>	27.66 ± 0.72 <sup>g</sup>	34.66 ± 0.72 <sup>g</sup>	42.33 ± 0.47 <sup>a</sup>	64.33 ± 0.72 <sup>a</sup>
Control	35.66 ± 0.72 <sup>a</sup>	46.66 ± 0.72 <sup>a</sup>	55.00 ± 0.47 <sup>a</sup>	0 ± 0.00 <sup>f</sup>	25.66 ± 0.98 <sup>f</sup>
CD ( $p \leq 0.05$ )	2.06	2.89	2.19	2.42	2.32

### Days taken to 50 per cent and complete germination

The minimum number of days taken to 50 per cent and complete germination were recorded in seeds primed with GA<sub>3</sub> @ 1500 ppm for 24 hours (27.66 days and 34.66 days respectively) which were followed by GA<sub>3</sub> @ 1000 ppm for 24 hours. The maximum number of days taken to reach 50 per cent and complete germination were recorded in control (46.66 days and 55.00 days respectively). GA<sub>3</sub> primed seeds recorded minimum days for 50 per cent and complete germination might be due to the fact that gibberellic acid acts on the embryo and causes synthesis of hydrolyzing enzymes particularly amylase and protease and this hydrolyzed food is utilized for growth of embryo and thereby enhanced the germination (Paleg, 1965). The present results are affirmed by the findings of Rana et al. (2020) in papaya, Yadav et al. (2018) in custard apple and Hota et al. (2018) in jamun.

**Table 2.** Plant height (cm)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS
H <sub>2</sub> SO <sub>4</sub> (Conc. 5 min)	0.49 ± 0.04 <sup>def</sup>	1.56 ± 0.09 <sup>ef</sup>	4.06 ± 0.25 <sup>e</sup>	8.20 ± 0.40 <sup>de</sup>	11.46 ± 0.30 <sup>ef</sup>
H <sub>2</sub> SO <sub>4</sub> (Conc. 10 min)	0.35 ± 0.02 <sup>ef</sup>	1.21 ± 0.11 <sup>f</sup>	3.20 ± 0.14 <sup>f</sup>	7.50 ± 0.26 <sup>ef</sup>	10.60 ± 0.26 <sup>f</sup>
KNO <sub>3</sub> (1 %)	0.79 ± 0.02 <sup>cd</sup>	1.66 ± 0.19 <sup>def</sup>	4.93 ± 0.19 <sup>cd</sup>	9.13 ± 0.52 <sup>cd</sup>	14.56 ± 0.40 <sup>bc</sup>
KNO <sub>3</sub> (2 %)	0.93 ± 0.04 <sup>bc</sup>	2.96 ± 0.21 <sup>bc</sup>	6.30 ± 0.38 <sup>b</sup>	11.00 ± 0.42 <sup>b</sup>	15.53 ± 0.36 <sup>b</sup>
Kinetin (0.50 ppm)	0.54 ± 0.02 <sup>def</sup>	1.44 ± 0.05 <sup>ef</sup>	4.66 ± 0.19 <sup>de</sup>	9.63 ± 0.28 <sup>bc</sup>	11.33 ± 0.40 <sup>ef</sup>
Kinetin (0.75 ppm)	0.65 ± 0.02 <sup>cde</sup>	2.33 ± 0.14 <sup>cd</sup>	5.76 ± 0.15 <sup>bc</sup>	10.43 ± 0.24 <sup>bc</sup>	13.60 ± 0.35 <sup>cd</sup>
GA <sub>3</sub> (500 ppm)	0.26 ± 0.02 <sup>fg</sup>	2.12 ± 0.19 <sup>de</sup>	4.06 ± 0.19 <sup>e</sup>	6.66 ± 0.19 <sup>fg</sup>	12.40 ± 0.45 <sup>de</sup>
GA <sub>3</sub> (1000 ppm)	1.20 ± 0.01 <sup>ab</sup>	3.66 ± 0.35 <sup>ab</sup>	7.26 ± 0.26 <sup>a</sup>	12.53 ± 0.49 <sup>a</sup>	16.76 ± 0.14 <sup>a</sup>
GA <sub>3</sub> (1500 ppm)	1.43 ± 0.02 <sup>a</sup>	4.23 ± 0.29 <sup>a</sup>	7.80 ± 0.14 <sup>a</sup>	13.46 ± 0.30 <sup>a</sup>	17.56 ± 0.37 <sup>a</sup>
Control	0.00 ± 0.00 <sup>g</sup>	1.20 ± 0.18 <sup>f</sup>	2.60 ± 0.35 <sup>f</sup>	5.36 ± 0.43 <sup>g</sup>	8.30 ± 0.21 <sup>g</sup>
CD ( <i>p</i> ≤ 0.05)	0.31	0.97	0.85	1.31	1.22

