Air Layering in Guava (*Psidium Guajava*L.) as Influenced By IBA and Polywrappers

ABSTRACT

~~The present experiment was conducted at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Prayagraj during the session 2022.~~ The experiment was conducted ~~laid out~~ employing ~~in~~randomized block design with three replications, and the study consists of 12 treatment combinations in total ~~by~~ using different concentration of IBA in liquid, powder and paste form as well as using of white polywrappers (WP) and black polywrappers (BP). The best treatment was T_{11} with IBA Powder @ 10000 ppm + ~~Black polywrapper~~ BP~~(Powder Form)~~ which showed the highest root ~~parameters~~ and growth parameters~~.~~ ~~and gave the best results~~ With respect to number of primary roots ~~(9.78)~~, length of primary roots ~~(5.36 cm)~~, diameter of primary roots (2.24 mm), number of secondary roots (8.67), length of secondary roots (2.20 cm), diameter of secondary roots (2.12 mm), and dry weight of roots, T_{11} was found superior. ~~(0.75 g),~~ At 90 days after planting, 70% success in rooting, 71.02% survival percentage, number of shoots per layer 7.78 ~~at 90 days after planting~~ and 15.56 number of leaf per plant ~~at 90 days after planting, that~~ was significantly (p>0.05??) found higher as compared to other treatment combinations. ~~The best treatment was recorded at T_{11} IBA @ 10000 ppm + Black polywrapper (Powder Form) followed by~~ Further, T_8 (IBA Liquid @ 10000 ppm + ~~Black polywrapper~~ BP~~(Liquid Form)~~ secured second position whereas minimum values were recorded in T_3 with IBA Paste @ 5000 ppm + White polywrapper ~~(Paste Form).~~

***Keywords*:** Guava, Air layering, IBA, White Polywrapper and Black Polywrapper.

Comment [M1]: Repetitive in materials and methods section, so please remove from here.

Comment [M2]: Please write full form on first use of abbreviation. Also, give abbreviation in bracket.

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Introduction

Guava (*Psidium guajava* L.) is a native of Tropical America (from Mexico to Peru) and belongs to family Myrtaceae. Guava is the fourth important fruit crop after mango, banana and citrus. It has ~~is hardy in nature~~hardy appearance. It gives an assured crop even with very little care. It has been~~is~~ cultivated in India since early 17th century. Guava is one of the most common fruits liked by both the rich and the poor community and is popularly known as the

"Apple of the tropics". Its cost of production is also low because its fertilizer, irrigation and plant protection requirements are very less. Further, its nutritive value is very high. The fruit is rich in vitamin C content and also a good source of vitamin-A and B, iron, calcium and phosphorus. It survives well due to its hardy nature even if it is ignored. It is believed that Guava is grown in subcontinent since 17th century it can be grown in different climatic and edaphic conditions. Guava propagates on seedling and, raised from open pollinated seeds resulteds in considerable variation in the size, shape, form and quality of the matured fruits (Zamir *et al.*, 2003; and Mishra *et al.*, 2007) and evidently take longer time to reach to bearing stage when compared to vegetative propagated materials. There are several vegetative methods for multiplication of the quality stock in fruit trees. Guava fruit plants are normally propagated by two methods i.e., sexual or by seed and asexual or by vegetative methods. Multiplication of fruits plants through vegetative method is one of the important aspects of modern fruit culture. Guava can be propagated by grafting, budding and also by layering. Layering is the cheapest, rapid and simple method of guava propagation. (Hartmenn and Kester, 1972;) and (Mujumdar and Mukherjee, 1968), Red and Blue wrappers significantly (p>0.05) increased the rooting and survival of guava layers. Increase in dry matter percentage under red and blue poly wrappers may be, due to accumulation of food material in roots of layers. (Singh and Bhuj, 2000)., Red and Blue light are most effective for synthesis of biomass (Baghel 1999), besides, black poly wrappers are most suitable for increasing the callusing, rooting, survival of air layers (Yadav, 2015)., Coloured poly wrappers asare better to induce maximum rooting and survival of guava layers (Patel *et al.*1989).

There are several vegetative methods used for multiplication of different tree species but air layering is widely used as a method of propagation, where the formation of roots from cuttings is slow. The use of growth regulators to enhance rooting for air layering is well documented for guava and is reported to be the most successful reproduction method for noted that members of the genera Abies, Picea, Pinus, Larix, Pseudotsuga, Chamaecyparis, and Cryptomeria had all been observed to reproduce by layering.

Among the vegetative methods of guava propagation, air layering with the help of growth regulators is a successful method of propagation. Exogenous application of IBA speeds upescalates the rate of rooting, increases root percentage and number of roots per plant. Growth regulators like IBA stimulate cell division, cell elongation and metabolic activity at the place where incision is made.

