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The Study of Indole-3-Butyric Acid (IBA) and Rooting Media and its Interaction with Various Root and Shoot Growth Behaviours through Air Layering in Guava (*Psidium guajava* L.)

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ABSTRACT

A study on rooting on different types of media and IBA at various concentrations was tested for their effects on guava cv. L-49 on rooting and growth characteristics. A combination of sphagnum moss, cocopeat and vermicompost enhanced root induction when IBA (7500 ppm) was applied. Based on concentration between other treatments and controls, air layering had an 82.33% success rate, primary roots had a 23.21% success rate and secondary roots had a 31.57% success rate; in addition, there was the number of branches (6.93), shoots (7.49), leaves (47.18) as well as survival percentages (82.19). In July, sphagnum moss + cocopeat + vermicompost showed the highest rooting percentage (70.27) and the highest root and growth characteristics.

Key words : Air layering, IBA, rooting, sphagnum moss, vermicompost

INTRODUCTION

Guava (*Psidium guajava* L.), indigenous to tropical America, is a very demand fruit crop in India. Since it is very adaptable, it has a pleasant taste, is of good quality, and can be grown throughout the year for an extended period. Verma *et al.* (2019) reported that in 100 g of the fruit, there was 80 mg of vitamin C, 0.9-1.0 g of crude fibre, 0.1-0.5 g of protein, 9.1-17 mg of carbohydrates, minerals and pectin. The hardy nature of the guava plant allows it to grow under harsh conditions. However, guava's popularity has been held back primarily because of the prevalence of seedling generations. A sexual propagation in guava can be done through cutting, grafting, layering and budding (Pereira *et al.*, 2017).

As compared to budding and grafting, the only reliable method of growing guava is air-layering because a mist propagation bed is necessary for stem cutting to minimize suckering (Verma *et al.*, 2019). Furthermore, the moderately low temperature (23 to 31°C), heavy rainfall and high humidity (80 to 90%) during June-July favour root establishment (Parmar *et al.*, 2018). By preparing layers during these months, the soil has a more extended period of favourable conditions throughout the season to allow the layer to settle in the soil.

According to Parmar *et al.* (2018), hormonal deficiency and an absence of rooting media led to low survival rates and low establishment of rooted layers. However, the dose and interaction of PGR with rooting medium were challenging to standardize when applied to fruits such as guava. Therefore, more research is needed on a scientific basis to produce cheaper planting materials with vigorous growth that will meet the needs of fruit growers. In light of the above facts, a systematic study was carried out to quantify the effects of growth regulators, such as indole-3-butyric acid different rooting media, such as coco peat, sphagnum moss and vermicompost, in the guava cv. L-49. In addition, these factors were analyzed in light of their interactions with the different rooting and growth characteristics of air-layers for providing improved rooting characteristics.

MATERIALS AND METHODS

This study was conducted at the Agricultural Farm of School of Agriculture, Lovely Professional University, Phagwara, Punjab using trees of uniform growth and planted at 6 × 6 m distance. A factorial randomized block design was adopted in the experiment replicated three times. Five media combinations were examined, sphagnum moss, coco peat, vermicompost, sphagnum moss + coco peat (1:1), and sphagnum moss + cocopeat + vermicompost (1:1:1), as well as five levels of IBA. All guava plants which were selected for this experiment were uniform in vigour and size. Air-layering was performed on healthy, pencil-thick branches one to two years old. In one experiment, talc powder was dissolved in absolute alcohol to prepare a growth regulator formulation (Parmar *et al.*, 2018). Below the top end of each selected shoot of guava, two circular cuts were made approximately 45-60 cm. Below the bud, a ring of bark about 2-2.5 cm wide was carefully girdled so that the underwood was not damaged. A growth regulator formulation was applied evenly across all cut surfaces of the ring. Polythene wraps and various types of rooting media were used as per the treatments. Each treatment was replicated on all plants.

