STRATEGIES FOR SUITABLE FORAGE-BASED LIVESTOCK PRODUCTION IN SOUTHEAST ASIA

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LIGHT RESPONSE CURVE: A CRITERIA FOR SPECIES SELECTION UNDER PLANTATION CROPS

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Abstract

A laboratory experiment was conducted to determine the light response curve of Brachiaria mutica, B. humidicola, Stenotaphrum secundatum, Panicum maximum cv. Hamil and P. maximum cv. TD58. The initial slopes of the curve were calculated to obtain quantum yield of each species. This photosynthetic capacity indicates some potential criteria for selection of plant under low radiation level. However, this value may not reflect pasture productivity.

INTRODUCTION

Integration of pasture with plantation crops is a mean to diversify production systems and to so utilise space and radiation under the canopy of plantation crops. It is well known that this system will maximise land use and could provide a sustainable agricultural system. Several articles have been reviewed on prospect and future of pasture under plantations (Shelton et al. 1987, Reynold 1988).

Naturally occuring forage resources are commonly low in productivity. While the improved forage species mostly are well known as sun plant, hence they lack of long term persistence under plantations (Stür and Shelton 1991). Hence there is a need to understand and investigate the nature of forage species which will probably more suitable to the plantation environments. Wilson and Ludlow (1991) proposed a logical model which described basic on plant adaptation to shade. They suggested that 3 major characters of plant need to be identified in order to estimate potential productivity of forage under plantations. These were the light use efficiency (E), the light level under storey (PI) and the light interception (J).

This paper discusses E of 4 well known tropical grasses as shade tolerator by the measures of light response curves and the analyse of it.

MATERIALS AND METHODS

Light response curves of cut plant were measured in laboratory at Klong Hoi Khong research station of Faculty of Natural Resources, Prince of Songkla University, 40 km south-west of Hat-Yai. The observed species were *Brachiaria mutica, B. humidicola, Stenotaphrum secundatum, Panicum maximum* cv. Hamil and cv.

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TD58. Measurement of leaf photosynthesis was done on the youngest fully expanded leaves for 2 replicates except *B. mutica* which was measured for 6 replications. The equipment was a modified IRGA system (ADC made) using a halogen lamp (Phillips, 50W) as light source. The lamp was mounted with adjustable neutral filters in order to vary the photon fux without changing light quality.

An analysis of quantum yield (Φ) and saturated rate of CO_2 assimilation (A_{sat}) was determined as described in Long and Hallgren (1985). This technique enable to compare the genotypic differences on photosynthetic capacity of the used materials.

RESULTS

Figure 1 shows the light response curve (A/Q) of *B. mutica*. A curvilinear response was obtained with greater discrepency at high photon flux (Q). The initial linear phase of increase assimilate (A) with Q gives an estimation of quantum yield (Φ).

Similarly, light response curve and Φ of the other four species were also obtained (*Figure 2*). A_{sat} can be averaged from the potential highest A values after the curve reached saturation. Quantum requirement (Q_r) was determined from the reciprocal of quantum yield. The summary of these results for all species is shown in *Table 1*.

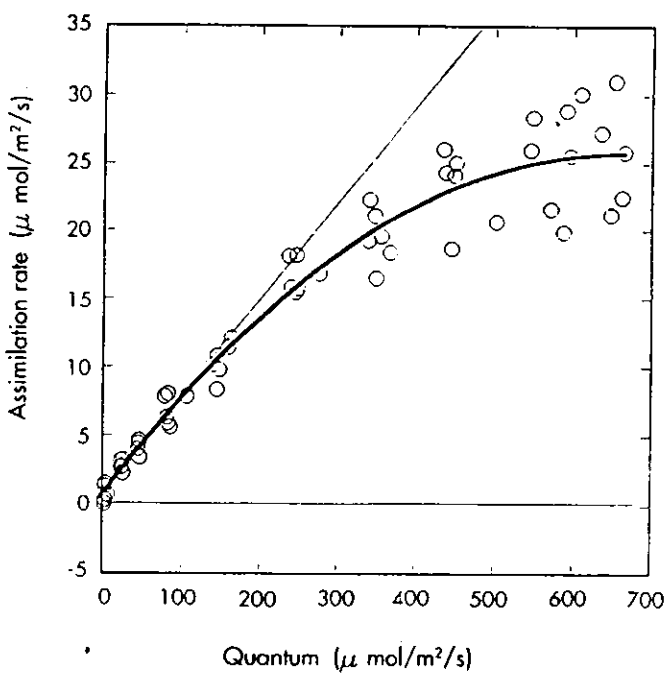

Figure 1. CO_2 assimilation rate (A) of *B. mutica* in response to photon flux (Q). The straight line indicates initial linear phase of light response curve

