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The effect of IBA on the shoot and root formation in guava (*Psidium guajava* L.) softwood cuttings

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Abstract
The study on the effect of IBA on Rooting of Softwood cuttings of Guava *cv* Barafkhana' was conducted to identify the most suitable IBA concentration for Guava Softwood cuttings. In this study, IBA concentrations of 1000, 2000, 3000, 4000, 5000 and 6000 ppm were prepared and treated with Softwood cutting as a quick dip method. These cuttings were placed in Polybags and stored in the mist room for root formation. This study used a completely randomized block design (CRD), which was studied using six treatment sand control in three replications. Observations like percent Sprout (%), time taken for Sprouting (days), Shoot length (cm), number of Leaves, number of Roots per Stem cutting, Root length (cm), Root weight (g), and survival percentage (%) were noted and statistically analyzed. Cuttings treated with IBA showed a shorter Sprouting time, a higher Sprouting percentage, and a better survival rate. Results also revealed that cuttings showed fewer days for Sprouting, high Sprouting percentage and Survival percentage when treated with IBA (3000 ppm), This was followed by T7 (4000 ppm). Based on the results, it may be concluded that cuttings treated with IBA @ 3000 ppm had the most desirable values for all parameters. Therefore, this can be used as an alternative for the multiplication of Guava Seedlings.

Keywords: Softwood cuttings, clonal propagation, IBA, quick dip method, Barafkhana

Introduction
Guava (*Psidium guajava* L.) belongs to the Myrtaceae family, with 3,000 species divided into 80 genera. It thrives throughout the world's tropical and subtropical climates, particularly in South America, Asia, and Australia. It grows well in India up to 1515 meters, but the finest quality Guava is grown in the Indo Gangetic plains, where low Night temperatures (10 degrees Celsius) prevail throughout the winter months. Besides its excellent nutritional content, it produces a large harvest each year and provides good economic benefits. In recent years, Guava has grown in popularity in the international market due to its nutritional benefits and the creation of numerous processed goods made from Guava fruits, including Jelly, Jam, Sharbat, Ice cream, Cheese, and canned fruit RTS, Nectar, Squash, and powders. Although commercial-grade fruits are not achieved, they are commercially cultivated using vegetative and direct seedling techniques. This is due to the fact that Guava seedlings do not retain the characteristics of their parents and bear fruits of varying sizes and quantities despite having a long life span, so it is necessary to use vegetative propagation techniques to use those plants with good characteristics such as high-performance and pest and disease tolerance (Rajamanickam *et al.,* 2021) [8]. Because of segregation and recombination of diverse characteristics, descendants from the direct seedling.

The approach is not uniform. Furthermore, plants reproduced by seeds reach maturity significantly later than plants propagated by vegetative techniques. Guava clonal propagation is one method for ensuring consistency among offspring and maintaining high-quality fruits (Prakash *et al.,* 2018) [12]. Initially, Guava plantations require true-to-type planting material to assure both quality and quantity of Guava fruits. Guava propagation via Air-layering and ground layering takes a long time, necessitating a quest fora faster but equally efficient method of vegetative growth. For the production chain, the methods of vegetative propagation have been investigated. The prices of new technologies must also be considered in addition to the propagation structure. Several wood perennials have recently been grown effectively and quickly using terminal cuttings. When planting material is restricted owing to the unavailability of a clone or variety, or when land is suddenly expanded, quick means of propagation become highly crucial. As a result, a concept for using terminal cuttings in Guava quick growth approaches emerges.

IBA on the rooting of Guava (*Psidium guajava* L.) by terminal cuttings of 'Barafkhana' was conducted.

Material and Methods

The current experiment was carried out in 2019–20 to determine the effect of various IBA concentrations on the rooting of softwood cuttings in Guava. This study was conducted on the guava variety 'Barafkhana'. In this experiment, IBA concentrations of 1000, 2000, 3000, 4000, 5000, and 6000 ppm were made and treated with a rapid dip approach with softwood cutting. The cuttings were consistent in size, measuring 18 to 20 cm long and including four buds and two clipped leaves for the experiment. Before being put in the trial plot, the proximal ends of the prepared cuttings were dipped for 10 seconds in each IBA concentration and water for control as treatment. Then, the cuttings were inserted 8cm deep in polybags and maintained in a 'mist chamber' for sprouting. The experiment was set up with the statistical design Completely Randomized Block Design (CRD), having seven treatments and replications. Biometric data related to Shoot and Root percentage as Sprouting percentage (%), Bud sprouting days, number of leaves per cutting, shoot length (cm), Root length (cm), Root weight (g), number of Roots per cutting, survival percentage (%), and dried Root weight(mg) were collected and statistically analyzed.

