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CONTENTS

Effect of plant growth regulators on seed germination of wild fruit of kilmora (*Barberis asiatica* Roxb. exDC.)

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ABSTRACT: The current study aimed to assess the impact of GA3 and NAA at various concentrations on seed germination and seedling growth in kilmora. Seven treatments and three replications made up the experiment's randomised block design. Regarding improving seed germination, plant height, and the number of leaves per plant, the kilmora seed treated with GA3 at 75 ppm was the most successful treatment compared to other treatments.

Key words: *Barberis asiatica*, concentration, germination, leaf area, seedling

Over 675 wild edibles are known to exist in the Indian Himalayan Region (Samant and Dhar, 1997). *Berberisasiatica* DC. is a member of the Berberridaceae family, also referred to as kilmora. Of the 675 species, 55 were found in India (Rao *et al*., 1998), 24 of which are Berberis species, which are found in Uttarakhand (Tiwari *et al*., 2012). *B. asiatica* is a hard woody spiny shrub that grows to 1.8-3.6 meters in height and is typically upright and evergreen. The spines are 1-2 cm long and triplex in shape. Typically 7–10 mm in diameter, globose, enclosed in a persistent green calyx, green when unripe and turning aconite violet when mature, and containing 2–5 seeds, berries are fruits (Parmar and Kaushal, 1982; Prajapati *et al*., 2003).kilmora seeds have a hard seed coat or endocarp, which hinders water absorption and limits seed germination. Another element that affects seed germination is the presence of seed dormancy, a physiological state in which the seed is inactive until specific environmental conditions are met. The purpose of the study is to look into how a growth regulator affects kilmora seed germination. As an alternative, it is anticipated to offer data helpful in management plans to safeguard its endangered populations. Therefore, an investigation on the effect of a growth regulator on the seed germination of kilmora was conducted to facilitate its management and conservation strategies.

MATERIALS AND METHODS

A field experiment was conducted at the College of Horticulture, VCSG, UUHF, Bharsar, Pauri Garhwal, Uttarakhand, India in 2020. The experimental site is located at an altitude of 1900 metres above mean sea level at a longitude of 78.990 E and a latitude of 30.0560 N (Bisht and Sharma, 2014).The seeds were collected from forest areas of Bharsar, Pauri Garhwal district of Uttarakhand. The collected seeds were cleaned by rubbing all the extraneous materials off and then dipped in water. All the floating seeds were discarded, and only the healthy seeds that settled down were used. The solution of Gibberellic acid (GA3) and Naphthaleneacetic acid (NAA) was prepared by weighing quantities of the chemical with the help of an electronic balance. After weighing, GA3 and NAA were transferred into a glass beaker with the help of a soft brush and a small amount of acetone was added, followed by distilled water to make the final volume. The extracted seeds were soaked in various concentrations of Gibberellic acid and NAA for 24 hours. A freshly prepared solution of different Gibberellic acid and NAA concentrations was added separately to each glass beaker as per treatment.

Observations recorded

Days taken for initial germination (days): Daily after sowing up until the time of the subsequent emergence of seedlings, the data on days required for initial germination were recorded. The time taken for seed germination to begin was calculated as the interval between the date of sowing and the appearance of the first seedling**.**

Seed germination per cent (%): This observation was made after the seedlings stopped emerging further. When the plumule had just begun to appear on the soil's surface and the radical had grown to a length of 2 mm, the seeds were deemed to have germinated. Based on how many seeds out of the total sown germinated, the percentage of seed germination was calculated. The following formula was used to determine the germination percentage (GP) at the conclusion of the germination period: GP $=\Sigma G/N^{*}100$ GP stands for germination percentage, G for a number of germinations, and N for total number of seeds.

Plant height (cm): At 45 days after sowing, the data on plant height was collected. The length was measured from the soil's surface to the main axis' terminal bud, and it was expressed as the average length per shoot in centimetres.

