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Relationship between field measurements in three *Brachiaria* species with leaf area index and light interception by indirect methods

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Introduction

Brachiaria species play a strategic role in ruminant production systems in Brazil, covering an estimated pasture area of approximately 90 million hectares (Karia *et al*., 2006), however, these pastures are subject to different degrees of degradation due to inadequate management. In pasture management, field measurements such as canopy height, for example, are used by managers as a tool to establish parameters for the optimal point to cut the forage and for the post-grazing residue, in order to maximize production by harvesting at maximum of herbage mass accumulation, and to avoid problems associated to overgrazing, by setting ideal post-grazing height for forage regrowth. The use of the variables light interception (LI) and leaf area index (LAI) has been recommended as a tool for pasture management, based on the theory that, when the canopy reaches a light interception of 95%, the forage is near its maximum growth rate, which is called critical LAI (Brougham, 1956). The residual LAI refers to the leaf area of the post-grazed stubble. Residual LAI is used to establish the minimum leaf area necessary to ensure an efficient pasture regrowth (Lemos *et al*., 2014). Light interception and the LAI are difficult to measure at the farm level, due to the high cost of the equipment and technical feasibility of the process. The objective of this study was to evaluate the relationship between LI and LAI measured by two different equipment, with canopy height and soil cover in three species of *Brachiaria*.

Materials and Methods

The experiment was carried out at Universidade Federal Rural de Pernambuco - Brazil, using as experimental area forage plots measuring 2.80 x 1.80 m. The evaluated species were *Brachiaria brizantha* cv. Xaraés, *Brachiaria* hybrid cv. Mulato II, and *Brachiaria humidicola*. Light interception, leaf area index and mean leaf angle (MLA) where taken using two equipment, Plant Canopy Imager CI-120 (CID Bio-science®) and LAI-2000 (LI-COR®). These parameters were measured simultaneously with the canopy height (cm) and soil cover (%). Soil cover was estimated visually considering a scale of 0 to 100%. Measurements were taken along five months, in intervals between 15 to 20 days, covering a total of eleven evaluations. During the experimental period, forages were cut to 5cm to soil level, when they reached maturity stages, were proceeded a total of 3 cuts during this period. Correlation analyses were performed using PROC CORR in SAS 9.3 software, null hypothesis (no correlation) was tested for 1 and 5% of probability. Classification of correlations magnitude followed: if $|r| < 0.20$ nonexistent correlations; if $0.20 < |r| < 0.40$ weak correlations; $0.40 < |r| < 0.60$ moderate correlations; $0.60 < |r| < 0.80$ strong correlations; if $|r| > 0.80$ very strong correlations. Regressions analyses were performed for the relations that showed high correlations coefficients, models tested were: linear, exponential, logarithmic and polynomial (quadratic).

Results and Discussion

In both equipment, correlations between canopy height and soil cover with MLA, showed no significance ($P < 0.05$) (Table 1), the only exception was the correlation between soil cover of *B*rachiaria hybrid cv. Mulato II, measured by CI-120. Correlations between canopy height and soil cover with LI and LAI presented more significant results for the measurements performed with the LAI-2000 than CI-120. For the CI-120 equipment, only four relations had significant results, with *B. humidicola* showing one of the strongest correlations ($P < 0.01$) between canopy height with LI and LAI. Coêlho *et al*. (2014) reported few significant correlations for the relations between canopy height with LI and LAI, when measured by CI-120 in tropical grasses with different growth habits. In general, canopy height correlated better than soil cover with LI and LAI measured by LAI-2000, predominating strong and very strong correlations. The correlations between soil cover with LI and LAI measured by LAI-2000 were moderate to *B. brizantha* and *B. humidicola*, and very strong for *Brachiaria* hybrid cv. Mulatto II ($P < 0.01$). Pedreira *et al*. (2007) evaluating light interception in *B. brizantha* pastures, using the equipment LAI-2000, considered that canopy height is an efficient and practical parameter to indicate the level of light interception.

Logarithmic equations best fitted the relationship between canopy height and LI (Figure 1) for *B. brizantha* and *Brachiaria* hybrid cv. Mulato II, based on the generated equations, these grasses would reach 95% of light interception at the canopy height of 114 and 62 cm, respectively. In *B. humidicola* the quadratic equation did not allow the estimation of canopy height at 95% of LI, the maximum value reached to LI was 89%. This could be explained by the fact that only in *B. humidicola* a quadratic equation best fitted the relationship between canopy height and LAI. Therefore, by increasing the canopy height of *B.humidicola*, just few increments would be expected for its LAI. For *B. brizantha* and *Brachiaria* hybrid cv. Mulato II, positive linear regressions best fitted the relation of

canopy height and LAI, then even when the LI reach its maximum, LAI could still be increasing for these species, probably due to herbage mass accumulation.

Table1. Correlations between canopy height and soil cover with leaf area index, light interception (%) and mean leaf angle in three *Brachiaria* species.

