THE EFFECTS OF AUXINS (IBA, NAA AND 2,4-D) ON ROOTING OF *DRYOBALANOPS LANCEOLATA* (KAPUR - DIPTEROCARPACEAE) CUTTINGS

PEDRO H. MOURA-COSTA & LISTER LUNDOH

Innoprise-Face Foundation Rainforest Rehabilitation Project (Infapro)

Innoprise Corporation Sdn. Bhd., Danum Valley Field Centre,

PS 282, 91108 Lahad Datu, Sabah, Malaysia.

Vegetative propagation by cuttings has been investigated as a method of supplying planting material of dipterocarps (Momose, 1978; Hallé & Hanif-Kamil, 1981; Srivastava & Penguang Manggil, 1981; Smits, 1983, 1986; Hamzah, 1990 a, b; Kantarli, 1993 a, b; Moura-Costa & Lundoh, in press). Auxins are widely used for promoting rooting of hardwood cuttings (Leakey *et al*., 1982; Smits, 1986; Hartmann *et al*., 1990). However, little is known of the effects of different auxins on cuttings of dipterocarps. The use of auxin is often determined by the availability of commercial formulations, although these formulations may not be the most appropriate or the optimal concentration for the species to be rooted. This paper describes an experiment on the effects of three auxins at different concentrations on rooting of cuttings of *Dryobalanops lanceolata* Burck (kapur paji, Dipterocarpaceae).

Stockplants were wild seedlings of *Dryobalanops lanceolata* collected from the forest of the Ulu Segama region (Sabah, Malaysia) and potted in 7 x 21 cm poly-bags containing 79 cm^3 forest top-soil. The age of seedlings at the time of collection was approximately three months. Plants were grown under 30 % light intensity in the Danum Valley Field Centre nursery for four months before cuttings were taken for this experiment. The methods of vegetative propagation used are described in detail by Moura-Costa & Lundoh (in press). Two-node cuttings, *ca*. 7 to 10 cm length, were prepared using the apical portion of seedlings, according to the method in Smits (1983, 1986). The main stem of stockplants was cut across the third node proximal to the apex. Leaves were trimmed to reduce leaf area to *ca*. 30 cm^2, approximately 1/3 of the original area, based on the methods of Leakey *et al*. (1982), Smits (1983) and Hamzah (1990 a). The basal end of cuttings were dipped briefly in a fungicide solution (0.1 % w/v Benlate) prior to treatment with auxin powders. To minimise stress, cuttings were placed into a mist chamber immediately after preparation. Three auxins were tested for their effects on rooting of *D.lanceolata* cuttings, these were indole-3-butyric acid (IBA), α-naphthalene acetic acid (NAA) and 2,4-

dichlorophenoxyacetic acid (2,4-D). Powder formulations were prepared by dissolving the pure compounds (Sigma Chemical Company Ltd., UK) in 95 % ethanol, mixing the solution with talcum powder and allowing it to dry at room temperature. The concentrations used were 0.2, 0.8 and 3.0% w/w in talcum powder, chosen to test the range of concentrations of commercial auxin formulations available in Malaysia (*eg*. Trihormone - 3.0% w/w NAA; Serodix 2 and 3 - 0.2 and 0.8% IBA). Talcum powder mixed with pure ethanol was used as a control. Cuttings were rooted in a closed chamber mist propagation unit, as described by Moura-Costa & Lundoh (in press). Three batches of six cuttings were prepared for each of the ten treatments. Each six-cutting batch was randomly distributed inside the mist chamber. Rooting was assessed at 12 weeks. Cuttings were scored as rooted if roots at least 0.5 cm long were formed.

The results of this experiment are summarised in Table 1. The control promoted the highest rooting percentage of *Dryobalanops lanceolata* cuttings (83.3 %). Among the auxins tested, 0.2 % 2,4-D was the most effective in promoting rooting (72.2 %). However, higher concentrations of 2,4-D (0.8 and 3.0 %) decreased rooting percentages and caused desiccation of some cuttings. This is possibly due to a phytotoxic effect of this potent auxin on cuttings of *D.lanceolata*. When applied in high concentrations, 2,4-D has a herbicidal effect (Hartmann *et al*., 1990). In contrast, a positive trend in rooting percentages was observed with increasing concentrations of the other two auxins (IBA and NAA). However, both auxins had a suppressant effect on rooting as compared to the control.

Although auxins have been successfully used to promote rooting of hardwood cuttings (Hallé & Hanif-Kamil, 1981; Leakey *et al*., 1982; Smits, 1983, 1986) the rooting of dipterocarp cuttings without auxins has been previously reported (Momose, 1978; Srivastava & Penguang Manggil, 1981; Hamzah, 1990 b). Cuttings used for this experiment were taken from juvenile stockplants. Juvenility may be an important factor in the rooting potential of dipterocarp cuttings (Momose, 1978; Hallé & Hanif-Kamil, 1981; Srivastava & Penguang Manggil, 1981; Smits, 1983, 1986). Juvenile tissues of woody plants tend to have higher levels of endogenous auxins and are less differentiated (and therefore more prone to dedifferentiation - Hackett, 1985; Hartmann *et al*., 1990). Haissig (1974) postulated that phenols can act as auxin cofactors or synergists in root initiation, and the concentration of phenols in juvenile tissues of certain plants tends to be higher than their mature forms (Girouard, 1969). Furthermore, cuttings were prepared including the apical meristems of stockplants, the region where auxins are synthesised in plants (Kramer and Kozlowski, 1979). It may be that the high percentage rooting of the control was due to high concentrations of endogenous auxins in these cuttings. If this assumption is true,

the application of exogenous auxins may have led to supraoptimal concentrations in plant tissues, with negative effects on rooting. The use of bioassays to determine endogenous levels of auxins would provide useful information for understanding the control of rooting of *Dryobalanops lanceolata*.

