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24. PHYSIOLOGICAL APPROACHES TO THE CONSERVATION AND IMPROVEMENT OF *TRIPLOCHITON SCLEROXYLON*—A WEST AFRICAN TIMBER TREE

R.R.B. LEAKEY

Triplochiton scleroxylon K. Schum. is an important timber tree of West Africa (Plate 16), whose genetic resources have been severely depleted by the clearance of high forest for: (i) usable timber, (ii) the needs of shifting agriculture, and (iii) the construction of roads, towns, etc. Although a pioneer species, natural regeneration of *T. scleroxylon* is spasmodic because in most years few seeds are produced. Even when flowering is prolific, many fruits are destroyed by pests and pathogens, eg *Apion* and *Mycosyrinx* spp (Jones, 1975b). In addition, seeds remain viable for only a few months (Bowen & Jones, 1975), so restricting the possibilities of commercial plantings.

1975a, b, c) to provide alternative planting stock and (v) field growth of clonal plantations (Howland et al., 1977). While colleagues in Nigeria have been focussing on these more immediately practical aspects, the ITE team has investigated the fundamentals of some of the physiological mechanisms controlling (i) root initiation in cuttings, (ii) apical dominance and the control of branching, which is of importance to the maintenance of stockplants and the early selection of superior clones, and (iii) flower initiation and seed production, vital to a breeding programme. In this way it is hoped that the overall programme, pure and applied, is properly balanced and may be regarded as a model for the conservation and improvement of other potentially important tropical tree species.

1. Vegetative propagation

Having evolved conditions favouring the rooting of *T. scleroxylon* cuttings in tropicalised glasshouses in Edinburgh (Leakey *et al.*, 1975) 2 aspects have been studied in detail:
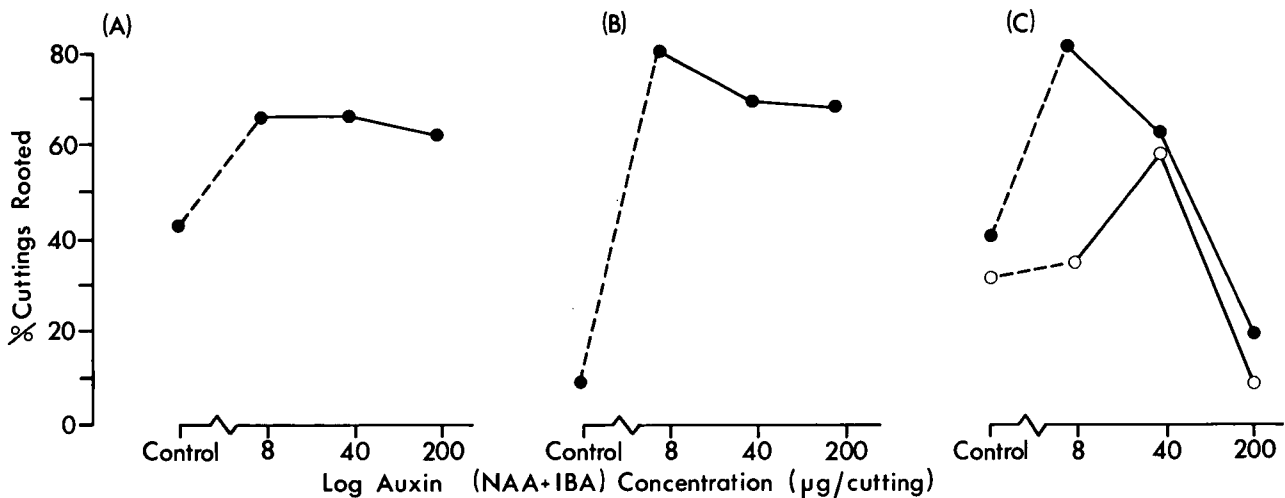

Fig. 48 *Effects of different concentrations of a 50:50 mixture of NAA and IBA (auxins) on the rooting of leafy single-node cuttings of* T. scleroxylon.

