Journal of Tropical Forest Science 13(1):223–227 (2001)

VEGETATIVE PROPAGATION BY STEM CUTTINGS WITH AUXINS OF FOUR MANGROVE (AND ASSOCIATE) SPECIES OF BHITARKANIKA, INDIA

Hrudayanath Thatoi[1], Prafulla Kumar Mishra, Alphonse Ouseph, Jyoti Ranjan Mohanty & Lakshmi Narayan Acharjyo[2]*

M. S. Swaminathan Research Foundation, 3rd Cross Street, Taramani Institutional Area, Chennai 600113, India

Mangrove forests in India, estimated in the past to be 1.4 million hectares, have declined to 0.35 million hectares (Untawale 1986), largely due to over-exploitation. Most of the mangrove forests in India are in a state of degradation and their conservation and restoration are matters of urgency.

Mangrove forests of Bhitarkanika, Orissa, in the Eastern part of India, constitute approximately 130 km^2 located within Bhitarkanika Wildlife Sanctuary. *Heritiera fomes, Amoora cucullata, Intsia bijuga* and *Pongamia pinnata* are commonly found in Bhitarkanika. While *Heritiera fomes* is the dominant mangrove species seen in terrestrial areas constituting the top canopy, *P. pinnata* (a mangrove associate) occurs both in terrestrial locations and near creeks and channels. *Amoora cucullata* and *I. bijuga* are shrubby elements. *Heritiera fomes* and *I. bijuga* are timber species of economic value.

Mangroves are mostly viviparous in nature, i.e. seeds germinate within the ovary while still attached to the tree. Therefore, seed is not available for storage and use as and when needed. To overcome the problems of non-availability of propagules throughout the year and also poor germination rate in some mangrove species, it is necessary to undertake efforts to propagate mangroves by vegetative methods such as in the present study using stem cuttings with auxins under mist for four mangrove (and associate) species of Bhitarkanika, India.

The experiment was conducted in the nursery at the Bhitarkanika Wildlife Sanctuary (20° 30' - 20° 50' N, 86° 30' - 87° 6' E). Stem cuttings, 2.0–2.5 cm diameter, were taken from young lower branches of healthy and vigorous *H. fomes, A. cucullata, I. bijuga* and *P. pinnata* from selected plants of each species. Cuttings were 20 cm long with at least two nodes. The leaves from the bottom node were removed and a basal cut was made just below the node. The two leaves at the terminal node were trimmed by about 1/3 to reduce transpiration. Cuttings were made during the cooler morning hours when the leaves were turgid. These cuttings were then treated with auxins [indole-3-acetic acid (IAA), indole-3-butyric acid (IBA) and α-napthylene acetic acid (NAA)] by the quick dip and prolonged dip (12 h) methods, and commercial rooting powders, Rootex (No. 3) and Keradix by smearing. The following 15 treatments each consisting of 20 cuttings were used: T-1 (control), T-2 (IAA, 100 ppm; 12 h dip), T-3 (IAA, 500 ppm; quick dip), T-4 (IAA, 1000 ppm; quick dip), T-5 (IAA, 2000 ppm; quick dip), T-6 (IBA, 100 ppm; 12 h dip), T-7 (IBA, 500 ppm; quick dip), T-8 (IBA, 1000 ppm; quick dip), T-9 (IBA, 2000 ppm; quick dip), T-10

Present addresses:
[1] *Post-graduate Department of Botany, Utkal University, Bhubaneswar-751004, Orissa, India.*
[2] *M-71, Baramunda Housing Board Colony, Bhubaneswar-751003, Orissa, India.*
* *Author for correspondence.*

Table 1. Effect of auxins on sprouting and rooting response of *Heritiera fomes, Amoora cucullata, Intsia bijuga* and *Pongamia pinnata*

