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Effect of IBA and NAA with or without GA_3 treatment on Rooting Attributes of Hard Wood Stem Cuttings of Pomegranate (*Punica granatum* L.)

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ABSTRACT: Pomegranate regarded as fruit of paradise which commercially propagated by hard wood stem cuttings but the method is not yet standardized as the plant raised are weaker due to shorter and lesser number of roots resulting in poor survival. Therefore, an experiment was planned at the Garden of Department of Fruit Science, Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P.). The experiment conducted in the two consecutive years of 2019-20 and 2020-21. Four levels each of NAA and IBA i.e. 3000, 4000, 5000, and 6000 ppm with and without GA_3 2000 ppm along with a control (Water Spray) were taken. Thus there were 18 treatments all tried in Randomized Block Design replicating thrice pooled analysis of the data recorded that treatment IBA 4000 ppm + GA_3 2000 ppm significantly maximized percentage of rooted cuttings (82.83%), number of primary roots per cutting (44.37), length of longest root (16.37cm), diameter of root (2.49 mm), fresh weight of roots (385.33 mg) and dry weight of roots (96.01 g) while the rooting was hastened taking 28.11 days. Second effective treatments was observed IBA 5000 ppm + GA_3 2000 ppm expressing 81.51 %, 42.42, 15.64 cm, 2.41 mm, 377.25 mg and 92.55 mg values in the above attributes and 28.98 days were taken to root initiation. Control recorded minimum of 50.60%, 31.12, 8.06 cm, 1.49 mm, 279.53 mg and 67.02 mg values respectively while the maximum of 35.63 days were taken to root initiation.

Keywords: IBA, NAA, GA_3 root initiation, Primary roots and Dry and Fresh weight of roots.

INTRODUCTION

Pomegranate is one of the most important fruit crop of the tropical and subtropical region of the world. It is originated from Iran and belongs to the family Punicaceae. It is commercially grown for its sweet-acidic fruit used for desert purpose. It is highly nutritive and medicinal and rich source of minerals, vitamins, antioxidant and tannin **(**Pawar and Singh, 2020). The juice contain sugar, minerals (K and Fe), antioxidant, polyphenols (Sarrou *et al.,* 2014) which control blood pressure and cholesterol and prevent heat attacks and strokes (Aviram *et al.,* 2004). It is a excellent source of vitamins specially B and C. The pomegranate cultivation is spread broad due to its hardy nature (Kamboj *et al.*, 2017). High yield with low maintenance cost and long keeping quality. Therefore, pomegranate is called as the "Fruit of paradise". It has been recognized as a drought and salinity tolerant crop and adapts well in marginal lands (Rao *et al.,* 2021) of arid and semi arid areas**.** Due to its hardy nature, high yield and low input it has emerged as potential fruit crop under poor resource and undesirable condition. Stem cutting is easiest method for pomegranate propagation. Generally 15-20 cm length having pencil size diameter of stem (Rajkumar *et al.,* 2016) are used beneficially for obtaining better cutting by malis and nurseryman. Rooting and sprouting capability varies location to location season to season and age of the mother plant (Kabir *et al.,* 2017). The exogenous application of IBA, NAA, GA_3 individually and in combination (Zimmerman and Wiolcoxon 1935, Tanwar *et al.*, 2020; Kumar and Singh 2020) enhance rooting in stem cutting due to their achieve active cambium division and cell multiplication. The work done in respect of this aspect is very erratic and scanty in India and world. In the present study keeping the above points in view an experiment was planned to standardized the vegetative propagation technique of pomegranate with the help of effective plant growth regulators and their optimal concentrations with the chief of objective of having high survival of healthy plants.

MATERIALS AND METHODS

Two years experiment during 2019-20 and 2020-21 was carried out in rainy season at the Garden, of the Department of Fruit Science, Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P.) India. The planting material i.e. shoots were

selected for taking cuttings that were healthy and free from diseases having a pencil thickness 20 cm length and 4-6 buds. For exogenous application of growth regulators the solutions were prepared treatment wise and cutting were treated by quick dip method. Regarding treatments IBA and NAA at 3000, 4000, 5000 and 6000 ppm, GA_3 2000 ppm, along with a control were tried. The experiment was laid out in under a Randomized Block Design replicating thrice. Twenty cuttings were used as a unit plot under each replication. All the recommended dose of manure and fertilizers given and all the tillage, cultural operation, and plant protection measures were applied as per requirement. The cuttings were treated with growth regulators and planted 10 cm apart with row to row distance of 30 cm. Nearby 2/3rd length of cuttings were buried in soil and remained 1/3rd part exposed as arial. All the rooting attributes were recorded under the experimentation with routine methods and data were analyzed statistically statistically (Panse and Sukhatme 2000) year wise and finally pooled analysis was worked out and the data presented here are according to pooled analysis.

