A NOTE ON THE GROWTH OF *LABISIA PUMILA* UNDER DIFFERENT LIGHT CONDITIONS

Philip, E[1], Jaafar, H.Z.E.[2] and Rizal, M.K.M.[1]
[1]Forest Research Institute Malaysia (FRIM), Kepong, 52109 Selangor
[2]University Putra Malaysia, 43400 UPM, Selangor

ABSTRACT

A study on light response curves of *L. pumila* growing under three different light intensities from two different locations in Selangor *viz.* Sungai Congkak Forest Reserve (planted on forest floor receiving about 100 μmol m^{-2} s^{-1}) and Sungai Tekala Forest Reserve (growing naturally on forest floor and receiving about 60 μmol m^{-2} s^{-1}; planted in the open area receiving about 1000 μmol m^{-2} s^{-1}), was carried out. The main objective of the study was to document the light saturation level for optimum physiological growth of *L. pumila* for domestication. Maximum photosynthesis of *L. pumila* was recorded at 200 μmol m^{-2} s^{-1} when the relative humidity recorded at 90%. The F_v/F_M values for plants under planted forest floor, growing naturally on forest floor and planted in the open were 0.83, 0.80 and 0.65, respectively, indicating that *L. pumila* is sensitive to high light at 1000 μmol m^{-2} s^{-1}. Plants under full light also exhibited smaller (185 vs 502 cm^2) leaves with lighter green shade (relative chlorophyll content 29.1 vs 70.5) compared to those under closed canopy of forest reserve (at respective 502 cm^2 and 70.5).

Keywords: light response curves, maximum photosynthesis, maximum quantum efficiency of PSII photochemistry, photoinhibition, relative chlorophyll content

INTRODUCTION

Labisia pumila is an erect or ascending undershrub and is often used in pre- and post-partum care amongst rural folks in Peninsular Malaysia. It is common in primary and old secondary forest. In general screening with crude ethanol extract, biocidal acitivitty against *Artemia salina* and oestrogen–specific enhancement in human endometrial adenocarcinma cells were noted (Jamal et al. 1998). In addition, *L. pumila* is reported to show moderate antibacterial and weak antifungal activities (Mastura et al. 1998). In the pursuit for a healthy and 'green' lifestyle, demand for plant based medicine and supplements are increasing. The objective of this paper is to document the light saturation level for optimum physiological growth of *L. pumila* for domestication.

MATERIALS AND METHODS

The growth rates of *L. pumila* were evaluated at Sungai Congkak Forest Reserve and Sungai Tekala Forest Reserve, Selangor, Peninsular Malaysia. Growing conditions are summarized in Table 1. Light response curves were derived with portable photosynthesis meter (LICOR 6400, Nebraska, USA). These species were subjected to light intensities between 0 to 1500 μmol m^{-2} s^{-1}. Curves were generated at 80% relative humidity (RH), leaf temperature, 28 °C and carbon dioxide concentration, 380 μmol mol^{-1}. In addition, chlorophyll fluorescence was also measured at light saturation (I = 100%) using fluorescence meter (Hansatech Plant Efficient Analyser, UK). The excitation light for fluorescence was given at about 500 μmol m^{-2} sec^{-1} for 5 sec. Measurements of F_o, (initial fluorescence), F_M, (maximum fluorescence) and F_v (variable fluorescence) were obtained from this procedure. A value for Fv is derived as the difference between F_M and F_o. The F_v/F_M indicates the maximum quantum efficiency of PSII photochemistry. Leaf area was measured with a portable leaf area meter (CID, Canada) while relative chlorophyll content was determined using a portable chlorophyll meter (SPAD 502, Minolta Co. Ltd, Japan). Physiological values were obtained from means of three replicates taken from each of the six plots. Comparisons between means were evaluated by *t-test* as indicated at p =0.01 and 0.05 levels.

Table 1. Growing conditions of *Labisia pumila* at different sites of forest reserves.

Growing conditions	Different sites		
	Sg Congkak FR	Sg. Tekala FR	Sg Tekala FR
Light intensity	100 μmol m^{-2} s^{-1}	60 μmol m^{-2} s^{-1}	1000 μmol m^{-2} s^{-1}
Relative humidity	90%	90%	60%
Occurrence	Planted on forest floor (FF)	Growing naturally	Planted in the open (PO)

FR = Forest Reserve; FF= planted on forest floor; PO= planted in the open

RESULTS AND DICUSSION

Results obtained are shown in Figure 1. Maximum photosynthesis occurred between light intensities of about 200 μmol m^{-2} s^{-1}. A decline was noted beyond this point, thus, suggesting that photoinhibition occurred. The same trend was noted for light response against F_v/F_M values (Figure 2). Photoinhibition could occur when understorey plants are exposed to high light intensities (Gray et al. 1996; Dodd et al. 1998). Above this, the process is impeded and carbohydrates are used for respiration (Larcher 1995). Secondary metabolism like flavonoids, organic acids and phenol derivatives would be affected when carbohydrates productions are reduced in plants (Schlee 1992).