(A) An easily propagated clone, relatively insensitive to different auxin concentrations

(B) Clone whose rooting is considerably enhanced by a wide range of auxin concentrations

(C) Two different clones (● and ○) requiring specific auxin applications with different optimum concentrations.

In 1970, the UK Ministry of Overseas Development established 2 projects on *T. scleroxylon*, jointly aimed at the conservation and improvement of this species. One is based at the Forestry Research Institute of Nigeria (FRIN) and the other at ITE Edinburgh. The former is primarily concerned with (i) the natural distribution and phenology of *T. scleroxylon* in West Africa (Jones, 1975a), (ii) the collection of seed and establishment of a gene bank, (iii) fruit maturation and factors affecting seed storage (Jones, 1976; Bowen & Jones, 1975; Howland & Bowen, 1977), (iv) techniques for vegetative propagation (Howland,

1.1 Inherent variation in relation to rooting ability and responses to rooting hormones

Howland (1975b) found that applications of auxins (NAA—naphthalene acetic acid: IBA, indole-3-butyric acid) were usually unnecessary for rooting. Subsequently, however, it has become apparent that rooting ability varies widely within *T. scleroxylon*. Some clones root well with or without auxins while within a group of poor rooters the responses to auxins may be (a) virtually independent of their concentrations or (b) concentration specific (Figure 48). Clones such as 8021

are more responsive to IBA whereas others (eg 8036) respond similarly to IBA and NAA. For practical purposes, the recommended application for *T. scleroxylon* cuttings is now a 50:50 mixture of NAA & IBA at 40 µg/cutting, or a 'quick-dip' in 0.4% alcoholic solution. This application enhances rooting and increases the number of roots per cutting.

shoots of decapitated stockplants support the hypothesis that competition for a root factor affects their subsequent rooting ability (Figure 49a). Furthermore shoots only 5-6 nodes apart had markedly different rooting abilities even when the level of inter-shoot competition was constant (Figure 49a). This result, however, can probably be attributed to an effect of light, for, when equally
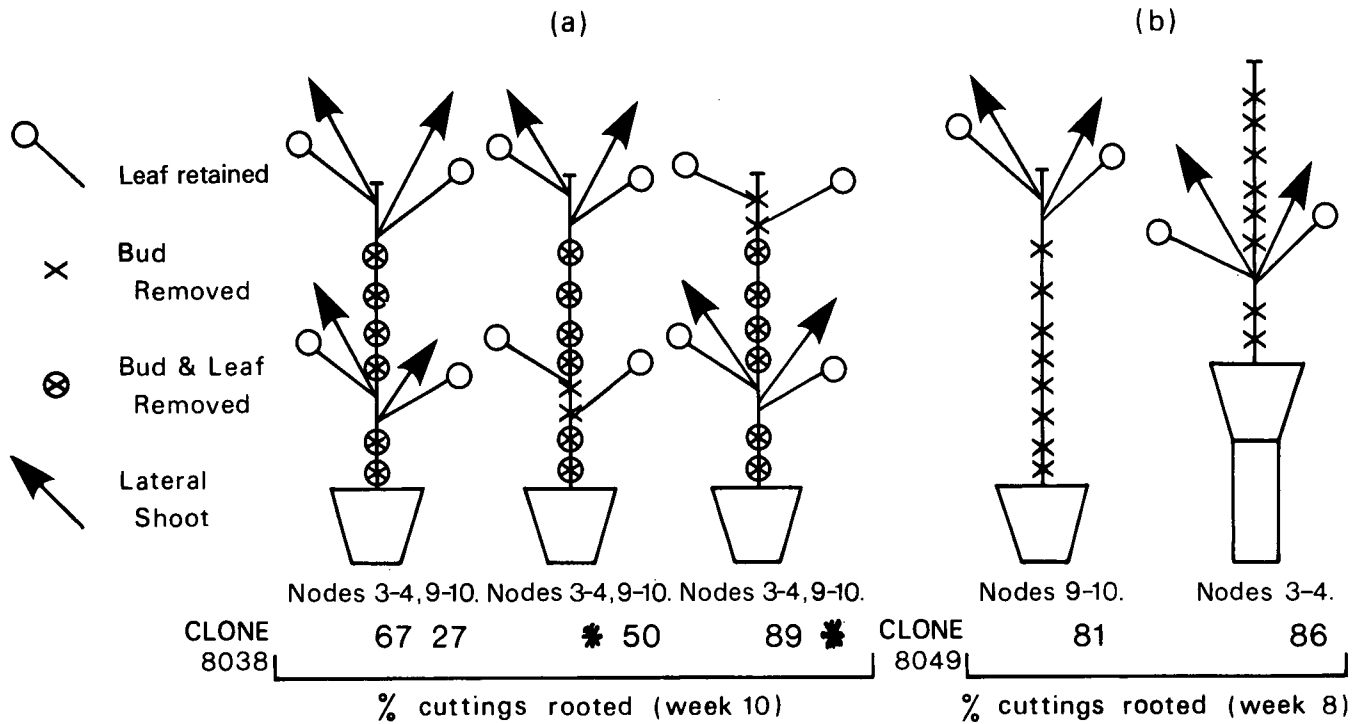