**Table 3.** Number of shoots

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS
H <sub>2</sub> SO <sub>4</sub> (Conc. 5 min)	1.00 ± 0.00 <sup>b</sup>	3.66 ± 0.72 <sup>cde</sup>	6.00 ± 0.47 <sup>cde</sup>	7.33 ± 0.72 <sup>de</sup>	9.00 ± 0.47 <sup>de</sup>
H <sub>2</sub> SO <sub>4</sub> (Conc. 10 min)	1.00 ± 0.00 <sup>b</sup>	3.00 ± 0.47 <sup>def</sup>	5.00 ± 0.47 <sup>def</sup>	6.33 ± 0.98 <sup>ef</sup>	8.00 ± 0.47 <sup>ef</sup>
KNO <sub>3</sub> (1 %)	1.00 ± 0.00 <sup>b</sup>	4.33 ± 0.72 <sup>cd</sup>	7.00 ± 0.47 <sup>bcd</sup>	10.00 ± 0.47 <sup>bc</sup>	11.00 ± 0.47 <sup>bcd</sup>
KNO <sub>3</sub> (2 %)	1.00 ± 0.00 <sup>b</sup>	5.33 ± 0.72 <sup>abc</sup>	9.00 ± 0.47 <sup>ab</sup>	11.33 ± 0.27 <sup>abc</sup>	12.33 ± 0.72 <sup>abc</sup>
Kinetin (0.50 ppm)	1.00 ± 0.00 <sup>b</sup>	4.00 ± 0.47 <sup>cde</sup>	6.66 ± 0.72 <sup>cd</sup>	9.00 ± 0.47 <sup>cd</sup>	10.66 ± 0.72 <sup>cd</sup>
Kinetin (0.75 ppm)	1.00 ± 0.00 <sup>b</sup>	4.66 ± 0.72 <sup>bcd</sup>	7.66 ± 0.72 <sup>bc</sup>	9.66 ± 0.72 <sup>bcd</sup>	11.66 ± 0.72 <sup>bc</sup>
GA <sub>3</sub> (500 ppm)	1.00 ± 0.00 <sup>b</sup>	2.00 ± 0.47 <sup>ef</sup>	4.00 ± 0.47 <sup>ef</sup>	5.66 ± 0.72 <sup>ef</sup>	6.66 ± 0.54 <sup>fg</sup>
GA <sub>3</sub> (1000 ppm)	1.33 ± 0.27 <sup>ab</sup>	6.66 ± 0.72 <sup>ab</sup>	10.00 ± 0.94 <sup>a</sup>	12.00 ± 0.47 <sup>ab</sup>	13.00 ± 0.47 <sup>ab</sup>
GA <sub>3</sub> (1500 ppm)	1.66 ± 0.27 <sup>a</sup>	7.00 ± 0.47 <sup>a</sup>	10.66 ± 0.72 <sup>a</sup>	13.00 ± 0.47 <sup>a</sup>	14.00 ± 0.47 <sup>a</sup>
Control	0.00 ± 0.00 <sup>c</sup>	1.33 ± 0.27 <sup>f</sup>	3.00 ± 0.47 <sup>f</sup>	4.66 ± 0.72 <sup>f</sup>	5.66 ± 0.72 <sup>g</sup>
CD ( <i>p</i> ≤ 0.05)	0.43	2.25	2.26	2.36	2.21