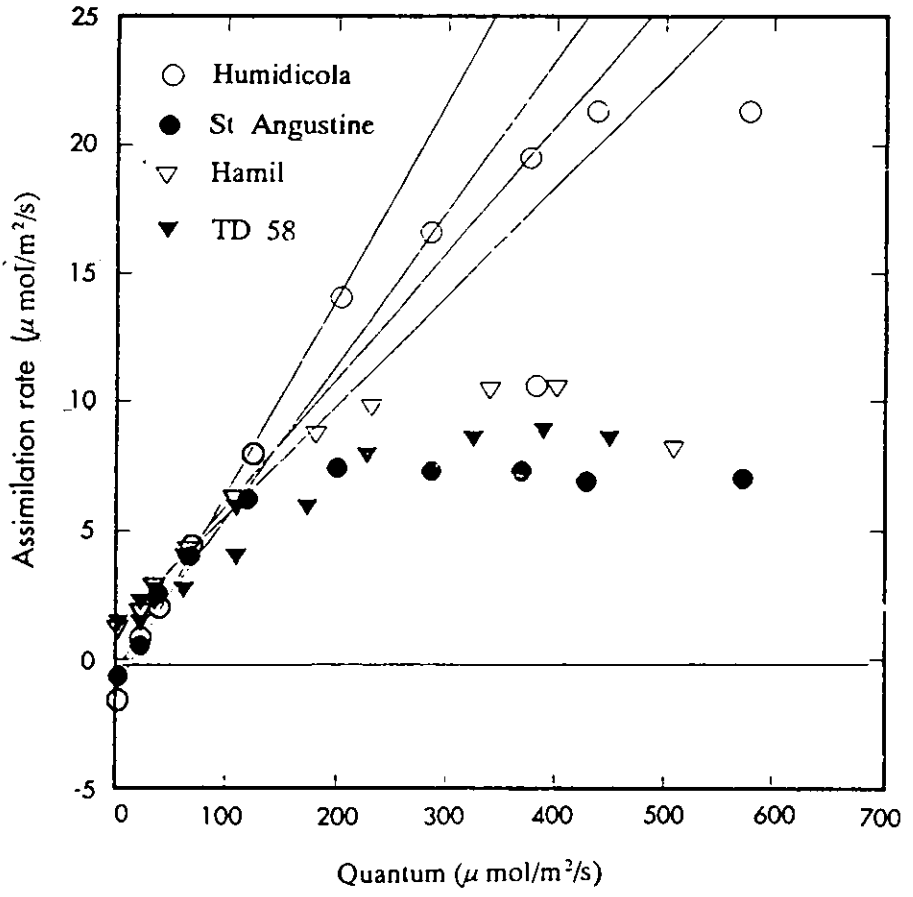

Figure 2. CO_2 assimilation rate (A) of *B. humidicola, Stenotaphrum secundatum, Panicum maximum* cv. Hamil and cv. TD58 in response to photon flux (Q). The straight lines indicate initial linear phase of light response curve

Table 1. Quantum yield (Φ), quantum requirement (Q_r), light saturated rate of CO_2 assimilation (A_{sat}) of *Brachiaria mutica, B. humidicola, Stenotaphrum secundatum, Panicum maximum* cv. Hamil and cv. TD58.

Species	Φ molCO$_2$/molQ	Q_r molQ/molCO$_2$	A_{sat} μ molCO$_2$/m²/s
B. mutica	0.0707	14.1	25.56
B. humidicola	0.0765	13.1	21.35
S. secundatum	0.0596	16.8	7.43
P. maximum cv. Hamil	0.0494	20.2	10.53
P. maximum cv. TD58	0.0427	23.4	8.96

The data shows that both Brachiaria species have higher Φ than the rest. Maximum A_{sat} was obtained from *B. mutica* at 25.56 μmol $CO_2/m^2/s$ slightly higher than *B. humidicola*. Light response curves of these two species showed saturation at Q of above 600 μmol/m_2/s while the rest were saturated at c. 200 μmol/m^2/s.

DISCUSSION

Forage yield of species used in this experiment were ranged according to Ng (1991) showed some correlation with pasture yield with Φ except for *P. maximum*. In fact in Ng (1991) the cultivars were Riversdale and Vencedor which were different from species used in this experiment. Possibly *P. maximum* used in this experiment received slightly low nitrogen fertilizer. Several reports showed that N supply could modify E value (Sophanodora 1989, Wilson and Ludlow 1991).

The technique can provide an estimation of genotypic leaf photosynthesis capacity of the studied plants. This could possibly be adopted as a quick method for selection program which comprise large number of species. However, productivity of pasture per unit area may not necessary accord to its potential leaf photosynthesis capacity since the amount of photon flux intercepted by the canopy can be modified by the rate of canopy development and canopy structure.

The results suggested that *B. humidicola* which is known as more shade tolerant than B. mutica could operate through the strategy of more leaf development and canopy light interception than *B. mutica*. This need to investigate in greater details. Partitioning of assimilate rather than improving in maximun photosynthetic capacity would play more important role.

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