Air-layers were removed using sharp secateurs through a cut beneath the lower most end of the ring. Polythene covers were gently removed after the air-layers were detached, after which the rooted air-layers were planted in polythene bags with 4 : 2 : 4 ratios of soil, sand and farmyard manure. Each of the three replications contained two air-layers, for a total of six air-layers observed during detachment. Four plants grew successfully under each replication of the treatment after transplanting the air-layers. The data were examined using a factorial randomized block design, and observations were conducted every two weeks.

RESULTS AND DISCUSSION

It was found that rooting parameters were affected substantially by IBA and rooting media interaction. In comparison with other treatments, IBA with a higher concentration of 7500 ppm in combination with $RM5A_3$ (sphagnum moss + cocopeat + vermicompost) substantially increased the success percentage (82.33%), as well as the number of primary roots (23.21) and the number of secondary roots (31.57; Table 1). A 10% success was observed in all media combinations as IBA concentration increased above 7500 ppm. In contrast, in a combination of media with an IBA of 7500 ppm, sphagnum moss + vermicompost + cocopeat gave the best results. It might be because of auxin as cambial activity was necessary to initiate primordial roots. Hence, IBA @ 7500 ppm yielded the best results. The improved expression of root primordia and root radicles may be attributed to a synergistic action of auxins in plant cells (Gonin *et al.*, 2019). It was found that the longest root length (10.15 cm) was observed in IBA @ 7500 ppm with the medium combination of $RM5A_3$, which was the best among the other treatments. In terms of secondary root length (6.83 cm), fresh root weight (3.59 g) and dry weight (0.82 g), IBA @ 7500 ppm with $RM5A_3$ (sphagnum moss + vermicompost+cocopeat) had shown the best results. Those treated with 5000 ppm of IBA in the presence of sphagnum moss+cocopeat+vermicompost ($RM5A_2$) showed larger root diameters, followed by those treated with 7500 ppm of IBA in the presence of $RM5A_3$ (sphagnum moss+vermicompost+cocopeat). Therefore, it can be stated that the combination of media had the most impact on root diameter. In other words, there was a possibility that the increased lengths of primary and secondary roots were due to hormone effects and internal factors - basipetal movement (Wakle *et al.*, 2021). Auxin must be applied for natural auxin and other materials to move from the leaves and shoot tips to the target area of the root incision, leading to a more fresh and dry weight. The present study found increased IBA concentrations stimulated root growth, resulting in more significant root length and weight. Anandhanambi *et al.* (2016), Munde *et al.* (2016), Manga *et al.* (2017), Naithani *et al.* (2018) and Kaur and Kaur (2021) reported similar results.

Among all combinations of treatments, IBA @ 7500 ppm ($RM5A_3$) had the most significant number of leaves (47.18), branches (6.93) and sprouts (7.49), as well as the highest survival rate (82.19%; Table 2). The establishment rate was higher when IBA was at 8000 ppm due to the better absorption of nutrients and food materials (Parmar *et al.*, 2018). The maximum number of leaves indicated that more mineral nutrients were available and that the vigorous root system could efficiently absorb them. Plants might have grown faster and matured further if more food materials and other essential minerals were available. Therefore,

Table 1. Influence of IBA concentrations on rooting media combinations on rooting parameters in air-layering of guava