### Germination per cent at 30 and 60 DAS

The maximum seed germination per cent (42.33 % and 64.33 %) at 30 and 60 DAS was recorded in seeds primed with GA<sub>3</sub> @ 1500 ppm for 24 hours which was statistically at par with GA<sub>3</sub> @ 1000 ppm for 24 hours primed seeds. Whereas, the minimum germination per cent (22.33 %) was observed in seeds primed with GA<sub>3</sub> @ 500 ppm for 24 hours followed by Kinetin @ 0.50 ppm (25.33 %). However, no seed germination initiated upto 30 DAS in control. At 60 DAS, the minimum germination per cent (25.66 %) was recorded in control. The highest germination per

cent with GA<sub>3</sub> primed seeds might be due to the fact that GA<sub>3</sub> involved in the activation of cytological enzymes which stimulates  $\alpha$ -amylase enzyme which convert insoluble starch into soluble sugars or might have antagonized the effect of inhibitors present in seeds thus help in higher germination (Hartman and Kester 1997). These results are in conformity with Anjanawe et al. (2013) in papaya and Kalyani et al. (2014) in guava.

**Table 4.** Stem diameter (mm)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS
H <sub>2</sub> SO <sub>4</sub> (Conc. 5 min)	0.45 ± 0.07 <sup>de</sup>	1.08 ± 0.07 <sup>de</sup>	1.96 ± 0.05 <sup>f</sup>	2.73 ± 0.05 <sup>f</sup>	3.56 ± 0.08 <sup>e</sup>
H <sub>2</sub> SO <sub>4</sub> (Conc. 10 min)	0.37 ± 0.05 <sup>e</sup>	0.96 ± 0.04 <sup>ef</sup>	1.73 ± 0.09 <sup>e</sup>	2.34 ± 0.05 <sup>e</sup>	3.34 ± 0.06 <sup>e</sup>
KNO <sub>3</sub> (1 %)	0.63 ± 0.05 <sup>bcd</sup>	1.25 ± 0.05 <sup>bc</sup>	2.32 ± 0.06 <sup>c</sup>	3.16 ± 0.03 <sup>c</sup>	3.95 ± 0.06 <sup>b</sup>
KNO <sub>3</sub> (2 %)	0.75 ± 0.08 <sup>bc</sup>	1.36 ± 0.05 <sup>b</sup>	2.47 ± 0.07 <sup>b</sup>	3.24 ± 0.6 <sup>b</sup>	4.03 ± 0.06 <sup>b</sup>
Kinetin (0.50 ppm)	0.54 ± 0.05 <sup>cde</sup>	1.19 ± 0.06 <sup>cd</sup>	2.06 ± 0.05 <sup>e</sup>	2.95 ± 0.05 <sup>e</sup>	3.64 ± 0.07 <sup>d</sup>
Kinetin (0.75 ppm)	0.65 ± 0.05 <sup>bcd</sup>	1.24 ± 0.05 <sup>bc</sup>	2.24 ± 0.05 <sup>d</sup>	3.06 ± 0.05 <sup>d</sup>	3.76 ± 0.05 <sup>c</sup>
GA <sub>3</sub> (500 ppm)	0.47 ± 0.09 <sup>de</sup>	0.85 ± 0.03 <sup>fg</sup>	1.65 ± 0.05 <sup>h</sup>	2.33 ± 0.07 <sup>e</sup>	3.25 ± 0.06 <sup>e</sup>
GA <sub>3</sub> (1000 ppm)	0.86 ± 0.22 <sup>b</sup>	1.70 ± 0.01 <sup>a</sup>	2.56 ± 0.04 <sup>a</sup>	3.43 ± 0.04 <sup>a</sup>	4.23 ± 0.03 <sup>a</sup>
GA <sub>3</sub> (1500 ppm)	1.17 ± 0.25 <sup>a</sup>	1.80 ± 0.15 <sup>a</sup>	2.60 ± 0.09 <sup>a</sup>	3.48 ± 0.06 <sup>a</sup>	4.27 ± 0.06 <sup>a</sup>
Control	0.00 ± 0.00 <sup>f</sup>	0.75 ± 0.05 <sup>e</sup>	1.36 ± 0.04 <sup>i</sup>	2.03 ± 0.05 <sup>h</sup>	2.95 ± 0.06 <sup>f</sup>
CD ( $p \leq 0.05$ )	0.24	0.15	0.07	0.05	0.10