Fig. 49 *Effects of node position and competition between shoots on percentage rooting of leafy single node cuttings of* Triplochiton scleroxylon. **Lateral shoots removed as part of treatment and therefore not available for later rooting.*

1.2 Identification of some stockplant effects on rooting

Cuttings taken from different parts of the same stockplant have different rooting abilities, the overall percentage rooting also reflecting the physiological condition of the stockplants. These effects may be ephemeral or persistent, the latter being generally attributed to 'phase-change', the change from juvenility to maturity, which probably includes many physiological processes. Experiments with *T. scleroxylon* have tested the effects of stockplant orientation, soil nutrient status, stockplant size, numbers of shoots/plants, position of shoots on mainstems and the removal of stem apices from stockplants. In all these experiments, cuttings from basal shoots were always the easiest to root. Nonetheless, the degree of success was dependent upon the supply of soil nutrients and the degree of competition for a gravity sensitive factor, originating in stockplant roots, which stimulates root initiation in cuttings. The rooting success of cuttings was inversely proportional to the number of shoots per stockplant. Experiments which limited growth to particular lateral

illuminated, rooting percentages of cuttings from apical and basal shoots were similar (Figure 49b).

TABLE 33 Effects of different day lengths on the growth of vegetatively propagated plants of *Cordia alliodora* of mainstem and lateral shoot origin, after 5 weeks.

	Origin of cuttings			
	Plant height (mm)		Leaf area (cm^2)	
	Mainstem	Lateral	Mainstem	Lateral
Long days (15 h)	326	205	1078	740
Short days (10 h)	126	89	673	415

