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Standardization of IBA concentration for rooting of cuttings of some indigenous fruit crops of Assam

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ABSTRACT

An experiment was conducted to study the effect of different concentrations of IBA (250, 500, 1000, 1500 and 2000 ppm) on rooting of cuttings in five indigenous fruit species- Barthekera (*Garcinia pedunculata* Roxb.), Teportenga (*Garcinia xanthochymus* Hk.f), Jalphai (*Eleocarpus floribundus* Bl), Nagatenga (*Rhus semialata* Murr.) and Outenga (*Dillenia indica* Linn.) during March 2007. Among all the five species studied, Outenga registered highest percentage of rooting (38.86), number of primary roots (12.00), survival percentage (40.47) and longest shoots (20.41cm). IBA @ 2000 ppm exhibited highest percentage of rooting (37.13), number of primary roots (9.13), survival percentage (35.69) and longest shoots (17.91cm).

Key words: Cuttings, indigenous fruits, rooting, vegetative growth, indole butyric acid

INTRODUCTION

North-Eastern region of India is endowed with a unique physiography and rich plant genetic diversity. This region is blessed with nature's gift of a large number of indigenous fruit crops of tropical, subtropical and temperate nature. Many of these have medicinal, therapeutic and commercial value. However, a large number of indigenous minor fruits are still found in the wild and many are yet to be precisely identified and used. Known species, however, are on the verge of extinction due to inadequate methods of propagation. Therefore, in an effort to prevent their extinction considering their importance in the environment of the rural area and home-life of the community, their large-scale multiplication through cuttings is the need of the hour. Five fruit species indigenous to Assam were used in the study: Barthekera (*Garcinia pedunculata* Roxb.), Teportenga (*Garcinia xanthochymus* Hk.f), Jalphai (*Eleocarpus floribundus* Bl), Nagatenga (*Rhus semialata* Murr.) and Outenga (*Dillenia indica* Linn. Vegetative propagation is particularly important in horticulture because genetic make up of most fruit cultivars is highly variable, and unique characteristics of such plants are lost for ever if these are seed-propagated. Vegetative propagation makes possible production of trees with desirable characters and enables their perpetuation and multiplication.

In propagation by cuttings, formation of roots or "rhizogenesis", is an important stage which is attained only when several influencing factors come into play. Among these, plant growth regulators are known to have a stimulatory effect on rooting of cuttings (Audus, 1965). So far, among a number of synthetic plants growth substances used for rooting of cuttings, indole butyric acid (IBA) has been found to be (Hartman and Kester, 1993). Thus, the objective of this experiment was to work out and optimize the most appropriate concentration of IBA for good rooting and high survival of cuttings in the stated indigenous fruit species of Assam and to study morphological characters of the established cuttings as influenced by different concentrations of IBA.

MATERIAL AND METHODS

The present investigation was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat, during March 2007. The experiment was laid out in split plot design, the main plot being species of the fruit crop, while, IBA concentration was considered in the sub-plot. These were replicated three times. Uniform, diseases-free, 1.5 to 2 year old shoots were selected for the experiment. About 10mm thick and 15-20cm long cuttings were made with a slanting cut on both sides,

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retaining 2-3 round buds in between. Basal ends of the prepared cuttings were treated with indole 3-butyric acid for 5-10 seconds. Solutions of 0, 250, 500, 1000, 1500 and 2000 ppm IBA were prepared by dissolving IBA in a drop of 1N KOH and then making up the volume with water. Treated cuttings were than planted (15 x 20cm spacing) in the nursery bed.