### Plant height

Seed priming with GA<sub>3</sub> @ 1500 ppm solution for 24 hours recorded the maximum plant height (1.43 cm, 4.23 cm, 7.80 cm, 13.46 cm and 17.56 cm) at 30, 60, 90, 120 and 150 DAS respectively. The minimum plant height (0.26 cm) was recorded in seeds primed with GA<sub>3</sub> @ 500 ppm and no seed germination was initiated in seeds under control at 30 DAS. The untreated seeds (control) recorded the minimum plant height (1.20 cm, 2.60 cm, 5.36 cm and 8.30 cm) at 60, 90, 120 and 150 DAS respectively. The maximum plant height under GA<sub>3</sub> might be due to cell multiplication and cell elongation in the cambium tissue of the internodal region, since GA<sub>3</sub> appears to promote metabolic processes or neutralize the influence of growth inhibitors (Singh et al., 1989). The observations are in agreement with the findings of Yadav et al. (2018) in custard apple and Hota et al. (2018) in jamun.

**Table 5.** Leaf number

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS
H <sub>2</sub> SO <sub>4</sub> (Conc. 5 min)	4.66 ± 0.98 <sup>de</sup>	6.50 ± 0.62 <sup>de</sup>	17.00 ± 0.94 <sup>ef</sup>	25.00 ± 0.47 <sup>ef</sup>	32.66 ± 0.72 <sup>de</sup>
H <sub>2</sub> SO <sub>4</sub> (Conc. 10 min)	3.33 ± 0.72 <sup>e</sup>	5.33 ± 0.72 <sup>ef</sup>	16.66 ± 0.72 <sup>ef</sup>	23.66 ± 0.72 <sup>fg</sup>	30.33 ± 0.72 <sup>ef</sup>
KNO <sub>3</sub> (1 %)	6.33 ± 0.72 <sup>bcd</sup>	7.66 ± 0.72 <sup>cde</sup>	22.33 ± 0.72 <sup>cd</sup>	31.66 ± 0.72 <sup>bc</sup>	38.66 ± 0.72 <sup>c</sup>
KNO <sub>3</sub> (2 %)	7.33 ± 0.72 <sup>abc</sup>	9.33 ± 0.72 <sup>bc</sup>	23.66 ± 0.72 <sup>bc</sup>	33.00 ± 0.94 <sup>ab</sup>	41.66 ± 0.72 <sup>b</sup>
Kinetin (0.50 ppm)	5.00 ± 0.47 <sup>cde</sup>	7.66 ± 0.72 <sup>cde</sup>	19.66 ± 1.18 <sup>de</sup>	28.00 ± 1.24 <sup>de</sup>	34.33 ± 0.72 <sup>d</sup>
Kinetin (0.75 ppm)	5.33 ± 0.72 <sup>cde</sup>	8.33 ± 0.72 <sup>cd</sup>	21.33 ± 0.72 <sup>cd</sup>	29.00 ± 1.24 <sup>cd</sup>	37.33 ± 0.47 <sup>d</sup>
GA <sub>3</sub> (500 ppm)	4.33 ± 0.72 <sup>de</sup>	6.33 ± 0.72 <sup>de</sup>	15.33 ± 0.72 <sup>fg</sup>	27.00 ± 0.94 <sup>def</sup>	29.00 ± 0.47 <sup>fg</sup>
GA <sub>3</sub> (1000 ppm)	8.66 ± 0.72 <sup>ab</sup>	11.33 ± 0.72 <sup>ab</sup>	26.66 ± 0.72 <sup>ab</sup>	34.33 ± 1.44 <sup>ab</sup>	44.66 ± 1.81 <sup>a</sup>
GA <sub>3</sub> (1500 ppm)	9.33 ± 0.72 <sup>a</sup>	12.33 ± 0.72 <sup>a</sup>	27.33 ± 0.72 <sup>a</sup>	36.00 ± 0.47 <sup>a</sup>	45.00 ± 0.94 <sup>a</sup>
Control	0.00 ± 0.0 <sup>f</sup>	3.33 ± 0.72 <sup>f</sup>	12.33 ± 0.72 <sup>g</sup>	20.66 ± 0.98 <sup>e</sup>	27.33 ± 0.72 <sup>g</sup>
CD ( $p \leq 0.05$ )	2.37	2.51	3.01	3.30	2.57