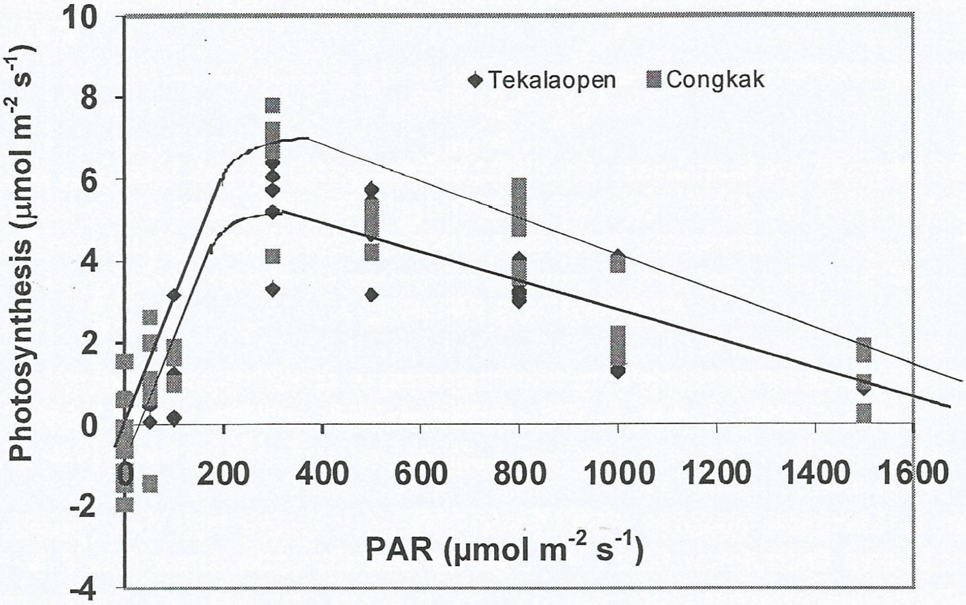

Figure 1. Light response curves for *L .pumila* planted in the open (◆) and planted under forest floor (■) using portable photosynthesis meter set at 80% RH, 28 °C and 380 µmol mol^{-1} CO_2 photosynthetic active radiation.

L. pumila grown at RH of about 80 - 90% gave the highest maximum quantum efficiency of PSII photochemistry (Table 2). At Sg. Tekala, plants growing naturally under forest floor recorded lower values because light was the limiting factor (60 µmol m^{-2} s^{-1}), while at Sg. Congkak (FF) the physiological parameters were all in their optimum levels. Maxwell and Johnson (2000) reported that most plants had value of F_v/F_M at 0.83 when not subjected to environmental stress. At Sg. Tekala (PO), the maximum quantum efficiency of PSII photochemistry was about 65%, thus, suggesting that the conversion from solar energy to chemical has resulted in some lost as heat (Percival & Fraser 2001). The increase in F_o for *L. pumila* planted in the open suggested that the leaves were subjected to heat stress. Havaux, in 1993, reported that a rise in F_o when subjected to high temperature stress as a result of PSII inactivation.