Results and Discussions

Table 1 shows the effect of IBA on the roots and shooting of guava cv. 'Barafkhana'. The maximum sprouting percentage (76.83%) was reported when cutting treatment with 3000 ppm of IBA (T3), whereas the lowest success percentage (59.27%) was observed in T1 (1000 ppm IBA). The higher percentage of rooted cuttings might be due to increased hydrolytic activity in the presence of administered IBA. The treatment T3 (3000 ppm IBA) sprouted in the shortest time (16.70 days), followed by T4 (17.74 days). Cuttings treated with 1000 ppm of IBA took the longest time to sprout (23.46 days) (T1). Siva Prakash *et al.* (2018) [12] reported similar findings. In terms of the number of Leaves per cutting, treatment T3 (3000 ppm IBA) had the most (4.9) number of Leaves, followed by treatment T4 (4000 ppm IBA) and treatment T2 (2000 ppm IBA). Treatment T3 (6000 ppm IBA) had the least (2.2) number of leaves. Favorable climate condition shave vital influence on increasing the number of leaves. The use of IBA may have increased the number of leaves per cutting (Ghosh *et al*., 2017) [1]. These results are consistent with those of Singh *et al.* (2015) [11]. The treatment T3 had the longest Shoot length (8.11 cm), followed by T4 (7.63 cm), while cuttings treated with IBA 1000 ppm (T1) had the shortest Shoot length (4.93 cm).This might be attributed to the action of IBA, which promoted hydrolysis and transport of Carbohydrates and nitrogenous substances at the cellular level at the cuttings' base, resulting in rapid cell elongation and cell division under favourable climatic conditions. The Softwood cuttings treated with IBA @ 3000 ppm (T3) had the longest Root length (27.32 cm), whereas the cuttings produced under 1000 ppm of IBA had the shortest Root length (18.47 cm) (T5). This might be attributable to IBA activity, which triggered hydrolysis and transport of Carbohydrates and nitrogenous substances at the cellular level at the base of cuttings, resulting in faster cell elongation and cell division under favourable environmental conditions. This is similar to the findings of Gilani *et al*., (2019) [2]; Kareem *et al.* (2016) [4] found that IBA (3000 ppm) produced the best outcomes in terms of shooting per cent, root number per cutting, and normal Root length in Guava. In terms of Root weight, T3 (1.52 g) had the highest weight, followed by T4 (1.49 g), while cuttings treated with IBA 1000 ppm (T1) had the lowest weight (0.89 cm). A similar pattern was seen in dry Root weight. T3 (IBA 3000 ppm) cuttings had the maximum dry Root weight of 108.42 mg, followed by T4 (IBA 4000 ppm) (106.52 mg). T1 had the smallest weight of 100.92 mg. According to in Stevia and Singh and Tomar (2015) [10] in Phalsa, the rise in Root weight may have directly impacted the fresh weight of the roots. The maximum number of roots per cutting was found in T3 (7.0), followed by T4 (6.20), while the lowest number of roots was found in cuttings treated with IBA 1000 ppm (4.5). In Phalsa, Rajamanickam *et al*., (2021) [8], Singh and Tomar (2015) [10] and Singh *et al.* (2015) [11] showed similar results. T3 had the best survival rate of 65.51 per cent, followed by T4 with 61.74 per cent. The lowest survival rate was observed in IBA 1000 ppm treated cuttings (45.65 percent). This might be because the plant transferred the largest assimilate amounts to the leaf buds, which are one of the manufacturing locations of natural Auxins and are extremely crucial for critical functions including photosynthesis and respiration (Ghosh *et al*., 2017) [1]. The findings are similar to Soni *et al.* (2016) [13] and Kuntagol *et al*., (2018) [5] in Guava hardwood cuttings.

Table 1: Effect of IBA on Rooting and Shooting of Guava 'Barafkhana'

IBA Concentrations	Sprouting per cent (%)	Days taken for bud sprouting (days)	Number of leaves per cutting	Shoot Length (cm)	Root Length (cm)	Root Weight (g)	No. of roots per cutting	Survival Percent (%)	Root dry Weight (mg)
Control	55.63	24.13	1.8	5.87	15.63	1.23	4.6	39.47	100.27
T2-IBA @ 2000 ppm	69.75	21.80	4.2	7.34	25.46	1.46	6.2	57.35	104.54
T3-IBA @ 3000 ppm	76.83	16.70	4.9	8.11	27.32	1.52	7.0	65.51	108.42
T4-IBA @ 4000 ppm	74.24	17.74	4.6	7.63	26.51	1.49	6.2	61.74	106.52
T5-IBA @ 5000 ppm	59.85	22.57	2.6	6.93	18.47	1.32	5.7	47.39	103.63
T6-IBA @ 6000 ppm	61.59	22.00	2.2	6.78	18.59	1.36	5.2	46.54	103.73
Seed	0.39	0.26	0.10	0.563	1.045	0.05	0.09	0.385	20.35
CD (p = 0.05%)	0.69	0.50	0.23	1.012	3.013	0.17	0.207	0.578	39.42

The results of the study demonstrated that IBA 3000 ppm had the highest Sprouting percentage, number of leaves, Root length, Root weight, Root dry weight, Shoot length and Survival per cent

Conclusion

According to the study's findings, varying concentrations of IBA had a substantial impact on the growth characteristics of Guava terminal cutting. IBA 3000 ppm had the highest

percentage of sprouting, shoot length, root length, Sprouting percent, and the number of leaves, early sprouts, fresh Root weight, dry Root weight, and survival percent in the current study. Compared to other IBA concentrations, softwood cuttings treated with IBA. 3000 ppm performed better in rooting and sprouting. Therefore, Softwood cutting with IBA 3000 ppm rapid dip is advised for effective propagation of Guava cuttings.

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