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Standardization of vegetative propagation in *Oroxylum indicum* (L.) Vent. : A threatened medicinal tree

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ABSTRACT

An experiment was undertaken to standardize the vegetative propagation in *Oroxylum indicum* (L.) Vent. at College of Horticulture, Mudigere during 2016-17. Hardwood and limb cuttings were used for the study. The cuttings were treated with different hormonal treatments like NAA, IBA and their combinations. Among the different treatments, hardwood cuttings treated with NAA 200 ppm+IBA 3000 ppm showed maximum sprouting (86.67%), number of shoots (7.05), shoot length (10.97 cm), number of leaves (28.33), rooting percentage (60.33), number of roots per rooted cutting (43.30) and average root length (31.53 cm). Findings of this study can be used for large scale propagation of this highly useful medicinal tree species for their sustainable use.

Key words : Cuttings, hardwood, limb, *Oroxylum indicum* (L.) Vent., propagation

INTRODUCTION

Oroxylum indicum (L.) Vent. belongs to the family Bignoniaceae described as a medium sized, deciduous tree. This plant is widely found in India, Shri Lanka, China, Philippines and Malaysia (Bennet *et al.*,1992). *Oroxylum indicum* is commonly known as Broken bones tree, Indian trumpet flower, Midnight horror (Rajurkar *et al.*, 2011). Pods of the plant make huge noice in the night which makes fear in human beings so plant is called Midnight horror.

Root extract of this plant has been used in Ayurvedic preparations like Dashmularisht and Chyawanprash (Yasodha *et al.*, 2004). This species is included in the Red Data List and categorized as vulnerable (Ravikumar and Ved, 2000), due to indiscriminate collection, over exploitation and uprooting of whole plants for pharmacological usage. Production of quality seedlings for commercial plantation is one of the main objectives to conserve and also have a continuous supply of this species for its medicinal preparations. Hence, the present investigation was carried out to study the vegetative propagation in *Oroxylum indicum* (L.) Vent.

MATERIALS AND METHODS

Hardwood and limb cuttings of 30 cm length with 4-5 buds per cutting and uniform thickness were collected from the plants grown in the Field Gene Bank, Division of Plant Genetic Resources, ICAR–Indian Institute of Horticultural Research, Bengaluru.

Selected hardwood and limb cuttings were treated with growth regulators of different concentrations viz., NAA (100, 200 and 300 ppm), IBA (1000, 2000 and 3000 ppm) and combination of NAA+IBA.

Thus, the possible combination treatment was as follows : T_1–Control (untreated), T_2–NAA 100 ppm, T_3–NAA 200 ppm, T_4–NAA 300 ppm, T_5–IBA 1000 ppm, T_6–IBA 2000 ppm, T_7–IBA 3000 ppm, T_8–NAA 200 ppm+IBA 1000 ppm, T_9–NAA 200 ppm+IBA 2000 ppm and T_{10}-NAA 200 ppm+IBA 3000 ppm.

The cuttings were soaked in growth regulator solutions for 5 min, and planted on a

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planting media and kept in a polyhouse under partial shade condition (50% shade). This structure helps for maintaining the higher temperature and relative humidity. During the period of experimentation, the average temperature of 20^{0}C was maintained. After every 30 days, the cuttings were examined for rooting and the following observations were recorded, average number of roots per cutting, average number of leaves per cutting, average number of longest root and percentage of rooting per cutting. The data were analyzed statistically as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Days Taken to Sprouting and Sprouting Percentage

In the present study, type of cuttings greatly influenced the days to first sprouting and percentage of sprouted cuttings. The hardwood cuttings recorded minimum number of days (17.23) to first sprouting and maximum percentage of sprouting (33.17) compared to the limb cuttings (24.13 days for sprouting and 23.00%) (Table 1). This might be due to the fact that hardwood cuttings had lower phenolic content.

Increase in the concentration of NAA and IBA significantly decreased the days to first sprouting and increased sprouting percentage. NAA 200 ppm+IBA 3000 ppm recorded minimum number of days for sprouting (30.67) and increased sprouting percentage (70.83). Earliness in sprouting may be due to better utilization of stored carbohydrates, nitrogen and other factors with the help of growth regulators (Chandramouli, 2001). Similar findings were reported by Shirol and Patil (1992) in Ixora.

