NOTES

VEGETATIVE PROPAGATION OF *MILICIA EXCELSA* BY ROOT CUTTINGS

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Milicia excelsa Welw. [formerly know as *Chlorophora excelsa* (Welw.) Benth. & Hook.; trade name Iroko] is a commercially valuable timber species of West, Central and East Africa. At present, timber of this species is largely obtained by extraction from natural forests. Cultivation of the species in plantations is severely limited by its susceptibility to attacks by the gall forming insect *Phytolyma lata* Walker. Studies at the Forestry Research Institute of Ghana (FORIG) are aimed at the development of pest-resistant planting stock through a programme of genetic improvement. Initial results from seedling screening trials indicate that pest-resistant genotypes may exist in natural populations (Cobbinah 1990). To multiply genotypes which display pest-resistance, vegetative propagation techniques are required. Recent research at FORIG has identified the appropriate treatments by which leafy stem cuttings of this species may be propagated vegetatively, using a low technology non-mist propagation system (Ofori *et al.* 1996a,b). However, no information is currently available concerning the propagation of this species using root cuttings. The ability to propagate material in this way would be of particular value in multiplying clones which fail to produce coppice shoots suitable for propagation by stem cuttings. Little research has been undertaken on propagation by root cuttings, particularly in tropical trees. A series of experiments were therefore undertaken at FORIG to test whether *Milicia excelsa* could be propagated from root cuttings, and to assess the influence of tree age, cutting length and orientation.

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Material for propagation was obtained from 2- and 20-y-old trees grown in the field at the Mesewam Research Centre of FORIG, Kumasi (annual rainfall, 1520 mm; altitude, 300 m a.s.l.). Roots with a diameter between 5 and 15 mm were excavated and washed with water, followed by a fungicide solution (Dithane M.45, Rohm & Haas, France S.A.). They were then cut into 6 and 12 cm segments. Root cuttings were inserted into a propagation medium composed of coarse river sand (particle size approximately 2-4 mm) either horizontally or vertically (proximal end upwards) in 4 randomised blocks. Eight cuttings per treatment were placed in each block giving a total of 32 cuttings per each of the 8 factorial treatment combinations. The rooting medium was treated 3 days prior to the beginning of the experimental both with fungicide (2.5 g l^{-1} Dithane M.45) and insecticide (0.58 ml l^{-1} Cymbush 10 EC, Imperial Chemical Industries Plc. Plant Protection Division, Surrey, England). In an separate experiment, 30 root cuttings were taken from 2-y-old saplings as described above. They were inserted vertically in coarse sand in two blocks, one with the proximal end uppermost, and the other with the distal end uppermost.

Low-technology non-mist propagators were constructed following the method as described by Leakey *et al.* (1990) (see Ofori *et al.* 1996a,b). The propagators were constructed out of a wooden frame enclosed in clear polythene, and filled with water to a depth of 5 cm below the surface of the rooting medium. The propagators were positioned under a shade screen (85% light interception) composed of green palm fronds and placed at a height of 2.5 m above the ground. When the propagators were open, cuttings were sprayed with a fine jet of water from a knapsack sprayer (Tecnoma Pulsar 2, Epernary, France). Bed temperatures during propagation were measured with a mercury thermometer (THL-210-051R, Gallenkamp Express, Loughborough, England) inserted into the rooting medium to a depth of 6 cm. Air temperature and humidity were measured with a portable thermohygrometer (HYT-705-010G, Gallenkamp Express, Loughborough, England). Measurements were taken daily between 1230 h and 1400 h throughout the experiment. A mean mid-day irradiance of 677 lux was recorded in the propagator during the course of the experiment, which represents approximately 13% of the mean mid-day irradiance measured outside the propagation unit. The mean relative humidity and bed and air temperatures in the propagator were 90.4%, 25.1 °C and 27.4 °C respectively.

Round swellings were produced two weeks after insertion on the proximal ends of the root pieces. The swellings developed from cambial regions, and four weeks after insertion, green shoots emerged from them. Roots developed from the distal ends four to six weeks after the emergence of the shoots.

The age of the tree from which roots were obtained influenced the capacity of the root cuttings to regenerate shoots. Roots obtained from the 2-y-old saplings began producing shoots 6 weeks after insertion, and after 24 weeks, 70.7% of the cuttings had produced shoots. However, none of the cuttings from the 20-y-old trees sprouted. The failure of root cuttings from older trees to sprout has been reported for a range of other species (Hudson 1954, Browse 1980, Hartmann & Kester 1983, Dirr & Heuser 1987). Two possible explanations are physiological ageing (Browse 1980) and a higher capacity of young saplings to produce cytokinins since cytokinins are known to promote shoot formation (Robinson & Schwabe 1977, Browse 1980, Hartmann & Kester 1983).

Long (12 cm) cuttings displayed a higher propensity to form shoots than the short (6 cm) cuttings whether inserted vertically or horizontally (Table 1). This may be related to the total carbohydrate contents of the root cuttings, as indicated by previous results with other species (Robinson & Schwabe 1977). For example, Schier (1972) and Eliasson (1971) reported that excised and intact roots of *Populus tremula* require carbohydrates for shoot production.

Table 1. Effect of length and orientation of root cuttings taken from 2-y-old seedlings on shoot production in *Milicia excelsa*

	Cutting orientation	
	Vertical	Horizontal
Cutting length (cm)		
6	66.7% b	54.5%b
12	100% a	61.5%b

Values presented are mean percentages of cuttings which produced shoots during propagation. n= 32 cuttings per treatment in each case. Means grouped by the same letter are not significanly different at $p<0.05$. Cuttings derived from 20-y-old trees failed to produce any shoots.

The root cuttings displayed pronounced polarity. Shoots arose from the proximal ends of the cuttings while adventitious roots developed exclusively from the distal ends. In the current investigation, when cuttings were inverted such that their proximal ends were inserted into the medium, shoots always emerged from the proximal ends. Evidence of polarity in root segments has been reported in *Populus tremula* (Maini 1968, Schier 1973), raspberry (Hudson 1954) and apple (Robinson & Schwabe 1977).

In summary, these preliminary results suggest that *M. excelsa* may be successfully propagated by root cuttings, using the techniques described. Further research is required to define how shoot production by root cuttings taken from mature cuttings may be increased, and to evaluate the rooting ability of stem cuttings derived from root cuttings.

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