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Light Requirements of *Shorea Materialis* Seedlings

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Key words: Light requirements; Relative Light Intensities; shoot root ratio; dry matter production.

ABSTRAK

Kertas ini membincangkan perbandingan kadar tumbesaran anak pokok Shorea materialis *(Balau Pasir) di bawah beberapa kebuk teduh yang mempunyai 21%, 33% dan 55% keamatan cahaya. Perbandingan ini dibuat dengan tanaman yang diletak di kawasan lapang. Didapati tumbesaran yang baik di antara 30 – 55% keamatan cahaya berdasarkan kepada peningkatan mengikut ketinggian, perepang, keluasan daun dan bahan kering (overall dry matter). Nisbah pucuk: akar di kawasan lapang lebih rendah jika dibandingkan di bawah naungan.*

ABSTRACT

This paper deals with the growth responses of Shorea materialis *seedlings to various light conditions under shade chambers of 21%, 33% and 55% Relative Light Intensities (RLI), compared to open conditions (100% RLI). The best growth was observed between 30 – 55% RLI in terms of optimum increases in height, stem diameter, leaf area and overall dry matter. The weight ratio of shoot to root in the open is lower than that in the shade conditions.*

INTRODUCTION

In order to improve our knowledge of the silvics of indigenous species of Dipterocarps, several studies have been carried out to estimate the relative light tolerance of several timber species (Walton 1939; Nicholson 1960; Sasaki and Mori 1980, Mori, 1980). This study is to investigate the effect of varying light levels on the growth of *Shorea materialis*. Artificial conditions were used so as to maintain a given light value over a considerable period of time.

MATERIALS AND METHODS

Four relative light intensities were used namely 21%, 33%, 55% and 100% (open condition being about 100,000 lux at midday). The method used to prepare the chambers is described in Aminuddin (1982). The chambers were placed in a north-south direction at an open site in the FRIM nursery and spaced out so that they did not shade each other.

Within each chamber as well as in the open, 60 seedlings of *S. materialis* were placed. The seedlings were raised in the nursery, the seeds having been sown in March 1981 after collection and the seedlings subsequently potted in May 1981. The potted seedlings were placed in the chambers in August 1981.

Height and stem diameter (measured at root collar) of seedlings were taken every 3 months up to 9 months.

At the beginning of the experiment and before the seedling were placed under various treatments, 20 seedlings were randomly selected and (harvested). At 6 months, 20 seedlings from each chamber and from the open were randomly selected and harvested. The leaf area of the

harvested seedlings was monitered by an area meter and the dry weight of seedlings was determined.

A calculated parameter termed Relative Growth Rate (RGR) (Radford, 1967) was used as an index of seedlings growth at the end of study period. The index is deemed appropriate since it is a measure of growth rate and not absolute measurement.

The formula for RGR is given below:

$$RGR = \frac{\text{Ln } H_F - \text{Ln } H_I}{T_F - T_I}$$

Where: Ln = Natural logarithm.
H_F = Final
H_I = Initial height
T_I = Time at initial reading (0 month)
T_F = Time at final reading (9 months)

Following conversion to RGR values for both height and stem diameter, growth data was subjected to a one-way analysis of variance (ANOVA) (Sokal, 1969) to test amongst treatment.

RESULTS

Analysis of variance (ANOVA) on Relative Growth Rate for both height and stem diameter showed that there is significant difference on treatment imposed for both parameters (height – 0.1% level, stem diameter – 0.5% level).

As shown in Table 1, the best increment for *S. materialis* was at 33% RLI. It performs reasonably well between 33 – 55% RLI. This is illustrated in *Figure 1* where at higher and lower light values, the increment is lower.

For stem diameter, the best increment for diameter growth seems to be in the open condition which is the reverse of the height growth. The smallest diameter growth demonstrated was

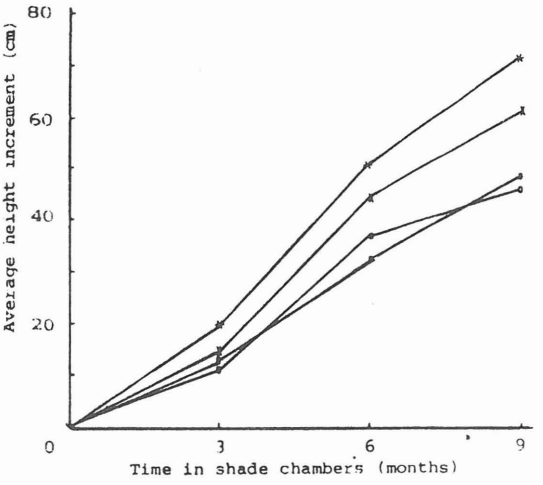

Fig. 1: Relation between light intensity and average height increment of ***Shorea materialis*** *seedlings.*