At planting, the base of the cuttings was pressed firmly to avoid formation of air pockets. After planting, nursery beds were watered well. Periodic observation on rooting percentage, number of primary roots, length of the longest primary root, fresh and dry weights of the root were recorded randomly for each replication of the treatment, and, mean values were calculated. Similarly, for the aerial part of the cutting, number of branches and new leaves, length of the shoot, leaf area and survival percentage were recorded and subjected to statistical analysis as per Panse and Sukhatm (1967). Data on rooting and survival percentage were subjected to angular transformation prior to statistical analysis (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Plant species: As for root formation, *Outenga* registered highest percentage (38.86) of rooting at 90 days from planting. Higher percentage of rooting in *Outenga* may be attributed to presence of a higher number of rapidly dividing cells leading to early callusing and, ultimately, rooting (Yakobashvilli, 1964). *Outenga* produced maximum number of primary roots (12.00), longest root (11.44 cm), higest root fresh weight (1.03g) and dry weight (0.21g). Better performance of *Outenga* in all root characters could be ascribed to presence of higher rooting cofactors in the tissues of cuttings (Leonard, 1968). Superiority of *Outenga* could also be due to higher C:N ratio in the tissues of cuttings and greater food reserves in the shoot (Basu and Ghosh 1974). Higher endogenous auxin concentrations are known to improve rooting (Haissig, 1970) but application of cytokinin inhibits rooting (Drewes and Van Staden, 1989). Higher endogenous auxin and lower cytokinin concentration may have enabled better rooting in *Outenga* cuttings.

Higher percentage of survival of cuttings of *Outenga* was observed to be related to higher amount of callusing and rooting compared to that in the other species. Contrary to this, *Nagatenga* recorded lowest percentage of survival. This might be due to failure of formation of vascular connection between the root primordial and vascular tissue of the cutting itself, (Bose *et al*, 1991).

Nagatenga recorded highest number of branches (5.56) and number of new leaves (15.23), and lowest (5.33) number of primary roots. This could be due to high endogenous levels of cytokinin and sugars. Similar explanation had been given by (Gur *et al*, 1986) where high cytokinin and sugar concentration have been were shown to be related to leaf retention in peach cuttings.

Longest (20.41cm) shoots were found in *Outenga*. This may be due to a better root system which absorbed more nutrients for plant growth, as shown by Deol and Khosla (1983). Maximum leaf area (88.37cm^2) in *Outenga* might be due to its genetic propensity for production of larger-sized leaves.

IBA treatments: Increased rooting response of IBA @ 2000ppm in cuttings may be attributed to induction of more vigorous cell division at the basal end of cutting and increases accumulation of sugars, which favours callus formation and, subsequently, rooting. This is in conformity with findings of (Sundharai *et al*, 2002).

Cuttings treated with IBA @ 2000ppm showed significant superiority over all other IBA concentrations and exhibited highest number of primary roots (9.13), root length (9.30cm), fresh weight (1.12g) and dry weight (0.22g). This might be due to increased metabolic activity in the cuttings treated with IBA, as shown by Audus (1965).

Higher survival % of cutting treated with IBA @ 2000 ppm might be attributed to higher number of primary roots, branches and leaves, which paid in higher uptake of water (Kher, 1987).

IBA treatment significantly increased the number of new leaves (13.16), number of branches (5.62), length of the shoot (17.91cm) and leaf area (49.72cm^2) per cuttings. Better response of IBA @ 2000 ppm with reference to all shoot characters may be attributed to an improved root system. Similar inference was drawn by Chauhan and Maheshwari (1970) in their work with peach cuttings.

Interaction effect: Data in Tables 1 to 6 reveal that the interaction effect of plant species and IBA treatments was significant longest primary root per cutting, fresh weight of roots per cutting, survival percentage, number of branches per cutting, number of new leaves per cutting, size of the longest shoots per cutting. Further, the findings revealed that the combination of *Outenga* and IBA @ 2000 ppm (P_5T_5) exhibited superiority over all combination in respect of number of new leaves per cutting (18.87) and survival percentage (45.00). Superiority of this two combination may be attributed to presence of a rooting cofactor in the stem

Table 1. Effect of plant species and IBA on length of longest primary roots per cutting

IBA Treatments (T)	Plant species (P)					
	P_1	P_2	P_3	P_4	P_5	Mean T
T_0	6.67	7.00	6.83	6.17	10.57	7.45
T_1	6.50	8.17	7.57	6.90	12.47	8.32
T_2	6.33	7.80	8.23	7.57	12.00	8.39
T_3	6.00	7.53	8.90	8.17	11.40	8.40
T_4	6.00	10.73	9.37	8.63	11.17	9.18
T_5	5.83	11.00	9.67	8.93	11.07	9.30
Mean P	6.22	8.71	8.43	7.73	11.44	

