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VEGETATIVE PROPAGATION OF *TRIPLOCHITON SCLEROXYLON* IN GHANA: EFFECTS OF CUTTING ORIGIN

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Triplochiton scleroxylon K. Schum (Sterculiaceae) is an economically important timber tree native to West Africa. As viable seed of this species is rarely available, vegetative propagation techniques are an important alternative for providing planting material for reforestation (Leakey *et al.* 1982). Although *T. scleroxylon* has been cloned on a large scale in Cameroon and Côte d'Ivoire (Ladipo *et al.* 1994), little research on the species has been previously undertaken in Ghana (c.f. Britwum 1970). Four preliminary experiments were therefore carried out to provide a basis for future genetic improvement of the species using clonal approaches. The experiments were designed to assess the rooting of cuttings taken from different origins, namely (i) mature tree crowns, (ii) coppice shoots from felled mature trees, (iii) coppice shoots from 3-y-old saplings, and (iv) mature material grafted onto 3-y-old rootstocks.

Experiments were carried out at the Mesawam Research Centre of the Forestry Research Institute of Ghana (FORIG), Kumasi (annual rainfall 1520 mm; altitude 300 m). Non-mist propagators were constructed from a wooden frame enclosed in clear polythene, as described by Nketiah *et al.* (1998), 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). In each experiment, the propagation medium was treated three days prior to the beginning of the experiment with fungicide (Dithane M.45, Rohm and Haas, France S.A.) and insecticide (Cymbush 10 EC, Imperial Chemical Industries Plc, Plant Protection Division, Haslemere, Surrey, UK). Cuttings were sprayed with a fine jet of water whenever the propagator lid was opened for inspection. Single-node cuttings were taken according to node position to a uniform stem length of 5 cm and leaf area of 50 cm^2. Unless otherwise stated, cutting bases were treated with 40 µg of indole-3-butyric acid (IBA) (Sigma Chemical Company, St. Louis, USA) dissolved in 10 µl of industrial methylated spirit, applied with a microsyringe and then dried off with a fan (after Leakey *et al.* 1982). The rooting medium used was coarse sand (approximately 2–3 mm diameter), obtained by sieving river sand. Rooting percentages were arcsin transformed prior to being subjected to ANOVA using SAS (1980); root number and root length were also subjected to ANOVA.

In the first experiment, cuttings were taken from the branches of three trees of 13 years age growing at the Mesawam nursery of FORIG. Cuttings were taken from six positions within the canopy, differing in their distance from the canopy apex. The cuttings were inserted in a randomised block design, with 54 cuttings per treatment arranged in nine

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replicate blocks split between two propagators. The bases of the cuttings were dipped in rooting powder (Seradix 3, 0.8% IBA, Embetec Crop Protection, North Yorkshire, England) prior to insertion. Rooting percentage was uniformly very low, with a maximum rooting percentage of 4.9% recorded in cuttings taken from near the apex of the crown. The fact that cuttings taken from mature tree crowns are generally difficult to root is well known (e.g. see MacDonald 1986, Reuveni *et al.* 1990) and may be attributed to processes of physiological and/or ontogenetic ageing occurring within the tree as it matures (Leakey *et al.* 1992).

A second experiment examined rooting of cuttings from coppice shoots from the three mature (13-y-old) trees felled in Experiment 1. The stumps were cut at a height of 1 m above the ground. The experimental design used was the same as mentioned in Experiment 1 above, with 45 cuttings taken per treatment. Significant variation in rooting was recorded between the three trees ($p=0.017$, ANOVA), with values ranging from 32.4 to 65.8% at week 9 after insertion. The higher rooting percentages recorded in cuttings taken from coppice shoots than from branches of the same tree is consistent with results from other species such as *Eucalyptus camaldulensis* and *Picea sitchensis* (Van Den Driessche 1983, Heth *et al.* 1986). The marked variation in rooting ability of cuttings from the three trees tested may reflect clonal variation in rooting ability, a characteristic which has been noted in previous studies (Leakey *et al.* 1982).

In a third experiment, rooting of three different types of plant materials was compared, namely (i) coppice shoots from 3-y-old saplings grown in direct sunlight or shade (50% light interception); (ii) coppice shoots from felled mature trees (13 y old) grown in direct sunlight, and (iii) coppice shoots from mature material (21 y old) grafted (budded) onto rootstock (3 y old) and grown in direct sunlight or shade (50% light interception). The base of each cutting was dipped in rooting powder (Seradix 3, 0.8% IBA) prior to insertion. The cuttings were arranged in a randomised block design with nine replicates, with a total of 72 cuttings per treatment.

