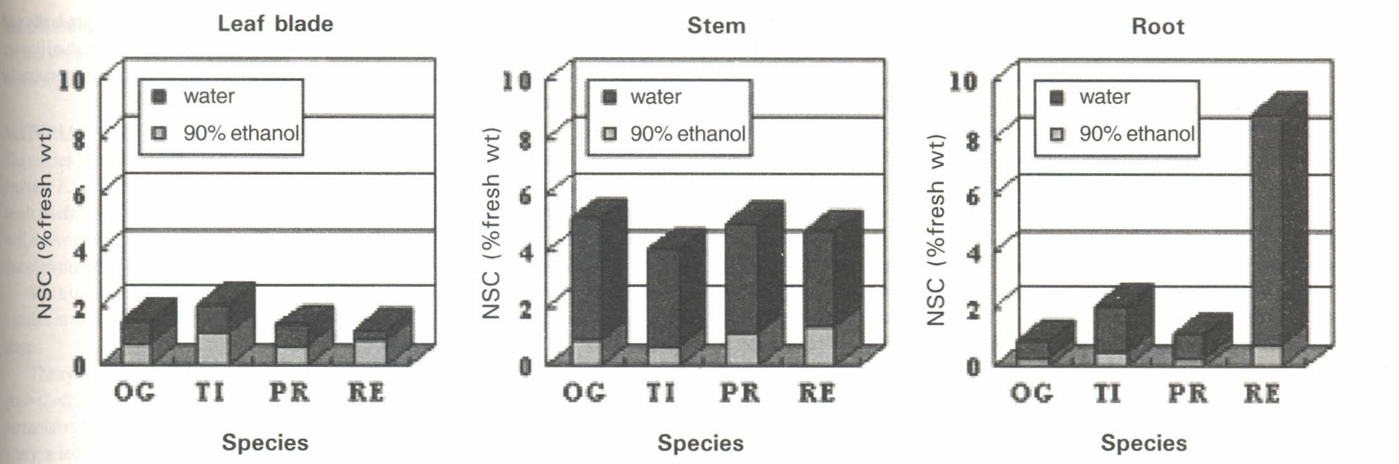

Figure 1 - Nonstructural carbohydrate reserves of temperate grasses in early growth stages in fall. Water; fructosans extracted with water from 90% ethanol extracted residue. 90% ethanol; Mono- and oligo-saccahrides extracted with 90% ethanol. OG; Orchardgrass, TI; Timothy, PR; Perennial ryegrass, RE; Reed canarygrass.

Table 1 - Growth of the grasses used in the experiment (Nov. 15, 1999).

Grass species	Plant height	Dry matter weight(g/m²)				Root/Total
	cm	Total g/m²	Leaf g/m²	Stem g/m²	Root g/m²	
Orchard grass	55.0	539.4	263.6	205.8	70.0	0.130 a
Timothy	46.4	475.0	234.7	139.4	100.8	0.214 b
Perennial ryegrass	56.3	789.7	389.2	305.3	95.3	0.122 a
Reed canarygrass	44.2	513.6	188.3	157.2	168.1	0.326 c

Root/Total indicates root/total dry matter weight ratio, and the means followed by the different letters are significantly different at $P<0.05$, student t-test.

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Phothosynthetic light response of Tanzania grass under four levels of leaf temperature

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ABSTRACT

The purpose of this paper is to establish photosynthetic light response curves for Tanzania grass (*Panicum maximum* Jacq.) under four leaf temperature levels. Photosynthetic rate was measured as a response to levels of photosynthetic photon flux density (PPFD) on the youngest fully expanded leaves of 12 representative tillers with an infra red gas analyzer. The effect of PPFD was tested for each leaf temperature level in a randomized complete block design. Photosynthetic light response curves were adjusted for each leaf temperature using a non-linear hyperbolic model. The maximum photosynthetic response was 25,59; 31,43; 34,57 and 27,53 mmol CO_2 m^{-2} s^{-1} for 25, 30, 35 and 40°C of leaf temperature, respectively. Although light saturation was not attained, response to light increments declined with light levels higher than 1000 – 2000 µmol photon m^{-2} s^{-1}, and the response curve approximated saturation slowly. Photosynthetic rates of Tanzania grass depend on light and temperature level and these must be considered when modelling crop yield potential.