TABLE 1
Average height and stem diameter of *Shorea materialis* seedlings

Parameter	RLI (%)	0 month	3 months	6 months	9 months
Height (cm)	21	24.06 ± 4.94	36.04 ± 12.37	56.94 ± 23.66	71.66 ± 31.04
	33	25.27 ± 4.67	44.38 ± 12.33	76.18 ± 24.88	99.82 ± 28.38
	55	22.18 ± 6.27	36.42 ± 12.36	66.53 ± 23.58	84.25 ± 30.39
	100	22.14 ± 3.91	34.03 ± 7.91	58.46 ± 15.09	69.33 ± 18.38
Stem diameter (cm)	21	0.33 ± 0.07	0.43 ± 0.09	0.58 ± 0.15	0.73 ± 0.23
	33	0.37 ± 0.07	0.47 + 0.08	0.61 ± 0.13	0.77 ± 0.16
	55	0.40 ± 0.07	0.45 ± 0.08	0.51 ± 0.11	0.64 ± 0.17
	100	0.39 ± 0.07	0.54 ± 0.09	0.69 ± 0.12	0.89 ± 0.15

at the low light value of 21% RLI, as shown in *Figure 2*. *Figure 3* suggests that root development is slightly better in the open condition than in lower RLI conditions.

The best mean leaf area per plant was in the range of 33 – 55% RLI at 6 months of study period *(Figure 4)*.

Strong sunlight reduces shoot and root growth, but the degree of growth reduction is greater in shoot than in root for the open condition than at lower RLI. Hence the ratio of shoot weight to root weight is higher in the shade condition (Table 2).

Height to diameter ratio is another index used to show the effect of shade on seedlings. The lower light values as shown in *Figure 5*, produce an etiolation effect (longer thinner internodes).

DISCUSSION

The results showed that seedlings of *S. materialis* require moderate shade for their best growth. The best height growth occured at a light value of 55% RLI.

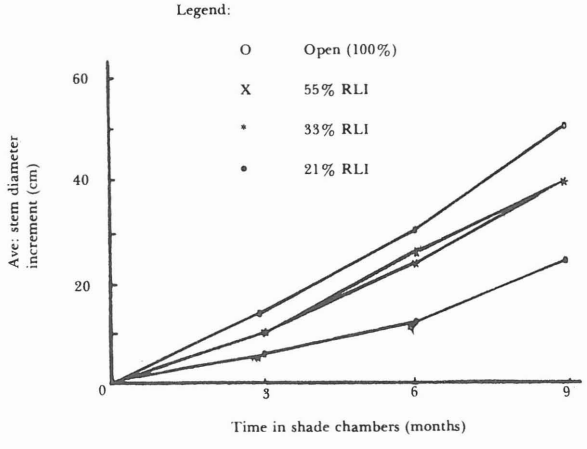

Fig. 2: Relation between light intensity and average stem diameter increment of ***Shorea materialis*** *seedlings.*

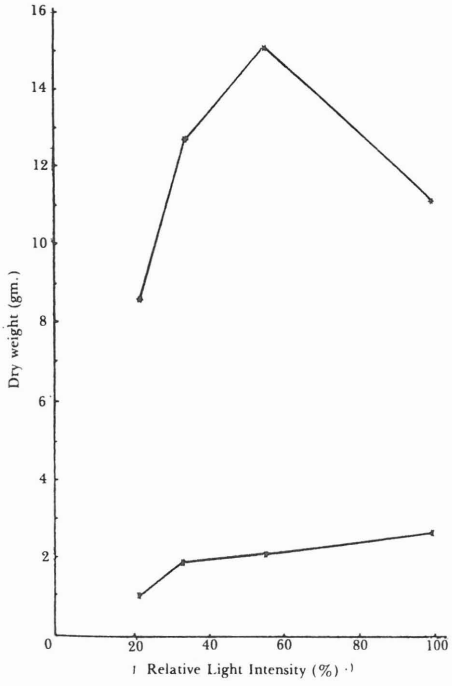

Fig. 3: Relationship between light intensity and weight growth of shoot (*) and root (x) ***Shorea materialis*** *seedlings at 6 months.*

