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SEEDLING GROWTH PERFORMANCE OF *SYZYGIUM* SPECIES IN SIMULATED LIGHT AND SOIL NUTRIENT ENVIRONMENTS IN A LOWLAND RAIN FOREST IN SRI LANKA

BY

HARSHI KUMUDINI GAMAGE

Ph.D. **2000**

DECLARATION

The work described in this thesis was carried out by me under the supervision of Dr. B.M.P. Singhakumara and Prof. P.M.S. Ashton and a report on this has not been submitted to any University for another degree.

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24/02/2000
Date

We citify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

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Thesis submitted to the University of Sri Jayewardenapura for the award of the degree of Doctor of Philosophy in Forestry on Tropical Forest Ecology.

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DEDICATED

TO

MY PARENTS AND TEACHERS

WHOSE ENTHUSIASTIC ENCOURAGEMENT MADE ME

TO

SUCCESS IN HIGHER EDUCATION

SEEDLING GROWTH PERFORMANCE OF *SYZYGIUM* SPECIES IN SIMULATED LIGHT AND SOIL NUTRIENT ENVIRONMENTS IN A LOWLAND RAIN FOREST IN SRI LANKA

Harshi Kumudini Gamage

ABSTRACT

Many studies have shown that seedling leaf anatomy, physiology, and morphology differ between tree species categorized as early- and late-successional or shade-intolerant and shade-tolerant. Yet, few studies have investigated the linkage between seedling growth performance and their ecology among co-existing species of similar successional status. No studies have been carried out that correlate these species changes within ecological groupings that have been grown under varying amounts of light and soil nutrients in a mixed dipterocarp rain forest. The knowledge of how light and soil nutrient interaction affect seedling leaf anatomy, physiology, and mycorrhizal infection as compared to gross plant morphology is critical for understanding seedling regeneration and survival in the limiting environment of the forest understorey. This study examines variation in leaf physiology, anatomy, morphology (leaf number and leaf area, height increment, tap root length, root collar diameter, net and dry mass allocation), and the degree of symbiotic association among seedlings of four canopy and sub canopy tree species characterized as late- successional and relatively shade-tolerant.

Seedlings of *Syzygium firmum* Thw., *S. makul* Gaertn., *S. operculatum* (Roxb.) Niedz., and *S. rubicundum* Wight and Arn. were grown for two years within environmental shelters that reflect a range of light and soil nutrient conditions. These treatments represent a range of

photosynthetic photon flux densities (PFD) and the red:far red ratios found within the rain forest environment. The treatments comprise light environments similar to i) complete daily exposure to full sun, ii) the center of a large canopy opening (300-400 m^2), iii) the center of a small canopy opening (150-250 m^2), iv) the groundstorey environment within an opening adjacent to the forest edge, v) the groundstorey environment beneath the forest canopy adjacent to a forest opening and vi) the forest understorey. For each light treatment seedlings were grown in five different soil nutrient regimes with additions of i) phosphorus, ii) potassium, iii) magnesium, iv) all three combined and a vi) control group. After one year of seedling growth, leaf photosynthesis and stomatal conductivity were measured. At the end of two years seedlings were harvested and investigated for leaf anatomy, leaf nutrients, morphology and the degree of mycorrhizal infection.

Results show significant differences in all growth performance measures among species and across the various treatment combinations. Rates of photosynthesis, anatomical measures and mycorrhizal infection increased with increasing amounts of light and with the addition of soil nutrients. Stomatal conductivity and leaf nutrients (mg/g) were greatest in the dark understorey treatment. In general all four species performed best in the shelters that simulated PFD similar to the centers of small and large canopy openings. Comparison among the species reveals *S. firmum* to be the most shade-tolerant and conservative in use of water and soil nutrients. *S. operculatum* is shade-intolerant and the most exploitive of the *Syzygium* species; but is the most susceptible to drought stress and soil infertility. *S. makul* appears to be moderately tolerant to shade, drought and nutrient stresses. *S. rubicundum* is suggested to be the most shade-intolerant, but less water wasteful than *S. operculatum*.

This study contributes to our understanding of seedling responses of late-seral species to interacting influences of light and soil nutrients. This study demonstrates that seedlings of late-seral rain forest species differ substantially when anatomical, morphological and physiological attributes are taken together but further studies are needed in the field across a range of microhabitats for a better understanding of the species' ecology.