Marked differences in rooting were found between cuttings of different origins. The highest percentage (56.9%) rooting was recorded for coppiced saplings grown under shade, followed by shoots from coppiced saplings grown without shade (39.7%). None of the cuttings from budded material (either from the shaded or unshaded treatment) successfully rooted. The number of roots per rooted cutting was higher in saplings than coppice shoots from mature trees at week 8. However, root length was highest in saplings grown under shade and lowest in cuttings from saplings grown under direct sunlight (Table 1).

In a fourth experiment, 3-y-old seedlings of *T. scleroxylon* were cut back to different heights (0.5, 1.0, 1.5 and 2.0 m) from the ground for production of coppice shoots. Nine plants were coppiced in each height treatment. The coppice shoots were allowed to grow for 16 weeks prior to propagation. The cuttings were set in randomised blocks with 12 replicates, and 60 cuttings per treatment were taken in total.

The number of shoots produced after coppicing was positively correlated with stump height, with the highest number of shoots recorded in the 2.0 m treatment (Table 2). However, rooting percentage was significantly ($p = 0.046$, ANOVA) higher in the stump height of 0.5 m compared with the other stump heights at week 5. The root length per rooted cutting and root number per rooted cutting decreased with increasing stump height at week 5 (Table 2).

Table 1. Effect of coppice shoots from different types of plant material on rooting of leafy stem cuttings of *Triplochiton scleroxylon*

	Type of plant material				
	Bud grafted		Saplings		Mature
	Light	Shade	Light	Shade	Light
Number of roots per rooted cutting	-	-	2.0a	1.9a	1.4a
Mean root length (mm)	-	-	14.5a	25.8b	18.0ab
Rooting percentage (%)	0c	0c	39.7ab	56.9a	31.9b

Values grouped by the same letter are not significantly different at $p < 0.05$ (ANOVA).
n = 72 cuttings per treatment. Rooting assessed eight weeks after insertion.

Details of treatments: 'Light', grown in full sunlight; 'shade', grown under shade screen (50% interception); 'saplings', cuttings derived from coppice shoots from 3-y-old saplings; 'mature', cuttings derived from coppice shoots from felled mature trees (13-y-old); 'bud grafted', cuttings derived from coppice shoots from mature material (21-y-old) grafted (budded) onto rootstock (3-y-old).

Table 2. Effect of stump height on coppice shoot production and rooting ability of leafy stem cuttings of *Triplochiton scleroxylon*

	Stump height (m)			
	0.5	1.0	1.5	2.0
Total number of shoots	24	37	48	61
Rooting percentage (%)	58.3a	51.4ab	37.7b	30.9b
Number of roots per rooted cutting	3.6a	3.3a	3.1ab	1.5b
Mean root length (mm)	14.8a	12.8a	10.4ab	4.1b

Values grouped by the same letter are not significantly different at $p < 0.05$ (ANOVA).
n = 60 cuttings per treatment. Rooting assessed five weeks after insertion.

The lower percentage rooting for 1.5 and 2.0 m stump heights recorded above supports results obtained by Porlingis and Therios (1976) with *Olea europea*, where rooting ability was found to decrease with increasing shoot height to a constant value at heights of 1.5–2.0 m. Similarly, in *Picea sitchensis* rooting ability was found to decline with increasing height of hedges, with an optimum height of 0.75 m recommended (Morgan & Mason 1992). These results may reflect the increasing transport distance between the root system and the potential cutting as the stump height increases (Rauter 1982), or a process of physiological ageing (Leakey *et al.* 1992). The lack of rooting in cuttings from grafted material may similarly reflect the occurrence of physiological or ontogenetic ageing. Grafting onto a juvenile rootstock is often assumed to physiologically reinvigorate the adult scion (Leakey 1985), but this appears not to have influenced rooting ability in the current experiment. In general, the processes responsible for the decline in rooting ability with plant age and size are poorly understood (Leakey *et al.* 1992).

These results indicate that *T. scleroxylon* may be successfully vegetatively propagated using the techniques described, but that rooting ability is strongly influenced by the origin of material. For practical purposes, coppice shoots from either seedlings or felled mature trees would appear to provide the most appropriate material for propagation. These results also suggest that the height of the coppice stump should be about 0.5 m to ensure high rooting success. However, these results also indicate that in *T. scleroxylon*, a small proportion of cuttings from mature crowns may be successfully rooted as leafy cuttings. It may therefore be possible to procure ramets directly from mature trees for use in genetic conservation or tree improvement programmes, even when coppice shoots are not available. This offers a possible alternative to more conventional grafting techniques.

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