### Stem diameter

The data obtained regarding stem diameter depicted that the seed priming with GA<sub>3</sub> @ 1500 ppm for 24 hours recorded the maximum stem diameter (1.17 mm, 1.80 mm, 2.60 mm, 3.48 mm and 4.27 mm respectively) at 30, 60, 90, 120 and 150 DAS which was followed by seeds primed with GA<sub>3</sub> @ 1000 ppm for 24 hours. The minimum stem diameter (0.37 mm) was noticed in seeds primed with conc. H<sub>2</sub>SO<sub>4</sub> for 10 min at 30 DAS. There was no seed germination taken place in control at 30 DAS. At 60, 90, 120 and 150 DAS, the minimum stem diameter (0.75 mm, 1.36 mm, 2.03 mm and 2.95 mm) was recorded in control. The increase in stem diameter might be due to GA<sub>3</sub> increase osmotic uptake of nutrient and boost the growth by increasing cell division, cell elongation and cell multiplication in the cambium tissue of the stem portion. These results are in accordance with Ramteke et al. (2015) in aonla, Parab et al. (2017) and Bhavya et al. (2017) in karonda.

**Table 6.** Leaf area (mm<sup>2</sup>)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS
H <sub>2</sub> SO <sub>4</sub> (Conc. 5 min)	6.43 ± 0.16 <sup>ef</sup>	16.00 ± 0.35 <sup>de</sup>	25.90 ± 0.33 <sup>de</sup>	30.46 ± 0.45 <sup>e</sup>	35.06 ± 0.33 <sup>e</sup>
H <sub>2</sub> SO <sub>4</sub> (Conc. 10 min)	6.63 ± 0.14 <sup>de</sup>	15.06 ± 0.21 <sup>e</sup>	25.10 ± 0.43 <sup>ef</sup>	29.33 ± 0.21 <sup>f</sup>	33.63 ± 0.21 <sup>f</sup>
KNO <sub>3</sub> (1 %)	7.63 ± 0.22 <sup>bc</sup>	17.96 ± 0.23 <sup>bc</sup>	27.40 ± 0.33 <sup>bc</sup>	33.56 ± 0.41 <sup>bc</sup>	37.63 ± 0.28 <sup>bc</sup>
KNO <sub>3</sub> (2 %)	7.66 ± 0.28 <sup>b</sup>	18.60 ± 0.35 <sup>b</sup>	27.93 ± 0.35 <sup>b</sup>	33.76 ± 0.44 <sup>b</sup>	37.76 ± 0.19 <sup>b</sup>
Kinetin (0.50 ppm)	6.76 ± 0.23 <sup>cd</sup>	16.76 ± 0.42 <sup>cd</sup>	26.53 ± 0.51 <sup>cd</sup>	32.26 ± 0.28 <sup>d</sup>	36.00 ± 0.38 <sup>d</sup>
Kinetin (0.75 ppm)	7.30 ± 0.26 <sup>bcd</sup>	17.53 ± 0.53 <sup>bc</sup>	26.96 ± 0.37 <sup>bc</sup>	33.13 ± 0.25 <sup>c</sup>	36.86 ± 0.25 <sup>c</sup>
GA <sub>3</sub> (500 ppm)	5.86 ± 0.28 <sup>e</sup>	14.63 ± 0.42 <sup>e</sup>	24.53 ± 0.33 <sup>f</sup>	28.10 ± 0.23 <sup>g</sup>	32.23 ± 0.24 <sup>g</sup>
GA <sub>3</sub> (1000 ppm)	8.60 ± 0.30 <sup>a</sup>	20.10 ± 0.51 <sup>a</sup>	29.26 ± 0.36 <sup>a</sup>	35.03 ± 0.25 <sup>a</sup>	39.86 ± 0.35 <sup>a</sup>
GA <sub>3</sub> (1500 ppm)	8.90 ± 0.37 <sup>a</sup>	20.63 ± 0.50 <sup>a</sup>	29.43 ± 0.35 <sup>a</sup>	35.10 ± 0.35 <sup>a</sup>	39.90 ± 0.38 <sup>a</sup>
Control	0.00 ± 0.00 <sup>f</sup>	6.63 ± 0.43 <sup>f</sup>	15.06 ± 0.45 <sup>g</sup>	24.16 ± 0.38 <sup>h</sup>	29.60 ± 0.57 <sup>h</sup>
CD ( <i>p</i> ≤ 0.05)	0.87	1.38	0.98	0.59	0.80