All these factors are therefore contributing to short-term carry-over or 'c' effects unrelated to persistent phase-change, but of considerable importance to the development of stockplant management systems aimed at the production of uniform planting stock. The degree of undesirable traits such as plagiotropism (Plate 17) and reduced vigour (Table 33) incorporated in cuttings established from badly-managed stockplants requires further investigation.
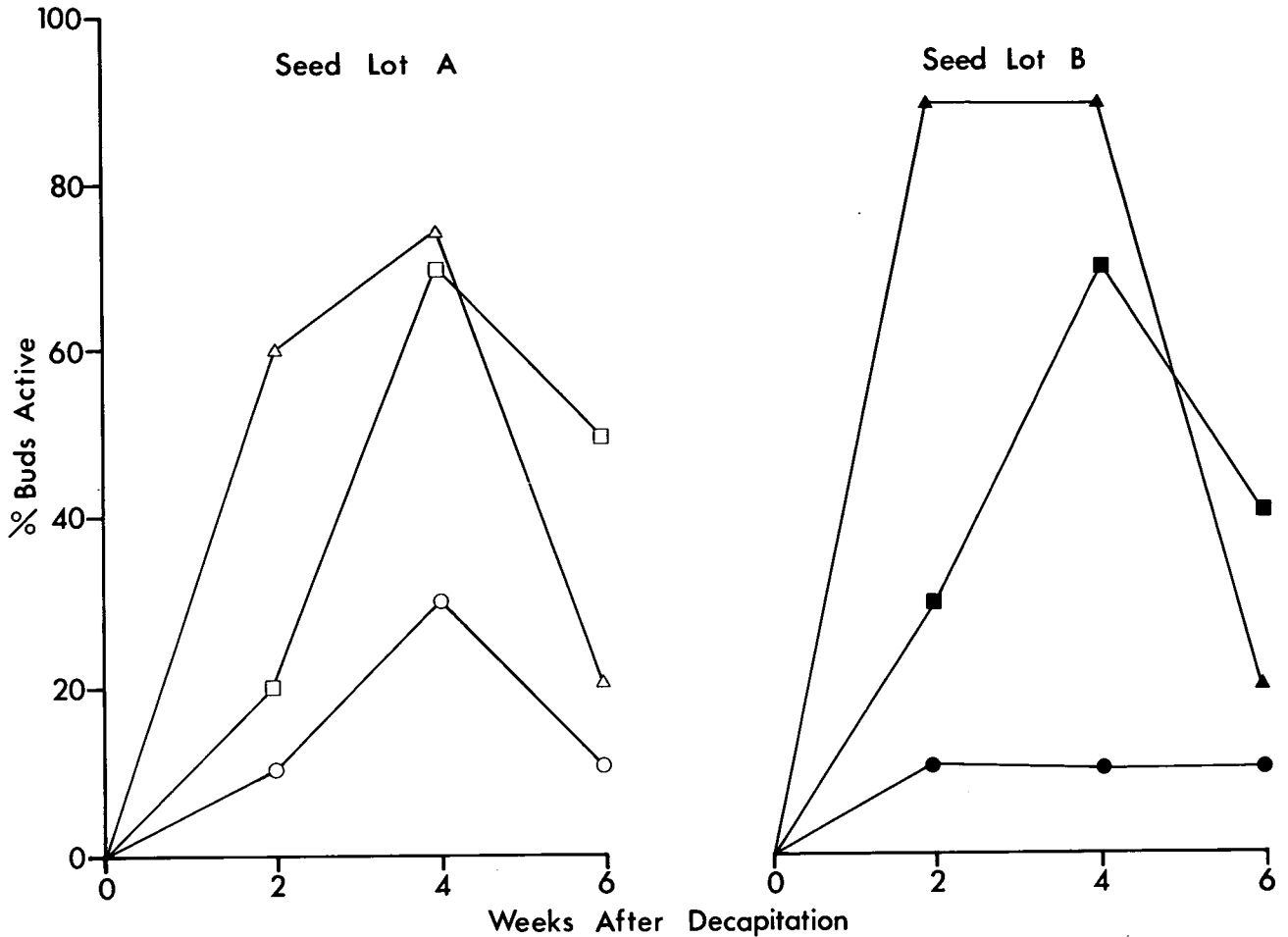
Fig. 50 *Genetic variation in bud growth of* T. scleroxylon *seedlings following decapitation at node 10, 4 months from germination (3 seedlings per seed lot △, □ and ○; ▲, ■ and ●).*

2. Clonal selection

Forest plantings of clones derived from seed collected from the entire natural range of *T. scleroxylon*, from Zaire in the east to Sierra Leone in the west, have been made by colleagues in Nigeria. Meanwhile attempts have been made in Edinburgh to develop a rapid test for predicting branching habit of mature trees, the test being based on the way in which lateral shoots develop after the removal of the dominating mainstem apex. In the event it was found that the responses of seedlings from the same mother tree differed greatly—in some, apical dominance was quickly re-established with relatively few buds becoming active whereas in others with weak apical dominance many buds flushed, at least temporarily (Figure 50). These differences were subsequently shown to be inherent.

Apical dominance is affected by many environmental and physiological variables which need to be standardized for predictive tests. These include:

2.1   Numbers of leaves per plant and their positions

Fewer lateral shoots extended on undefoliated plants than on those whose leaves were either partially or fully removed (Table 34);

TABLE 34 Effects of partial and complete defoliation on the activity (%) of buds remaining when the 2 uppermost nodes were removed from *T. scleroxylon* plants.