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Considering these ~~facts and paucity of~~ research findings, ~~on these aspects~~ there is need to work out optimum combination of IBA and polywrappers for air layering in Guava.

Materials and Methods

The experiment was carried out at the Horticulture Research farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Prayagraj is situated at an elevation of 78 meters above sea level at 25.87^0 North altitude and 85.15^0 of E longitude.

The present experiment was laid out inrandomized block design with three replications, and the study consists of Twelve treatment combinations by using different concentration of IBA in liquid power and paste form as well as using of white and black polywrappers.

Treatment ~~Details~~: -

All observations for rooting and growth studies were recorded at 30, 60 and 90 days after preparation of air layers and roots are observed after planting of air layered twigs in polythene bags. The observations included are Number of primary roots, Length of primary roots (cm), Diameter of primary roots (mm), Number of secondary roots, Length of secondary roots (cm), Diameter of secondary roots (mm), Dry weight of roots (g), Success in rooting (%), Survival (%) after Planting, Number of shoots per layer, Number of leaves per layer .

Results and Discussion

All the parameters measured were significantly ~~as~~ influenced by IBA and Polywrappers (Table 1). ~~Significantly,~~ The number of primary roots was found ~~highest~~ maximum(9.78) in T_{11} containing IBA powder @ 10000 ppm~~(Powder Form)~~ + BP~~Black polywrapper represented as T_{11}~~ where as it was minimum (5.67) in T_3 IBA Paste @ 5000 ppm~~(Paste Form)~~ + WP~~White polywrapper~~. The length of primary roots was found highest (5.36cm) in IBA @10000 ppm (Powder Form) + Black poly wrapper represented as T_{11} where as it was minimum (2.76 cm) in T_3 IBA @ 5000 ppm(Paste Form) + White polywrapper. The diameter of primary roots was found highest (2.24mm) in IBA @ 10000 ppm (Powder Form) + Black polywrapper represented as T_{11} where as it was minimum (0.78 mm) in T_3 IBA @ 5000 ppm (Paste Form) + White polywrapper. The number of secondary roots was found highest (9.78) in IBA @ 10000 ppm (Powder Form) + Black Polywrapper represented as T_{11} where as it was minimum (5.67) in T_3IBA @ 5000 ppm(Paste Form) + White polywrapper. The length of

Comment [M9]: Please modify this paragraph as it is also there in abstract . Elaborate the methods using IBA and polywrappers. Mention statistical test worked out with its level of signification and statistical software used during data analysis.

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Comment [M11]: Do not mention the word "form", only write liquid/ powder/ paste after IBA. Do the same in the entire manuscript to maintain uniformity.

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secondary roots was found highest (2.20 cm) in IBA @ 10000 ppm (Powder Form) + Black polywrapper represented as T_{11} where as it was minimum (1.44 cm) in T_3 IBA @ 5000 ppm(Paste Form) + White polywrapper.

The diameter of secondary roots was found highest (2.12 mm) in IBA @ 10000 ppm(Powder Form) + Black poly wrapper represented as $T_{11}$where as it was minimum (0.73 mm) in T_3 IBA @ 5000 ppm(Paste Form) + White polywrapper. All the three parameters found significant. The dry weight of roots was found highest (0.75 g) in IBA @ 10000 ppm (Powder Form) + Black polywrapper represented as T_{11} where as it was minimum (0.50 g) in T_3 IBA @ 5000 ppm (Paste Form) + White polywrapper ~~as indicated in Table 1~~.

Significantly, the success in rooting was found highest (70%) in IBA @ 10000 ppm(Powder Form) + Black polywrapper represented as T_{11} where as it was minimum (40%) in T_3 IBA @ 5000 ppm(Paste Form) + White polywrapper. The survival percentage was found highest (71.02%) in IBA @ 10000 ppm (Powder Form) + Black polywrapper represented as T_{11} where as it was minimum (47.78%) in T_3 IBA @ 5000 ppm (Paste Form) + White polywrapper ~~mentioned in (~~Table 2~~)~~.

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Table ~~. No.~~ 1. Impact~~influenced~~ of IBA and Polywrappers on rooting of air layering in guava

