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Studies on different concentrations of IBA as powder and lanolin paste formulation on survival and growth of air layers in guava (*Psidium guajava* L.)

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Abstract
The present investigation was conducted at PFDC (Precision Farming Development Centre), Department of Fruit Science, IGKV, Raipur (C.G.) during 2020-21. Entitled "Studies on different concentrations of IBA as powder and lanolin paste formulation on survival and growth of air layers in guava (*Psidium guajava* L.)." The experiment was laid out in Randomized Block Design (RBD) with 11 treatments *viz*. T_0 (No IBA treatment), T_1 (IBA 1500 ppm as powder form), T_2 (IBA 2000 ppm as powder form), T_3 (IBA 2500 ppm as powder form), T_4 (IBA 3000 ppm as powder form), T_5 (IBA 3500 ppm as powder form), T_6 (IBA 1500 ppm as lanolin paste), T_7 (IBA 2000 ppm as lanolin paste), T_8 (IBA 2500 ppm as lanolin paste), T_9 (IBA 3000 ppm as lanolin paste) and T_{10} (IBA 3500 ppm as lanolin paste) with 3 replications. The study revealed that maximum rooting percentage, number of primary roots and secondary roots per air layer, length of primary roots and secondary roots per air layer, fresh weight and dry weight of roots per air layer and maximum survival percentage recorded under treatment T_{10}. Minimum values of these characters were recorded under treatment T_0 (i.e. Control).

Keywords: IBA, Guava, Air layering

Introduction
Guava (*Psidium guajava* L.) is one of the most important and commercial fruit crops of tropical and subtropical region of India. It's belongs to be family Myrtaceae and genus *Psidium* which contains about 150 species. The fruit is native of tropical America (Hayes, 1953) [11]. In guava, most commercial cultivars are diploid (2n = 22), while seedless cultivars are triploid and shy bearer in nature. It has been cultivated in India since early 17th century. It is known as "Apple of tropics" or "Poor man's apple". Its fruit is rich in vitamin-C (260 mg of vitamin C in 100g of fruit), Pectin (0.5-1.8%) (Verma and Shrivastava, 1965) [21].

Guava stands in area and production after mango, banana and citrus. It occupies an area of 290 thousand ha and production of 4359 thousand MT in India (Anonymous, 2019-20) [3]. Its cultivation is common in India, which is concentrated mainly in Andhra Pradesh, Assam, Bihar, Punjab, Madhya Pradesh, Karnataka, Uttar Pradesh, Maharashtra and Chhattisgarh. In Chhattisgarh it occupies 21.016 thousand hectare area and production 192.005 thousand MT (Anonymous, 2019-20) [4].

Guava fruit plants are normally propagated by two methods i.e., sexually by seed and asexually 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) [10] and (Mujumdar and Mukherjee, 1968) [13]. The success in layering of guava and other fruit crops depends upon mother plants, time of layering, rainfall, humidity, temperature, rooting media, growth regulators and care at the time of removal of bark/ringing of shoot. The percentage of establishment and survival of rooted layers is reported to be poor, mainly due to hormonal imbalance and non-availability of standardized rooting media (Singh, 2002) [18]**.** The use of plant growth regulators to increase the efficacy of propagation in cutting and layering are now common and moreover, use of growth regulators has opened a new vista for nursery men for propagation of fruit trees (Tyagi and Patel 2004) [20]. IBA is most effective than IAA and 2, 4-D for rooting (Hartman and Kester 1975) [9]. Besides hormonal influences, different season and month of layering operation, also affect rooting and survival percentage of guava air layers. Among different season, the rainy season proved more favorable compared to summer and winter (Ahamed 1964) [1].

Material and Methods

The present investigation was conducted at PFDC (Precision Farming Development Centre), Department of Fruit Science, IGKV, Raipur (C.G.) during 2020-21.

The air layering of guava cv. Lalit was done in September, 2020. For air layering; 1 year old, disease free, healthy branches of pencil thickness were selected. The length of branches was 45-60 cm and diameter 1.0- 1.5 cm, approximately. The experiment was laid out in Randomized Block Design (RBD) with 11 treatments and 3 replications. The total number of treatment in each replication was 11, the total number of layers per treatment 10. Total number of layers taken under experiment was 330.