Number of leaves per plant: After sowing, the observation was noted 45 days later. The average number of leaves per plant was calculated by taking into account all unfolded leaves, regardless of their size.

Leaf area on average: Randomly selected fully expanded leaves from the seedlings were measured using a leaf area metre (LI-COR Model-3100), and their area was expressed in square centimetres (sqm). The statistical analysis was carried out for each observed character under the study using MS-Excel, OPSTAT. The mean values of data were subjected to analysis of variance and ANOVA was set as per Statistical Procedures for Agricultural Research by Gomez and Gomez (1984) for Randomized Block Design (RBD).

RESULTS AND DISCUSSION

Days have taken for initial germination

The days required for initial germination varied significantly, as shown in Table 1. The minimum days taken for initial germination were observed in GA3 75 ppm (9.40 days), followed by NAA 75 ppm (10.86 days). However, the maximum number of days taken for initial germination was recorded in the control (19.53 days). The reduction in days to initial seed germination might be because GA3 plays an important role in two stages of germination, one at initial enzyme induction and the other in the activation of the reserve food mobilizing system, which helps in the enhancement of germination (Jha *et al.*, 1997). Meshram *et al.* (2015) also observed that the seed germination of acid lime was significantly influenced by GA3 and NAA, which started after 21 days of sowing and continued up to 67 days.

Percentage of seed germination

The data regarding this trait is presented in Table 2. It is evident from the data that seed germination is significantly influenced by the gibberellic acid concentration. The data revealed that the maximum value recorded in the single treatment with GA3 75% was followed by NAA 75% at 69.00%, while the minimum seed germination per cent was recorded with control at 35.00%. All the treatments were found to be significant as compared with control. It might be due to the fact that GA3 is involved in the activation of cytological enzymes which stimulate the α–amylase enzyme that converts insoluble starch into soluble sugars and it also initiates radical growth by removing some metabolic

Table 1: Days taken for initial germination by using different media concentrations

Treatment details		Initiation of Seed germination (days) ± SE(m)
T_1	Control	19.53±0.63
T_2	NAA 100 ppm	13.06*±0.29
T_3	NAA 75 ppm	10.86*±0.29
T_4	NAA 50 ppm	14.40*±0.41
T_5	GA3 100 ppm	11.73*±0.43
T_6	GA3 75 ppm	9.40*±0.11
T_7	GA3 50 ppm	12.93*±0.35
	$CD_{(0.05)}$	1.28
	SE(d)	0.58
	CV	5.43

*Significant at 5% level of significance as compared with control blocks (Babu *et al.*, 2010). GA3 also plays an important role in the leaching out of the inhibitors, which in turn helps in breaking the seed dormancy. Dilip *et al.* (2017) observed in Rangpur lime that the maximum seed germination (90%) was observed under the treatment at GA3 80ppm.Meshram *et al.* (2015) recorded in acid lime that the maximum seed germination was observed in GA3 @ 200ppm (81.63%), which was found at par with NAA @40ppm.

Plant height

Results revealed a significant effect of GA3 and NAA on plant height (Table 3). Plant height was maximum in GA3 75 ppm (2.68 cm), followed by NAA 75 ppm(2.36 cm), while the minimum was recorded in control (1.98 cm). Plant height was the highest in GA3 because the GA3 hormone increases cell size by stimulating the cell wall to release and transmit calcium into the cytoplasm, allowing for water absorption and cell growth.GA3 is inactivated after growth, and calcium returns to the cell wall to stiffen it. After the absorption of water by the seed and following the active absorption stage, the embryo produces GA3 and stimulates aleuronic cells to produce hydrolytic enzymes such as α and β-amylase that hydrolyse starch to glucose, which can be absorbed by the embryo. GA3 activated α-amylase, which digested available carbohydrates into simpler sugars, allowing faster-growing seedlings to easily access energy and nutrition. GA3 affects the proteins that produce mRNA, thereby increasing DNA replication and inducing the analysis of endospermic materials in the seed (Lahuti *et al.*, 2003). Dilip *et al.* (2017) also recorded that GA3 80 ppm exhibited a significant increase in plant height (4.49 cm) over control at 45 days after sowing.