	Weeks after removing uppermost nodes		
	1	5	8.5
Undefoliated	50.0	22.3	13.9
Top 5 nodes defoliated	61.7	32.3	17.4
Nodes 6-10 defoliated	78.5	31.1	22.0
Totally defoliated	62.5	32.8	26.0

2.2   The amount of stem removed when decapitating

When different amounts of stem were cut from a uniform batch of trees, the percentage of buds

(a) Plants of uniform height cut to different numbers of nodes.

No. Of
Nodes
Remaining
After
Decapitation
10

20
25
29
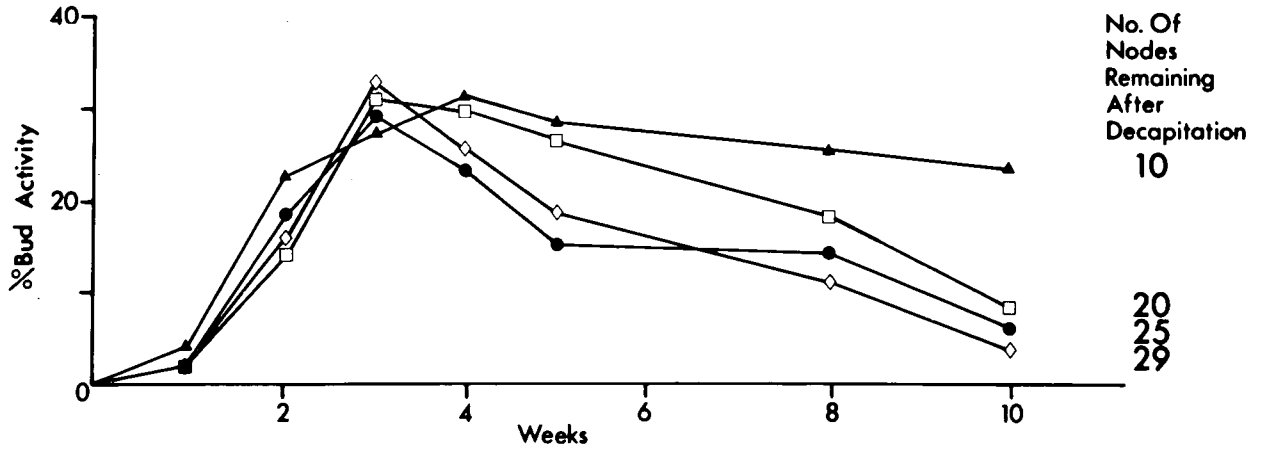
(b) Terminal bud and uppermost node removed from plants of different sizes.

