

LIVING WITH THE TREES OF LIFE

TOWARDS THE TRANSFORMATION OF TROPICAL AGRICULTURE



ROGER LEAKEY

Further Reading

- Ladipo, D.O., Grace, J., Sandford, A. and Leakey, R.R.B. (1984) Clonal variation in photosynthesis, respiration and diffusion resistances in the tropical hardwood tree *Triplochiton scleroxylon* K. Schum. *Photosynthetica* 18, 20–27.
- Ladipo, D.O., Leakey, R.R.B. and Grace, J. (1991a) Clonal variation in apical dominance in young plants of *Triplochiton scleroxylon* K. Schum.: responses to decapitation. *Silvae Genetica* 40, 135–140.
- Ladipo, D.O., Leakey, R.R.B. and Grace, J. (1991b) Clonal variation in a four year old plantation of *Triplochiton scleroxylon* K. Schum. and its relation to the predictive test for branching habit. *Silvae Genetica* 40, 130–135.
- Ladipo, D.O., Leakey, R.R.B. and Grace, J. (1992) Variations in bud activity from decapitated, nursery-grown plants of *Triplochiton scleroxylon* in Nigeria: effects of light, temperature and humidity. *Forest Ecology and Management* 50, 287–298.
- Ladipo, D.O., Britwum, S.P.K., Tchoundjeu, Z., Oni, O. and Leakey, R.R.B. (1994) Genetic improvement of West African tree species: past and present. In: Leakey, R.R.B. and Newton, A.C. (eds) *Tropical Trees: Potential for Domestication. Rebuilding Forest Resources*. HMSO, London, pp. 239–248.
- Leakey, R.R.B. (1986) Prediction of branching habit of clonal *Triplochiton scleroxylon*. In: Tigerstedt, P.A., Puttonen, P. and Koski, V. (eds) *Crop Physiology of Forest Trees*. University of Helsinki, Finland, pp. 71–80.
- Leakey, R.R.B. (1987) Clonal forestry in the tropics – a review of developments, strategies and opportunities. *Commonwealth Forestry Review* 66, 61–75.
- Leakey, R.R.B. (1991) Clonal forestry: towards a strategy. Some guidelines based on experience with tropical trees. In: Jackson, J.E. (ed.) *Tree Breeding and Improvement*. Royal Forestry Society of England, Wales and Northern Ireland, Tring, UK, pp. 27–42.
- Leakey, R.R.B. and Ladipo, D.O. (1987) Selection for improvement in vegetatively-propagated tropical hardwoods. In: Atkin, R. and Abbott, J. (eds) *Improvement of Vegetatively Propagated Plants*. Academic Press, London, pp. 324–336.
- Leakey, R.R.B. and Longman, K.A. (1986) Physiological, environmental and genetic variation in apical dominance as determined by decapitation in *Triplochiton scleroxylon*. *Tree Physiology* 1, 193–207.
- Leakey, R.R.B., Ferguson, N.R. and Longman, K.A. (1981) Precocious flowering and reproductive biology of *Triplochiton scleroxylon* K. Schum. *Commonwealth Forestry Review* 60, 117–126.
- Longman, K.A., Leakey, R.R.B. and Denne, M.P. (1979) Genetic and environmental effects on shoot growth and xylem formation in a tropical tree. *Annals of Botany* 44, 377–380.
- Longman, K.A., Manurung, R. and Leakey, R.R.B. (1990) Use of small, clonal plants for experiments on factors affecting flowering in tropical trees. In: Bawa, K.A. and Hadley, M. (eds) *Reproductive Ecology of Tropical Forest Plants*. Man and the Biosphere Series, UNESCO Paris and Parthenon Publishing, Carnforth, UK, pp. 389–399.
- Newton, A.C., Baker, P., Howard, W., Ramnarine, S., Mesén, F.J. and Leakey, R.R.B. (1993) The mahogany shoot borer: prospects for control. *Forest Ecology and Management* 57, 301–328.

- Newton, A.C., Leakey, R.R.B. and Mesén, J.F. (1993) Genetic variation in mahoganies: its importance, capture and utilization. *Biodiversity and Conservation* 2, 114–126.
- Newton, A.C., Leakey, R.R.B., Baker, P., Ramnarine, S., Powell, W., Chalmers, K., Mathias, P.J., Alderson, P.G. and Tchoundjeu, Z. (1994) Domestication of mahoganies. In: Leakey, R.R.B. and Newton, A.C. (eds) *Tropical Trees: Potential for Domestication. Rebuilding Forest Resources*. HMSO, London, pp. 256–266.
- Newton, A.C., Cornelius, J.P., Mesén, J.F. and Leakey, R.R.B. (1995) Genetic variation in apical dominance of *Cedrela odorata* seedlings in response to decapitation. *Silvae Genetica* 44, 146–150.
- Wilson, J., Munro, R.C., Ingleby, K., Mason, P.A., Jefwa, J., Muthoka, P.N., Dick, J.McP. and Leakey, R.R.B. (1991) Agroforestry in semi-arid lands of Kenya – role of mycorrhizal inoculation and water retaining polymer. *Forest Ecology and Management* 45, 153–163.

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