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NUTRITIVE QUALITY OF TROPICAL GRASSES SOWN UNDER A PINE PLANTATION*

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Abstract

A trial was conducted in Brazil to evaluate the nutritive quality of 6 tropical grasses: tanzania (*Panicum maximum* cv. Tanzania), green-panic (P. *maximum* var. *Trichoglume),* aruana *(P. maximum* cv. Aruana), brizanta (*Brachiaria brizantha),* humidicola (*B. humidicola)* and tifton-85 (*Cynodon dactylon* cv. Tifton 85), planted under two different densities of pines (*Pinus elliottis)*: 200 and 400 stems/ha, as well as in full sunlight. The results showed a significant increase in protein content and a significant decrease in NDF and cellulose contents as tree density increased. Comparing the values obtained under shading conditions with those obtained in the open, it was observed an increase in the contents of CP (+2,47), ADF (+0,73), lignin (+1,38), ash (+0,87) and in the digestibility (+2,16), and a decrease in the contents of NDF (-3,46), hemicellulose (-4,19) and cellulose (-1,20) in percentage units. Tanzania presented the best nutritive quality under shade: 13 % CP, 32 % cellulose, 5 % lignin and a digestibility of 54%. This grass was also the best under full sunlight, showing that it was the less sensitive to shading. It was concluded that, although less productive, the nutritive quality of tropical grasses was enhanced by shading.

Keywords: Agroforestry, pines, tropical grasses, shading, nutritive quality, protein content, digestibility, NDF.

Introduction

The growth of pasture species is markedly dependent on the light environment but some studies, where N availability was limiting, have demonstrated higher total biomass production under moderate levels of shade than under full sunlight conditions, although there was also an increase in the moisture content. (Wilson, 1981; Eriksen and Whitney, 1981).

Regarding the forage structural components, under shade conditions it was observed that the content of lignin increased, of cellulose and hemicellulose practically did not alter or decreased very little, and those of soluble carbohydrate decreased significantly. In general, the cell wall content (CWC) and insoluble ash concentrations decreased, and N or crude protein (CP) percentage increased, which would contribute to an increase in dry matter digestibility (DMD). On the other hand, total nonstructural carbohydrates consistently decreased and lignin tended to increase, changes that would lead to a decrease in DMD. Depending on the balance of the changes in tissue constituents, the effect of the shade may be positive, nil or negative (Wilson, 1981; Samarakoon et al., 1990a; Samarakoon et al., 1990b; Belsky, 1992).

The aim of this work was to evaluate how shading by pine trees would affect the nutritive quality of six tropical grasses grown in SE Brazil.

Material and Methods

This trial was conducted at Instituto de Zootecnia, in Nova Odessa – SP – Brazil. The local soil type is the Red Yellow Latossol (acid oxisol), of medium texture and with low fertility.

The study consisted of two parts – agroforestry and open pastures. In the agroforestry system, six grasses: tanzania (*Panicum maximum* cv. Tanzania), green-panic (P. *maximum* var. *Trichoglume),* aruana *(P. maximum* cv. Aruana), brizanta (*Brachiaria brizantha),* humidicola (*B. humidicola)* and tifton-85 (*Cynodon dactylon* cv. Tifton 85) were tested under two densities of pines (*Pinus elliottis),* aged 25 years old: 200 stems/ha (D1) and 400 stems/ha (D2). The experimental design was in randomized blocks with subdivided plots and with four replications. Each subplot had the dimension of 44m x 12m.

The open pasture was located adjacent to the pine plantation. The pasture species were assigned to plots in a randomized block design with four replications. Each plot measured 3m x 5m. No statistical comparison between the agroforestry and open pasture plots was intended, so only trends are discussed.

The pasture species in both conditions were planted at the same time and managed similarly. Before planting, there were applied lime at a rate of 2500 kg/ha and a month later 20 kg N/ha, 100 kg P2O5/ha and 60 kg K_2O/ha. Forage samples were weighted, dried, grinded and analyzed for its nutritive quality. This report refers to a period of one year, composed of 4 periods of 3 months, corresponding to each annual season.

Results and Discussion

The results showed no interaction between grasses and tree densities. As shown in Table 1, the two tree densities tested did not significantly affect the contents of ADF, lignin, ash and the digestibility of the forages, however there was influence of the shading level on the yield and on the contents of CP, NDF and cellulose. D2 (the most shaded) presented significantly higher contents of CP and lower of NDF and cellulose, besides a lower yield.

Comparing the values obtained under shading conditions with those obtained in the open, it was observed an increase in the contents of CP (+2,47), ADF (+0,73), lignin (+1,38),

ash (+0,87) and in the digestibility (+2,16), and a decrease in the yield (-41%) and in the contents of NDF (-3,46), hemicellulose (-4,19) and cellulose (-1,20) in percentage units. Therefore, shade affected mainly the yield and the plant structural tissues (NDF and hemicellulose). In spite of a higher digestibility and of a higher CP content in the forage produced under shade, there was a considerable decrease in the hemicellulose content, which is going to reflect in a lower nutritive value, that is, in a lower content of available energy to animal feeding.

