International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 04-10-2020; Accepted: 19-10-2020; ; Published: 05-11-2020
Volume 2; Issue 2; 2020; Page No. 281-284

Standardization of time of layering and IBA concentration on rooting and establishment of air layers of Guava cv. Lalit under southern transitional zone of Karnataka

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Abstract
The study was conducted to know the exact time of layering and IBA concentration on rooting and establishment of air layers of Guava cv. Lalit under Southern Transitional Zone of Karnataka during the year 2019-2020 at Guava Mother Block, Organic Farming Research Centre and Department of Horticulture, College of Agriculture, University of Agriculture and Horticulture Sciences, Shivamogga. The experiment was laid out in Factorial Randomized Completely Block Design having sixteen treatment combinations with four repetitions. The study revealed that, among different time of layering, the minimum number of days for root initiation (38.62), maximum rooting percentage (71.75), maximum number of primary and secondary roots per layer (17.00 and 7.39 respectively), length and diameter of longest root per layer (9.51 cm and 0.84 mm respectively), fresh and dry weight of roots (2.35 g and 0.80 g respectively) observed best in the layers prepared on first fortnight of June. Among different concentration of IBA, the minimum number of days for root initiation (36.75), maximum rooting percentage (77.19) maximum number of primary and secondary roots per layer (18.91 and 8.93 respectively), length and diameter of longest root per layer (10.16 cm and 0.85 mm respectively), fresh and dry weight of roots (2.56 g and 0.98 g respectively) was recorded best with 4500 ppm IBA concentration. On the basis of the results obtained in the present investigation, air layering performed during first fortnight of June, treated with 4500 ppm IBA concentration have been found significantly superior compared to other treatments under Southern Transitional Zone of Karnataka.

Keywords: guava, lalit, time of layering, iba concentration, rooting percentage

Introduction
Guava (*Psidium guajava* L.) belongs to the Myrtaceae family is one of the most common fruits in the tropical and subtropical regions of India. It is originated in Tropical America. Most of the cultivar's are diploid (2n=22), but some are triploid natural and artificial (3n=33); these are generally produced seedless fruits. It is also recognized as "Apple of Tropics" because it is sold at moderate prices. It occupies an important place in horticulture wealth of our country. In India, Guava is the fourth most valuable crop after Mango, Banana and Citrus. It has gained tremendous popularity owing to its high nutritive value. Guava fruits are rich in Vitamin C. Guava is commercially being grown in an area of 2.62 lakh hectare with the total production of 36.48 lakh metric tons with the productivity of 13.90 metric tonnes ha-1 (Anonymous, 2018) [1]. In Karnataka, the major guava producing districts are Kolar, Ramanagar, Tumkur, Dharwad and Chikkaballapura. Guava is commonly propagated by sexual and asexual methods. The seedling raised from open-pollinated seeds can be expected to result in a certain amount of variations. Whereas, vegetatively propagated fruit plants are genetically identical, uniform in growth, fruit quality and yield. Therefore, to satisfy the demand for genetically pure cultivars, it is essential to go for an alternative method of propagation which is simple and in a short time can provide more progeny / off-springs. Air layering is a successful method with the assistance of a growth regulator. Applying appropriate growth regulators, especially auxins in accordance with the specific plant species, have made a breakthrough in rooting of air-layers. To attain better results and to avoid toxicity, the auxins have to be used in the optimum concentrations, which may vary from crop to crop. The successful air layering depends on various factors *viz.*, time of layering, rainfall, humidity, temperature, growth regulator, and physiology of mother plants, nutritional status of plant and soil and care after layering. Time of air layering is an important factor for the successful establishment of roots. It is found that certain percentage of layers die in the nursery due to untimely layering. Looking to the importance of time of layering and plant growth regulators the present investigation entitled "Standardization of time of layering and IBA concentration on rooting and establishment of air layers of Guava cv. Lalit under Southern Transitional Zone of Karnataka" was conducted at Guava mother block, Organic Farming Research Centre (OFRC) and Department of Horticulture, College of Agriculture, UAHS, Shivamogga.