	Brachiaria brizantha		*Brachiaria* hybrid cv. Mulato II		*Brachiaria humidicola*	
Equipment/variable	Canopy height	Soil cover (%)	Canopy height	Soil cover (%)	Canopy height	Soil cover (%)
CI-120						
Leaf area index	0.25ns	0.51**	0.33ns	0.35ns	0.66**	0.35ns
Light interception (%)	0.24ns	0.15ns	0.46**	0.63**	0.69**	0.19ns
Mean leaf angle	0.04ns	-0.11ns	-0.26ns	-0.52**	0.12ns	-0.02ns
LAI-2000						
Leaf area index	0.87**	0.45**	0.89**	0.89**	0.70**	0.55**
Light interception (%)	0.70**	0.57**	0.63**	0.84**	0.74**	0.57**
Mean leaf angle	0.20ns	-0.06ns	-0.15ns	0.29ns	-0.10ns	-0.22ns

** Significant at (P <0.01); ***** Significant at (0.01 =< P < 0.05); ns = not significant (P> 0.05).

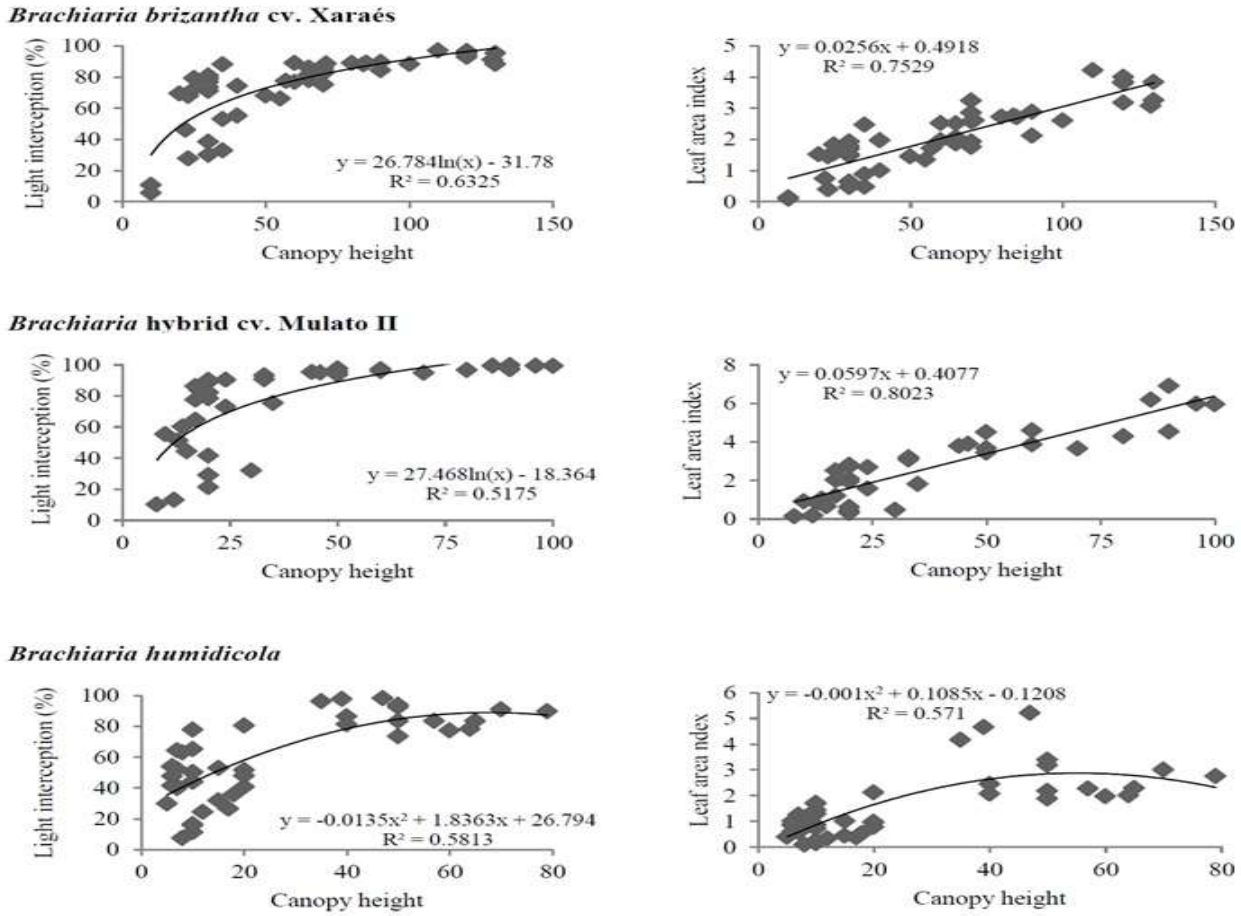

Fig 1. Relationship between canopy height with light interception (%) and leaf area index measured by LAI-2000 in three *Brachiaria* species.

Conclusion

The equipment LAI-2000 presented better correlations coefficients for the relationships between canopy height and soil cover with light interception and leaf area index, proving to be suitable for being used in researches that try to create growth models for different species of *Brachiaria*. Canopy height was characterized as a good predictor of light interception and leaf area index for *B.brizantha* and *B*rachiaria hybrid cv. Mulato II measured by LAI-2000.

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