Table 1: Treatments details

S. No.	Treatments	Notations
1	Control (No IBA treatment)	T_0
2	IBA 1500 ppm as powder form	T_1
3	IBA 2000 ppm as powder form	T_2
4	IBA 2500 ppm as powder form	T_3
5	IBA 3000 ppm as powder form	T_4
6	IBA 3500 ppm as powder form	T_5
7	IBA 1500 ppm as lanolin paste	T_6
8	IBA 2000 ppm as lanolin paste	T_7
9	IBA 2500 ppm as lanolin paste	T_8
10	IBA 3000 ppm as lanolin paste	T_9
11	IBA 3500 ppm as lanolin paste	T_{10}

Results and Discussions

The growth regulators (IBA) significantly affect the rooting percentage, number of primary and secondary roots, length of primary roots and secondary roots, fresh weight and dry weight of roots which was recorded after 60 days of air layering. The survival percentage of air layers of guava which was recorded after 60 days transplanting of air layers of guava. The data is presented in table 2 and table 3.

The study revealed that maximum rooting percentage found in treatment T_{10} (90%) followed by treatments T_9 (86.67%) and T_5 (83.33%). The lowest rooting percentage was recorded in treatment T_0 (53.33%). The increase in percentage of rooted air layer might be due to optimum concentration of IBA that can bring about the mobilization and utilization of carbohydrates and nitrogen components with the presence of rooting cofactors in the girdled zone, which may help better rooting. The similar results have been reported by Anandhanambi *et al.* (2016) [2] in guava air layering and Das *et al*. (2014) [6] in litchi air layering. The maximum number of primary roots per air layer was obtained in treatment T_{10} (14.17) followed by treatments T_9 (13.58) and T_5 (13.5). The minimum number of primary roots per air layer was noted in treatment T_0 (4.25). The advantageous impact of IBA on number of primary roots was additionally seen by Deshlehra *et al*. (2019) [8] in guava, Baghel *et al*. (2017) [5] in guava and Dawar *et al*. (2020) [7] in pomegranate.

Table 1: Effects of different concentrations of IBA as powder and lanolin paste formulation on rooting percentage, number of primary and secondary roots per air layer of guava.

Notations	Treatments	Rooting percentage (%)	No. of primary roots per air layer	No. of secondary roots per air layer
T_0	Control (No IBA treatment)	53.33%	4.25	9.08
T_1	IBA 1500 ppm as powder form	60.00%	7.42	11.17
T_2	IBA 2000 ppm as powder form	66.67%	9.25	12.50
T_3	IBA 2500 ppm as powder form	70.00%	10.33	15.42
T_4	IBA 3000 ppm as powder form	80.00%	12.83	17.00
T_5	IBA 3500 ppm as powder form	83.33%	13.50	18.00
T_6	IBA 1500 ppm as lanolin paste	63.33%	9.08	13.25
T_7	IBA 2000 ppm as lanolin paste	70.00%	10.75	15.50
T_8	IBA 2500 ppm as lanolin paste	73.33%	12.67	16.17
T_9	IBA 3000 ppm as lanolin paste	86.67%	13.58	18.33
T_{10}	IBA 3500 ppm as lanolin paste	90.00%	14.17	20.91
S.Em±		3.24	0.28	0.33
CD at 5% level		9.56	0.83	0.98

Table 2: Effects of different concentrations of IBA as powder and lanolin paste formulation on length (cm), fresh and dry weight (g) of primary and secondary roots per air layer and survival percentage of air layers of guava