Among the treatment combinations, hardwood cuttings treated with NAA 200 ppm+IBA 3000 ppm recorded minimum number of days to sprouting (25.67) and maximum percentage of sprouting (86.67). Generally, age of the hardwood cutting is less than limb cutting. Beneficial effects of applied NAA and IBA combination on cuttings decreased with increase in age of cuttings due to decreased sensitivity of aged tissues to rooting hormones. Similar results were recorded in case of African Blackwood by Amri (2010). This may be also due to cell division in the presence of IBA resulting in quick callus formation (Singh and Attri, 2000).

Number of Shoots/Cutting

Type of cuttings significantly affected the number of shoots. Among different types

Table 1. Effect of different growth regulator treatments on number of sprouts and sprouting percentage of cuttings in *O. indicum* (L.) Vent.

Treatment	No. of sprouts/cutting			Sprouting percentage		
	C_1	C_2	Mean	C_1	C_2	Mean
T_1–Control	0.00	0.00	0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_2–NAA 100 ppm	0.00	0.00	0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_3–NAA 200 ppm	0.00	0.00	0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_4–NAA 300 ppm	0.00	0.00	0.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T_5–IBA 1000 ppm	1.83	1.33	1.58	33.33 (35.26)	25.00 (30.00)	29.17 (32.69)
T_6–IBA 2000 ppm	2.08	1.83	1.96	50.00 (45.00)	31.67 (34.25)	40.83 (39.72)
T_7–IBA 3000 ppm	3.17	2.08	2.63	58.33 (49.80)	45.00 (42.13)	51.67 (45.96)
T_8–NAA 200 ppm+IBA 1000 ppm	2.50	1.42	1.96	41.67 (40.20)	35.00 (36.27)	38.33 (38.25)
T_9–NAA 200 ppm+IBA 2000 ppm	3.34	2.33	2.83	61.67 (51.75)	38.33 (38.25)	50.00 (45.00)
T_{10}–NAA 200 ppm+IBA 3000 ppm	4.25	2.67	3.46	86.67 (68.59)	55.00 (47.87)	70.83 (57.31)
Mean	1.72	1.17	1.44	33.17 (35.17)	23.00 (28.66)	28.08 (32.00)
For comparing mean of	S. Em±	C. D. (P=0.05)		S. Em±	C. D. (P=0.05)	
Cutting (C)	0.07	0.21		1.40	4.01	
Treatment (T)	0.16	0.47		3.14	8.98	
Interaction (C × T)	0.23	0.66		4.44	12.69	

C_1 : Hardwood cuttings and C_2 : Limb cuttings. Figures in parentheses indicate arcsin transformed values.

Table 2. Effect of different growth regulator treatments on number of shoots, average shoot length and number of leaves per cutting at different days after planting in *O. indicum* (L.) Vent.

Treatment	No. of shoots/ cutting			Average shoot length of cuttings (cm)			No. of leaves/ cutting		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1–Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_2–NAA 100 ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_3–NAA 200 ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_4–NAA 300 ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_5–IBA 1000 ppm	2.83	2.33	2.58	6.13	3.4	4.77	12.10	10.67	11.38
T_6–IBA 2000 ppm	3.75	2.67	3.21	6.73	4.13	5.43	15.33	12.87	14.10
T_7–IBA 3000 ppm	6.67	3.33	5.00	9.23	4.70	6.97	23.67	15.33	19.50
T_8–NAA 200 ppm+IBA 1000 ppm	4.67	2.83	3.75	7.33	3.83	5.58	19.67	13.50	16.58
T_9–NAA 200 ppm+IBA 2000 ppm	5.33	3.67	4.50	8.03	4.63	6.33	22.67	14.50	18.58
T_{10}–NAA 200 ppm+IBA 3000 ppm	7.05	4.21	5.63	10.97	5.47	8.22	28.33	22.67	25.50
Mean	3.03	1.90	2.47	4.84	2.62	3.73	12.18	8.95	10.57
For comparing mean of	S. Em±	C. D. (P=0.05)		S. Em±	C. D. (P=0.05)		S. Em±	C. D. (P=0.05)	
Cutting (C)	0.10	0.28		0.10	0.27		0.47	1.33	
Treatment (T)	0.22	0.64		0.21	0.61		1.04	2.98	
Interaction (C × T)	0.31	0.90		0.30	0.86		1.47	4.21	

C_1 : Hardwood cuttings and C_2 : Limb cuttings.

of cuttings used hardwood cuttings recorded maximum number of shoots (3.03) at 120 days after planting (Table 2). This might be due to the fact that hardwood cutting gave more number of sprouts and shoot than limb cutting because of more maturity. Also, it was inferred that more number of roots produced would absorb more amounts of nutrients and moisture from the soil and resulted in production of more number of sprouts and shoots on hardwood cuttings.