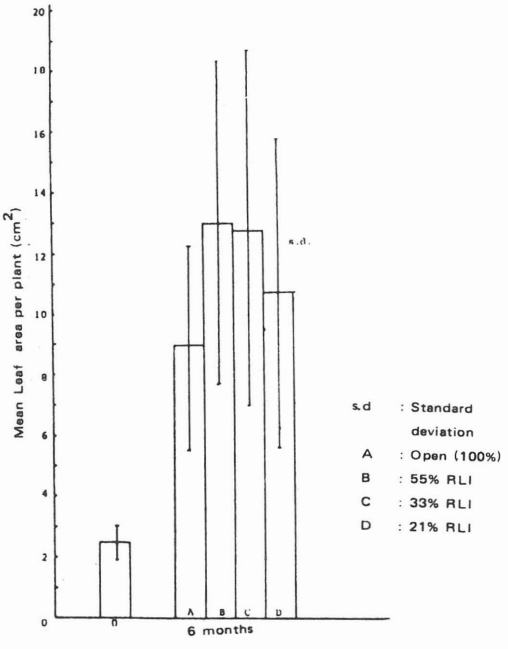

Fig. 4: Effects of shade on Mean Leaf Area per plant of ***Shorea materialis*** *seedlings at 6 months.*

TABLE 2
Ratio of shoot weight (dried) to root weight (dried) of *S. materialis* seedlings grown at various light conditions

RLI (%)	21	33	55	100
Ratio	8.61	6.64	7.35	4.14

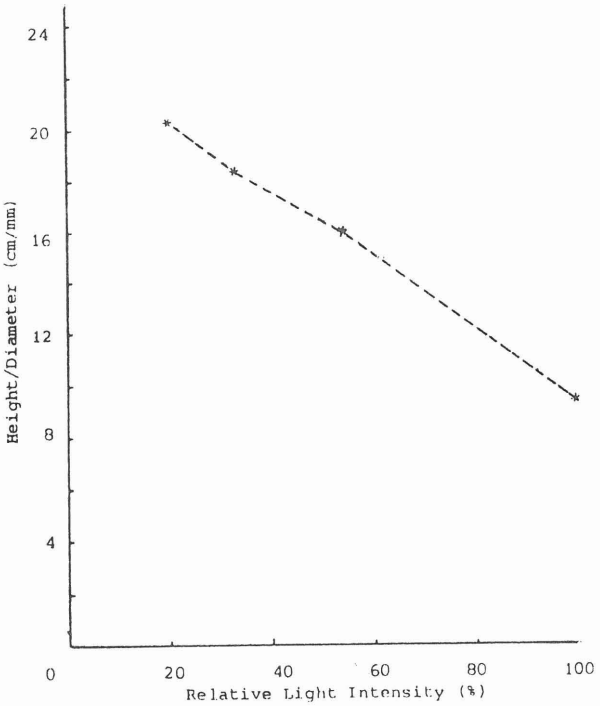

Fig. 5: Effect of shade on the ratio of stem height to stem diameter of ***Shorea materialis*** *seedlings after 9 months.*

A few workers (Logman and Jenik, 1974; Yoda 1974) have documented that the amount of light reaching the forest floor in a tropical rainforest is about 3% that of an open condition. Since *S. materialis* responds best at 55%, it can be said that *S. materialis* is a relatively light demanding species. This has also been noted by Walton (1939). Therefore, *S. materialis* require moderate canopy thinning for successful regeneration in the forest. Too much thinning is, however, detrimental to its growth. Canopy thinning to allow average RLI's between 21% and 55% would give acceptable growth rates. However, care must be taken in using the above results because the fertility of the soil was not included in the analysis. Further investigation to look into the relationship between light and nutrient conditions should be conducted in future investigations.

The ratio of shoot weight to root weight is one of the important indicators of the condition of nursery stock as suggested by Sasaki and Mori (1980). Strong sunlight reduces shoot growth, and slightly promotes root growth. Hence the ratio of shoot weight to root weight is higher in a shade condition (Table 2) for *S. materialis* seedlings. Compared with seedlings grown at a high light intensity, seedlings grown at 30% and 50% RLI have tall and slim shoots with large dark green leaves and relatively poor root system. These seedlings are unhardened and succulent and are generally sensitive to dessication. Therefore, in nursery practice, it is important to maintain more open light conditions to produce well balanced hardened seedlings suitable for outplanting.

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