### Leaf number

The data pertaining to leaf number showed that seed priming with GA<sub>3</sub> @ 1500 ppm recorded the maximum leaf number (9.33, 12.33, 27.33, 36.00 and 45.00) which was statistically at par with seeds treated with GA<sub>3</sub> @ 1000 ppm for 24 hours at 30, 60, 90, 120 and 150 DAS respectively. The minimum leaf number (3.33) was recorded in conc. H<sub>2</sub>SO<sub>4</sub> for 10 min at 30 DAS. At 60, 90, 120 and 150 DAS, the minimum leaf number (3.33, 12.33, 20.66 and 27.33 respectively) was recorded in control. More number of leaves might be due to the activity of GA<sub>3</sub> at apical meristem, resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation and leaf expansion (Palepad et al., 2017). These results are in accordance with Nimbalkar et al. (2012) and Sen et al. (1990) in papaya seeds.

### Leaf area

The maximum leaf area (8.90 mm<sup>2</sup>, 20.63 mm<sup>2</sup>, 29.43 mm<sup>2</sup>, 35.10 mm<sup>2</sup> and 39.90 mm<sup>2</sup>) was observed in seeds primed with GA<sub>3</sub> @ 1500 ppm solution for 24 hours which was statistically at par with seeds treated with GA<sub>3</sub> @ 1000 ppm for 24 hours at 30, 60, 90, 120 and 150 DAS. The minimum leaf area (5.86 mm<sup>2</sup>) was observed in seeds primed with GA<sub>3</sub> @ 500 ppm for 24 hours. However, no seed germination initiated in control upto 30 DAS. At 60, 90, 120 and 150 DAS, the minimum leaf area (6.63 mm<sup>2</sup>, 15.06 mm<sup>2</sup>, 24.16 mm<sup>2</sup> and 29.60 mm<sup>2</sup> respectively) was recorded in control. Leaf area increment of the seedlings treated with GA<sub>3</sub> can be attributed to GA<sub>3</sub> availability at the apical meristem which might have accelerated the nucleoprotein synthesis to an increase in cell division and their multiplication which enhanced the leaf production with increased leaf area (Manthri and Bharad, 2017). The results are in line with the findings of Nimbalkar et al. (2012) in karonda and Anjanawe et al. (2013) in papaya cv. Solo.

## Conclusion

The results of current study revealed that seed priming with GA<sub>3</sub> @ 1500 ppm and GA<sub>3</sub> @ 1000 ppm have shown statistically non-significant behaviour except all other treatments which were statistically significant with each other. Seed priming with GA<sub>3</sub> @ 1500 ppm for 24 hours proved to be superior for earlier and highest germination per cent, production of vigorous seedlings with better growth parameters like plant height, shoot number, stem diameter, leaf number and leaf area. Hence, standardization of GA<sub>3</sub> treatment can be used for improving seed germination and growth of Kainth. This simple intervention can help nurserymen raise vigorous Kainth rootstocks in short period of time.