Material and Methods
The present experiment was carried out during the year 2019-2020 at Guava Mother Block, Organic Farming Research Centre and Department of Horticulture, College of Agriculture, University of Agriculture and Horticultural Sciences, Shivamogga, Karnataka. The experiment was laid out in Factorial

Randomized Completely Block Design having sixteen treatment combinations with four repetitions. The detail of experiment is as follows –

Factors	Levels	Notation
1. Time	First fortnight of June	T1
	Second fortnight of June	T2
	First fortnight of July	T3
	Second fortnight of July	T4
2. Rooting hormone	Indole -Butyric Acid at 0 ppm	RH1
	Indole -Butyric Acid at 3000 ppm	RH2
	Indole -Butyric Acid at 4500 ppm	RH3
	Indole -Butyric Acid at 6000 ppm	RH4

Treatment combinations

T1RH1	T2RH1	T3RH1	T4RH1
T1RH2	T2RH2	T3RH2	T4RH2
T1RH3	T2RH3	T3RH3	T4RH3
T1RH4	T2RH4	T3RH4	T4RH4

The mother plants of guava cultivar Lalit of four years old were selected. Transparent polythene sheet (size 200 guage), sharp knife, thread, sphagnum moss and IBA were used for carrying out layering for guava cv. Lalit plants at different intervals. The air layering was performed during first fortnight of June, second fortnight of June, first fortnight of July, second fortnight of July of the year 2019. Air layering was done on four years old guava plants well matured and healthy active shoots of pencil thickness were selected for layering. A ring of bark about 2 cm wide was completely removed between two nodes with sharp knife. As per treatment, IBA solution was applied at the girdled portion with the help of cotton swab. Then the girdled portion was covered with moist sphagnum moss and secured firmly with transparent polythene sheets of 200 gauge and was wrapped securely and both the ends tied tightly using thread.

The observations *viz.*, Days taken for root initiation (days), Rooting percentage of layers (%), Number of primary roots per layer, Number of secondary roots per layer, Length of longest root per layer (cm), Diameter of longest root per layer (mm), Fresh and Dry weight of roots (g) were recorded after 60 days of air layering during the period of the experimentation from 5 randomly selected plants of each treatment and replications. The data comprising the calculated mean values of each treatment and replication wise were subjected to computerized statistical analysis using a method suggested by Sunderaju *et al.* (1972) [11] for factorial randomized complete block design. The test of significance (F- test) and critical difference (CD) were calibrated at 0.05 probability.

Results and Discussion

Effect of time of layering

The present investigation on effect of time of air layering have differed significantly on days taken to root initiation, rooting percentage, number of primary and secondary roots, length and diameter of longest root, fresh and dry weight of roots in Lalit guava as presented in Table 1. The results reveals that, the minimum days taken for root appearance (38.62 days), maximum rooting percentage (71.75), number of primary (17.00) and secondary roots (7.39), length of longest root (9.51 cm), diameter of longest root (0.84 mm), fresh (2.35 g) and dry weight of root (0.80 g) was recorded in the layers which were performed on First fortnight of June (T1). The reason for better rooting attributes might be due to establishing of roots in different months influenced by different natural factor alongside expanded relative humidity in the long stretch of July and decreasing temperature from summer to pre-winter season. Successful rooting depends on rainfall, temperature, evaporation, sunshine and relative humidity. More number of primary and secondary roots might be due to the attribution of moderate rainfall during June. The soil status and available nutrients to the plants along with favourable environmental conditions. The length of longest root might be due to the impact of time of layering on rapid cell elongation and other response of physiological modifications in the air layered shoot. On top of that severity of girdled portion additionally helps in faster elongation of roots. More diameter of the root might be due to the creation of most reliable conditions for the storage of photosynthates in root zone and further increase of cortex parenchymatous cells which were responsible for the increased diameter of roots. Overall, it may be due to the availability of required climatic and weather conditions during the period of root development attributed in better rooting. Comparative outcomes are supported by Singh (2002) [9] in Guava, Rymbai and Reddy (2010) [7] in Guava, Gowda *et al.* (2006) [5] in Rose apple and Tomar (2016) [12] in *Spondias pinnata.* Whereas the late rooting (47.75 days), minimum rooting (57.17%) and less number of primary (7.90), secondary roots (4.87) were observed in (T_3) the layers performed during first fortnight of July.