Treatment	Symbol	Success percentage	No. of primary roots	No. of secondary roots	Primary root length	Secondary root length	Primary root diameter	Fresh root weight	Dry root weight
SM	RM1	64.77	12.12	20.83	5.54	1.77	0.25	2.10	0.40
CP	RM2	64.24	11.14	18.72	5.16	1.7	0.24	2.08	0.38
SM+CP	RM3	66.64	12.65	21.17	5.58	1.86	0.30	2.40	0.47
VC	RM4	63.31	10.16	16.60	4.84	1.56	0.26	1.92	0.37
SM+CP+VC	RM5	70.27	13.67	22.04	6.68	2.64	0.40	2.49	0.52
C. D. (P=0.05)		1.78	0.79	1.15	1.16	0.74	0.90	0.064	0.011
IBA @ 2500 ppm+SM	RM1A$_1$	62.41	6.98	16.52	4.79	1.41	0.26	1.60	0.30
IBA @ 2500 ppm+CP	RM2A$_1$	62.03	6.35	14.22	4.67	1.54	0.21	1.20	0.27
IBA @ 2500 ppm+SM+CP	RM3A$_1$	64.11	7.26	16.60	5.25	1.26	0.36	1.75	0.32
IBA @ 2500 ppm+VC	RM4A$_1$	59.43	7.14	14.21	4.46	1.10	0.13	1.04	0.22
IBA @ 2500 ppm+SM+CP+VC	RM5A$_1$	64.43	8.25	17.38	4.46	3.40	0.42	1.85	0.35
IBA @ 5000 ppm+SM	RM1A$_2$	66.20	10.66	21.26	5.74	3.46	0.30	2.32	0.40
IBA @ 5000 ppm+CP	RM2A$_2$	65.83	10.07	20.37	5.17	3.43	0.29	2.24	0.35
IBA @ 5000 ppm+SM+CP	RM3A$_2$	67.92	12.34	22.43	4.98	3.54	0.28	2.35	0.44
IBA @ 5000 ppm+VC	RM4A$_2$	65.08	9.32	14.32	4.49	3.36	0.15	2.20	0.34
IBA @ 5000 ppm+SM+CP+VC	RM5A$_2$	70.75	13.49	23.21	7.35	5.52	0.49	2.56	0.45
IBA @ 7500 ppm+SM	RM1A$_3$	71.84	21.26	29.13	7.55	5.17	0.45	3.33	0.62
IBA @ 7500 ppm+CP	RM2A$_3$	70.63	20.37	28.25	5.61	5.04	0.35	3.27	0.60
IBA @ 7500 ppm+SM+CP	RM3A$_3$	71.99	22.43	30.45	7.93	5.42	0.45	3.52	0.75
IBA @ 7500 ppm+VC	RM4A$_3$	69.28	16.90	25.32	5.21	3.22	0.32	3.15	0.55
IBA @ 7500 ppm+SM+CP+VC	RM5A$_3$	82.33	23.21	31.57	10.15	6.83	0.46	3.59	0.82
IBA @ 10000 ppm+SM	RM1A$_4$	71.20	16.22	25.26	6.87	3.12	0.32	2.31	0.50
IBA @ 10000 ppm+CP	RM2A$_4$	70.15	14.22	19.82	5.57	2.28	0.30	2.29	0.46
IBA @ 10000 ppm+SM+CP	RM3A$_4$	72.64	16.60	26.50	7.29	3.41	0.42	2.59	0.67
IBA @ 10000 ppm+VC	RM4A$_4$	68.47	14.21	16.90	5.12	3.21	0.29	2.25	0.45
IBA @ 10000 ppm+SM+CP+VC	RM5A$_4$	73.40	17.38	27.26	7.88	3.60	0.43	2.82	0.71
C. D. (P=0.05)		3.98	1.77	4.83	NS	NS	NS	0.145	0.022

A$_1$–IBA 2500 ppm, A$_2$–IBA 5000 ppm, A$_3$–IBA 7500 ppm, A$_4$–IBA 10000 ppm, RM–Media combinations, SM–Sphagnum moss, CP–Cocopeat and VC–Vermicompost. NS–Not Significant.

a change in the physiological state of plants resulted in a more significant number of sprouts. Ezekiel *et al.* (2016), da Silva Tamwing *et al.* (2021), Kaur and Kaur (2021) and Rathour *et al.* (2021) reported similar results.

The media RM5 (sphagnum moss + cocopeat + vermicompost) substantially increased the number of air layers (70.27%), The length of primary (6.68 cm) and the number of secondary roots (2.64), the diameter of the primary roots (0.40), and the fresh weight and dry weight of the roots (0.52) compared to sphagnum moss, cocopeat and vermicompost individually or combined (Table 1). The increase in nutrient availability, proper aeration, and high-water holding capacity of the RM5 media may have contributed to this increase. Singh *et al.* (2015), Baghel *et al.* (2016), Naithani *et al.* (2018), Gilani *et al.* (2019) and Kaur and Kaur (2021) reported similar results.

