Effect of hormones on rooting of apical cuttings for propagation of guava cv. Lucknow-49

ABSTRACT

An attempt on the propagation of Guava cv. Lucknow-49 was made during 2022-23 from apical cuttings under mist chamber conditions was undertaken. The apical cuttings were collected from shoot tips measuring about 10 to15 cm were treated with different hormones of concentrations *viz.,* IAA @ 2000, 3000 and 4000 ppm; NAA @ 2000, 3000 and 4000 ppm along with IBA @ 3000, 4000 and 5000 ppm and these are compared with control, the treated apical cuttings were planted in 40 cavity protrays till 30 days for root induction under mist conditions. The different growth hormonal applications and its varied concentrations excerted a significant effect on root development in cuttings. Apical cuttings treated with IBA @ 5000 ppm was found better for rooting percentage (69.90 %), survival percentage (67.50 %), time taken to root (23.75 days), number of roots per cutting (15.15, 16.25, 17.53 and 24.64) and root length (7.33, 9.78, 13.85 and 18.33 cm) respectively at 30, 60, 90 and 120 DAP, fresh root weight (3.93 and 10.15 g), dry root weight (1.13 and 2.18 g) at 60 and 120 DAP, respectively. The rooting hormone IBA performed better in formation of rooting in apical cuttings when compared to IAA, NAA and untreated control. It can be revealed from the current study that propagation of guava by cuttings when treated with IBA @ 5000 ppm will be a better propagation method for rooting of cuttings.

Keywords: Guava, propagation, cuttings, IBA, growth rate, mist chamber

INTRODUCTION

Guava is a nutritious fruit that belongs to the family Myrtaceae. It is one of the most important fruit crop after Mango, Banana and Citrus. In India, it is cultivated in an area of 3.59 Lakh Ha with annual production of 55.90 Lakh MT (Anonymous, 2023). In Telangana state, Guava stands as a major fruit crop with an area of 0.14 lakh acres and production of 1.17 Lakh MT (Anonymous, 2022). There is a great demand for true to type and quality planting material (Amit *et al*., 2010). Vegetative propagation of guava by ground layering or stooling is a commercially practiced to ensure true to type and early bearing of fruits but, in asexual method of propagation, soil media may carry the nematodes along with plant materials. Hence, the production of nematode free planting material is very essential for the sustainable production of guava. Commercial methods of propagation such as air layering, grafting or stooling cannot meet the requirement of planting stock. Therefore, there is an urgent need to develop low cost protocol; fast and can provide high quality genetically true to type planting material. In this regard, a rapid method of propagation becomes an important when planting material supply is limited. Apical/terminal cutting is an easy, quick, novel and economical method of propagation.

Production of any crop is influenced mainly by the use of quality planting material (Ambebe *et al*., 2018). External and internal factors affect the rooting of cuttings where the

hormonal treatment is an important exogenous factor to enhance the initiation of root primordia and growth through cell multiplication (Fogasa and Fett-Neto, 2005). Hormones support mobilization of sugars and nutrients by the hydrolysis of starch to the base of cuttings (Das *et al*., 1997). Most of the time auxins like Indole acetic acid (IAA), Indole Butyric Acid (IBA), Naphthalene Acetic Acid (NAA) are used for rooting of cuttings. The present experiment was formulated to standardize the technique of propagation method in multiplying a good and healthy root system through cuttings under controlled mist chamber with the use of hormonal substances (Davies and Hartman, 1988).

MATERIAL AND METHODS

The present experimentation entitled "Effect of hormones on rooting of cuttings for propagation of guava cv. Lucknow-49" was carried out under controlled mist chamber during 2022-23. The experiment was laid out in Completely Randomized Design with 10 treatments replicated four times. The apical cuttings were collected during the month of January and around 40 terminal cuttings per treatment were used for the trial. The tender, terminal portion of immature cuttings were taken from 8 years old healthy mother plants of uniform size measuring a length of 10-12 cm, consisting of 2-3 nodes. These terminal cuttings were treated with different concentrations of IAA @ 2000, 3000 and 4000 ppm and NAA @ 2000, 3000 and 4000 ppm; IBA @ 3000, 4000 and 5000 ppm by quick dip method in respective hormonal concentration and compared with untreated control these cuttings were immediately planted in 40 celled cavity of portray measuring 3.5 cm top diameter, 3 cm bottom diameter and 8 cm depth and were transferred to mist chamber by maintaining a temperature of 25^0C and 90% RH till first 30 days of rooting of cuttings (Plate 1). Irrigation applied with the help of foggers in the form of mist at an interval of every 20 minutes for 30 seconds till 30 days to maintain moist for rooting of cuttings. Before planting these cuttings were immersed in 1% Bavistin solution to avoid any fungal attack. The root formation was observed during mist chamber conditions and shoot formation in the shade net conditions. After 30 days in the mist chamber conditions, these portrays with rooted cuttings were transferred for further study under partial shade net (50% shade net) for 15-20 day for shoot initiation. The data recorded were statistically analysed by adopting procedure suggested by Yates *et al* (1963).