Treatment	*Heritiera fomes*				*Amoora cucullata*				*Intsia bijuga*				*Pongamia pinnata*			
	Sprouting (%)	Rooting (%)	Mean root No.	Mean root length (cm)	Sprouting (%)	Rooting (%)	Mean root No.	Mean root length (cm)	Sprouting (%)	Rooting (%)	Mean root No.	Mean root length (cm)	Sprouting (%)	Rooting (%)	Mean root No.	Mean root length (cm)
Control	60	30	1.0	1.8	60	0	0	0	40	0	0	0	90	80	08	6.4
IAA 100	70	40	1.0	3.2	30	0	0	0	20	0	0	0	100	90	10	7.5
500	70	30	1.0	3.8	50	20	1.0	0.7	70	20	1	0.6	90	90	12	7.5
1000	80	50	2.0	3.5	30	10	1.0	0.8	30	20	2	1.4	80	80	10	8.0
2000	30	10	1.0	3.2	20	0	0	0	50	10	1	1.5	90	90	09	8.5
IBA 100	80	20	0	3.5	60	0	0	0	30	0	0	0	90	90	09	6.0
500	90	30	0	4.0	40	20	1.0	0.3	20	0	0	0	100	100	10	7.0
1000	30	40	2.0	5.5	20	0	0	0	30	0	0	0	90	80	12	8.0
2000	60	20	1.0	5.8	50	0	0	0	30	20	2	1.6	100	100	14	9.4
NAA 100	80	50	0	4.2	70	10	1	0.8	20	0	0	0	100	90	15	9.0
500	100	60	0	4.0	70	20	2	1.5	30	0	0	0	70	70	12	8.5
1000	80	50	1.0	3.6	80	20	1	1.2	20	0	0	0	80	80	16	8.2
2000	90	40	0	4.0	0	0	0	0	20	0	0	0	90	90	10	8.4
Rootex	90	40	0	2.5	20	0	0	0	0	0	0	0	90	80	09	7.0
Keradix	90	30	0	3.0	30	0	0	0	0	0	0	0	90	90	10	6.8

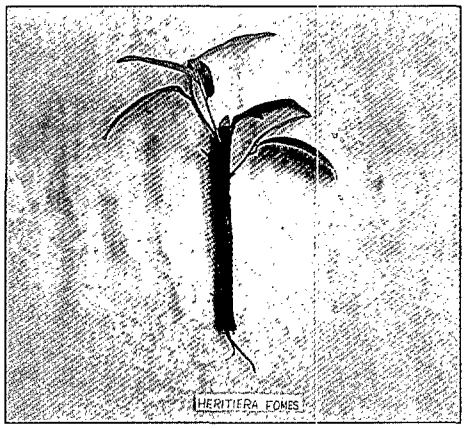
(NAA, 100 ppm; 12 h dip), T-11 (NAA, 500 ppm; quick dip), T-12 (NAA, 1000 ppm; quick dip), T-13 (NAA, 2000 ppm; quick dip), T-14 (Rootex; smear) and T-15 (Keradix; smear).

The treated cuttings were then stuck in plastic pouches containing river sand as rooting medium and transferred to a mist chamber, a low-cost polyhouse (size 3.0–4.0 m × 1.5–2.5 m; ht. 2.0–2.5 m). Intermittent mist of fresh water was provided 4 times at 3 hourly intervals during daytime with the help of a pneumatic sprayer. Humidity was maintained at 85 ± 5% RH and maximum day and night temperatures were 32 ± 20 and 24 ± 10 °C respectively. The potted cuttings were examined every week for root initiation. The cuttings were uprooted two and half months after planting and the rooting data recorded. The rooted cuttings were transferred to pots containing a mixture of sand:soil:compost (1:1:1) and maintained for further observations. The data presented in the table were subjected to ANOVA after arc sin transformation.

Sprouting was observed in the cuttings of *H. fomes* and *P. pinnata* after one week but the other two species, i.e. *A. cucullata* and *I. bijuga*, sprouted after two weeks. The cuttings remained fresh and rooting took place after two and half months. Similar delayed rooting of mangrove stem cuttings for about two months has been noticed in *Avicennia* species (Keshava Reddy *et al.* 1994).