A combination of rooting media i. e. sphagnum moss+vermicompost+cocopeat (RM5) produced the most numbers of leaves (35.06), branches (5.59) and sprouts (5.62), as well as the highest survival percentage (63.98%; Table 2). A higher establishment percentage may have been attributed to the root system having more primary and secondary roots and longer roots, which resulted in better nutrient absorption and food materials.

CONCLUSION

As one of India's most important fruits, guava is exceptionally nutritious, has a high nutritional value, and is available all year round at a very reasonable price. Therefore, research was conducted to determine whether different rooting media and IBA hormone impacted the air-layering process in guava. IBA at 7500 ppm with various media combinations showed 80% success for air-layering, primary roots were 23.21, secondary roots 31.57, and longest primary roots and secondary roots were

Table 2. Influence of IBA concentrations on rooting media combinations on growth parameters in air-layering of guava

Treatment	Symbol	No. of leaves	No. of branches	No. of shoots	Survival (%)
SM	RM1	29.53	3.21	3.97	61.27
CP	RM2	28.65	2.87	3.62	59.51
SM+CP	RM3	31.95	4.87	4.14	62.32
VC	RM4	24.99	2.39	2.84	55.04
SM+CP+VC	RM5	35.06	5.59	5.62	63.98
C. D. (P=0.05)		5.47	1.31	1.41	5.92
IBA @ 2500 ppm+SM	$RM1A_1$	25.51	1.74	2.51	64.55
IBA @ 2500 ppm+CP	$RM2A_1$	25.23	1.59	2.26	62.79
IBA @ 2500 ppm+SM+CP	$RM3A_1$	30.41	3.34	3.26	64.67
IBA @ 2500 ppm+VC	$RM4A_1$	23.17	1.24	2.08	36.83
IBA @ 2500 ppm+SM+CP+VC	$RM5A_1$	30.74	6.18	5.68	64.86
IBA @ 5000 ppm+SM	$RM1A_2$	29.93	3.18	3.18	66.73
IBA @ 5000 ppm+CP	$RM2A_2$	28.43	1.84	3.01	66.53
IBA @ 5000 ppm+SM+CP	$RM3A_2$	30.93	4.34	5.34	67.42
IBA @ 5000 ppm+VC	$RM4A_2$	23.59	1.52	2.34	65.12
IBA @ 5000 ppm+SM+CP+VC	$RM5A_2$	37.26	6.68	6.01	64.44
IBA @ 7500 ppm+SM	$RM1A_3$	34.09	5.18	5.01	79.75
IBA @ 7500 ppm+CP	$RM2A_3$	33.01	4.26	5.01	72.66
IBA @ 7500 ppm+SM+CP	$RM3A_3$	40.68	5.68	6.01	80.40
IBA @ 7500 ppm+VC	$RM4A_3$	25.15	3.34	3.34	68.95
IBA @ 7500 ppm+SM+CP+VC	$RM5A_3$	47.18	6.93	7.49	82.19
IBA @ 10000 ppm+SM	$RM1A_4$	30.26	4.43	5.01	69.56
IBA @ 10000 ppm+CP	$RM2A_4$	29.11	3.59	4.84	66.42
IBA @ 10000 ppm+SM+CP	$RM3A_4$	36.76	4.59	5.59	73.88
IBA @ 10000 ppm+VC	$RM4A_4$	23.93	2.59	3.26	61.68
IBA @ 10000 ppm+SM+CP+VC	$RM5A_4$	43.34	6.74	6.43	78.41
C. D. (P=0.05)		NS	NS	NS	NS

A_1–IBA 2500 ppm, A_2–IBA 5000 ppm, A_3–IBA 7500 ppm, A_4–IBA 10000 ppm, RM–Media combinations, SM–Sphagnum moss, CP–Cocopeat and VC–Vermicompost. NS–Not Significant.

10.15 and 6.83 cm, respectively, for rooting characters. In terms of growth characteristics, the guava air-layer had the most number of leaves (47.17), sprouts (7.48) and branches (6.92) in the same treatment. The study concluded that the success rate could be improved when exogenously applying the treatment described above, as can guava air layers' root and growth characteristics.

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