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

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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, Aminah 1990 a, b, Kantarli 1993 a, b, Moura-Costa & Lundoh 1994). 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 and Lundoh (1994). 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 Aminah (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: 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 (e.g. 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 and Lundoh (1994). 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, Aminah 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 & 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.*

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.

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.

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