## References

- Anjanawe SR, Kanpure RN, Kachouli BK and Mandloi DS (2013) Effect of plant growth regulators and growth media on seed germination and growth vigour of papaya. *Annals of Plant and Soil Research* 15:31-34.
- Bhavya N, Naik N, Kantharaju V and Nataraj KH (2017) Studies on effect of different pre-sowing treatments on germination of karonda (*Carrisa carandas* L.) seeds. *Journal of Pharmacognosy and Phytochemistry* 6:352-354.
- Bound SA (2021) Managing crop load in European pear (*Pyrus communis* L.)- a review. *Agriculture* 11: 637.
- Hartman HT and Kester DE (1997) *Plant propagation principles and practices*. Fourth Edition, Prentice Hall of India, Ltd., New Delhi. pp. 407.
- Hota SN, Karna AK, Jain PK and Dakhad B (2018) Effect of gibberellic acid on seed germination, growth and survival of jamun (*Syzygium cumini* L. Skeels). *Pharma Innovation Journal* 7: 323-326.
- Jha BN, Kumar V, Singh, Kumari RPR and Sinha M (1997) Dormancy in groundnut standardization of procedure of breaking. *Journal of Applied Biology* 7:23-25.
- Kalyani M, Bharad SG and Parameshwar P (2014) Effect of growth regulators on seed germination in guava. *International Journal of Biological Sciences* 5:81-91.
- Manthri K and Bharad SG (2017) Effect of pre sowing seed treatments on growth pattern of guava variety L-49. *International Journal of Chemical Studies* 5:1735-1740.
- Meitei MI (1998) Rootstock effects on the performance of certain pear cultivars. M.Sc. (Horticulture) Thesis, Dr. Yashwant Singh Parmar University of Horticulture and Forestry Nauni Solan (Himachal Pradesh) India.
- Nimbalkar SD, Jadhav YS, Adat SS and Savvashe AY (2012) Effect of different seed treatments on germination and growth of karonda (*Carissa congesta* W.) seedlings. *Green Farming* 3:340-342.
- Palepad KB, Bharad SG and Bansode GS (2017) Effect of seed treatments on germination, seedling vigour and growth rate of custard apple (*Annona squamosa*). *Journal of Pharmacognosy and Phytochemistry* 6:20-23.
- Paleq L (1965) Physiological effects of gibberellins. *Annual Review of Plant Physiology* 16:291-322.
- Pareb AM and Malshe K (2017) Effect of pre-soaking chemicals on germination and subsequent seedling growth of papaya (*Carica papaya* L.) cv. Solo. *International Journal of Chemical Studies* 5:1812-1816.
- Pooja GK and Honnabyraiah MK (2022) Impact of pre-sowing seed treatments on germination and seedling growth of different fruit crops: a review. *Pharma Innovation Journal* 11:470-478.
- Ramteke V, Dhpaithankar, Mahantesh K, et al. (2015) Seed germination and seedling growth of papaya as influenced by GA<sub>3</sub> and propagation media. *International Journal of Farm Sciences* 5:74-81.

Rana G, Deb P, Dowarah B and Sushmitha K (2020) Effect of seed pre-treatment on seed germination and seedling growth of papaya. *International Journal of Current Microbiology and Applied Sciences* 9:1066-1071.

Sandhu AS, Singh SN and Minhas PPS (1995) Note on clonal propagation of pear rootstock Kainth. *Indian Journal of Horticulture* 52:197-98.

Sen SK, Hore IK and Bandhopadhyay A (1990) Pre-sowing seed treatment and its role in germination, seedlings growth and longevity of papaya. *The Orissa Journal of Agricultural Research* 2:160-164.

Shah RA, Sharma A, Wali VK, et al. (2013) Effect of seed priming on peach, plum and apricot germination and subsequent seedling growth. *Indian Journal of Horticulture* 70:591-594.

Singh M, Singh GN, Singh LN and Singh BN (1989) Effect of gibberellic acid on seed germination in mosambi (*Citrus sinensis*). *Haryana Journal of Horticultural Sciences* 18:29-33.

Suryakanth LA, Mukunda GK and Raghavendraprasad GC (2005) Studies on seed germination in guava cvs. Taiwan guava and Allahabad safeda. *Karnataka Journal of Horticulture* 1:47-50.

Tania SS, Rhaman MS and Hossain M (2020) Hydro-priming and halo-priming improve seed germination, yield and yield contributing characters of okra (*Abelmoschus esculentus* L.). *Tropical Plant Research* 7:86-93.

Yadav RS, Sharma TR, Pandey SK and Maske G (2018) Effect of GA<sub>3</sub> and cow urine on germination and morphology of custard apple. *International Journal of Chemical Studies* 6: 1131-1134.

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

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