

**COMPARATIVE STUDY OF MICROHABITAT UTILIZATION BY
SEEDLINGS OF CANOPY DOMINANT TREE SPECIES IN
TROPICAL RAIN FORESTS OF SRI LANKA**



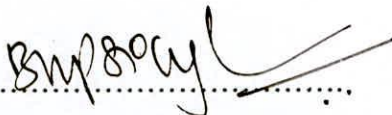
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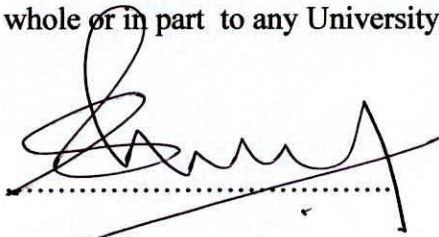
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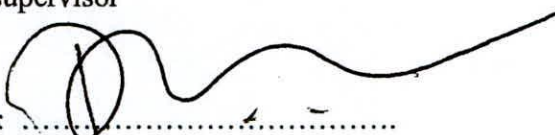
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ABBREVIATIONS

Chl	Chlorophyll
Chl _a	Chlorophyll <i>a</i>
Chl _b	Chlorophyll <i>b</i>
Chl _{a/b}	Chlorophyll <i>a/b</i>
Chl _{tot}	Total Chlorophyll
cm	Centimeter
DL	Length of drip-tip
gg ⁻¹	Grams per gram
IH	Index of herbivory
LA	Leaf area
LDMC	Leaf dry matter content
LL	Leaf length
ln	Natural log
LSI	Leaf shape Index
LW	Leaf width
LWC	Leaf water content
mgcm ⁻²	Milligrams per square centimeter
molm ⁻² s ⁻¹	Moles per square meter per second
PL	Petiole length
PPF	Photosynthetic photon flux
RCD	Root collar diameter
SAI	Stomatal area index
SD	Stomatal densities
SL	Stomatal lengths
SLA	Specific leaf areas
SLW	Specific leaf weight
µm	Micrometer
<i>D. zeylanicus</i>	<i>Dipterocarpus zeylanicus</i>
<i>M. ferrea</i>	<i>Mesua ferrea</i>
<i>M. nagassarium</i>	<i>Mesua nagassarium</i>
<i>S. disticha</i>	<i>Shorea disticha</i>
<i>S. megistophylla</i>	<i>Shorea megistophylla</i>
<i>S. trapezifolia</i>	<i>Shorea trapezifolia</i>
<i>S. worthingtonii</i>	<i>Shorea worthingtonii</i>
<i>S. makul</i>	<i>Syzygium makul</i>
<i>S. rubicundum</i>	<i>Syzygium rubicundum</i>

DEDICATION

**To my parents, and loving wife whose enthusiastic encouragement made me to be
successful in higher education**

**COMPARATIVE STUDY OF MICROHABITAT UTILIZATION BY
SEEDLINGS OF CANOPY DOMINANT TREE SPECIES IN TROPICAL RAIN
FORESTS OF SRI LANKA**

R.D.S.S Ranathunga

ABSTRACT

Deforestation and forest degradation are more severe in the tropics that have serious consequences for species, tropical forest ecosystem services and people who depend on forests for their livelihoods. Therefore, knowledge on germination and seedling establishment is important for understanding such community processes as plant recruitment and succession, which is useful for the reforestation, and restoration of degraded forest areas. This study focused to identify variation of seedling leaf anatomy, leaf morphology, seedling growth and mortality along a gradient in light availability ranging from forest understories to small canopy gaps and elevation ranging from low elevation to high elevation in tropical rain forests of Sri Lanka.

The study was carried out at three different elevations in the wet evergreen mixed Dipterocarp rainforest of southwest Sri Lanka. The selected sites were Waga Forest Reserve ($6^{\circ}.55'N$, $80^{\circ}.10'E$: 125 ± 50 m asl), Sinharaja World Heritage Site ($6^{\circ}.45'N$, $80^{\circ}.30'E$: 580 ± 250 m asl) and Eastern region of Sinharaja ($6^{\circ}.40'N$, $80^{\circ}.40'E$: 1200 ± 200 m asl). For this study, four *Shorea* species, one *Dipterocarpus* species, two *Syzygium* species and two *Mesua* species were selected. Experiments were designed to investigate competitive outcomes of these species in different light (canopy gap and understory) and elevations (low elevation, valley, mid-slope, ridge and high elevation). The experiment comprised 5184 seedlings of nine species (16 seedlings \times 9 species per plot \times 2 plots per site \times 14 sites).

To find out the competitive growth of the selected nine species along the light and elevation gradient, seedling height from the top of the apical shoot to the ground, root collar diameter, number of leaves and branches were measured every year. Six leaf extractions of each species in micro-sites at each elevation were prepared to determine area base Chlorophyll *a*, *b*, *a/b* ratio and total Chlorophyll using a spectrophotometric method. One hundred and eight leaf surface impressions were taken from each species in micro-sites at each elevation to analyze stomatal density and aperture length. Leaf herbivory damage and proportion of damage leaves were measured in all plots that represent the elevation gradient. Three thousand five hundred and twenty five leaves from nine species in micro-sites at all elevation were sampled and leaf morphological parameters were measured. Specific leaf area, specific leaf mass, leaf shape index, leaf dry matter content and leaf water content were derived and analyzed.

Shorea trapezifolia and *S. rubicundum* can be regarded as the more light demanding species, competitively superior as evidenced by their height increment, root collar diameter increment, leaves and branch increment and their morphological adjustment. On other hand *Mesua ferrea* and *S. worthingtonii* can be considered as more shade tolerant species and with less competitive ability as compared to other species because of their slow growth rate and high survival under low light availability. Results revealed that leaf area, leaf length, leaf width, drip tip length and petiole length of all species in canopy gaps had higher values than the respective species in the understory conditions. *Shorea trapezifolia*, *D. zeylanicus* and *S. rubicundum* in the canopy gaps had the highest specific leaf area. The slow growing *M. ferrea*, *M. nagassarium* and *S. worthingtonii* in the canopy gaps showed the highest leaf dry matter content and the lowest leaf water content. It was demonstrated that *S. makul* and *S. rubicundum* had the highest stomatal

density and regarded as drought intolerant, while *S. disticha*, *S. megistophylla* and *S. worthingtonii* in the gaps recorded the lowest stomatal density as an adaptation to drought or water deficient conditions.

Comparing the gaps *Dipterocarpus zeylanicus*, *M. ferrea*, *S. trapezifolia* and *S. worthingtonii* in the gap centers recorded highest Chlorophyll *a* concentration, while, *D. zeylanicus*, *M. ferrea*, *S. disticha* and *S. megistophylla* had the highest Chlorophyll *b* concentration. It revealed that the gap leaves of non-*Dipterocarp* species tended to have a higher Chlorophyll content per unit leaf area than understory leaves. However, the opposite trends were reported for *Dipterocarp* species.

This study contributes to our understanding of canopy dominant tree seedling growth response and leaf morphological and stomatal variation to the influence of light and elevation. This understanding will help to identify suitable species to plant under different light conditions and different elevations for the purpose of the development of regeneration methods for the management of tropical wet forests. In addition to that, the study facilitated the ability to rank shade tolerance and drought tolerance of each study species. Further work is necessary to understand physiological performance of these species under field conditions.