KEYWORDS: Photosynthesis, photosynthetic photon flux density.

INTRODUCTION

Pasture-based livestock production depends on soil, plant, animal, and environmental factors. Simulation models are useful tools to integrate all these information and help on decision analysis, but require information on plant responses to environment.

Dynamic simulation models for livestock production on temperate pastures have been developed, but much information is lacking on most tropical forages. This characterizes a gap in international literature on adequate information related to tropical forages and their physiological responses to management. According to Boote & Tollenaar (1994), photosynthesis is one of the characteristics that must be considered when modelling crop yield potential.

The purpose of this work was to describe photosynthetic light response curves for Tanzânia grass under four leaf temperature levels.

MATERIAL AND METHODS

The experiment was carried out on an irrigated Tanzania grass pasture at Piracicaba, SP, Brazil (Lat. 22°42'30"S, Long. 47°38'30"W) on February 2000. The soil was previously fertilized with P, K, Ca Mg and micronutrients to ensure adequate nutrient availability. The pasture was rotationally grazed (3 days grazing and 33 days rest) and 80 kg N ha^{-1} was supplied after each grazing.

Net photosynthetic rate (AP) was measured at twelve levels of photosynthetic photon flux density (PPFD, µmol photon m^{-2} s^{-1}) under four leaf temperature levels, on the youngest fully expanded leaves of 12 representative tillers (3 per temperature level) with a model LI-6400 infra-red gas analyzer (LI-COR, Inc). Leaf temperature was set at the gas analyzer main console and monitored automatically inside the leaf chamber.

For initial determination of light responses, a steady-state rate of photosynthesis was obtained at the desired temperature (25, 30, 35 or 40°C) and 3000 µmol photon m^{-2} s^{-1}. Measurements were then made at 12 PPFD levels ranging from high (3000 µmol photon m^{-2} s^{-1}) to low (250 µmol photon.m^{-2}.s^{-1}) at 250 µmol photon.m^{-2}.s^{-1} intervals.

The effect of PPFD was tested for each leaf temperature level in a randomized complete block design with 12 treatments (PPFD levels) and three replications (3 leaves). Analysis of variance was conducted and a photosynthetic light response curve was adjusted for each leaf temperature with a non-linear hyperbolic model using the SAS system (SAS, 1989).

RESULTS AND DISCUSSION

The following photosynthetic light response curves were adjusted (AP is expressed in mmol CO_2 m^{-2} s^{-1} and PPFD in mmol photon m^{-2} s^{-1}):

- T 25°C ⇒ AP = (25,59 * PPFD) / (448,48 + PPFD); $R^2 = 0,97$
- T 30°C ⇒ AP = (31,43 * PPFD) / (383,21 + PPFD); $R^2 = 0,96$
- T 35°C ⇒ AP = (34,57 * PPFD) / (449,54 + PPFD); $R^2 = 0,95$
- T 40°C ⇒ AP = (27,53 * PPFD) / (663,70 + PPFD); $R^2 = 0,83$

The maximum photosynthetic responses predicted by the model were 25,59; 31,43; 34,57; and 27,53 µmol CO_2 m^{-2} s^{-1} for 25, 30, 35 and 40°C of leaf temperature, respectively. Ziska et al. (1999) observed that the photosynthetic rate of *Panicum maximum* at 25°C, ambient [CO_2] and saturating PPFD levels (2100 µmol photon m^{-2} s^{-1}) were 44,7 µmol CO_2 m^{-2} s^{-1}. This response was higher than that obtained in the present experiment (21,0 µmol CO_2 m^{-2} s^{-1} for 25°C and 2100 µmol photon m^{-2} s^{-1}), probably due to genetic differences between cultivars or to the controlled conditions used by Ziska et al. (1999) for grass growth.