RESULTS AND DISCUSSION

A. Percentage of rooted cutting and number of primary roots per cutting

It is obvious from Table 1 that treatment IBA 4000 ppm in association with GA_3 2000 ppm significantly maximized rooting (82.83%). It was closely followed by IBA 5000 ppm + GA_3 2000 ppm treatment revealing rooting 81.51%. Control showed poorest performance exhibiting poorest 50.60 % rooting. However, IBA 4000 ppm + GA_3 2000 ppm induced 63.69 % more rooting as compared to control. Irrespective of concentration individual treatment of IBA caused significantly greater than NAA treatment. GA_3 2000 ppm alone also proved significantly greater among all the doses of NAA. The cuttings treated with IBA 4000 ppm + GA_3 2000 ppm proved significantly most effective recording 44.37 primary roots. The second effective treatment IBA 5000 ppm + GA_3 2000 ppm showed 42.42 roots. The cuttings under control expressed the minimum number of roots 31.12. The highest (44.37) number of primary roots were recorded by treatment IBA 4000 ppm + GA_3 2000 ppm being 42.58 % greater than control (31.12). IBA concentration proved significantly superior in greater number of rooting contemporary to NAA doses. GA_3 2000 ppm also exhibited higher number of roots than NAA concentrations. The present findings are in accordance with the reports of Ahmad *et al.,* (2018) who observed that the cuttings treated with IBA 4000 ppm proved most effective in rooting, whereas, untreated exhibited poorest performance in respect of rooting as well as and production of primary roots. Damar *et al.,* (2014) in pomegranate also found that the combined treatment of IBA promoted rooting percentage and number of primary roots in cuttings. Similar results have been advocated by Deb *et al.,* (2009) in lemon, Poudel *et al.,* (2018) in pomegranate, Ahmad *et al*., (2018) in Rangpur lime, Sujin *et al.,* (2020) in guava, Dahale *et al.,* (2018) in fig and Rao *et al.,* (2021) in pomegranate.

Days taken to root initiation: Root initiation in the cutting treated with IBA 4000 ppm + GA_3 2000 ppm taking 28.11 days was significantly earliest than all the treatments followed by IBA 5000 ppm + GA_3 2000 ppm treatment taking 28.98 days. Untreated cutting i.e. control recording significantly longer 35.63 days. Earliest root initiation occurred in the cuttings treated with IBA 4000 ppm + GA_3 2000 ppm over control being 7.52 days earlier GA_3 2000 ppm applied alone also influenced root initiation positively being more effective than all the individual concentrations of NAA. All the individual doses of IBA exhibiting earlier root initiation when compared with contemporary doses of NAA (Table 1). As regards days taken to root initiation earlier, IBA was described as a synthetic auxin that elicited auxin like substances effect such as root initiation in stem cuttings. Latter studies have demonstrated that IBA is an endogenous compound which enhance quickly and earlier root initiation in variety of plant species (Korasick *et al.,* 2013). These findings are also in line with the reports of Panda and Bhushan (2016) in pomegranate.

Size of roots (Length and width): The length of roots was observed longest when the cutting were treated with IBA 4000 ppm + GA_3 2000 ppm exhibiting 16.37 cm followed by IBA 5000 ppm + GA_3 2000 ppm showing 15.64 cm length being at par with IBA 4000 ppm + GA_3 2000 ppm treatment. The control revealed the shortest (8.06 cm) of roots (Table 1). Enhancement was brought about nearby double root length due to application of IBA 4000 ppm in association with GA_3 2000 ppm treatment over control. GA_3 2000 ppm proved effective than the different levels of NAA tried. It was however, less effective than varying levels of IBA applied either alone or in combination with GA_3. The diameter was observed significantly greater when cuttings were treated with IBA 4000 ppm + GA_3 2000 ppm recording 2.49 mm diameter closely followed by IBA 5000 ppm with combination of GA_3 2000 ppm recording 2.41 mm diameter 67.11 % improvement on diameter of roots was observed due to application of IBA 4000 ppm + GA_3 2000 ppm over control (1.49 mm). Quite similar to length of root the diameter was influenced by GA_3 being lesser than IBA alone or under combined treatments. It was however greater than NAA alone or combined treatments. The superiority brought about by the growth regulators in size of roots may be attributed to its role in metabolic activities and cell division resulting in increase of the growth of the roots (Edmond *et al.,* 1977); (Hartmann and Kester, 1976) also reported such reaction which is in support to the above fact Cooper, (1961) presumed that the application of growth regulators result in accumulation

of certain chemical substrates at the base of cutting which stimulates the meristem to divide quickly affecting the roots Burstrom, (1982) reported in was of the view that the growth regulators loose the basal cell and admit more oxygen which induce root initiation, root formation and cell elongation. The results obtained in present investigation are in line with the reports of Saroj and Pathak (1998) in guava, Shukla *et al.*, (2010) in peach and Kumar and Singh (2020) in kagzilime, Sujin *et al.*, (2020) in guava, Ahmad *et al.*, (2018) in Rangpur lime and Poudel *et al.*, (2018) in pomegranate.

Table 1: Effect of IBA and NAA with or without GA_3 treatment on root parameters of pomegranate stem cuttings (Pooled analysis).