No. Of
Nodes
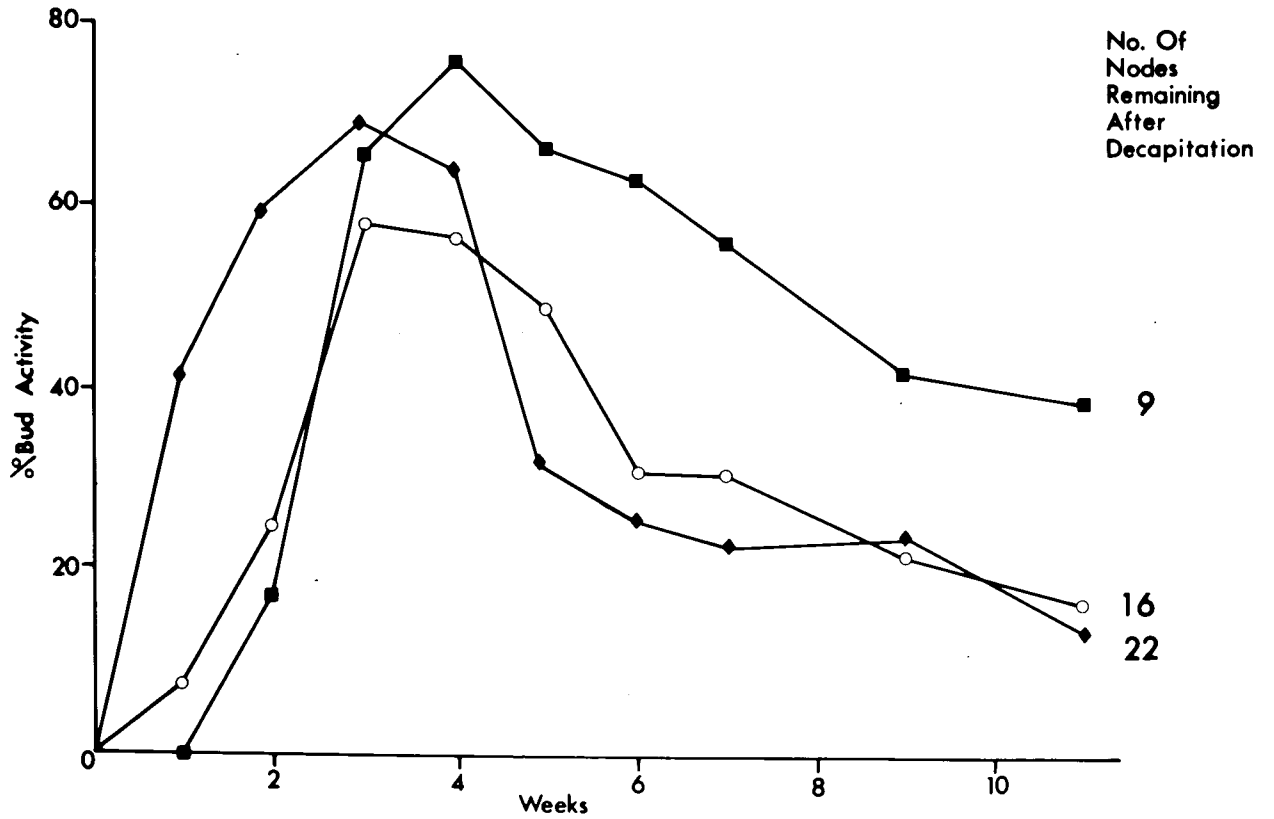Remaining
After
Decapitation

9

16
22

Fig. 51 *Effects of decapitation at different heights on bud activity in* T. scleroxylon.

which became active did not vary appreciably (Figure 51a). On the other hand when plants of different heights were cut to the same level the percentages of active buds were more variable (Figure 51b).

2.3 Nutrient status

Although other species can be released from apical dominance by the application of fertilisers (McIntyre, 1977), effects on bud activity of decapitated plants of *T. scleroxylon* have not been clearly demonstrated. Numbers of lateral buds flushing after the removal of apical meristems seemed to be independent of nutrient status but subsequently dominance was asserted sooner in plants with fewer nutrients.

It should soon be possible to calibrate results from such predictive tests with clones planted in Nigeria.

3. Flowering and flower induction

In nature, *T. scleroxylon* rarely flowers before it is 15-20 years old, when, because of its size, controlled pollination is already almost impossible. Grafts and cuttings from mature trees have flowered in the forest nursery in Nigeria, and controlled pollinations resulted in the production of viable seed. Cuttings from mature trees have flowered and fruited in tropicalised glasshouses in Edinburgh, but more importantly 12 young trees, of 2-3 years old, have also flowered. Seeds from self-pollinations did not germinate, whereas those from controlled cross-pollinations did. Stocks of these clones with a propensity to flower are being increased so as to make a thorough examination of flower induction, recognising that the techniques used on temperate trees (Longman, 1975) may be inappropriate.

4. Conclusion

To date, many aspects of vegetative propagation and some of flower induction have been investigated for *T. scleroxylon*. There is now some hope that this species will be sustained and that supplies of its timber 'Obeche' will be safeguarded. Already extensive experimental plantings have been made. Improvement by the combination of sexual and asexual propagation (Longman, 1976; Bowen *et al.*, 1977; Longman *et al.*, 1979) requires that the key to flower induction in young trees be found yielding progeny which would contribute both to the gene bank and to commercial forestry. Such an approach could also benefit many other 'endangered' tropical tree species.

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