Number of shoots per cutting at 120 days after planting (5.63) was significantly higher in cuttings treated with NAA 200 ppm+IBA 3000 ppm. This might be due to the fact that external application of auxin promoted growth and enhanced sprouting of dormant buds on the cutting leading to the formation of more number of shoots per cutting. It was also observed that treatment with increased roots per cutting absorbed increased uptake of nutrients and moisture which in turn increased the production of sprout as compared to cutting in all other treatments. These findings are in conformity with those of Upadhyay and Badyal (2007) in pomegranate.

Treatment NAA 200+IBA 3000 ppm recorded significantly higher number of shoots (7.03) at 120 days after planting. This might be due to the combined effect of hardwood cuttings with IBA and NAA combination.

Average Shoot Length of Cutting

All the levels of growth regulators and types of cutting also influenced the average shoot length of cutting and indicated that maximum shoot length (4.84 cm) at 120 days of planting was observed in hardwood cutting than limb cutting.

The maximum shoot length was associated with the cutting treated with NAA 200 ppm+IBA 3000 ppm (8.22 cm) at 120 days of planting. Among the interactions, maximum shoot length was recorded in hardwood cutting (10.97 cm) treated with NAA 200 ppm+IBA 3000 ppm gave at 120 days of planting, which might be due to fact that IBA led to the best aerial growth (Fig. 1).

Number of Leaves

Maximum number of leaves per cutting was observed in hardwood cuttings (12.18) at 120 days after planting (Table 2). This might be due to fact that more maturity and thickness and hardwood cutting contained higher amount of food reserve than limb cutting.

Increase in number of leaves under the treatment NAA 200 ppm+IBA 3000 ppm (25.50 at 120 days after planting) was observed. This might be due to the absorption of more nutrients along with moisture as compared to

Fig. 1. Field view of *Oroxylum indicum* (L.) Vent.

cuttings in all other treatments which in turn increased the production of more number of leaves.

The hardwood cutting of *O. indicum* treated with NAA 200 ppm+IBA 3000 ppm (28.33 at 120 days after planting) showed the maximum number of leaves as compared to other treatment combinations. This might be due to fact that hardwood cutting treated with NAA 200 ppm+IBA 3000 ppm gave more number of roots per cutting which in turn absorbed more nutrients along with moisture.

Percentage of Rooting

Hardwood cutting recorded maximum percentage of rooting (22.7) than limb cutting (16.10). This might be due to the fact that hardwood cuttings contained more starch content which in turn brought about favourable conditions for root initiation.

The maximum percentage of rooted cuttings was associated when cuttings were treated with NAA 200 ppm+IBA 3000 ppm (48.50%) (Table 3). This might be due to the fact that auxins were known to induce stimulus for regeneration of roots by promotion of hydrolysis, mobilization and utilization of nutritional reserves in the region of root formation (Nanda, 1975).

Hardwood cutting of *O. indicum* treated with NAA 200 ppm+IBA 3000 ppm showed the maximum percentage of rooting (60.33) as compared to other treatment. This might be

Table 3. Effect of different growth regulator treatments on rooting percentage, number of roots per rooted cutting and average root length of cuttings at different days after planting in *O. indicum* (L.) Vent.

Treatment	Rooting percentage			No. of roots/rooted cuttings			Average root length of cutting (cm)		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1–Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00	0.00	0.00	0.00
T_2–NAA 100 ppm	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00	0.00	0.00	0.00
T_3–NAA 200 ppm	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00	0.00	0.00	0.00
T_4–NAA 300 ppm	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00	0.00	0.00	0.00
T_5–IBA 1000 ppm	23.33 (28.88)	18.33 (25.35)	20.83 (27.15)	25.67	9.83	17.75	19.62	0.93	10.28
T_6–IBA 2000 ppm	36.67 (37.27)	24.33 (29.55)	30.50 (33.52)	30.00	11.33	20.67	22.17	1.47	11.82
T_7–IBA 3000 ppm	43.33 (41.17)	33.33 (35.26)	38.33 (38.25)	39.67	12.67	26.17	28.2	2.03	15.12
T_8–NAA 200 ppm+IBA 1000 ppm	28.33 (32.16)	21.67 (27.74)	25.00 (30.0)	28.00	10.95	19.48	21.47	1.23	11.35
T_9–NAA 200 ppm+IBA 2000 ppm	35.00 (36.27)	26.67 (31.09)	30.83 (33.73)	35.00	13.17	24.08	25.40	1.73	13.57
T_{10}–NAA 200 ppm+IBA 3000 ppm	60.33 (50.96)	36.67 (37.27)	48.50 (44.14)	43.30	16.33	29.82	31.53	2.10	16.82
Mean	22.70 (28.45)	16.10 (23.66)	19.40 (26.13)	20.16	7.43	13.80	14.84	0.95	7.89
For comparing mean of	S. Em±	C. D. (P=0.05)		S. Em±	C. D. (P=0.05)		S. Em±	C. D. (P=0.05)	
Cutting (C)	0.95	2.72		0.26	0.74		0.11	0.32	
Treatment (T)	2.12	6.07		0.58	1.65		0.25	0.71	
Interaction (C × T)	3.00	8.59		0.82	2.33		0.35	1.00	