For recording the observations 4 cuttings were selected randomly for each replication per each treatment. The rooting percentage in each treatment was recorded at every 30 days after planting (DAP). The percentage of rooting was determined by counting the number of the rooted cuttings per replication to the total number of cuttings per replication and expressed in percentage.

$$\text{Rooting percentage (\%)} = \frac{\text{Number of the rooted cuttings per replication}}{\text{Total number of for replication}} \times 100$$

Survival percentage of rooted cuttings was calculated at 60, 90 and 120 days after planting (DAP) by following formulae. Survival percentage of cuttings = T-Mp /T x 100 were, T: Total number of rooted cuttings, Mp: Mortal plants

The apical cuttings were picked randomly within the treatment from pro trays after 20 DAP under mist chamber to observe the days taken to root till transferring to 50% shade net and the mean value was calculated and expressed in days. The number of roots per cutting was recorded from randomly selected 4 cuttings per treatment at 30, 60 and 90 days and average values were drawn. The root length from collar region to the tip of the root was measured for 4 randomly uprooted plants in each treatment in centimetre scale at 30, 60 and 90 DAP and then average was calculated. The fresh weight of roots per cutting was recorded at 30, 60 and 90 DAP with the help of electronic weighing balance and the average value was computed. The same samples were kept in hot air oven at 60°C for 24 hrs to arrive a constant dry weight with the help of electronic weighing balance and the average value was computed and expressed in grams.

RESULTS AND DISCUSSION

Rooting percentage

The method of propagation of guava through terminal cuttings, and it's respectively hormonal concentrations significantly influenced rooting of cuttings under mist chamber and the data obtained are presented in Table 1 and Fig 1. The rooting percentage resulted significantly with respective hormones and its concentrations. The maximum rooting percentage was recorded in IBA @ 5000 ppm (69.90 %) and it was followed by IBA @ 4000 ppm (65.85 %), while the minimum (46.00 %) in untreated control. The exogenous application of IBA can synthesise auxins and cytokinins for the initiation of root and shoot in softwood cuttings. Auxins are synthesized in apical shoots and then translocated downwards, it moves from cell to cell in a polar fashion, with a basipetal polarity in stems (Lomax *et al*., 1995). The possible reason for the lower success in untreated control might be due to the presence of higher polyphenols which acts as auxin transport inhibitors (Brown *et al*., 2001).

Survival percentage

The treatment with IBA @ 5000 ppm significantly influenced the survival percentage of 67.50 % and it was followed by IBA @ 4000 ppm (64.73 %), while the minimum percentage (47.50 %) was observed in untreated control (Table 1) and (Fig 1). The highest survival percentage might be due to the fact that higher number of roots and root length influenced the better uptake of water and nutrients (Reddy *et al*., 2008). The translocation of photo assimilates synthesized in a newly formed shoots towards the root system helps in better survival of apical rooted cuttings. These results are in agreement with the findings of Shukla and Bist (1994) in Pear, Lakhani and Gajapara (1998), Srivastava *et al*. (2005) in Kiwi fruit, Saed (2010) in Pomegranate and Rahad *et al*. (2016) and Ali *et al*. 2022 in Dragon fruit.

Days taken for root initiation

The cutting treated with different hormones and its concentrations significantly differed days taken for root initiation, root length and no. of roots per cutting and obtained mean data are represented in Table 1.

Among the different hormones used, IBA decreased days taken for rooting of cuttings. The terminal cuttings dipped in 5000 ppm IBA resulted early rooting (23.75 days) and it was followed by IBA @ 4000 ppm (24.53 days), while the maximum days (30.32) observed in untreated control. The better utilization of reserve carbohydrates, nitrogen and other factors stored in stem cuttings activated hydrolytic enzymes with IBA application (Chandramouli, 2001). The rooting in terminal cuttings might be due to availability of auxins and cytokinins with IBA and these apical cuttings are one of the sites of natural auxins synthesis (Wahab *et al*., 2001). The minimum root initiation (30.32 days) was observed in untreated control which might be due to the over absorption of auxins, causing inhibitory action on rooting. Temperature, relative humidity and media played a significant role in realizing better success rate (Rymbai and Satyanarayana Reddy, 2010). Similar findings were reported earlier by Srivastava *et al*. (2005) in Kiwi fruit and Muhammad *et al*. (2009) in Ber.