This experiment showed that cuttings of *Dryobalanops lanceolata* do not require exogenous auxins for rooting. Further experimentation is needed to determine the requirements of cuttings from physiologically older stockplants.

ACKNOWLEDGEMENTS

The authors are grateful to the Danum Valley Research and Training Programme for giving permission to carry out this study, the Forest Department of Sabah for providing the nursery facilities at Danum and the Royal Society of London for a grant given to L.Lundoh. We would also like to thank M.Pinard and R.Nussbaum for their critical comments on earlier versions of the manuscript.

REFERENCES

GIROUARD, R.M. 1967. Physiological and biochemical studies of adventitious root formation. Extractable rooting cofactors from *Hedera helix*. *Canadian Journal of Botany* **45**(5): 687-699.

HACKETT, W.P. 1985. Juvenility, maturation and rejuvenation in woody plants. *Horticultural Reviews* **7**:109-155.

HALLÉ, F. & HANIF-KAMIL 1981. Vegetative propagation of dipterocarps by stem cuttings and air-layering. *The Malaysian Forester* **44**(2 & 3): 314-318.

HAISSIG, B.E. 1974. Influences of auxins and auxin synergists on adventitious root primordium initiation and development. *New Zealand Journal of Forest Science* **4**: 311-323.

HAMZAH, A 1990 a. A note on the effect of leaf number on rooting of *Hopea odorata* stem cuttings. *Journal of Tropical Forest Science* **3**(4): 384-386.

------ 1990 b. A note on the rooting of *Shorea bracteolata* stem cuttings. *Journal of Tropical Forest Science* **3**(2): 187-188.

HARTMANN, H.T., KESTER, D.E. & DAVIES, F.T. 1990. *Plant propagation. Principles and practices*. Fifth

edition. Prentice-Hall International Editions, New Jersey. 645 pp.

KANTARLI, M. 1993 a. Vegetative propagation of dipterocarps by cuttings in ASEAN region. Review Paper No. 1, ASEAN-Canada Forest Tree Seed Centre Project, Saraburi. 58 pp.

------ 1993 b. Vegetative propagation of *Hopea odorata* by cuttings: a low-cost technology. Technical Publication No. 16. ASEAN-Canada Forest Tree Seed Centre Project, Saraburi. 7 pp.

KRAMER, P.J. & KOZLOWSKI, T.T. 1979. Physiology of woody plants. Academic Press, London. 811 pp.

LEAKEY, R.R.B., CHAPMAN, V.R. & LONGMAN, K.A. 1982. Physiological studies for tree improvement and conservation. Factors affecting root initiation in cuttings of *Triplochiton scleroxylon* K. Schum. *Forest Ecology and Management* **4**: 53-66.

MOMOSE, Y. 1978. Vegetative propagation of Malaysian trees. *The Malaysian Forester* **41**(3): 219-223.

MOURA-COSTA, P.H. & LUNDOH, L. A method for vegetative propagation of *Dryobalanops lanceolata* (Dipterocarpaceae) by cuttings. *Journal of Tropical Forest Science* (in press).

SMITS, W.T.M. 1983. Vegetative propagation of *Shorea* cf. *obtusa* and *Agathis dammara* by means of leaf-cuttings and stem-cuttings. *The Malaysian Forester* **46**(2): 175-185.

------ 1986. Vegetative propagation and possibilities for its use with Dipterocarpaceae. In Wirakusumah, S. (ed.). *Disckusi tebatas beberapa aspek pembangunan hutan. Menelusuri cara-cara inovatif reboisasi di Indonesia I*. Jakarta. INHUTANI I. 8 pp.

SRIVASTAVA, P.B.L. & PENGUANG MANGGIL 1981. Vegetative propagation of some dipterocarps by cuttings. *The Malaysian Forester* **44**(2 & 3): 301-313.

Table 1: Percentage rooted cuttings of *Dryobalanops lanceolata* treated with different types and concentrations of auxins after 12 weeks in a mist propagator. Means with the same letter are not significantly different by Duncan's multiple range test ($P < 0.05$; $N = 3$; $LSD^{*} = 28.61$).

Treatment	% rooting	% rooting (transformed data)[1]	SD[2]	Rank
IBA 0.2 %	33.3	34.8	10.5	bcd
IBA 0.8 %	49.7	44.9	20.9	abc
IBA 3.0 %	50.0	45.0	1.0	abc
NAA 0.2 %	11.0	16.0	13.9	d
NAA 0.8 %	16.6	19.8	18.0	cd
NAA 3.0 %	22.2	23.0	22.5	cd
2,4-D 0.2 %	72.2	58.4	6.5	ab
2,4-D 0.8 %	38.8	33.2	29.2	bcd
2,4-D 3.0 %	38.8	38.5	5.6	bcd
Control	83.3	70.2	18.0	a

[1] Data transformed by arc-sin transformation, values given in degrees.
[2] SD = standard deviation of transformed data.