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Effect of growth regulators on rooting of cuttings in pomegranate (*Punica granatum* L.) cv. 'Bhagwa'

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ABSTRACT

An experiment was conducted at Regional Horticultural Research and Extension Center (RHREC), UHS, GKVK, Bengaluru, in the summer of 2014. Ten treatments of growth regulator formulations were imposed, including the Control, under Completely Randomized Design (CRD). Semi-hardwood cuttings of pomegranate were prepared from healthy twigs 20 to 30cm long, bearing 4 to 5 nodes and a thickness of 0.75 to 1.0cm. The cuttings were treated with a combination of different concentrations (500, 1000 or 1500 ppm) of indole butyric acid (IBA), and 500, 1000 or 1500 ppm of naphthalene acetic acid (NAA) for 8 hours. Results showed that highest sprouting percentage (68.00%), highest rooting percentage (60.40%), maximum number of sprouts (2.09), greatest diameter of sprout (0.59cm), longest roots (18.9cm) and widest diameter of root (1.62mm) were recorded in cuttings treated with IBA 1500ppm + NAA 1500ppm, whereas, longest sprout (34.50cm), highest number of primary roots (10.30) and secondary roots (62.70), highest fresh weight of sprout (9.03g), highest dry weight of shoot (4.66g), highest fresh weight of root (2.70g) and the highest dry weight of root (1.63g) per cutting was recorded with IBA 1500ppm + NAA 1000ppm.

Key words: IBA, NAA, pomegranate, semi-hardwood cuttings

INTRODUCTION

Pomegranate (*Punica granatum*. L.) is an ancient fruit crop, belonging to the family Punicaceae and genus *Punica*. Pomegranate is cultivated in the tropical and sub-tropical parts of the world for its delicious fruits. It is extensively cultivated in India, Spain, Morocco and other countries around the Mediterranean, and, in Egypt, Iran, Afghanistan, Arabia and Baluchistan. In India, among the different states growing pomegranate, Maharashtra is the largest producer covering 2/3rd of the total area under pomegranate in the country, followed by Karnataka, Andhra Pradesh, Gujarat and Rajasthan. Karnataka has the distinction of cultivating pomegranate under tropical conditions in an area of 12,042ha, with production of 1,29,547 tons. The most popular varieties suitable for processing and table use are Ganesh, Mridula, Arakta, Bhagwa (Kesar), G-137 and Kandahar (Jayalakshmi, 2010). Pomegranate is commonly propagated by air layering, hard-wood cuttings and semi hard wood cuttings, because propagation through stem cuttings is the simplest, effective and most convenient (Sharma *et al*, 2009). Auxin is generally accepted as playing a role in initiation and development of adventitious roots. This is the only group of chemicals (synthetic or natural) which consistently improves root formation in cuttings (Singh *et al*, 2009; Damar *et al*, 2014). Therefore, the present study was conducted to study the effect of various concentrations and combinations of IBA and NAA on rooting in pomegranate (*Punica granatum* L.) cuttings of cv. Bhagwa.

MATERIAL AND METHODS

The present investigation was carried out during the summer of 2014 at Regional Horticultural Research and Extension Center (RHREC), UHS, GKVK, Bengaluru - 560065. The experiment was laid out in CRD (Completely Randomized Design), with twenty

cuttings per replication. Ten treatments were imposed, viz., T_1 - Control, T_2 - IBA 500ppm + NAA 500ppm, T_3 - IBA 500ppm + NAA 1000ppm, T_4 - IBA 500ppm + NAA 1500ppm, T_5 - IBA 1000ppm + NAA 500ppm, T_6 - IBA 1000ppm + NAA 1000ppm, T_7 - IBA 1000ppm + NAA 1500ppm, T_8 - IBA 1500ppm + NAA 500ppm, T_9 - IBA 1500ppm + NAA 1000ppm, and T_{10} - IBA 1500ppm + NAA 1500ppm. Semi-hardwood cuttings of 0.75 to 1.0cm diameter of a length of 20 to 30cm were used. The basal 6 - 8cm portion of the cuttings was dipped in the growth regulator formulation for 8 hours and the cuttings were planted in a plastic bag (9 x 5 inches) containing a mixture of sand, soil and FYM in equal proportions. Then, the plastic bags were placed in polyhouse during March. Observations were recorded on stem, leaf and root characters.

RESULTS AND DISCUSSION

Days taken to sprouting

Data indicated significant differences between days taken for the last sprout to appear (Table 1). Among various levels of growth regulators used, IBA 1500ppm + NAA 1000ppm and IBA 1500ppm + NAA 1500ppm resulted in significantly early completion of sprouting (25.00 days and 26.00 days, respectively), while, maximum number of days taken for the last sprout to appear was seen in Control (36.00 days). Damar *et al* (2014) reported that days taken to sprouting, and, days taken to fifty percent sprouting of cuttings were significantly affected by different growth regulators, but, the earliest sprouting of cuttings was noticed with IBA 2000ppm. Similarly, cuttings treated with IBA 5000ppm took minimum duration to sprout (8.75 days), whereas, it was longest (9.73 days) in the Control (Srivastava *et al*, 2008).