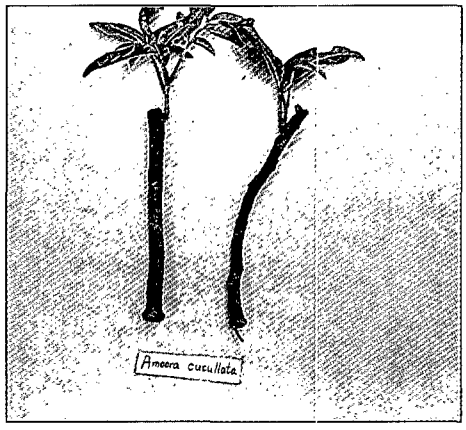
Pongamia pinnata showed a different rooting pattern from *H. fomes, A. cucullata* and *I. bijuga* in which one or two strong and thickened roots, reddish-brown in colour, emerged at the base and often showed branching; *P. pinnata* developed a cluster of roots which were thin and long and emerged at the basal region (Figure 1). Table 1 shows the different effects of auxins and commercial rooting powders on sprouting, rooting, root number and mean root length of the cuttings.

The stem cuttings of all the four species exhibited significant variation ($p < 0.001$, ANOVA) in their sprouting and rooting responses. But such variation under the effect of different auxins and their concentrations was not significant except for the root length ($p<0.01$, ANOVA). Among the four species, *H. fomes* and *P. pinnata* showed better sprouting and rooting response than the other two species. Sprouting in *H. fomes* was generally above 60 %. But the rooting response was within 60% in which IAA 100 ppm, 1000 ppm and NAA 100 ppm, 500 ppm and 1000 ppm showed the best responses. Cuttings treated with commercial rooting powders exhibited good sprouting and rooting responses. Between the two rooting powders, Rootex induced higher rooting (40%) than Keradix (30%). In *H. fomes* (and *P. pinnata*), rooting was noticed even under control conditions (30%). Basak *et al.* (1995) reported low rooting (up to 33%) of this species through application of IAA and IBA mixtures at low concentration (1000 ppm) and higher rooting (39.9% and 85.8%) due to IBA and NAA mixture at 2500 ppm and 5000 ppm concentration levels respectively. The present study reported successful rooting ability of *H. fomes* under mist at a much lower concentration (100 ppm) of growth regulators IAA, IBA, NAA as well as under control condition and with commercial rooting powders. The two species, *A. cucullata* and *I. bijuga*, showed low percentages of sprouting and rooting. Though sprouting was between 20 and 80% for *A. cucullata*, and 20 and 70% for *I. bijuga*, rooting response was well within 10 to 20% for both species. In *A. cucullata* the auxins IAA 500 ppm, IBA 500 ppm, and NAA 500 ppm, 1000 ppm were found effective in inducing rooting, whereas in *I. bijuga* IAA 500 ppm, 1000 ppm and IBA 2000 ppm were found to have better inducing effect. Both commercial rooting powders showed no rooting ability for these two species.

