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Effect of IBA, time of layering and rooting media on air-layers and plantlets survival under different growing nursery conditions in guava

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ABSTRACT

The present investigation on the effect of IBA concentrations, time of layering and rooting media on rooting, root characters and survival percentage of rooted air layers under different growing nursery conditions *i.e* open and polyhouse conditions on guava, cv. L-49 were carried out during 2008-09. Three different concentration of IBA viz., 2000, 3000 and 4000 ppm were used in three time of layering viz., 15th June, 15th July and 15th August with two rooting media viz., sphagnum moss and coco peat. It was revealed that High percentage of rooting and root characters of air layers of guava have been successfully achieved by exogenous application of IBA at 4000 ppm. Regarding the time of layering, 15th August gave the maximum rooting success and root attributes. Among the rooting media, moist sphagnum moss produced highest rooting percentage and root characters. The survival of rooted air layers was found to be maximum with the treatment combination of IBA at 4000 ppm, 15th August and sphagnum moss and polyhouse conditions produced higher survival than open conditions after 45 days of detachment from the mother plants.

Key words: IBA, layering, media, nursery, guava.

INTRODUCTION

Guava is one of the most important tropical fruit with high nutritive value, pleasant aroma and good flavours. Guava (*Psidium guajava* L.) belongs to the family Myrtaceae and of tropical American origin. Owing to its hardy nature it comes up well even under neglected. The fruits are liked by rich and poor equally and are popularly known as the "Apple of Tropics". Preponderance of seedling progeny appears to be the main constraint in the popularization of guava (*Psidium guajava* L.). It is mostly propagated from seed. However, plants raised from seeds are not true to type and evidently take longer time to reach to bearing stage when compared to vegetative propagated materials. Air layering reported to have yielded good results. Air layering with the help of growth substances stimulating root primordial in air layers of fruit plants (Tyagi and Patel, 8). However, the percentage of establishment and survival of rooted layers in open conditions is very poor (Singh, 5) and is not achieving up to an expectation of the demand at cheaper rate with high establishment and survival percentage. Polyhouse technology has been in use for crop production in more than fifty countries all over the world. Application of this technology is more common for vegetable production and in India is a recent phenomenon but gaining important these days. To facilitate better percentage of establishment and survival of rooted layers, a polyhouse nursery condition is the alternative to an open nursery conditions.

MATERIALS AND METHODS

The experiment was carried out during 2008-09, on a Guava cv. L-49 orchard, planted at a spacing of 4 x 4 m in square system of planting at Fruit Research Station, Sangareddy, Medak district, Andhra Pradesh, from 15th June to 15th December, 2008. The time of layering was done in 3 months *i.e.* 15th June (M_1), 15th July (M_2) and 15th August (M_3) with moist sphagnum moss (S) and coco peat (C) as rooting media and they were soaked in water over night and squeezed it before used to avoid excess water and IBA concentrations used were control (I_0), 2000 ppm (I_1), 3000 ppm (I_2) and 4000 ppm (I_3). The period of observations was 75 days after layering and for establishment percentage was taken at 45 days after transplanting under both open and polyhouse nursery. The selected plants were healthy, well matured, uniform and vigorous. These selected plants were kept under

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ideal cultural practices, the flowers and fruits were frequently removed from the layer shoots during the course of studies and the soil was light to medium in texture (Sandy loam) locally called as 'chalka'. The shoot selected was of one year old and of pencil thickness with the average length of 60cm and showing brown streaks on the bark.

In a selected shoots, a ring of bark about 2-2.5 cm were girdled carefully by giving two circular cuts a bout 45-60cm below the top end of a shoots and the exposed portion was rubbed. The lanolin paste containing IBA in difference concentrations was applied evenly above the upper portion of the cut ring with the help of glass rod. Control shoots were left as such. A sleeve (15 X 20 cm) of black polythene (150 gauges) was then covered. These air layers were separated from the parent plants 75 days after layering by given three installations cut at an interval of one week, so as to reduce the shock of sudden detachment. After detachment of air layers shoot, ten of the successful rooted shoots were transplanted in the polybag (10 x 15 cm) containing Soil: Sand and FYM in the ratio of 1:1:1. These were maintained under both polyhouse and open field for studying their establishment.