Treatment	Treatment Combination	Number of primary roots	Length of primary roots (cm)	Diameter of primary roots (cm)	Number of Secondary Roots	Length of Secondary Roots (cm)	Diameter of Secondary Roots (mm)	Dry weight of Roots (g)
T_1	IBA @ 5000 ppm (Liquid Form) + White polywrapper	7.33	3.77	0.83	4.44	1.73	1.23	0.62
T_2	IBA @ 5000 ppm (Powder Form) + White polywrapper	9.00	3.57	1.81	6.33	1.8	1.77	0.68
T_3	IBA @ 5000 ppm (Paste Form) + White polywrapper	5.67	2.76	0.78	2.78	1.44	0.73	0.50
T_4	IBA @ 5000 ppm (Liquid Form) + Black polywrapper	7.33	3.16	1.33	3.67	1.66	1.87	0.63
T_5	IBA @ 5000 ppm (Powder Form) + Black polywrapper	8.89	3.11	1.76	5.67	1.83	1.54	0.69
T_6	IBA @ 5000 ppm (Paste Form) + Black polywrapper	5.89	3.12	1.31	3	1.58	0.76	0.56
T_7	IBA @ 10000 ppm (Liquid Form) + White polywrapper	8.56	4.83	1.79	6.67	1.87	1.81	0.70
T_8	IBA @ 10000 ppm (Powder Form) + White polywrapper	8.33	4.87	2.11	7.67	1.91	1.97	0.72
T_9	IBA @ 10000 ppm (Paste	6.33	3.58	1.77	3.33	1.84	1.42	0.67

	Form) + White polywrappers							
T_{10}	IBA @ 10000 ppm (Liquid Form) + Black polywrapper	8.22	4.17	1.81	5.00	2.17	1.83	0.71
T_{11}	IBA @ 10000 ppm(Powder Form) + Black polywrapper	9.78	5.36	2.24	8.67	2.2	2.12	0.75
T_{12}	IBA @ 10000 ppm(Paste Form) + Black polywrapper	7.11	3.6	1.5	3	2.1	1.56	0.69
F-Test		**S**	**S**	**S**	**S**	**S**	**S**	**S**
S. Ed. ±		0.214	0.108	0.08	0.186	0.094	0.074	0.013
CD at 5%		0.447	0.226	0.166	0.389	0.196	0.154	0.028
CV		3.408	3.474	6.15	4.55	6.234	5.822	2.482

Table ~~no.~~ 2. Performance of Air Layering in Guava in success rooting and survival of parameters

Treatment	Treatment Combination	Success in rooting (%)	Survival (%)
T_1	IBA @ 5000 ppm (Liquid Form) + White polywrapper	56.66	62.67
T_2	IBA @ 5000 ppm (Powder Form) + White polywrapper	60.00	66.01
T_3	IBA @ 5000 ppm (Paste Form) + White polywrapper	40.00	47.78
T_4	IBA @ 5000 ppm (Liquid Form) + Black polywrapper	53.33	62.20
T_5	IBA @ 5000 ppm (Powder Form) + Black polywrapper	63.33	68.21
T_6	IBA @ 5000 ppm (Paste Form) + Black polywrapper	43.33	49.97
T_7	IBA @ 10000 ppm (Liquid Form) + White polywrapper	60.00	66.01
T_8	IBA @ 10000 ppm (Powder Form) + White polywrapper	66.66	69.81
T_9	IBA @ 10000 ppm (Paste Form) + White polywrappers	46.66	53.31
T_{10}	IBA @ 10000 ppm (Liquid Form) + Black polywrapper	66.66	68.81
T_{11}	IBA @ 10000 ppm (Powder Form) + Black polywrapper	70.00	71.02
T_{12}	IBA @ 10000 ppm (Paste Form) + Black polywrapper	50.00	58.87
F-Test		**S**	**S**
S. Ed. ±		0.942	7.885
CD at 5%		0.821	0.971
CV		20.458	15.562

Simultaneously, Table 3~~.~~ indicates that ~~significantly~~ the maximum number of shoots per layer of 4.22 at 30 days after planting ~~was recorded at~~ in T_{11} ~~IBA @ 10000 ppm (Powder Form) + Black polywrapper~~ whereas minimum plant height of 1.44 was recorded at~~in~~ T_3 ~~IBA @ 5000 ppm (Paste Form) + White polywrapper~~. The maximum number of shoots per layer of 6.56 at 60 days after planting ~~was~~ were recorded at T_{11} ~~IBA @ 10000 ppm (Powder Form) + Black polywrapper~~ whereas minimum plant height of 2.89 was recorded in T_3 ~~IBA @ 5000 ppm(Paste Form) + White polywrapper~~. The maximum plant height of 7.78 at 90 days after planting was recorded at T_{11} ~~IBA @ 10000 ppm (Powder Form)+ Black polywrapper~~ whereas minimum plant height of 5 was recorded in T_3 ~~IBA @ 5000 ppm (Paste Form) + White polywrapper~~. The ~~maximum~~ higher number of leaves per plant ~~of~~ as 7.22 at 30 days after planting was recorded at T_{11} ~~IBA @ 10000 ppm (Powder Form) + Black polywrapper~~ whereas lesser ~~minimum~~ leaf per plant ~~of~~(~~-~~4) was recorded in T_3 ~~IBA @ 5000 ppm(Paste Form) + White polywrapper~~. Moreover,