Effect of IBA concentration

The data on different IBA concentrations had differed significantly on days taken for root initiation, rooting percentage, number of primary and secondary roots, length and diameter of longest root, fresh and dry weight of roots (Table 1). Among the different concentration of IBA, the less number of days taken for root initiation (36.75), maximum rooting percentage (77.19), number of primary (18.91) and secondary roots (8.93), length of longest root (10.16), diameter of longest root (0.85), fresh (2.56 g) and dry weight of root (0.98 g) was recorded in the layers which were treated with 4500 ppm IBA (RH3). This might be due to the positive effect of growth regulator together with the contribution of other biochemical elements of the plants. Exogenous application of auxin would have converted starch to carbohydrates that is always required for the synthesis of fresh cells. On top of that, auxin's allows in balancing protein synthesis and metabolism mechanisation to the root zone. Hence, it can be the purpose for early root appearance. Maximum rooting percentage might be due to more accumulation of simple sugars like carbohydrates in the root primordia and usage of carbohydrates was higher in IBA treated layers and also depends on the availability of carbohydrates in the root zone and more utilization of carbohydrates leads to the success of rooting in air layers. Stimulation of root promoting hormone like auxin leading to accumulation of inner substances as well as their basipetal movement and also it enhances the cell division process. Also, the rooting can be better with increased concentration of IBA up to certain level, which further helps in cell wall elongation, which in turn will increases the process of cell division. Thus, the quantity of roots additionally will increase and it also may be due to other metabolic activities. Bora *et al.* (2006) [4] and some other workers additionally stated that it might be due to the impact of

specific concentration of IBA on the initiation of root meristems which accordingly produces more number of roots. Formation of longest root per layer could be due to availability of energy to the root primordia through the respirational process and also rapid hydrolysis of starch into physiologically active sugars, which further boost up the elongation of meristematic cells. Additionally, external application of auxin which stimulates the movement of inner natural auxin in the basipetal direction from shoots to girdled portion, which further resulted in the initiation of greater quantity of roots consequently the weight of roots increases. The outcomes are in conformity with the findings of Srivastava *et al*. (2005) [10] in Kiwifruit, Seran and Thiresh (2015) [8] and Ayesha (2018) [2] in Dragon fruit. While, the late rooting (47.37 days), minimum rooting (47.12%) and less number of primary (5.95), secondary roots (3.85) were observed in (RH1) the layers without IBA treatment.

Interaction effect of time of layering and IBA concentration

The interaction of time of layering and IBA concentration had differed significantly on number of days taken for root initiation, rooting percentage, number of primary and secondary roots, length of longest roots per layer, fresh and dry weight of roots (Table 2). The less number of days (32.75) taken for root initiation, maximum rooting percentage (88.80), number of primary (26.25) and secondary roots (11.75), length of longest (13.15 cm) and diameter of longest root (1.20 mm), fresh (2.96 g) and dry weight of roots (1.31g) was observed when the layering was performed on first fortnight of June with the application of 4500 ppm IBA (T1RH3). The reason for better rooting attributes might be due to favourable climatic and weather conditions coupled with the application of IBA. The rooting hormone (IBA) at most efficient concentrations attributed to increase cambial activity. Hence there may be a greater possibility for early initiation of root primordia. Also can be due to adequate supply of carbohydrates and congenial environmental factors *viz.*, relative humidity, temperature and root generating tissue of air layered shoot helps in a greater extent, as opined by Naitani *et al*. (2016) [6] in Guava. Better rooting percentage might be due to the combination of IBA and weather condition prolong the root developmental stage results in the success of rooting and also better absorption of moisture and nutrients from the soil. Vyas *et al.* (2016) [13] in Red jamun reported that time of layering impact greatly on rooting success. More number of roots per layer might be due to the balance between auxin and various combinations of environmental and weather variations. Maximum length of roots might have been due to the constructive support of environmental factors and rooting hormone. Auxin amplify the anatomical features like callus formation and differentiation of vascular and other tissues. The increased fresh and dry weight of roots may be due to increase in number primary, secondary and total number of roots per layer in addition to length, weight and diameter of primary and secondary root contributed for the increase fresh weight of roots. In general, constructive balance and support between time of layering, weather and climatic conditions during root establishment along with optimum concentration of IBA leads to success of roots. Minimum rooting success might be because of excess rainfall and high relative humidity during the month of July and August. Thus layers may be suffered from extreme weather imbalance at some point of their developmental stage. The results are similar to the work of Bisen and Barholia (1995) [3] in Jackfruit, Rymbai and Reddy (2010) [7] in Guava and Gowda *et al*. (2006) [5] in Rose apple.

