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Trees and sunlight

Sunlight is what makes plant life possible but sunlight also shortens the life-span of leaves. How do trees respond?

A thesis by P.S. Tong

Leaves need sunlight for photosynthesis, but sunlight can severely damage leaves. This paradox was investigated in an MSc thesis by P.S. Tong, in which she grew five species of forest trees experimentally under clear sky (100% light) and under shade-nets arranged to reduce the incident light to 50%, 25%, 7% and 4%. The experiment was conducted in Kuala Lumpur where the climate is non-seasonal.

Under each light condition, each species was represented by six plants. New leaves were tagged as soon as they appeared, and kept under observation until they were shed. Attention was focused on the leader shoot of each plant and one selected side branch. Thousands of leaves were monitored in this massive exercise. The plants began as seedlings and the best ones grew to over 3 m tall during the study period. The species were *Acacia mangium, Cinnamomum iners, Dyera costulata, Eusideroxylon zwageri and Shorea roxburghii.*

Acacia mangium is widely planted for wood production in the tropics, always under full sun. This study confirmed that height increment and rate of leaf production are both maximum under full sun, but leaf life-span is longest under deep shade. The leaf life-span is progressively shortened as the light intensity is increased. The shortening of leaf life-span under strong light is compensated by faster production of new leaves and faster growth in height. Under deep shade, the leaves lived longer but new leaves were produced very slowly and growth was very poor.

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In the case of *Cinnamomuminers* (wild cinnamon) the leaf life-span could not be established because all the leaves remained alive through the entire study period of 61 weeks, under all light intensities. *Cinnamomum iners* is very effective as a tall ornamental screen because it is always densely leafed, from the exposed top to the deeply shaded interior of the crown. The reason, it became apparent from this study, is because the leaves have a long life under all light conditions.

Dyera costulata (jelutong) is a light hardwood timber used principally for pencils and picture frames. Height growth and leaf production rate were both maximum under 25% light. Leaf life-span was longest at 4% or 7% light intensity, and shortest under full sun.

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Eusideroxylon zwageri (belian) is the famous highly durable Bornean ironwood. It grew fastest under 25% light intensity but its leaf production rate was best at 50-100%. The leaf life-span was longest at 4% light intensity and shortest at 25-100%. The range of 25 - 100% is imprecise, because several plants died in the experiment, reducing the sample size and sensitivity of the experiment.

Dyera costulata

Juvenile forest trees would make good indoor plants because they remain leafy for long periods under low light

Shorea roxburghii (meranti temak nipis) is one of the White Meranti timbers of the Malaysian timber industry. Maximum growth and leaf-production rate coincided at 50% light intensity. Maximum leaf life-span was at 4% and minimum at 50-100%.

Cinnamomum iners

This is the first time that detailed experimental evidence has been obtained to support the idea that most juvenile forest trees grow best at about 50% light intensity. Under deep shade, growth is minimal, but the ability of the leaves to survive for long periods of two or more years in deep shade enables juvenile plants to wait until a gap occurs in the canopy to let in more light. Tong's thesis indicates that juvenile forest trees can be used as indoor plants. Such plants could be raised under 25-50% light intensity to the desired size, pruned to stimulate leaf production, and the moved indoors where they would function for least 12 months before needing to be taken out for rejuvenation. Hundreds if not thousands of forest species are in danger of

Shorea roxburghii

extinction because they have no market value. If we popularise them as indoor plants, market demand for variety and novelty could provide the incentives to save many of them through commercial propagation.

Table: Average leaf life-span, height, and leaf production rate on the leader shoots *(maximum values in each row are highlighted in bold print)*

Species		4% light	7% light	25% light	50% light	Full light
Acacia mangium	Leaf life-span (days)	371	223	131	127	131
	Growth in 16 weeks	1 cm	15 cm	127 cm	158 cm	**258 cm**
	New leaves per wk	0.31	0.65	1.29	1.25	**1.72**
Cinnamomum iners	Leaf life-span (days)	Life span exceeded 61 weeks in all light intensities				
	Growth in 16 weeks	97 cm	106 cm	125 cm	**152 cm**	88 cm
	New leaves per wk	0.88	1.04	**1.12**	**1.12**	1.04
Dyera costulata	Leaf life-span (days)	**NA**	**410**	369	337	305
	Growth in 64 weeks	29 cm	99 cm	**117 cm**	89 cm	98 cm
	New leaves per wk	0.63	**0.91**	**0.91**	0.77	0.77
Eusideroxylon zwageri	Leaf life-span (days)	533	511	260	304	279
	Growth in 65 weeks	15 cm	18 cm	**51 cm**	40 cm	28 cm
	New leaves per wk	0.05	0.08	0.10	**0.12**	**0.12**
Shorea roxburghii	Leaf life-span (days)	555	462	397	224	231
	Growth in 38 weeks	16 cm	20 cm	81 cm	**168 cm**	118 cm
	New leaves per wk	0.13	0.13	0.41	**0.57**	0.50

Bibliography

Tong P.S. & Ng F.S.P. 2008. Effect of light intensity on growth, leaf production, leaf life-span and leaf nutrient budgets of *Acacia mangium, Cinnamomum iners, Dyera costulata, Eusideroxylon zwageri and Shorea roxburghii. Journal of Tropical Forest Science* 20: 218-234.