Notations	Treatments	Length of primary roots (cm) per air layer	Length of secondary roots (cm) per layer	Fresh weight of roots (g) per air layer	Dry weight of roots (g) per layer	Survival percentage (%)
T_0	Control (No IBA treatment)	2.53	1.50	1.22	0.38	46.67%
T_1	IBA 1500 ppm as powder form	4.20	1.93	1.65	0.54	58.89%
T_2	IBA 2000 ppm as powder form	5.17	2.20	1.96	0.70	62.70%
T_3	IBA 2500 ppm as powder form	5.83	2.83	2.35	0.88	69.84%
T_4	IBA 3000 ppm as powder form	6.83	3.50	2.81	0.97	77.97%
T_5	IBA 3500 ppm as powder form	7.43	3.80	3.10	1.12	79.17%
T_6	IBA 1500 ppm as lanolin paste	4.43	2.27	1.86	0.61	61.11%
T_7	IBA 2000 ppm as lanolin paste	5.70	2.70	2.10	0.82	65.28%
T_8	IBA 2500 ppm as lanolin paste	6.30	3.13	2.61	0.90	71.03%
T_9	IBA 3000 ppm as lanolin paste	7.73	3.93	3.23	1.18	80.09%
T_{10}	IBA 3500 ppm as lanolin paste	8.27	4.07	3.58	1.27	84.72%
S.Em±		0.35	0.17	0.05	0.03	3.98
CD at 5% level		1.03	0.50	0.16	0.09	11.75

The highest number of secondary roots per air layer was obtained under treatment T_{10} (20.92) followed by treatments T_9 (18.33) and T_5 (18.00) where as the minimum number of secondary roots per air layer was registered in treatment T_0 (9.08) i.e. (Control). The increase in number of primary roots and secondary roots may be due to accumulation of rooting co-factors above the ringed portion as influenced of IBA. This result is in close conformity with the earlier result given by Parmar *et al*. (2018) [14] in guava and Singh *et al*. (2007) [19] in guava. The longest length of primary roots per air layer was obtained in treatment T_{10} (8.27) followed by treatments T_9 (7.73 cm) and T_5 (7.43 cm) and the lowest length of primary roots per air layer was recorded in treatment T_0 (2.53 cm). The similar results were obtained by Parmar *et al.* (2018) [14] in guava and Baghel *et al.* (2017) [5] in guava. The longest length of secondary roots per air layer was obtained in treatment T_{10} (4.07 cm) followed by treatments T_9 (3.93 cm) and T_5 (3.80 cm) and the lowest length of secondary roots per air layer obtained in treatment T_0 (1.50 cm). The increase in length of primary roots and secondary roots could be due to hormonal effect and accumulation of other internal substances and their downward movements. This similar result was found by Singh *et al*. (2007) [19], Rymbai *et al.* (2010b) [17] and Baghel *et al*. (2017) [5] in guava. The maximum fresh weight of roots per air layer was obtained significantly in the treatment T_{10} (3.58 g) followed by treatments T_9 (3.23 g) and T_5 (3.10 g) and minimum fresh weight of roots per air layer was obtained in treatment T_0 (1.22 g). The increase in fresh weight of roots may be due to external application of auxin usually stimulated natural auxin and other substances to move downwards from the leaves and stem tips. These substances accumulate in the girdled portion, resulting in higher root formation with greater wet mass. This similar result was found by Parmar *et al.* (2018) [14] and Punasya *et al*. (2018) [15] in guava. The maximum dry weight of roots per air layer was obtained significantly in treatment T_{10} (1.27 g) followed by treatments T_9 (1.18 g) and T_5 (1.12 g) and minimum dry weight of roots per air layer was recorded in treatment T_0 (0.38 g). The similar results were obtained by Kaur *et al*. (2020) [12] and Das *et al*. (2014) [6] in litchi. Growth regulators (IBA) significantly affect survival percentage of guava. Survival percentage was recorded after 60 days transplanting of air layers of guava. The maximum survival percentage was registered in treatment T_{10} (84.72%) followed by treatments T_9 (80.09%) and T_5 (79.17%). The minimum survival percentage recorded under treatment T_0 (46.67%). The increase in survival percentage per air layer may be due to rooting cofactor and their balance with nutritive substances and auxin. This similar result was obtained by Punasya *et al*. (2018) [15] in guava and Das *et al.* (2014) [6] in litchi.

Conclusion

On the basis of present experiment, it can be concluded that the application of IBA 3500 ppm as lanolin paste was found best for all parameters namely, maximum rooting percentage, number of primary roots and secondary roots per air layer, length of primary roots and secondary roots per air layer, fresh weight and dry weight of roots per air layer and maximum survival percentage of air layers of guava. Minimum values of these characters were recorded under treatment T_0 (i.e. Control).

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