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Effect of plant growth regulator on soft-wood cutting of guava cv. sardar (l-49)

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Abstract
Present investigation was conducted under shade net condition during September 2021 to January 2022 at Research cum Demonstration Farm, College of Agriculture, Dhule, Maharashtra. Experiment was set in a Factorial randomized block design (FRBD) comprised of two factors *viz.* different rooting media (7 treatments) and growth regulators (5 treatments) along with 35 treatment combination replicated thrice. Results with respect to growth regulators were promising and IBA @ 4000 ppm (G_2) registered highest values for all characters studies except the days required to rooting. It recorded highest success percentage (52.64%), number of leaves per cutting at 30, 60, 90 and 120 DAP (2.36, 4.95, 9.45 and 12.63), number of shoots at 30, 60, 90 and 120 DAP (1.00, 1.09, 1.59 and 2.15), number of primary roots per cutting (2.02), number of secondary roots (3.95), highest length of root (2.55 cm), highest fresh weight of roots (2.16 g), highest dry weight of roots (0.48 g) and highest survival percentage (34.90%).

Keywords: IBA, plant growth regulator, rooting media, calcium and phosphorus

Introduction
Guava is one of the most prevalent and important fruit crops in India's subtropical and tropical regions. Guava (*Psidium guajava* L.) is a hardy evergreen plant and belongs to the family Myrtaceae. Guava though common but important commercial fruit crop of India which is famous as 'Poor man's apple and 'Apple of the tropics because of its richness in ascorbic acid content. In fact it is the cheap source of ascorbic acid as it contains 228.3 mg ascorbic acid/100 g edible portion (Rahman *et al.*, 2004) [15] which is 3-5 times more as compared to oranges. It is a good source of Pectin and Calcium and Phosphorus.

It has a great market potential due to its delicious taste, aroma, sweet flavour and a fine balance of acid, sugar and pectin. Beside its high nutritive value, it is hardy, heavy bearer and gives good returns (Singh *et al.* 2000) [17]. It is India and is 4th important fruit crop after mango, banana and citrus. The importance of guava is due to its hardy and prolific bearing nature which allows it to thrive in alkaline and poorly drained soil. In India, guava cultivated on 265 thousand hectare area with annual fruit production 40 lakh MT. Bihar, Uttar Pradesh, Maharashtra, Madhya Pradesh, West Bengal, Andhra Pradesh, and Karnataka are the top guava-growing states in India (Saxena, 2018) [16].

Guava is propagated by both sexually (Zamir *et al.*, 2003) [23] through seed and asexually methods *viz.*, like budding, grafting, layering and cutting (Chandra *et al.*, 2004) [4]. Asexual method of propagation is preferred over the seed propagation as the plants raised through seed not to true-to- true type and is unable to maintain genetic purity, resulting in segregating population in size, shape, yield and quality of fruits. To order to produce quality and genuine planting material which would be economically superior tree, it is obvious to use vegetative propagation (Albany *et al.*, 2004 and Giri *et al.*, 2004) [1, 7].

Vegetative method by using softwood and semi hardwood cuttings seems to be promising due to production of true to type plants in just one growing season (Tavares *et al.*, 1994) [20] and cost effective as compared to other methods. Many workers have reported good success with cutting by using growth regulators. Though Guava is difficult to root, the use of Auxin has shown positive outcomes in root initiation in stem cutting. Plant growth regulators (auxin) are used to stimulate adventitious root development in Guava stem cuttings. Yasir Ali (2018) reported that in guava stem cuttings, IBA at 2000 ppm had a greater survival rate and IBA at 4000 ppm had a higher rooting percentage.

A use of good rooting media with rooting hormone will increase root induction (Leonardi *et al.*, 2001) [10]. Therefore, a research experiment was envisaged at College of Agriculture, Dhule with objectives to study effect of different growth regulator on the rooting of guava cuttings and to find best growth regulator.