CD (*P=0.05*) P= 0.28 P_1 (Barthekera) T_0 (control)
T= 0.24 P_2 (Taportenga) T_1 (250 ppm)
PxT = * P_3 (Jalphai) T_2 (500 ppm)
*= Significant at *P=0.05* P_4 (Nagatenga) T_3 (1000 ppm)
P_5 (Outenga) T_4 (1500 ppm)
T_5 (2000 ppm)

Table 2. Effect of plant species and IBA on fresh weight of roots per cutting

IBA Treatments (T)	Plant species (P)					
	P_1	P_2	P_3	P_4	P_5	Mean T
T_0	0.46	0.54	0.43	0.45	0.45	0.47
T_1	0.9	0.83	1.05	0.80	1.15	0.95
T_2	0.99	1.10	1.01	1.00	1.19	1.06
T_3	1.07	1.17	0.99	1.03	1.18	1.09
T_4	1.11	1.18	1.07	1.05	1.13	1.11
T_5	1.13	1.22	1.09	1.07	1.08	1.12
Mean P	0.94	1.01	0.94	0.90	1.03	

CD (*P=0.05*) P= 0.03
T= 0.03
PxT = *
*= Significant at *P=0.05*

Table 3. Effect of plant species and IBA on survival percentage at 120 days

IBA Treatments (T)	Plant species (P)					
	P_1	P_2	P_3	P_4	P_5	Mean T
T_0	00.00 (0.29)	33.33 (35.22)	00.00 (0.29)	00.00 (0.29)	30.00 (33.21)	12.67 (13.86)
T_1	00.00 (0.29)	33.33 (35.22)	16.67 (23.86)	00.00 (0.29)	40.00 (39.23)	18.00 (19.78)
T_2	10.00 (18.43)	36.67 (37.22)	23.33 (28.78)	10.00 (18.43)	43.33 (41.15)	24.67 (28.81)
T_3	13.33 (21.14)	40.00 (39.23)	33.33 (35.22)	13.33 (21.14)	43.33 (41.15)	28.67 (31.58)
T_4	20.00 (26.57)	43.33 (41.15)	36.67 (37.22)	16.67 (23.86)	46.67 (43.08)	32.67 (34.38)
T_5	20.00 (26.57)	46.67 (43.08)	36.67 (37.22)	20.00 (26.57)	50.00 (45.00)	34.67 (35.69)
Mean P	10.56 (15.55)	38.89 (38.52)	24.44 (27.10)	10.00 (15.10)	42.22 (40.47)	

CD (*P=0.05*) P= 1.82
T= 2.45
PxT = *
*= Significant at *P=0.05*

Table 4. Effect of plant species and IBA on number of branches per cutting

IBA Treatments (T)	Plant species (P)					
	P_1	P_2	P_3	P_4	P_5	Mean T
T_0	1.75	3.50	3.83	4.00	4.92	3.60
T_1	2.00	4.25	4.50	5.42	4.92	4.22
T_2	2.08	5.00	6.00	5.33	6.00	4.88
T_3	2.42	5.33	5.75	6.00	5.50	5.00
T_4	3.00	6.00	5.83	6.25	5.58	5.33
T_5	3.67	6.33	6.50	6.33	5.25	5.62
Mean P	2.49	5.07	5.40	5.56	5.36	

CD (*P=0.05*) P= 0.21
T= 0.20
PxT = *
*= Significant at *P=0.05*

or to inherent rooting capacity of the species (Singh and Singh, 1972).

In the present investigation, it was also observed that *Outenga* treated with IBA 250ppm (P_5T_1) showed superiority in respect of length of the longest primary root (12.47 cm). *Taportenga* treated with IBA @ 2000 ppm (P_2T_5) showed highest fresh weight (1.22g). Highest number of branches (6.50) was observed in *Jalphai* treated with IBA @ 2000 ppm (P_3T_5), while, length of longest shoot (21.95cm) was superior in *Outenga* treated with IBA @ 1500ppm (P_5T_4).

It is also evident that interaction effect of plant species and IBA treatments was found to be non-significant in respect of rooting percentage at 90 days, number of primary roots per cutting, dry weight of roots per cutting and leaf area per cutting, which was ascribed to the inherent resistance of the plant species to rooting. This is in consonance with the finding obtained by Kehl (1950) who reported that though growth promoting hormones improved rooting in various plant species, these may be incapable of break down their inherent resistance to rooting.