C_1 : Hardwood cuttings and C_2 : Limb cuttings. Figures in parentheses indicate arcsin transformed values.

Fig. 2. Effect of NAA 200 ppm+IBA 3000 ppm on growth of *Oroxylum indicum* hardwood cuttings at 120 days after planting.

due to the fact that hardwood cutting contained more starch content which in turn brought about favourable conditions for root initiation and more rooting percentage coupled with positive response of IBA and NAA combination. The above results are in accordance with the findings of Camellia *et al.* (2009) in *Jatropha curcas*.

Number of Roots/Rooted Cutting

The hardwood cutting gave more number of roots (20.16 at 120 days of planting) than limb cutting. This might be due to fact that hardwood cutting contained higher stored carbohydrate (Hartman *et al.,* 1990). Superiority of hardwood cutting over limb cutting was confirmed with earlier findings of Camellia *et al.* (2009) in *Jatropha curcas* (Reddy *et al.*, 2008) in Fig. 2.

Application of different growth regulators significantly influenced the maximum number of roots per cutting. The maximum number of roots per cutting (29.82 at 120 days of planting) was observed in NAA 200 ppm+IBA 3000 ppm and minimum number of roots was observed in IBA 1000 ppm. This might be due to the fact that positive response of plant growth regulator induced an accelerated rate for initiation and consequent production of more number of roots.

The hardwood cutting of *O. indicum* treated with NAA 200 ppm+IBA 3000 ppm showed the maximum number of roots (43.30 at 120 days of planting) as compared to other treatment combinations. This might be due to fact that hardwood cutting contained more stored carbohydrate which was responsible for more root production coupled with positive response of IBA and NAA due to their synergistic effect.

Fig. 3. Sprout and root initiation in limb cuttings of *Oroxylum indicum.*

Fig. 4. Effect of NAA 200 ppm+IBA 3000 ppm on growth of *Oroxylum indicum* limb cuttings at different days after planting : (a) 90 days and (b) 120 days.

Average Root Length of Cutting

All the levels of growth regulators and types of cutting also influenced the average root length of cutting and indicated that maximum average root length (14.84 cm at 120 days of planting) was observed in hardwood cutting due to more starch which in turn brought about favourable condition for root initiation which ultimately increased the root length.

The maximum average length root was associated with the cutting treated with NAA 200 ppm+IBA 3000 ppm (16.82 cm) after 120 days after planting, which might be due to the fact that auxins would stimulate elongation of roots of many species (Figs. 3 and 4).

In the interaction effect, hardwood cutting of *O. indicum* treated with NAA 200 ppm+IBA 3000 ppm showed the maximum average root length (31.53 cm at 120 days of planting). This might be due to hardwood cutting contained more starch than limb cutting and auxins had a central role in the initiation and development of roots and the application of growth regulators caused greater metabolic activity of sugars and nitrogen substances. These findings agree with those of Mishra *et al.* (2010) in *Tinospora cordifolia.*

CONCLUSION

The experimental results revealed that the hardwood cuttings of *Oroxylum indicum* (L.) Vent. treated with NAA 200 ppm+IBA 3000 ppm was significantly increased the number of sprouts per cutting, sprouting percentage, number of shoots per cutting, average shoot length, number of leaves per cutting, rooting percentage, number of roots per rooted cutting and average root length as compared to other treatments. Hence, findings of this study can be used for large scale propagation of this highly useful medicinal tree species for their sustainable use.

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