The experiment was laid out in Factorial Randomized Block Design. The treatment was replicated thrice; each replication was a unit of 20 layers. The data were then analysed as per method of Panse and Sukhatme (4) for factorial under randomized block.

RESULTS AND DISCUSSION

The results revealed that IBA concentrations, time of layering and rooting media exhibited a significant effect on rooting and root parameters presented in Table 1. Among IBA concentrations, IBA at 4000 ppm produced the highest rooting (83.15 %), primary roots (9.14), secondary roots (22.82), length of longest roots (8.92 cm), and highest fresh weight (2.35 gm) and dry weight (0.43 g) of root layer^{-1}. Where as the minimum value of these characters were recorded under control. IBA at higher concentration (4000 ppm) gave better result than at lower concentrations or under control and there appeared to be an increasing tendency of rooting with an increasing concentration, this might be at higher concentration of IBA the quantity of auxin reaching the cambial activity may be adequate for initiating root primordia, so the highest performance was seen at higher concentrations of IBA. Indicating the possibility of better success with employing higher concentrations of IBA (Bhagat *et al*., 2). The maximum number of primary and secondary roots might be due to hormonal effect leading to accumulation of internal substances and their downward movement. Regarding the number of secondary roots might be due to more cell division. The maximum mean length of longest roots, suggesting that higher concentration of IBA stimulated faster growth of roots resulting in maximum length as reported by Tyagi and Patel (8). The highest roots weight may be attributed to the fact that external application of auxin generally stimulate the movement of natural auxin and others materials in downward direction from the leaves and shoot tips, which accumulate at the incision made on the shoot resulting in the formation of roots with higher

Table 1. Effect of IBA concentrations, time of layering and rooting media on rooting and root parameters in guava air-layering.

Factor	Rooting (%)	Primary roots	Secondary roots	Length of longest root (cm)	Roots weight (g)	
					Fresh	Dry
I_0	63.70	2.80	4.77	1.76	0.445	0.081
I_1	74.45	5.04	10.82	4.87	1.276	0.230
I_2	78.47	6.79	17.53	6.95	1.831	0.335
I_3	83.15	9.14	22.82	8.92	2.346	0.433
CD (0.05)	0.30	0.02	0.04	0.04	0.004	0.001
M_1	71.94	4.99	12.04	4.53	1.280	0.231
M_2	74.95	6.07	14.30	5.81	1.503	0.277
M_3	77.94	6.77	15.61	6.53	1.641	0.302
CD (0.05)	0.41	0.03	0.05	0.06	0.006	0.001
S	76.55	6.22	14.59	5.91	1.533	0.281
C	73.34	5.67	13.37	5.34	1.416	0.259
CD (0.05)	0.36	0.03	0.04	0.05	0.005	0.001

I_0= Control, I_1= IBA 2000ppm, I_2= IBA 3000 ppm, I_3= IBA 4000 ppm, M_1= 15th June, $M_{2=}$ 15th July , $M_{3=}$ 15th August , S= Sphagnum moss and C= Coco peat, *Data in parenthesis indicates angular transformed values

Table 2. Interaction effect of IBA concentrations and time of layering on rooting and root parameters in guava air layering.