Table 2: Seed germination per cent

Treatment details		Seed germination % ± SE(m)
T_1	Control	35.00±1.00
T_2	NAA 100 ppm	53.00*±1.52
T_3	NAA 75 ppm	69.00*±1.73
T_4	NAA 50 ppm	45.86*±1.18
T_5	GA3 100 ppm	58.13*±1.73
T_6	GA3 75 ppm	80.46*±2.40
T_7	GA3 50 ppm	49.66*±1.21
	$CD_{(0.05)}$	4.26
	SE(d)	1.93
	CV	4.24

*Significant at 5% level of significance as compared with control

Number of leaves

The number of leaves significantly varies among treatments, as shown in Table 4. The maximum number of leaves per plant was recorded at GA3 75 ppm (5.46), followed by NAA 100 ppm (5.06). The minimum number of leaves per plant was recorded in the control (4.46). The production of a greater number of leaves in gibberellic acid treatments may be due to the various growths induced by the GA3, which in turn facilitates a better harvest of sunlight by the plants and a greater number of leaves (Lahuti *et al.*, 2003). Our finding is in line with the report of Meshram *et al.* (2015) who observed that the maximum number of leaves in acid lime was recorded with GA3 @200ppm followed by GA3

Table 3: Plant height after 45 days of seed germination

Treatment details		Plant height (cm) ± SE (m)
`T_1	Control	1.98±0.01
T_2	NAA 100 ppm	2.15*±0.10
T_3	NAA 75 ppm	2.36*±0.09
T_4	NAA 50 ppm	2.02*±0.08
T_5	GA3 100 ppm	2.44*±0.14
T_6	GA3 75 ppm	2.68*±0.15
T_7	GA3 50 ppm	2.23*±0.17
	$CD_{(0.05)}$	0.39
	SE(d)	0.18
	CV	9.72

*Significant at 5% level of significance as compared with control

Table 4: Number of leaves 45 days after seed germination

Treatment details		Number of leaves per plant(sq. m) ± SE (m)
T_1	Control	4.46±0.24
T_2	NAA 100 ppm	5.06*±0.13
T_3	NAA 75 ppm	5.00*±0.11
T_4	NAA 50 ppm	4.67±0.17
T_5	GA3 100 ppm	5.00*±0.11
T_6	GA3 75 ppm	5.46±*0.67
T_7	GA3 50 ppm	5.00*±0.20
	$CD_{(0.05)}$	0.52
	SE(d)	0.23
	CV	5.87

*Significant at 5% level of significance as compared with control

Table 5: Leave area

Treatment details		Leave area (sq. m.) ± SE(m)
T_1	Control	0.26±0.02
T_2	NAA 100 ppm	0.37*±0.01
T_3	NAA 75 ppm	0.35*±0.00
T_4	NAA 50 ppm	0.27±0.02
T_5	GA3 100 ppm	0.40*±0.02
T_6	GA3 75 ppm	0.49*±0.02
T_7	GA3 50 ppm	0.41*±0.00
	C.D.	0.05
	SE(d)	0.02
	C.V.	7.94

*Significant at 5% level of significance as compared with control

@150ppm.

Leaf area

Results showed a significant different among treatment for leaf area (Table 5). The maximum number of leaves recorded in GA3 75 ppm (0.49 sp. m.) followed by GA3 50 ppm (0.41 sp. m.), while the minimum number of leaves was observed in control. The higher number of leaves under treatment might be due to the synthesis of protein in plants accelerating, which was indirectly exhibited by the increase in the size of different plants Vasthana *et al*. (2014).

CONCLUSION

It is concluded that GA3 75 ppm was the most effective seed treatment for enhancing seed germination and seedling growth of Kilmora.

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