Number of roots per cuttings

The data presented in the Table 2, indicated the number of roots per cutting significantly influenced with different hormones and its concentrations at 30, 60, 90 and 120 DAP. The maximum roots per cutting (15.15, 16.25, 17.53 and 24.64) was recorded in IBA @ 5000 ppm and it was followed by 4000 ppm IBA (13.75, 15.25, 16.51 and 22.04) whereas, the minimum roots per cutting was recorded in untreated control (6.10, 8.57 10.25 and 14.74) at 30, 60, 90 and 120 DAP, respectively. The treatment with maximum roots might be due to hormonal effect leading to accumulation of internal substances and their downward movement as well as cell division, enhanced better expression of root primordial and that resulted in significant development of root system. These findings are in accordance with the results reported earlier by Noor *et al*. (2000) in Litchi, Athani *et al*. (2001) in Guava, Kumar and Syamal (2005) in guava, Maurya *et al*. (2012) in Guava and Bhosale *et al*. (2014) in Pomegranate.

Root length (cm)

The root length parameter significantly differed with different hormones and its concentrations at 30, 60, 90 and 120 DAP (Table 2). Among the different treatments evaluated, the maximum root length (7.33, 9.78, 13.85 and 18.33 cm) was observed in 5000 ppm IBA at 30, 60, 90 and 120 DAP, respectively, while the minimum root length was recorded in control. The IBA @ 5000 ppm initiated better root length which could be due to hydrolysis of polysaccharides stored in these cuttings into physiologically active sugars, provides energy through respiratory activity to the root primordia that helped in rapid elongation of meristematic cells to initiate better root length (Singh *et al*. 2014). Similar results were reported by Kumar *et al*. (2007) in Guava, Reddy *et al*. (2014) in Fig, Gohil (2014) in Cashewnut and Tomar and Tomar (2012) in Pomegranate.

Fresh and dry root weight (g)

The fresh root weight (3.93 and 10.15 g) and dry root weight (1.13 and 2.18g) resulted significant with different hormones and its concentrations at 60 and 120 DAP in IBA

@ 5000 ppm while, the minimum fresh root weight (1.79 and 4.85 g) and dry root weight (0.48 and 0.85 g) was recorded in untreated control at 60 and 120 DAP, respectively (Table 1). The higher fresh and dry root weight could be attributed to the rapid hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars by activation of hydrolytic enzymes. These sugars provide energy for the meristematic tissue and root primordial through respiratory activity leads to initiate a greater number of adventitious roots and cell elongation which helps in establishment of higher root weight per cutting. The present findings are in agreement with the results of Singh *et al*. (2013) in Lemon, Porghorban *et al*. (2014) in Olive, Rahad *et al*. (2016) and Ali *et al*. (2022) in Dragon fruit.

Conclusion

It could be finally concluded from the present investigation effect of growth hormones on propagation of guava cv. Lucknow 49 through apical cuttings that, different rooting hormones and its concentrations excerted a significant effect on root development in apical cuttings. Among the various treatments IBA @ 5000 ppm was found better when compared to other treatments in respect to various attributes *viz*., rooting and survival percentage, time taken for root formation, number of roots and root length per cutting at 30, 60, 90 and 120 DAP, respectively, similarly with fresh and dry root weight at 60 and 120 DAP, respectively recorded higher when treated with 5000 ppm IBA. The hormonal treatment with IBA @ 5000 ppm performed better in propagation of apical cuttings when compared to IAA, NAA and untreated control. This experiment can reveal the potentiality of guava propagation through terminal or apical cuttings with IBA @ 5000 ppm and it will be a novel, economical method to propagate for mass production.