Sprouting percentage

Sprouting percentage increased significantly with application of growth regulators. The highest percentage (68.00% and 67.10%) of sprouting was recorded with IBA 1500ppm + NAA 1500ppm, and, IBA 1500ppm + NAA 1000ppm. The least number of cuttings sprouted (26.40) and the lowest sprouting percentage (44.00%) was recorded in the Control. Bhatt and Tomar (2010) obtained maximum number of sprouted cuttings (68.50%) with the growth regulator IBA at 500ppm. Similarly, Singh *et al* (2009) reported that cuttings treated with IBA 100ppm (slow dip) and 2000ppm (quick dip) resulted in maximum (90.96%) sprouting compared to (47.32%) sprouting in the Control. IBA treatment increased sprouting percentage over the Control. This may be attributed to cell division stimulated by the auxin at sprout-union initiation.

Shoot characteristics

A perusal of the data (Table 1) reveals that influence of different growth regulators on inducing number of sprouts, diameter of sprout, length of the longest sprout per cutting and number of leaves per cutting, were significant. Maximum number of sprouts (2.09) per cutting and greater diameter of the sprout (0.59cm) was recorded with IBA 1500ppm + NAA 1500ppm, while, significantly less (1.30) number of sprouts per cutting and the lowest diameter of the sprout (0.37cm) was observed in the Control. Similarly, Among various treatment of growth regulators, IBA 1500ppm + NAA 1000ppm, and IBA 1500ppm + NAA 1500 ppm showed significant results with respect to length of the longest sprout at 120 day after planting (34.50 to 32.40cm, respectively) over the Control (23.4cm). As for number of leaves, cuttings treated with IBA 1000ppm + NAA 1500ppm gave the maximum number of leaves per cutting (33.90), while the minimum number of leaves was recorded in untreated cuttings (20.10). The pomegranate cutting treated with IBA 2000 ppm produced the maximum number of shoots per cutting, but the minimum number of shoots per cutting was observed in control (Damar *et al*, 2014). This may be attributed to increased cell division and elongation at higher IBA concentrations and its possible reason for increased activation of shoot growth which probably increased the number of nodes that lead to development of more number of leaves.

Rooting percentage

Percentage of rooted cuttings as influenced by various growth regulator combination is presented in Table 2. Highest (60.40%) rooting percentage was noticed in cuttings treated with IBA 1500ppm + NAA 1500ppm, followed by IBA 1500ppm + NAA 1000ppm and IBA 1500ppm + NAA 500ppm (57.60% and 53.10%, respectively) as against the lowest (40.10%) recorded with IBA 500ppm + NAA 500ppm; the next lowest percentage (40.50%) was recorded in untreated cuttings. Sharma *et al* (2009) observed that treatment with IBA 500ppm + Borax 1% produced maximum

Table 1. Effect of growth regulators on days-taken-to-sprouting and shoot characters in cuttings of pomegranate (*Punica granatum* L.) cv. 'Bhagwa'

Treatment	Days taken for the last sprout to appear	Sprouting percentage	Number of sprouts / cutting	Diameter of sprout (cm)	Length of the longest sprout (cm)	Number ofleaves / cutting	Fresh weight of shoot (g)	Dry weight of shoot (g)
T_1 = Control	36.00	44.00 (41.55)	1.30	0.37	23.40	20.10	4.80	2.40
T_2 = IBA 500ppm+NAA500ppm	33.00	46.50 (43.00)	1.50	0.39	25.40	20.90	5.43	2.80
T_3 = IBA500ppm+NAA 1000ppm	33.30	49.60 (44.77)	1.90	0.43	26.50	20.20	5.50	2.86
T_4 = IBA 500ppm + NAA 1500ppm	32.30	53.30 (48.00)	1.90	0.41	27.00	20.70	5.96	3.10
T_5 = IBA 1000ppm + NAA 500ppm	31.00	51.66 (46.77)	1.80	0.39	27.10	26.50	6.33	3.46
T_6 = IBA 1000ppm + NAA 1000ppm	32.00	55.30 (48.04)	1.90	0.39	26.10	32.40	6.96	3.73
T_7 = IBA 1000ppm + NAA 1500ppm	30.00	56.50 (48.73)	1.80	0.41	25.30	33.90	7.26	3.80
T_8 = IBA 1500ppm + NAA 500ppm	29.00	59.80 (50.65)	1.90	0.51	28.10	32.30	7.30	4.10
T_9 = IBA 1500ppm + NAA 1000ppm	25.00	67.10 (55.00)	1.90	0.52	34.50	32.30	9.03	4.66
T_{10} = IBA 1500ppm + NAA 1500ppm	26.00	68.00 (55.55)	2.09	0.59	32.40	33.70	8.73	4.53
CD *(P=0.05)*	1.96	3.37	0.21	0.03	2.54	2.28	0.61	0.51
SE.m ±	0.66	1.26	0.07	0.01	0.86	0.77	0.20	0.17