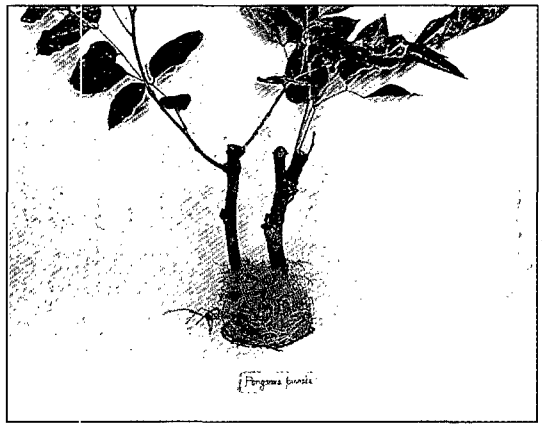


Heritiera fomes

Intsia bijuga



Amoora cucullata



Pongamia pinnata

Figure 1. Rooting in stem cuttings of four mangrove (and associate) species

Stem cuttings of *P. pinnata* showed maximum sprouting and rooting ability amongst all. Almost all growth regulators under all concentrations including control and commercial rooting powders resulted in excellent sprouting and rooting response ranging between 70 and 100%. However, IBA 500 ppm and 2000 ppm were the most effective. Many roots, thin and branched, arose at the base of the stem. In some cuttings, flowering was observed after a few weeks of sprouting and rooting. It is interesting to note that in vegetative propagation flowering of plants can be achieved within a short duration as the cuttings are taken from mature parts of the plant. This indicates genetical and physiological aging of clones following the pattern of the mother plants from which they are propagated.

Application of auxin has been shown to stimulate cambial activity resulting in mobilisation of reserve food materials to the site of root initiation (Gurumurti *et al.* 1984). Natural and synthetic auxins when applied to cuttings usually increase the development of already

existing root primodia (Hassing 1974). Factors determining rooting in cuttings include accumulation of sugars and auxin content which play a dominant role (Weaver 1972).

Among the various methods of propagation, rooting of branch or shoot cuttings is the most convenient method (Hartman & Kester 1983). For succesful multiplication of clones, type of cutting, growth hormone, the time of the year when cuttings are taken, age of the mother plant and several other factors play a significant role. Rao (1958) was the pioneer in the Forest Research Institute to use the 'mist tent'. With this facility, many difficult-to-root species can also be propagated easily. The technique adopted in the present study employed only a low-cost polyhouse system. This is simple and economical when compared to a sophisticated and more expensive mist chamber system. The polythene chamber develops high humidity and temperature inside the chamber thereby facilitating easy rooting.

Although the rooting response of *A. cucullata* and *I. bijuga* was not very encouraging (but could be improved through suitable modification of the procedures), the findings of the present study offer scope of application of this vegetative propagation technique for mass production of planting materials in the restoration of degraded mangrove areas.

Acknowledgements

We thank NORAD (RE:0442) for the generous financial support of the research project on the "Rejuvenation of degraded mangroves and development of seed banks at Bhitarkanika, Orissa" to the M. S. Swaminathan Research Foundation. M. S. Swaminathan, Chairman, MSSRF, was the source of inspiration to this project. R. J. Ranjit Daniels guided us throughout the study. We are also thankful to the Wildlife Wing of the Forest Department of Orissa for providing the necessary nursery facilities.

References

BASAK, U. C., DAS, A. B. & DAS, P. 1995. Metabolic changes during rooting in stem cuttings of five mangrove species. *Plant Growth Regulation* 17:141–148.

GURUMURTI, K., GUPTA, B. B. & ADARSH KUMAR. 1984. Hormonal regulation of root formation. Pp. 387–400 in Purohit, S. S. (Ed.) *Hormonal Regulation of Plant Growth and Development.* Agrobotanical Publishers, India.

HARTMAN, H. T. & KESTER, D. E. 1983. *Plant Propagation Principles and Practices.* 2nd edition. Prentice Hall of India, New Delhi, India: 211–270.

HASSING, B. E. 1974. Influence of auxins and auxin synergists on adventitious root primodium initiation and development. *New Zealand Journal of Forestry* 4:311–321.

KESHAVA REDDY, K., VENKAIAH, K. & BRAMARAMBA, B. 1994. Rooting of stem cuttings of *Avicennia officinalis* Linn. and *Avicennia alba* Bl.: a tool for conservation of banks in mangrove forests. *Indian Forester* 120(2):158– 161.

RAO, H. S. 1958. An alkathene mist tent for tree breeders. *Indian Forester* 84:273–274.

UNTAWALE, A. G. 1986. In: Introductory training course on mangrove ecosystem. UNESCO:1521.

WEAVER, R. J. 1972. *Plant Growth Substances in Agriculture.* W. H. Freeman and Co., San Francisco. 122 pp.