Materials and Methods

The present investigation was conducted under shade net condition during September 2021 to January 2022, at Research Farm, Department of Horticulture, college of Agriculture, Dhule, Maharashtra.

Location of the experimental site

Field is situated at 20.9 North latitude and 74.78 East longitude with an altitude of 250 m. Dhule lies in the North Maharashtra region, which form the Deccan Plateau. The climate of the district is warm and dry except during the south-west monsoon season.

Preparation of Cuttings

Soft wood cuttings of guava was taken from the 15 years old orchard of cv. Sardar (L-49) About 15-20 cm long cuttings with pencil size thickness and having 2 to 3 buds were taken from terminal portion of current seasons growth. The basal portion rapidly immerse into 1.1% Carbedizim solution to avoid fungal infection.

Preparation solutions of growth regulators

To prepare 2000 and 4000 ppm concentrations of IBA were prepared by dissolving 2 g and 4 g IBA separately in a small amount of acetone in beaker. Then volume up to 1000 ml was made by adding distilled water.

To prepare 200 ppm and 400 ppm concentrations, 2 ml and 4 ml of Paclobutrazol (Cultar) were dissolved in 1000 ml distilled water to make the required concentration.

Keradix powder is the herbal extract available in powder form. It is used by nurserymen for enhancing rooting of cuttings of different plants.

Experimental details

The experiment was laid out in Factorial Randomized Block Design (FRBD) consisting of 35 treatments with combinations of different growth regulators (Factor A) and rooting media (Factor B) replicated thrice. Each treatment comprised of 50 plants.

Table 1: Growth regulators and growth media used I. Factor-A

Sr. No.	PGR	Concentration
1	IBA	2000 ppm
2	IBA	4000 ppm
3	Paclobutrazol	200 ppm
4	Paclobutrazol	400 ppm
5	Keradix	-

Table 2: Factor B

Sr. No.	Types of Media	Proportion
1	Soil	Sole
2	Cocopeat	Sole
3	Soil + Cocopeat	1:1
4	Soil + Perlite	1:1
5	Soil + Peat-moss	1:1
6	Soil + Potting Mixture	1:1
7	Soil + Vermicompost	1:1

Results and Discussion

Days required for rooting

As regards growth regulators, notable influence was observed on days to rooting. Perusal of data presented in the Table 4. The shortest rooting time (18.98 days) was achieved with the Paclobutrazol-200 ppm treatment (G_3), whereas treatment G_2 (IBA @ 4000 ppm) took the longest period of (32.44 days) for rooting. It was interesting to note that, there was no rooting in the treatment G_5. The availability of adequate moisture essential for initiation of enzymatic and biochemical processes by rooting media and inhibition of gibberellin synthesis by Paclobutrazole which would have brought about certain anatomical and physiological changes in the cuttings leading to early root initiation.

Per cent success at 30 Days (%)

Among, the growth regulator treatments, IBA @ 4000 ppm concentration had significantly the highest percentage of rooted cuttings (52.64%), followed by IBA-2000 ppm (45.84%). The lowest percentage of rooting (25.29%) was noticed in treatment G_3 (Paclobutrazol-200 ppm). The reason for significant effect of different IBA concentration on soft-wood cuttings applied growth-regulator may have direct effect on root development. The results are in close agreement with Kareem *et.al.,* 2016 [9] who obtained maximum success at 4000 ppm IBA concentration. Because of favourable biological and physico-chemical characteristics of IBA would have resulted in better rooting, good cell division and callusing (Hartmann *et al.*, 2002) [8] which are associated with potential rooting.