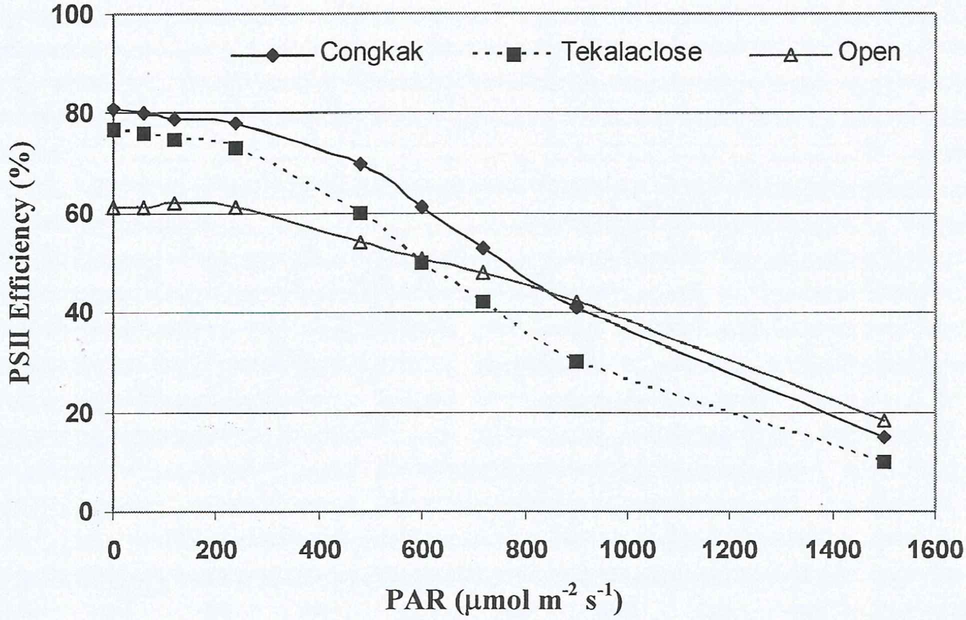

Figure 2. Maximum quantum yield of PSII efficiency against PSII for *L. pumila* either planted under forest floor (–◆–), grown naturally under forest floor (··■··) and planted in the open (–△–).

Table 2. Physiological and morphological parameters of *L. pumila* planted in different light conditions.

Physiological & morphological traits	*L. pumila* grown at different sites		
	Sg Congkak FR (FF)	Sg. Tekala FR	Sg Tekala FR (PO)
F_o	656.0±27	640.0±38	1124.9±13*
F_v/F_M	83%	80%	65%*
Chlorophyll content	70.5	68.0	29.1*
Leaf area (cm^2)	502.0	480.0	185.2

*, significant at $p \leq 0.01$; FR = forest reserve; FF = planted on forest floor; PO = planted in the open

Significant difference in leaf size and chlorophyll content was noted when plants were planted under different environmental conditions. Leaves were smaller and of lighter green when planted under full light as compared with those under close canopy (Table 2). Heat stress directly reflects structural changes within the membrane and, hence, alters the chlorophyll content levels (Schreiber & Bilger 1987).

CONCLUSION

It is concluded that the light saturation level for *L. pumila* is about 200 μmol m^{-2} s^{-1}. These plants grow well under high relative humidity (90%) and 90% shade. The effects of light on the chemical properties need to be examined.

ACKNOWLEDGEMENTS

The authors would like to express gratitude to 'Pejabat Hutan Daerah Selangor Tengah' for the approval to conduct research. This project was supported by IRPA 09-0401-0040-EA001.

REFERENCES

Dodd IC, Critchley C, Woodall GS, Stewart GR. 1998. Photoinhibition in differently coloured juvenile leaves of *Syzygium* species. *Journal of Experimental Botany* **49**: 1437- 1445.

Gray GR, Savitch LV, Ivannov AG, Hunter NPA. 1996. Photosystem II excitation pressure and development of resistance to photoinhibition. *Plant Physiology***110**: 61-71.

Havaux M. 1993. Rapid photosynthesis adaptation to heat stress triggered in potato leaves by moderately elevated temperatures. *Plant Cell Env.* **16**: 461-467.

Larcher W. 1995. *Physiological Plant Ecology*. 3rd Edition. Springer-Verlag Pub. 506 pp.

Jamal JA, Houghton PJ, Milligan SR. 1998. Testing of *Labisia pumila* for oestrogenic activity using a recombinant yeast strain. *Journal of Pharmacy and Pharmacology* **50**(Suppl.): 79

Mastura M, Shaari K, Nor Azah MA, Ali AM. 1998. Antimicrobial activity of selected Malaysian plants against micro organisms related to skin infections. *Journal of Tropical Forest Production* **4**(2): 199 –206.

Maxwell K, Johnson GN. 2000. Chlorophyll fluorescence – a practical guide. *Journal of Experimental Botany* **51**: 345: 659-668.

Percival GC, Fraser GA. 2001. Measurement of the salinity and freezing tolerance of *Crataegus* genotypes using chlorophyll fluorescence. *Journal of Arboriculture* 233-245.

Schlee, D. 1992. *Ecology Bochemistry* , 2 Aufl. SringerBerlin, Heidelberg New York.

Schreiber U, Bilger W. 1987. Rapid assessment of stress on plant leaves by chlorophyll fluorescence measurements. In Tenhunen JD, Catarino FM, Lange OL, Oechel WC (eds.) *Plant Response to Stress* , Springer-Verlag Pub. pp 48-75.