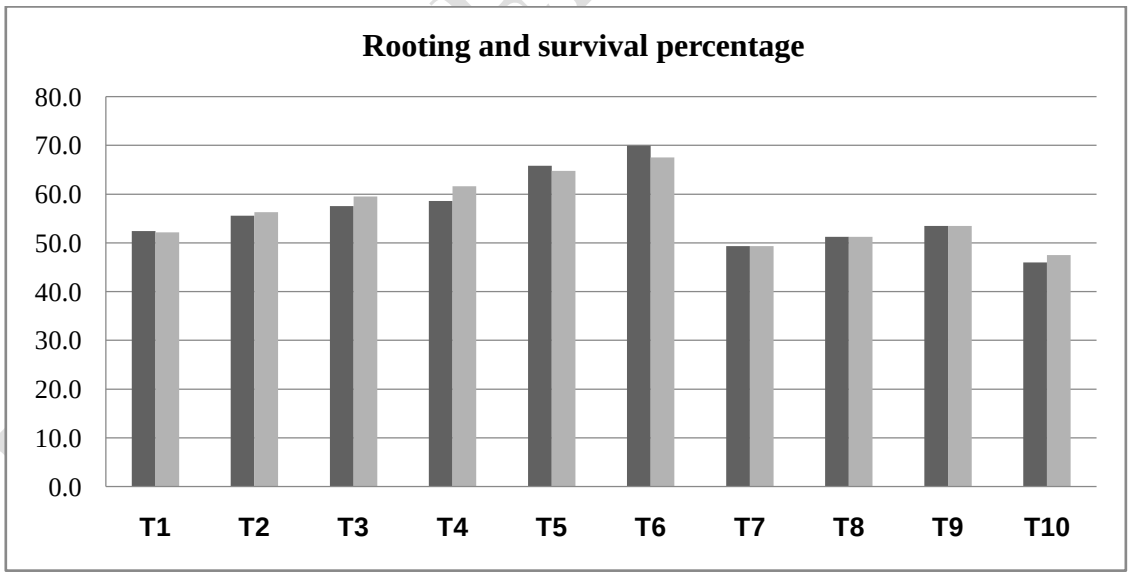

Fig: 1: Effect of hormones on rooting and survival percentage of rooted cuttings in Guava cv. Lucknow-49

Table-1: Effect of hormones on rooting percentage, days taken to root, survival percentage, fresh and dry root weight in propagation of guava apical cuttings cv. Lucknow-49

Treatments	Rooting percentage	Days taken for root initiation	Survival percentage	Fresh root weight (g)		Dry root weight (g)	
				60 DAP	120 DAP	60 DAP	120 DAP
IAA @ 2000 ppm	52.40	28.79	52.13	2.46	6.74	0.68	1.12
IAA @ 3000 ppm	55.65	26.77	56.26	2.74	8.16	0.72	1.29
IAA @ 4000 ppm	57.50	25.42	59.53	2.82	8.68	0.78	1.42
IBA @ 3000 ppm	58.65	24.79	61.62	2.89	9.25	0.85	1.57
IBA @ 4000 ppm	65.85	24.53	64.73	3.03	9.47	0.97	1.87
IBA @ 5000 ppm	69.90	23.75	67.50	3.93	10.15	1.13	2.18
NAA @ 2000 ppm	49.40	29.25	49.34	2.29	5.98	0.56	1.05
NAA @ 3000 ppm	51.28	28.91	51.22	2.41	6.34	0.65	1.13
NAA @ 4000 ppm	53.53	27.25	53.48	2.68	7.57	0.7	1.19
Control	46.00	30.32	47.50	1.79	4.85	0.48	0.85
S.Em ±	0.81	0.47	1.17	0.04	0.16	0.009	0.021
CD at 5%	2.35	1.37	3.39	0.133	0.47	0.026	0.06

Table 2: Effect of hormones on number of roots/cutting and root length at 30, 60, 90 and 120 DAP in propagation of guava apical cuttings cv. Lucknow-49

Treatments	No of roots/cutting				Root Length (cm)			
	30 DAP	**60 DAP**	**90 DAP**	**120 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**
IAA @ 2000 ppm	8.50	10.53	12.56	18.58	5.25	6.49	10.74	15.88
IAA @ 3000 ppm	9.60	10.75	13.53	20.52	5.45	6.88	11.36	16.53
IAA @ 4000 ppm	10.13	12.69	14.65	21.58	5.65	7.08	11.55	16.78
IBA @ 3000 ppm	10.91	13.35	15.65	21.87	5.83	7.15	11.85	16.92
IBA @ 4000 ppm	13.75	15.25	16.51	22.04	6.93	8.18	12.35	17.58
IBA @ 5000 ppm	15.15	16.25	17.53	24.64	7.33	9.78	13.85	18.33
NAA @ 2000 ppm	8.03	10.12	11.75	16.96	5.11	6.27	10.42	15.18
NAA @ 3000 ppm	8.35	10.25	12.38	17.81	5.15	6.35	10.68	15.52
NAA @ 4000 ppm	9.25	10.69	12.82	19.65	5.33	6.63	10.89	16.38
Control	6.10	8.57	10.25	14.74	4.73	5.88	9.17	12.13
S.Em ±	0.149	0.161	0.296	0.309	0.092	0.121	0.218	0.233
CD at 5%	0.430	0.465	0.857	0.893	0.266	0.351	0.631	0.673

Plate 1: Procedure and steps in preparation of apical cuttings for propagation of Guava cv. Lucknow-49

a) Guava mother block; b) Selected terminal shoots for preparation of softwood cutting; c) Prepared softwood cuttings d) Cuttings treated with 1% carbendazim to prevent any fungal disease; e) Treated cuttings planted in portrays; f) Pro-trays kept under mist chamber for rooting; g) Rooted cuttings; h) Clones produced by apical softwood cuttings after 120 DAP

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