Numbers of leaves (30, 60, 90, 120 Days)

Obvious influence growth regulators on number of leaves per cutting as evident from the (Table 2). Significantly highest number of leaves were produced in treatment G_2 (IBA-4000 ppm) at all stages of observations which produced 2.36, 4.95, 9.45 and 12.63 leaves per cutting at 30, 60, 90 and 120 DAP. Maximum number of leaves were produced in cuttings treated with IBA 4000 ppm which might be due to activation of shoot growth leading to an increased number of nodes which leads to development of more number of leaves. Results are corroborating the findings of Prakash (2018) [11] who recorded highest number of leaves in hardwood cutting of guava treated with IBA 4000 ppm concentration. Akram *et al.*, (2017) [3], Dhatrikarani (2019) [5] and Shahzad *et al.* (2019) [18], also revealed highest production of number of leaves by IBA treatments in guava.

Numbers of shoots (30, 60, 90, 120 Days)

Growth regulators showed significantly influence on shoot production as observed from the Table 3, the treatment G_2 (IBA @ 4000 ppm) recorded striking performance as it registered significantly the highest number of shoots at all growth stages of observations i.e. at 30, 60, 90 ad 120 days which respectively registered 1.00, 1.09, 1.59 and 2.15 shoots and linear increase in number of shoots were observed with advancement of age of cutting. The increase in the number of shoots in soft wood cutting may be because auxins produced in abundance in growing regions

Number of primary roots

Growth regulators showed significant effect on development of primary roots observed from the Table 4. Results showed that, soft wood cuttings treated with IBA-4000 ppm (G_2) produced significantly highest number of primary roots (2.02 cm) whereas there was no rooting in the treatment G_5 (Keradix). Wahab *et al.* (2001) [21] also recorded maximum number of roots per cutting with 3000 ppm IBA. No rooting

in the cuttings treated with Keradix indicating that Keradix is not useful in the guava propagation.

Number of secondary roots

In case of growth regulators (Table 4), the guava soft wood cuttings treated with IBA-4000 ppm (G_2) registered significantly the highest number of secondary roots i.e. 3.95 roots, which was followed by G_1 (IBA-2000) which recorded 2.79 secondary roots. The results are in close conformity of the results obtained by Wahab *et al.* (2001) [21], Kareem *et al.* (2016) [9], Gayathiri and Vijayaraj (2020) [6].

Length of roots (cm)

It is clearly evident from the perusal of data presented in Table 4. that rooting hormone exerted a significant impact on root length. The growth regulator treatment G_2 (IBA @ 4000 ppm) registered significantly the highest length of root (2.55 cm) followed by G_1 (IBA @ 2000 ppm) which had 1.73 cm length of root. Results are in similar line with Kareem *et al.*, (2016) [9], Rajamanickam *et al.* (2021) [13].

Fresh weight of roots (g)

Perusal of data presented in the Table 4 with regards treatments of growth regulators, IBA @ 4000 ppm (G_2) registered significantly the highest fresh weight of roots) 2.16 g). Treatment G_3 (Paclobutrazol @ 200 ppm) recorded lowest fresh weight of roots (0.47 g. Results are in close agreement with Anamika *et al.* (2022) [2]. Sujin *et al.* (2020) [19] also recorded maximum fresh weight of roots in guava due to IBA at higher concentration of 3000 ppm.

Dry weight of roots (g)

Considerable influence of growth regulator on dry weight of roots was observed in Table 4. The results showed that the treatment G_2 (IBA @ 4000 ppm) had significantly highest dry weight of roots at 120 DAP (0.48 g). The next best treatments were G_4 (Paclobutrazole @ 400 ppm) and G_1 (IBA @ 2000 ppm) which recorded 0.37 and 0.31 g dry weight of roots at 120 DAP. Qadri *et al.* (2018) [12] also endorsed the importance of rooting media in guava and good results with silt media in guava cuttings.

Survival percentage (%)

Growth regulator treatments significantly influenced survival percentage of soft wood cuttings of guava showed in Table 4. Significant survival percentage was noted in treatment G_2 (IBA @ 4000 ppm) which registered 34.90 survival percentage. The second best treatment was soft wood guava cuttings treated with IBA @ 2000 ppm (23.10%). The lowest survival rate was observed in the treatment Paclobutrazol @ 200 ppm (4.52%). The findings are similar to Kareem *et al.* (2016) [9], Rajamanickam *et al.* (2021) [13].