~~Significantly The~~ maximum number of leaves per plant of 9.22 at 60 days after planting was recorded at T_{11} ~~IBA @ 10000 ppm (Powder Form) + Black polywrapper~~ whereas ~~minimum~~ least number of leaves~~f~~ per plant ~~of (~~5.33) was recorded in T_3 ~~IBA @ 5000 ppm (Paste Form) + White polywrapper.~~ The maximum leaves~~f~~ per plant of 15.56 at 90 days after planting w~~a~~eres recorded at T_{11} ~~IBA @ 10000 ppm (Powder Form) + Black polywrapper~~ whereas minimum leaves~~f~~ per plant ~~of T_{11} was~~were recorded in T_3 ~~IBA @ 5000 ppm(Paste Form) + White polywrapper as indicated in Table 3~~.

IBA at higher concentration (10000 ppm) gave better result than at lower concentrations and these reappeared to be an increasing tendency of rooting with an increasing concentration.~~,~~ T~~t~~his might be at higher concentration of IBA the quantity of auxin reaching the cambial activity may be adequate for initiating root primordia.~~,~~ ~~so~~Thus, the highest performance was seen at higher concentrations of IBA which~~.~~ I~~i~~ndicate~~ding~~ the possibility of better success with employing higher concentrations of IBA. Similar results were reported by **Mandloi *et al.*, 2019~~;~~, Verma *et al.*, 2019.**

Comment [M15]: Don't mention treatment combination detail again and again, give only treatment code as T11 or T3 etcetera.

Table 3. Performance of Air Layering in Guava in Growth Parameters

Treatment	Treatment Combinations	Number of Shoots per layer			Number of leaf per plant		
		30 Days	60 Days	90 Days	30 Days	60 Days	90 Days
T_1	IBA @ 5000 ppm(Liquid Form) + White polywrapper	1.67	3.44	5.11	4.78	5.44	11.22
T_2	IBA @ 5000 ppm(Powder Form) + White polywrapper	1.56	3	5.33	4.56	5.33	12.11
T_3	IBA @ 5000 ppm(Paste Form) + White polywrapper	1.44	2.89	5	4	7.11	11
T_4	IBA @ 5000 ppm (Liquid Form) + Black polywrapper	1.67	4.11	5.44	4.33	6.67	11.89
T_5	IBA @ 5000 ppm(Powder Form) + Black polywrapper	2.11	4	5.22	4.11	6	11.56
T_6	IBA @ 5000 ppm(Paste Form) + Black polywrapper	1.78	4.22	6.22	4.44	6.56	12.67
T_7	IBA @ 10000 ppm(Liquid Form) + White polywrapper	2.78	5	5.56	5.22	6.22	12.11
T_8	IBA @ 10000 ppm(Powder Form) + White polywrapper	2.56	4.44	5.78	4.89	7.67	12.56
T_9	IBA @ 10000 ppm (Paste Form) + White polywrappers	2.44	3.89	5.67	5.33	6.44	12.44
T_{10}	IBA @ 10000 ppm (Liquid Form) + Black polywrapper	2.89	5.11	6.78	6	7.22	11.56
T_{11}	IBA @ 10000 ppm(Powder Form) + Black polywrapper	4.22	6.56	7.78	7.22	9.22	15.56
T_{12}	IBA @ 10000 ppm(Paste Form) + Black polywrapper	2.67	4.56	5.89	5	6.78	11.44
F-Test		**S**	**S**	**S**	**S**	**S**	**S**
S. Ed. ±		0.308	0.395	0.446	0.423	0.538	0.54
CD at 5%		0.643	0.825	0.932	0.882	1.124	1.126
CV		16.294	11.342	9.402	10.376	9.81	5.427

Conclusion

It was concluded from the above study that the best treatment was T_{11} IBA @ 10000 ppm (Powder Form) + Black polywrapper which showed the highest root parameters and growth parameters, and gave the best results with respect to Number of primary roots (9.78), Length of primary roots (5.36 cm), Diameter of primary roots (2.24 mm), Number of secondary roots (8.67), Length of secondary roots (2.20 cm), Diameter of secondary roots (2.12 mm), dry weight of roots (0.75 g), 70% success in rooting, 71.02% survival percentage, number of shoots per layer 7.78 at 90 days after planting and 15.56 number of leaf per plant at 90 days after planting, that was significantly higher as compared to other treatment combination. The best treatment was recorded at T_{11} IBA @ 10000 ppm (Powder Form) + Black polywrapper followed by T_8 IBA @ 10000 ppm (Liquid Form) + Black polywrapper whereas minimum values were recorded in T_3 IBA @ 5000 ppm (Paste Form) + White polywrapper.

Comment [M16]: Conclusion is concrete findings of the study in 3-4 sentences. do not mention data, just compare the treatments in scientific language and add recommended practices and future research prospects.

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