Light saturation was not attained at 25 or 35°C (Fig. 1) even under the highest PPFD level (3000 µmol photon m^{-2} s^{-1}). Veenendaal et al. (1993) working with a number C_4 grasses observed that photosynthesis of leaves grown under full sun light showed signs of light saturation above 1100 µmol photon m^{-2} s^{-1}, reaching photosynthesis levels between 25 and 42 µmol CO_2 m^{-2} s^{-1}. According to Ziska et al. (1999), light saturation point of *Panicum maximum* was near 1600 µmol photon m^{-2} s^{-1}. Although light saturation was not reached in the present work, photosynthetic responses to light were progressively smaller under light levels higher than 1000 – 2000 µmol photon m^{-2} s^{-1}, and light photosynthetic response curve approximated saturation slowly.

It was impossible to compare leaf temperature effects on photosynthesis due to the confounding effect (leaf x temperature effect), but at 40°C the response was more variable ($R^2 = 0,83$) and maximum photosynthesis tended to be lower (27,53 µmol CO_2 m^{-2} s^{-1}). The light response curve at 40 °C was not as well defined as for the other temperature levels, probably due to temperature stress. As temperature rises above optimum, photosynthesis begins to decline, at first gradually and reversibly, and then steeply and irreversibly as it rises above a critical value (Powles, 1984). Oberhuber and Edwards (1993) observed that the optimum temperature for *Panicum maximum* was 35°C.

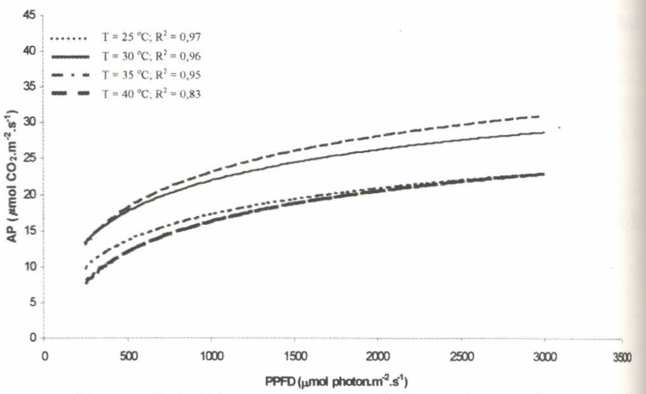

Figure 1 – Photosynthetic light response curves for Tanzania grass leaves under 25, 30, 35 and 40°C.

Photosynthetic rates of Tanzania grass respond to light and temperature levels, and this should be considered when modelling the yield potential of this forage crop. Information on plant physiological responses that have an impact on crop agronomic performance, under varying temperature and light environment, may be valuable in assessing yield potential and decision-making in year-round planning of foraging and feeding strategies in pasture-based livestock systems in the tropics.

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Light interception and dry matter yield in grass/legume mixtures

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ABSTRACT

The influence of grass variety on light interception and dry matter yield in a grass/clover mixture was studied. Two varieties of timothy (*Phleum pratense L.*) and five varieties of ryegrass (*Lolium spp*) as components in a mixture were compared during the spring period up to the first cut of the third harvest year. By replacing the timothy variety in the mixture both light interception and dry matter yield were significantly affected. The leaf orientation was thought to be a contributing factor with erect leaves intercepting less light. There were no significant differences neither in light interception nor in yield between the mixtures with different ryegrass varieties, not even between the earliest and the latest varieties being the two contrasts in light interception.

KEYWORDS: Light interception, grass/clover mixture, timothy, ryegrass, dry matter yield.

INTRODUCTION

Many papers have been published on light interception in agricultural crops. But few have dealt with the variation among varieties of a single species in this character