Factor	Rooting (%)	Primary roots	Secondary roots	Length of longest root (cm)	Roots weight (g)	
					Fresh	Dry
$I_0 M_1$	60.00	1.71	2.97	1.02	0.262	0.046
$I_0 M_2$	64.44	3.00	5.20	1.88	0.491	0.089
$I_0 M_3$	66.65	3.70	6.13	2.36	0.583	0.107
$I_1 M_1$	71.11	4.33	9.50	3.63	1.116	0.200
$I_1 M_2$	73.37	5.10	11.07	5.11	1.304	0.236
$I_1 M_3$	78.87	5.70	11.90	5.87	1.409	0.255
$I_2 M_1$	75.55	6.20	14.47	5.58	1.596	0.280
$I_2 M_2$	78.87	6.83	18.20	7.23	1.852	0.342
$I_2 M_3$	81.00	7.33	19.92	8.04	2.046	0.383
$I_3 M_1$	81.11	7.73	21.23	7.91	2.147	0.397
$I_3 M_2$	83.11	9.37	22.73	9.02	2.364	0.441
$I_3 M_3$	85.22	10.33	24.48	9.83	2.528	0.462
CD (0.05)	0.58	0.03	0.07	0.09	0.009	0.002

I_0= Control, I_1= IBA 2000ppm, I_2= IBA 3000 ppm, I_3= IBA 4000 ppm, M_1= 15th June, M_2= 15th July , M3= 15th August

Table 3. Interaction effect of IBA concentrations and rooting media on rooting and root parameters in guava air.

Factor	Rooting (%)	Primary roots	Secondary roots	Length of longest root (cm)	Roots weight (g)	
					Fresh	Dry
I_0S	65.92	3.07	5.22	1.96	0.473	0.087
I_0C	61.48	2.53	4.31	1.55	0.418	0.074
I_1S	76.28	5.31	11.33	5.12	1.344	0.243
I_1C	72.62	4.78	10.31	4.62	1.209	0.218
I_2S	79.92	6.98	18.16	7.23	1.344	0.348
I_2C	77.04	6.60	16.90	6.66	1.766	0.321
I_3S	84.07	9.53	23.65	9.33	2.420	0.444
I_3C	82.22	8.76	21.98	8.52	2.272	0.423
CD (0.05)	0.50	0.04	0.06	0.08	0.008	0.002

I_0= Control, I_1= IBA 2000ppm, I_2= IBA 3000 ppm, I_3= IBA 4000 ppm, S= Sphagnum moss and C= Coco peat

root fresh and dry weight.

Incase of time of layering, 15th August recorded maximum rooting (77.94%), number of primary (6.77) and secondary (15.61) roots, mean length of longest root (6.53) and highest fresh (1.64 gm) and dry weight (0.30 gm) of root layer^{-1}. While, 15th June recorded the minimum of these characters. This may be due to climatic and environmental factors variation and differences in varietal responses as reported by Changrappa and Gowda (3) in guava. It is evident from the results obtained that root characters had progressively improved in layer from 15th June to 15th August. The fact that August had recorded maximum rooting percentage, suggesting that the rooting in the other months was affected due to environmental conditions in the shape of steady increasing in relative humidity from June to August and with temperature approaching down from high temperature of summer to moderate temperature of rainy and autumn season.

The data pertaining to rooting media showed that Wet sphagnum moss produced maximum rooting (76.55%), number of primary (6.22) and secondary (14.59) roots, mean length of longest roots (5.91 cm) and highest fresh (1.53 gm) and dry weight (0.28 gm) of roots. However cocopeat recorded the minimum of these characters. Sphagnum moss has more success perhaps due to it capacity to retain higher moisture retention with high porosity for better aeration. This finding was also

Table 4. Interaction effect of time of layering and rooting media on rooting and root parameters in guava air layering.

Factor	Rooting (%)	Primary roots	Secondary roots	Length of longest root (cm)	Roots weight (g)	
					Fresh	Dry
M_1S	73.88	5.27	12.78	4.78	1.341	0.242
M_1C	70.00	4.72	11.30	4.29	1.219	0.219
M_2S	76.55	6.33	14.80	6.13	1.575	0.286
M_2C	73.35	5.82	13.80	5.49	1.430	0.267
M_3S	79.21	7.07	16.19	6.82	1.684	0.314
M_3C	76.66	6.47	15.02	6.24	1.599	0.290
CD (0.05)	0.71	0.05	0.08	0.11	0.011	0.002

M_1= 15th June, M_2= 15th July , M_3= 15th August , S= Sphagnum moss and C= Coco peat

Table 5. Interaction effect of IBA concentrations, time of layering and rooting media on rooting , root parameters in air layering.