It can thus be concluded that the plant species *Outenga* produced highest rooting percentage at 90 days, followed by *Jalphai, Nagatenga* and *Barthekera*. *Taportenga* exhibited minimum rooting percentage and was found difficult-to-root plant species. However, we have shown that all the species can be propagated by stem-cuttings with the aid of IBA. It was also evident that different concentrations of IBA induced different response in the five species of plants selected for this experiment. IBA at 2000 ppm showed superior behaviour in rooting as well as in shoot characteristics over all other concentrations tested in the

Table 5. Effect of plant species and IBA on number of new leaves per cutting

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	3.47	5.93	6.80	10.20	11.60	7.60
T_1	3.80	7.13	8.13	14.87	12.53	9.29
T_2	3.80	9.00	11.07	14.07	13.27	10.24
T_3	3.47	10.00	11.00	16.00	15.73	11.24
T_4	4.67	10.20	13.00	18.07	18.47	12.88
T_5	5.07	10.40	13.27	18.20	18.87	13.16
Mean P	4.05	8.78	10.54	15.23	15.08	

CD (*P=0.05*) P= 0.49
T= 0.58
PxT = *
*= Significant at *P=0.05*

Table 6. Effect of plant species and IBA on length of longest shoot per cutting

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	11.17	10.89	12.72	12.61	18.17	13.11
T_1	13.17	13.00	13.50	14.44	19.94	14.81
T_2	13.89	14.06	14.50	15.94	20.50	15.78
T_3	15.22	16.06	16.05	15.67	21.45	16.89
T_4	16.11	14.83	16.39	17.61	21.95	17.38
T_5	16.33	16.33	17.33	19.11	20.44	17.91
Mean P	14.31	14.19	15.08	15.90	20.41	

CD (*P=0.05*) P= 0.44
T= 0.39
PxT = *
*= Significant at *P=0.05*

Table 7. Effect of plant species and IBA on percentage of rooting at 90 days

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	13.33 (21.14)	10.00 (18.43)	30.00 (33.21)	16.67 (23.86)	33.33 (35.22)	20.67 (26.37)
T_1	16.67 (23.86)	16.67 (23.86)	33.33 (35.22)	23.33 (28.78)	36.67 (37.22)	25.33 (29.79)
T_2	20.00 (26.67)	23.33 (28.78)	33.33 (35.22)	26.67 (31.00)	36.67 (37.22)	28.00 (31.76)
T_3	23.33 (28.78)	26.67 (31.00)	36.67 (37.22)	23.33 (28.78)	40.00 (39.23)	30.00 (33.00)
T_4	26.67 (31.00)	23.33 (28.78)	40.00 (39.23)	30.00 (33.21)	43.33 (41.15)	32.67 (34.67)
T_5	30.00 (33.21)	26.67 (31.00)	43.33 (41.15)	36.67 (37.22)	46.67 (43.08)	36.67 (37.13)
Mean P	21.67 (27.43)	21.11 (26.97)	36.11 (36.88)	26.11 (30.47)	39.44 (38.86)	

CD (*P=0.05*) P= 2.31
T= 2.64
PxT = NS
NS= Not significant

Table 8. Effect of plant species and IBA on number of primary roots per cutting

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	5.00	6.33	6.33	4.33	10.00	6.40
T_1	5.67	6.67	7.00	5.33	11.67	7.27
T_2	7.00	7.67	7.67	5.00	12.00	7.87
T_3	7.00	8.00	7.67	4.67	12.33	7.93
T_4	7.33	8.33	8.00	6.00	12.67	8.47
T_5	8.00	9.33	8.33	6.67	13.33	9.13
Mean P	6.67	7.72	7.50	5.33	12.00	

CD (*P=0.05*) P= 0.60
T= 0.72
PxT = NS
NS= Not significant

Table 9. Effect of plant species and IBA on dry weight of roots per cutting

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	0.14	0.16	0.12	0.12	0.15	0.14
T_1	0.16	0.17	0.18	0.17	0.21	0.18
T_2	0.17	0.20	0.17	0.16	0.22	0.18
T_3	0.20	0.20	0.16	0.16	0.23	0.19
T_4	0.21	0.21	0.19	0.18	0.21	0.20
T_5	0.22	0.23	0.22	0.20	0.21	0.22
Mean P	0.18	0.20	0.17	0.16	0.21	