Symbols	Treatments	Percentage of rooted cutting	No. of primary roots per cutting	Days taken root initiation	Length longest root (cm)	Diameter of root (mm)	Fresh weight of root (mg)	Dry weight of root(mg)
T_1	Control (Water spray)	50.60	31.12	35.63	8.06	1.49	279.35	67.02
T_2	IBA 3000 ppm	75.90	38.28	31.68	11.66	1.98	343.10	82.71
T_3	IBA 4000 ppm	80.57	42.11	29.61	15.04	2.35	371.56	90.97
T_4	IBA 5000 ppm	77.61	39.42	31.09	13.26	2.17	354.48	87.33
T_5	IBA 6000 ppm	76.68	38.60	31.17	12.18	2.13	348.69	85.54
T_6	NAA 3000 ppm	62.02	33.39	33.20	8.69	1.57	302.72	74.78
T_7	NAA 4000 ppm	64.21	34.77	34.15	9.51	1.72	320.36	77.85
T_8	NAA 5000 ppm	62.29	33.53	34.17	8.99	1.61	309.16	75.61
T_9	NAA 6000 ppm	60.54	32.40	34.73	8.41	1.54	298.76	73.03
T_{10}	GA_3 2000 ppm	74.53	36.84	31.75	11.36	1.92	336.94	82.38
T_{11}	IBA 3000 ppm +GA_3 2000 ppm	78.40	40.19	30.46	13.87	2.25	358.37	87.29
T_{12}	IBA 4000 ppm +GA_3 2000 ppm	82.83	44.37	28.11	16.37	2.49	385.33	96.01
T_{13}	IBA 5000 ppm +GA_3 2000 ppm	81.51	42.42	28.98	15.64	2.41	377.25	92.55
T_{14}	IBA 6000 ppm +$GA_3$2000 ppm	78.91	41.27	29.85	14.57	2.30	365.18	89.37
T_{15}	NAA 3000 ppm + GA_3 2000 ppm	65.15	38.37	32.37	9.86	1.78	320.04	78.60
T_{16}	NAA 4000 ppm + GA_3 2000 ppm	66.91	38.13	31.96	11.20	1.88	330.61	81.10
T_{17}	NAA 5000 ppm + GA_3 2000 ppm	65.82	36.18	32.17	10.85	1.83	326.70	79.87
T_{18}	NAA 6000ppm +GA_3 2000 ppm	63.82	35.10	32.74	9.16	1.68	316.78	77.54
	C.D. at 5%	2.81	1.48	1.48	0.83	0.13	10.05	2.45

Fresh weight and dry weight of roots: The cutting treated with IBA 4000 ppm + GA_3 2000 ppm induced significantly maximum fresh weight of roots expressing 385.33 mg followed by IBA 5000 ppm in association with GA_3 2000 ppm revealing 377.25 mg fresh weight. The control recorded minimum (279.35 mg) fresh weight of roots. An examination of data showed that 37.94 % improvement occurred due to application of superficial treatment IBA 4000 ppm + GA_3 2000 ppm over control (Table 1). GA_3 2000 ppm treated cutting expressed relatively poor fresh weight of roots than all the IBA doses applied either alone or in combination. It was registered greater when compared to the doses of NAA. The dry weight content behave similar to fresh weight and treatment of IBA 4000 ppm combined with GA_3 2000 ppm significantly maximized (96.01 mg). It was closely followed by IBA 5000 ppm + GA_3 2000 ppm recording 92.55 mg value. GA_3 2000 ppm treatment recorded 82.38 mg dry weight content. However, it was greater than all the levels of NAA applied alone or with GA_3 2000 ppm. Irrespective of concentrations IBA levels registered greater dry weight content when compared with respective levels of NAA. Control produced poorest (67.02 mg) dry weight content of roots. The highest dry weight of roots recorded under IBA 4000 ppm + GA_3 2000 ppm treatment caused 43.26 % improvement over control. The weight of roots both fresh as well as dry enhanced when GA_3 2000 ppm was added. The superiority observed in present parameters may also due to the fact that applied auxin intensified root forming process in cutting for instance polysaccharide hydrolysis is activated under the influence of applied IBA added with GA_3, and result in the contents of physiologically active sugar providing strenthening materials to the meristematic tissues and later for root primordial and roots. Haising, (1972) examined the function of root forming components of plants which had auxin components and non auxin components. The improvement brought about in the fresh and dry weight of roots may be owing exogenous application of auxin in association with GA_3 which is known to promote root number and size which obviously enhanced the fresh and dry weight of roots in present investigation. These findings are in agreement with the reports of

Kaur *et al.,* (2016); Hakim *et al.,* (2018); Poudel *et al.,* (2018) in pomegranate and Deb *et al.,* (2009) in lemon.

CONCLUSION

In view of the above achievement it is concluded that the treatment of IBA 4000 ppm + GA_3 2000 ppm proved most effective enhancing rooting of cuttings, number of primary roots, length of longest root, diameter of root and fresh and dry weight of roots. Further investigation should be planned with the present treatments to observe the health and survival of cuttings as these parameters and closely related with the rooting performance.

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Conflict of Interest. There no any conflict regarding the conduct of this investigation.

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