Note: Angular transformation values are presented in parentheses

Table 2. Effect of growth regulators on root characters in cuttings of pomegranate (*Punica granatum* L.) cv. 'Bhagwa'

Treatment	Rooting percentage	Number of primary roots	Number of secondary roots	Length of the longest root (cm)	Diameter of the longest root (mm)	Fresh weight of root (g)	Dry weight of root (g)
T_1 = Control	40.50(39.52)	6.01	29.20	8.3	1.39	1.50	0.85
T_2 = IBA 500ppm + NAA 500ppm	40.10(39.28)	6.03	41.10	8.6	1.49	1.60	0.91
T_3 = IBA 500ppm + NAA 1000ppm	46.00(42.70)	6.90	45.90	9.9	1.53	2.00	1.16
T_4 = IBA 500ppm + NAA 1500ppm	47.30(43.45)	7.04	42.93	11.2	1.41	2.00	1.10
T_5 = IBA 1000ppm + NAA 500ppm	49.10(44.48)	7.00	45.70	16.1	1.45	2.10	1.26
T_6 = IBA 1000ppm + NAA 1000ppm	48.10(43.90)	7.09	55.20	15.5	1.42	2.20	1.30
T_7 = IBA 1000ppm + NAA 1500ppm	50.30(45.20)	8.90	60.12	16.1	1.47	2.20	1.30
T_8 = IBA 1500ppm + NAA 500ppm	53.10(46.77)	9.20	60.08	17.9	1.51	2.40	1.56
T_9 = IBA 1500ppm + NAA 1000ppm	57.60 (49.37)	10.30	62.70	17.8	1.55	2.70	1.63
T_{10} = IBA 1500ppm + NAA 1500ppm	60.40 (51.00)	10.20	61.90	18.9	1.62	2.50	1.56
CD *(P=0.05)*	2.48	0.18	1.40	1.32	0.02	0.24	0.20
SE.m ±	0.84	0.06	0.47	0.44	0.008	0.08	0.06

Note: Angular transformation values are presented in parentheses

root-number (16.47 and 27.12 in semi-hardwood and hardwood cuttings of pomegranate, respectively). Jain and Parmar (1993) also recorded a high number of roots in pomegranate cuttings with IBA 1000ppm + Boron 50ppm. According to Singh (1994), application of IBA to stem cuttings of pomegranate increased rooting percentage. Similarly, Melgarejo *et al* (2000) reported that IBA generally increased per cent rooting. Damar *et al* (2014) and Barde *et al* (2010) also observed better rooting percentage with 2000ppm IBA which could be attributed to auxin activity causing hydrolysis and translocation of carbohydrate and nitrogenous substances at the base of the cuttings, resulting in accelerated cell elongation and cell division under a suitable environment.

Root characters

Data reveals that growth regulators promoted the number of primary and secondary roots per cutting, as compared to the Control (Table 2). Among various growth regulator combinations used, IBA 1500ppm + NAA 1000ppm resulted in the maximum number of primary roots (10.3) per cutting and maximum number of secondary roots (62.70) per cutting; while, significantly low number of primary roots (6.01) per cutting and minimum number of secondary roots (29.20) per cutting was recorded in the untreated Control. Significantly high (18.9cm) primary root length and significantly greater diameter of root (1.62mm) was recorded with IBA 1500ppm + NAA 1500ppm, while, the lowest root length (8.3cm) and significantly low diameter of the longest root (1.12mm) was recorded in the Control. The next best treatment was IBA 1500ppm + NAA 1000ppm with respect to length and diameter of the longest primary root per cutting. Srivastava *et al* (2008) reported maximum number of primary and secondary roots, and average root number (7.68, 49.0 and 75.0, respectively) with 5000ppm IBA (up to a certain concentration) in leafless cuttings of kiwifruit. This may perhaps, be due to enhanced hydrolysis of carbohydrates caused by auxin treatment.

CONCLUSION

In general, all the nine treatments with growth regulators (IBA+NAA) applied at varying concentrations promoted rooting, with the exception of some treatments. Among the different concentrations of growth regulators tested, cuttings treated with IBA 1500ppm + NAA 1500ppm, and those treated with IBA 1500ppm + NAA 1000ppm recorded highest percentage of rooting, and, these were better for root characters such as number of days taken for root iniation, per cent success, highest number of roots, and length of the longest root. Overall, use of higher concentrations of growth regulators gave a better result than with low concentrations for root and shoot parameters. A probable reason could be better utilization by the plant of carbohydrates, nitrogen and other nutrients aided by growth regulators.

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