Table 1: Effect of time of layering and IBA concentration on rooting behaviour of Guava air layers cv. Lalit

Treatments	Days to root initiation (days)	Rootin g percen tage (%)	No. of Primary roots	No. of Secondary roots	Length of longest root (cm)	Diameter of longest root (mm)	Fresh weight of roots (g)	Dry weight of roots (g)
Time of air-layering (T)								
T1	38.62	71.75	17.00	7.39	9.51	0.84	2.35	0.80
T2	41.43	68.53	14.00	7.00	8.67	0.75	2.20	0.79
T3	47.75	57.17	7.90	4.87	5.50	0.38	1.76	0.43
T4	43.37	57.97	10.91	5.75	7.37	0.61	2.08	0.62
S. Em ±	0.68	1.41	0.45	0.33	0.09	0.04	0.03	0.03
C.D. at 5%	1.95	4.11	1.29	0.95	0.28	0.10	0.08	0.08
IBA concentrations (RH)								
RH1	47.37	47.12	5.95	3.85	4.76	0.42	1.35	0.26
RH2	40.93	73.09	15.10	6.42	8.66	0.72	2.33	0.83
RH3	36.75	77.19	18.91	8.93	10.16	0.85	2.56	0.98
RH4	46.12	58.84	9.83	5.76	7.45	0.48	2.08	0.55
S. Em. ±	0.68	1.41	0.45	0.33	0.09	0.04	0.03	0.03
C.D. at 5%	1.95	4.11	1.29	0.95	0.28	0.10	0.08	0.08

Table 2: Interaction effect of time of layering and IBA concentration on rooting behaviour of Guava air layers cv. Lalit

Treatment combinations	Days to root initiation (Days)	Rooting percentage (%)	No. of Primary roots	No. of Secondary roots	Length of longest root (cm)	Diameter of thickest root (mm)	Fresh weight of roots (g)	Dry weight of roots (g)
T1RH1	43.25	51.23	7.00	4.25	5.52	0.60	1.61	0.15
T1RH2	36.00	81.30	21.25	7.33	11.00	0.79	2.62	0.95
T1RH3	32.75	88.80	26.25	11.75	13.15	1.20	2.96	1.31
T1RH4	42.50	65.70	13.50	6.23	8.40	0.79	2.22	0.78
T2RH1	42.00	49.70	5.75	4.00	5.42	0.55	1.48	0.60

T2RH2	39.75	80.00	18.75	7.01	9.95	0.86	2.34	0.91
T2RH3	35.00	86.36	20.75	10.50	10.90	0.90	2.73	0.96
T2RH4	49.00	58.06	10.75	6.58	8.42	0.71	2.24	0.71
T3RH1	56.75	42.17	4.33	2.67	3.42	0.24	1.10	0.10
T3RH2	42.75	64.63	9.00	5.34	6.07	0.46	2.00	0.57
T3RH3	41.50	67.89	10.67	6.23	6.82	0.45	2.15	0.72
T3RH4	50.00	54.00	7.62	5.00	5.70	0.37	1.77	0.34
T4RH1	47.50	42.19	6.75	4.50	4.70	0.30	1.24	0.22
T4RH2	45.25	66.43	11.50	6.00	7.65	0.80	2.38	0.91
T4RH3	37.75	65.70	18.00	7.25	9.80	0.88	2.61	0.95
T4RH4	43.00	57.60	7.42	5.25	7.30	0.48	2.10	0.40
S. Em ±	1.36	2.83	0.90	0.66	0.19	0.07	0.05	0.06
C.D. at 5%	3.91	8.22	2.59	1.90	0.56	NS	0.15	0.16

NS = Non significant

Conclusion

From the present study, it is concluded that, among different time of air layering, air layer performed on first fortnight of June found effective with admire to root characters. In case of IBA application, 4500 ppm resulted better rooting and success of air layers. Regarding interaction between time of air layering and concentration of IBA, the air layers prepared on first fortnight of June with 4500 ppm IBA found to be better for all characters. Based on investigation it can be stated that, air layers prepared during first fortnight of June with 4500 ppm IBA can be utilized for getting early, healthy and vigorous air layers of Guava cv. Lalit under Southern Transitional Zone of Karnataka.

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