Factor	Rooting (%)	Primary roots	Secondary roots	Length of longest root (cm)	Roots weight (g)	
					Fresh	Dry
I_0SM_1	62.22	2.08	2.20	1.21	0.320	0.058
I_0SM_2	66.66	3.20	3.53	2.18	0.512	0.092
I_0SM_3	68.88	3.93	4.47	2.48	0.586	0.112
I_1SM_1	73.33	4.53	8.73	3.81	1.200	0.215
I_1SM_2	75.55	5.33	9.93	5.37	1.366	0.248
I_1SM_3	79.97	6.07	10.67	6.17	1.466	0.267
I_2SM_1	77.78	6.33	11.73	5.86	1.631	0.286
I_2SM_2	79.96	7.13	14.67	7.55	1.956	0.357
I_2SM_3	82.00	7.47	16.40	8.29	2.102	0.402
I_3SM_1	82.22	8.13	17.73	8.23	2.212	0.410
I_3SM_2	84.00	9.67	19.13	9.45	2.466	0.448
I_3SM_3	86.00	10.80	20.67	10.32	2.582	0.473
I_0CM_1	57.78	1.33	1.40	0.82	0.204	0.035
I_0CM_2	62.22	2.80	3.27	1.59	0.470	0.085
I_0CM_3	64.42	3.47	3.87	2.45	0.580	0.102
I_1CM_1	68.88	4.13	7.47	3.45	1.032	0.185
I_1CM_2	71.18	4.87	9.07	4.85	1.243	0.225
I_1CM_3	77.78	5.33	9.73	5.57	1.352	0.243
I_2CM_1	73.33	6.07	10.67	5.29	1.561	0.270
I_2CM_2	77.78	6.53	13.13	6.91	1.747	0.326
I_2CM_3	80.00	7.20	14.93	7.79	1.990	0.364
I_3CM_1	80.00	7.33	16.47	7.59	2.081	0.383
I_3CM_2	82.22	9.07	18.13	8.61	2.261	0.434
I_3CM_3	84.00	9.87	19.20	9.35	2.474	0.451
CD (0.05)	1.01	0.07	0.12	0.15	0.015	0.003

I_0= Control, I_1= IBA 2000ppm, I_2= IBA 3000 ppm, I_3= IBA 4000 ppm M_1= 15th June, M_2= 15th July , M_3= 15th August , S= Sphagnum moss and C= Coco peat

similar with that of Singh and Jawanda (7).

Results indicated that combined effect of IBA concentrations and Time of layering was significantly influenced rooting and root characters presented in Table 2. IBA at 4000 ppm + 15th August recorded maximum rooting (85.22 %), number of primary (10.33) and secondary (24.48) roots, mean length of longest roots (9.83 cm) and root fresh (2.53 gm) and dry weight (0.46 gm).

Interaction between IBA concentrations and rooting media also significantly influence on rooting and roots characters presented in Table 3. IBA at 4000 ppm + 15th August produced maximum rooting (84.07 %), %), number of primary (9.53) and secondary (23.65) roots, mean length of longest roots (9.33 cm) and root fresh (2.42 gm) and dry weight (0.44 gm). The minimum value of these characters was observed by control + coco peat.

The interaction effect of time of layering and rooting media on rooting and root parameters in guava air layering was also significant presented in Table 4. 15th August + Wet sphagnum moss produced maximum rooting (79.21 %), number of primary roots (7.07), secondary roots (16.19), mean length of longest roots (6.82 cm), root fresh (1.68 gm) and dry (0.31 g) weight.