Table 1: Effect of various growth regulators on days required for rooting of guava and percent success at 30 days (%) softwood cuttings

Sr. No.	Treatment (G)	Growth Regulator with Concentration	Days required for rooting	Per cent success at 30 days (%)
1.	G_1	IBA-2000 ppm	28.38	45.84
2.	G_2	IBA-4000 ppm	32.44	52.64
3.	G_3	Paclobutrazol-200 ppm	18.98	25.29
4.	G_4	Paclobutrazol-400 ppm	32.01	44.24
5	G_5	Keradix	0.00	0.00
		S.E.M±	0.43	0.69
		CD at 5%	1.21	1.98

Table 2: Effect of various growth regulators on number of leaves of guava soft wood cuttings

Sr. No.	Treatment (G)	Growth Regulator with Concentration	Number of Leaves (Days)			
			30	60	90	120
1.	G_1	IBA-2000 ppm	1.99	4.79	7.86	8.08
2.	G_2	IBA-4000 ppm	2.36	4.95	9.45	12.63
3.	G_3	Paclobutrazol-200 ppm	0.99	2.8	3.98	2.64
4.	G_4	Paclobutrazol-400 ppm	1.83	3.94	7.48	5.92
5	G_5	Keradix	0.00	0.00	0.00	0.00
		S.E.M±	0.05	0.11	0.17	0.36
		CD at 5%	0.15	NS	NS	1.04

Table 3: Effect of various growth regulators on number of shoots of guava soft wood cuttings

Sr. No.	Treatment (G)	Growth Regulator with Concentration	Number of shoots (Days)			
			30	60	90	120
1.	G_1	IBA-2000 ppm	0.89	1.06	1.39	1.49
2.	G_2	IBA-4000 ppm	1.00	1.09	1.59	2.15
3.	G_3	Paclobutrazol-200 ppm	0.47	0.56	0.70	0.32
4.	G_4	Paclobutrazol-400 ppm	0.90	0.95	1.11	0.94
5	G_5	Keradix	0.00	0.00	0.00	0.00
		S.E.M±	0.02	0.02	0.03	0.03
		CD at 5%	0.06	NS	NS	0.08

Table 4: Effect of various Growth regulators on number of primary roots, number of secondary roots, length of roots (cm), fresh weight of roots (g), dry weight of roots (g), survival Percentage (%)of guava softwood cuttings

Sr. No.	Treatment (G)	Growth Regulator with Concentration	Number of primary roots	Number of secondary roots	Length of roots (cm)	Fresh weight of roots (g)	Dry weight of roots (g)	Survival Percentage (%)
1.	G_1	IBA-2000 ppm	1.38	2.79	1.73	1.46	0.31	23.10
2.	G_2	IBA-4000 ppm	2.02	3.95	2.55	2.16	0.48	34.90
3.	G_3	Paclobutrazol-200 ppm	0.37	0.72	0.44	0.47	0.09	4.52
4.	G_4	Paclobutrazol-400 ppm	1.09	2.01	1.79	1.38	0.37	17.94
5	G_5	Keradix	0.00	0.00	0.00	0.00	0.00	0.00
		S.E.M±	0.03	0.06	0.06	1.46	0.02	0.53
		CD at 5%	0.09	0.16	0.19	2.16	0.06	1.53

Conclusion

The higher concentration of IBA (i.e. 4000 ppm) (G_4) was found ideal for maximum rooting, number of leaves and shoots, number of primary and secondary roots, length of roots, fresh and dry weight of roots and survival of the soft wood cutting guava cv. Sardar except *per cent* success at 30 DAP.

The results clearly indicates in guava that, where rooting is difficult, use of growth regulators is more important. Cuttings are also helpful in obtaining desired amount of vigorous plants in a shorter period of time. Therefore cuttings can result as a more efficient method of propagation of Guava along with use of IBA @ 4000 ppm concentration.

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