DOI : 10.31357/fapsmph.2007.00597

SEEDLING LEAF STRUCTURE OF TREE SPECIES IN RELATION TO THEIR SUCCESSIONAL STATUS AND CANOPY POSITION IN A SRI LANKAN RAIN FOREST.

BY

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Thesis submitted to the University of Sri Jayewardenepura for the award of the Degree of Master of Philosophy in Forestry on Tropical Forest Ecology.

DECLARATION

The work described in this thesis was carried out by me under the supervision of Prof B. M. P. Singhakumara and Prof P. M. S. Ashton and a report on this has not been submitted in whole or in part to any university or any institution for another Degree/Diploma.

Bandumala. 6/4/07.

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ACKNOWLEDGEMENTS

I am greatly indebted to my supervisors, Prof. B.M.P. Singhakumara, Department of Forestry and Environmental Science, University of Sri Jayewardenapura, and Prof. P.M.S. Ashton, Professor of Silviculture, School of Forestry and Environmental Studies, Yale University, USA, for their genuine guidance, advice and kind encouragement given to me throughout this project

I wish to express my gratitude to Conservator General of Forests , Department of Forestry and Environment, for giving three years study leaves, financial support and transport facilities to carry out this project.

I would like to thank Mrs. Uromi Goodle, Ph.D candidate, Yale university, USA, for giving her Li-6400 portable photosynthesis machine for photosynthesis measurements. I thank Mr. P. Dias, Senior Lecturer, Department of Mathematics, University of Sri Jayewardenepura, and Kumuduni panditharathna for giving the support in statistical analyzing. I must thank Mr.Sisira Ediraweera and Niroshan Dilruk for their support.

I would like to thank Technicians and all other non-academic staff of the Department of Forestry and Environmental Science, University of Sri Jayewardenapura. I thank Mr.B.W.Gunasoma, Nimal Chandrasiri and Miss. V. Sakunthala Devi for their field assistance.

My sincere thanks also go to Mr. Wasantha Ranasingha, who help me correct of language errors in the manuscript. I acknowledge University grant commission, National Science Foundation and Forest Department for funding this study.

Finally, I gratefully acknowledge my family (Duminda and Chamudi) for many kinds of supports throughout this study.

To my Husband

Duminda

And my Daughter

Chamudi

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Suduhakuruge Bandumala

ABSTRACT

Many comparative studies have showed interspecific differences in physiological, anatomical and morphological traits of plants. These aspects may be combined, and interactively influence the establishment of tree seedlings under natural conditions. However, few studies have combined these aspects (physiology, morphology and growth performance) at the whole plant level. This study examined the seedling growth performance and leaf level anatomical, physiological and morphological differences in relation to species successional stage and mature tree crown position within a range of simulated shade environments. The findings of this study are important for developing silvicultural guidelines for restoration and sustainable management of tropical rain forests.

For this study, three canopy species, four subcanopy species, seven understorey species, and six pioneer species were selected. All coexist in the rain forest of southwest Sri Lanka. Seedlings were grown for two years in replicated shade houses which were designed to create shade treatments that represented a range of light quantity (photosynthetic photon flux density (PPFD) and quality (red : far red ratios) found within the Sinharaja forest. Seedling height and mortality were recorded at three months intervals. After one and half years of seedling growth, leaf photosynthesis and stomatal conductivity were measured and leaf cross sections taken for anatomical measurements. Digital graphs of leaves were taken for leaf morphology measurements. After two years of growth, seedlings were uprooted and dried at 80 °C and dry mass recorded for root, stem and leaves.

Mass ratios (Mass of plant part divided by total mass) were calculated for leaves (LMR), roots (RMR), and stem (SMR). Results showed significant differences in seedlings of climax and pioneer species in growth morphology, leaf physiology, and anatomy. Pioneer species have higher plasticity values for seedling growth (height increment, root collar diameter increment, total dry mass, stem mass ratio, root mass ratio), leaf anatomy (leaf blade thickness, upper epidermis, lower epidermis) leaf physiology (net photosynthesis, stomatal conductance) and leaf morphological characters (leaf number, specific leaf area, and stomatal density) in relation to variation in shade. This study also revealed that patterns of various seedling growth, leaf anatomical, morphological, and physiological attributes that were related to the mature tree canopy position of the seedlings. Canopy species showed higher plasticity values for height increment, leaf mass ratio, upper epidermis, net photosynthesis, leaf dry mass, leaf area and specific leaf area. Subcanopy species had higher plasticity values for root collar diameter, total dry mass, stem mass ratio, root mass ratio, palisade layer thickness and lower epidermis. Understorey species showed the lowest plasticity values for most of the measured attributes. It can be concluded that medium shade (350 $\mu molm^{-2}s^{-1}$) and light shade (800 $\mu molm^{-2}s^{-1}$) favour the optimum growth of most of the species studied..