The combined effect of IBA concentrations, time of layering and rooting media was also significant on rooting and root characters presented in Table 5). IBA at 4000 ppm + 15th August + wet sphagnum moss recorded the maximum rooting percentage (86.00%), maximum number of primary (10.8) and secondary (20.67) roots, mean length of longest roots (10.32) and root fresh (2.58 g) and dry (0.47 g) weight. Westwood (1973) reported that the balance between auxins and other constituents in the plants tissues control organs formation and is the basis for rooting and root characters. This balance may be achieved by various combinations of genetics, environmental and chemical factors.

The establishment of rooted air layering was also significantly influenced by nursery and treatment combinations of IBA concentrations, time of layering and rooting media presented Table 6. Of the two nursery, Polyhouse recorded higher establishment (67.43%) than open nursery conditions (60.30%). Among the treatment combinations, I_3SM_3 (IBA at 4000 ppm + 15th August + moist sphagnum moss) recorded the highest establishment (87.50%). In the interaction effect of treatment combinations and nursery, I_3SM_3 under polyhouse nursery recorded the highest establishment (91.67%). This might be due to more number of primary and secondary roots and root length at this combination for better absorption of nutrients and moisture from the soil and ultimately resulted in higher establishment percentage (Tyagi and Patel, 8). Establishment under poly-house nursery conditions always higher than that of open nursery conditions irrespective of IBA concentrations, time of layering and media and their interactions. This might be due to congenial environmental conditions under poly-house conditions when compared to uncontrolled environmental conditions of open nursery. This finding is in agreement with the results obtained by Ahmad *et al.* (1) in patch budding of walnut, Singh *et al.* (6) on Wedge method of grafting in guava (*Psidium guajava*) cultivars Allahabad Safeda and Sardar under greenhouse obtained higher successes than in an opened conditions .

Table 6. Effect of IBA concentrations, time of layering, rooting media and nursery on survival of plantlets.

Treatments (T)	Nursery (N)		
	Open	Polyhouse	Mean
I_0SM_1	33.33	50.00	41.67
I_0SM_2	50.00	55.55	52.78
I_0SM_3	55.55	61.10	58.33
I_1SM_1	61.10	61.11	61.10
I_1SM_2	63.89	66.66	65.27
I_1SM_3	66.66	69.44	68.06
I_2SM_1	66.66	69.44	68.22
I_2SM_2	69.44	77.77	73.60
I_2SM_3	72.22	82.00	77.11
I_3SM_1	75.00	83.33	79.17
I_3SM_2	78.33	88.88	83.33
I_3SM_3	83.33	91.67	87.50
I_0CM_1	16.66	33.33	25.00
I_0CM_2	33.33	50.00	41.67
I_0CM_3	50.00	55.55	52.78
I_1CM_1	49.99	58.34	54.17
I_1CM_2	55.55	61.10	58.33
I_1CM_3	61.10	63.88	62.49
I_2CM_1	61.10	66.66	65.27
I_2CM_2	63.89	69.44	65.27
I_2CM_3	66.66	72.22	69.44
I_3CM_1	66.66	72.22	69.44
I_3CM_2	72.22	75.00	72.22
I_3CM_3	75.00	83.33	80.55
Mean	60.30	67.43	
$CD_{0.05}$	N	1.28	
	T	4.44	
	N x T	6.28	

I_0= Control, I_1= IBA 2000ppm, I_2= IBA 3000 ppm, I_3= IBA 4000 ppm M_1= 15th June, M_2= 15th July , M_3= 15th August, S= Sphagnum moss and C= Coco peat

Based on the above result it was concluded that rooting could be enhanced in air layer by exogenous

application of IBA at 4000 ppm with moist sphagnum moss as rooting media layering during 15th August. Besides it also improved root characters like number of roots, root length and root weight and also recorded highest establishment.Comparatively, establishment under polyhouse conditions always higher than that of open nursery conditions irrespective of IBA concentrations, time of layering and rooting media.

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