In general, other authors also verified a similar trend in relation to the yield (Eriksen and Whitney, 1981; Carvalho et al., 1997), and to the contents of N (Belsky, 1992; Wilson, 1996; Carvalho et al., 1997), CWC (Wilson and Wong, 1982; Samarakoon et al., 1990a; Belsky, 1992), hemicellulose (Samarakoon et al., 1990a), cellulose (Belsky, 1992), lignin (Wilson and Wong, 1982; Belsky, 1992), ash (Samarakoon et al., 1990a) and in the digestibility (Samarakoon et al., 1990a; Samarakoon et al., 1990b), what did not happen with the content of ADF (Belsky, 1992).

However, a controversial point was observed with relation to the content of NDF and its effect on the digestibility, once in our experiment we observed under shade a decrease in the content of NDF and an increase in the digestibility. Wilson (1981) stated that shading usually decreases the cell wall, lignin and silica contents, which would contribute to lower herbage dry matter digestibility. In another work, Wilson and Wong (1982) observed that since there was a decrease in leaf:stem ratio and in cell wall content, the lower herbage digestibility indicates that shade must have greatly reduced the digestibility of the cell wall material.

The answer to this question may be found in that grass species vary in their responses. Kephart and Buxton (1993) tested C_3 and C_4 grasses under different levels of shade and

concluded that in C_4 grasses CWC concentration decreased and the DMD increased with increasing shading, probably due to anatomic differences (reduced cell size).

The most promising grass under shade conditions in terms of yield and nutritive quality was tanzania, with the highest contents of CP and cellulose and the lowest of lignin, resulting in the highest digestibility. This grass also presented the best nutritive quality when produced in full sunlight, with the highest content of CP and the smallest of lignin.

It is concluded that, although less productive, the nutritive quality of tropical grasses was enhanced by shading.

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Table 1 - Effect of tree densities (shading conditions) on six tropical grasses nutritive quality, compared with the grasses grown under full sunlight. CP= crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; DMD = dry matter digestibility.

	DM yield	CP	NDF	ADF	Hemicel.	Cellulose	Lignin	Ash	DMD
	(kg/ha)				(%)				
SHADING									
Grasses									
Tanzania	10.961 a	12,94 a	66,73 c	40,74 a	25,99 b	32,70 a	4,08 d	10,72 a	53,55 a
Aruana	8.376 b	12,28 abc	68,46 b	40,94 a	27,52 b	32,66 a	4,94 c	9,70 b	50,38 ab
Green Panic	8.942 b	12,56 ab	66,18 c	40,75 a	25,43 b	31,14 b	5,02 bc	10,62 a	52,54 ab
Brizanta	9.382 ab	11,29 bc	63,67 d	38,42 b	25,25 b	30,81 b	4,54 cd	9,36 b	51,17 ab
Humidicola	4.277 c	10,95 c	67,18 bc	40,64 a	26,54 b	32,02 ab	5,86 a	7,32 d	43,76 c
Tifton 85	5.332 c	12,47 ab	72,93 a	39,83 ab	33,10 a	31,78 ab	5,67 ab	7,99 c	49,60 b
CV (%)	14,1	8,1	1,6	1,6	2,5	1,0	2,0	2,6	2,3
Mean	7.878	12,08	67,53	40,22	27,31	31,85	5,02	9,29	50,17
Densities									
D1	9.029 a	11,54 b	67,98 a	40,41 a	27,58 a	32,24 a	4,80 a	9,31 a	50,37 a
D2	6.727 b	12,62 a	67,07 b	40,03 a	27,04 a	31,46 b	5,14 a	9,26 a	49,96 a
CV (%)	16,0	7,8	1,6	3,5	5,9	2,7	9,4	4,4	4,3
SUNLIGHT									
Grasses									
Tanzania	16.047 a	10,57 a	70,16 bc	41,28 a	28,88 d	34,23 a	3,10 c	8,94 a	50,69 a
Aruana	13.556 ab	9,54 a	71,97 b	40,61 ab	31,36 bc	34,62 a	3,56 bc	8,44 a	49,37 a
Green Panic	16.139 a	10,27 a	70,43 bc	40,62 ab	29,81 cd	33,16 ab	4,20 a	9,23 a	51,91 a
Brizanta	13.979 ab	8,48 a	66,24 d	37,64 c	28,60 d	31,02 b	3,39 bc	9,19 a	45,93 a
Humidicola	10.032 b	9,67 a	69,91 c	37,97 c	31,94 b	31,85 ab	3,71 ab	7,57 b	45,50 a
Tifton 85	9.927 b	9,14 a	77,21 a	38,80 bc	38,41 a	33,39 ab	3,88 ab	7,14 b	44,66 a
CV (%)	14,7	11,9	1,1	2,0	2,9	4,1	6,0	4,3	6,8
Mean	13.280	9,61	70,99	39,49	31,50	33,05	3,64	8,42	48,01

* Data for individual treatment effects not followed by the same letters are different at the 5% level of significance as determined by the Tukey's Test.