CD (*P=0.05*) P= 0.01
T= 0.02
PxT = NS
NS= Not significant

Table 10. Effect of plant species and IBA on leaf area per cutting

IBA Treatments (T)	Plant species (P) P_1	P_2	P_3	P_4	P_5	Mean T
T_0	49.17	46.60	17.63	15.90	84.67	42.79
T_1	51.58	48.95	19.11	17.08	87.27	44.80
T_2	63.67	52.46	19.80	16.67	89.10	48.34
T_3	60.00	53.11	19.46	18.57	90.83	48.39
T_4	57.17	51.50	20.98	19.33	90.83	47.96
T_5	65.17	53.67	21.59	20.65	87.52	49.72
Mean P	57.79	51.05	19.76	18.03	88.37	

CD (*P=0.05*) P= 3.55
T= NS
PxT = NS
NS= Not significant

five plant species. Thus, indigenous fruit crops like *Barthekera, Taportenga, Jalphai, Nagatenga* and *Outenga* can be propagated with proper care and management under suitable soil and climatic conditions of Assam with application of IBA.

REFERENCES

Audus, L.J. 1965. Plant growth substances, Leonard Hill Book Limited, London, Second Edition, pp 553.

Basu, R.N. and Ghosh, S.K. 1974. Effect of nitrogen nutrition of stock plants *Justicia gendarussa* L. on rooting of cutting. *J. Hortl.Sci*., **49**:245-252.

Bose, T.K., Mitra, S.K. and Sadhu, M.K. 1991. Propagation of tropical and sub tropical Horticultural crops. First Edition Noya Prakash, Calcutta, pp. 33-38.

Chauhan, K.S. and Maheshwari, L.D. 1970. Effect of certain plant growth regulators, seasons and type of cuttings on root initiation and vegetative growth in stem cuttings of peach, var. Sharbati. *Ind J. Hort*., **27**:136-140.

Deol, G.S. and Khosla, R.K. 1983. Effect of size of stem cuttings on juvenile growth of *Populus ciliata*. Wall. Ex. Royle. *Ind.J.Forestry*, **6**:205-207.

Drewes, F.E. and Van Staden, J. 1989. The effect of 6-benzyladenine derivatives on the rooting of *Phaseolus vulgaris* L. primary leaf cuttings. *Pl. Growth Reg*., **8**:289-296.

Gur, A., Altman, A., Stern, R. and Wolowitz, B. 1986. Improving rooting and survival of softwood peach cuttings. *Sci. Hortic*., **30**: 97-108.

Haissig, B.E. 1970. Influence of indole-3-acetic acid on adventitious root primordia of brittle willow. *Planta*, **95**:27-35.

Hartman, H.T. and Kester, D.E. 1993. Plant propagation principles and practices, Fifth Edition. Prentice Hall, New Delhi, pp. 200-241.

Kehl, F.H. 1950. Vegetative propagation of tea by nodal cuttings. *Tea Quart*. **20**:3-18.

Kher, M.A. 1987. Chrysanthemum in India. Publ, NBRI, Lucknow, India

Leonard, P.S. 1968. Factors influencing root initiation in easy and difficult-to-root cuttings of chrysanthemum. *Proc. Amer. Soc. Hortl. Sci*., **92**:622-626.

Panse, V.G. and Sukhatm, P.V. 1967. Statistical methods of agricultural workers (2nd edition), ICAR, New Delhi.

Singh, R. and Singh, R.P. 1972. Effect of IBA, potting media and maturity of wood in propagation of sweet-lime and lemon by cuttings. *Ind. J. Hort*., **29**:505-510.

Snedecor, G.W. and Cochran, W.G. 1967. Statistical methods. 6th edition. Oxford and IBH Publishing Co., New Delhi, pp. 325-329

Sundharai, K., Ponnuswami, V. and Jaya Jasmine. 2002. Effect of growth regulators in the propagation of hippli (Long pepper). *South Ind. Hort*., **48**:172-174

Yakobashvilli, B.A. 1964. Anatomical study of some hard-rooting subtropical plants. *Tea and Subtropical Plants*, **1**:135-147.

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