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PRODUCTION AND MINERAL COMPOSITION OF TROPICAL GRASSES SOWN UNDER A PINE PLANTATION*

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Abstract

A trial was conducted in Brazil to evaluate the performance 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 the full sunlight. The results showed that the dry matter yield decreased as shading increased. The grasses tanzania and brizanta were the most tolerant to shading. Although N concentration increased with shading, the total N yield was still lower than that obtained with grasses in full sunlight, probably due to higher soil acidity and to lower nutrient content under the pines. The concentrations of P, K, Mg and S were higher and those of Ca lower under shading conditions. All elements were at adequate level, except for Tifton-85 that presented a low N content and a high content of S, probably due to the fact that this grass is more demanding in soil N. It is concluded that other factor besides light influenced DM and N yields; but even so, it was possible to obtain a satisfactory biomass production under shading conditions.

Keywords: Agroforestry, pines, tropical grasses, shading, DM yield, N yield, mineral concentration, tolerance.

Introduction

Silvipastoral system is a type of agroforestry where trees are planted together with pastures for animal grazing. In Brazil, private forest companies own at least 5,5 million hectares of planted forests but never had cattle to control the understory, although more recently some of them started to use it with great success (Garcia and Couto, 1997).

Some authors have observed that in many situations the dry matter (DM) yield of forage species was higher in the shade than in the full sunlight and presented higher nitrogen concentration (Wilson et al., 1986; Wilson et al., 1990; Samarakoon et al., 1990). Other nutrients in pasture plants were also increased with the shading: P, K, Ca, Mg, S, B and Cu, while some decreased: Mn, Zn and Mo (Eriksen and Whitney, 1981; Samarakoon et al., 1990; Castro et al., 1998). These minerals reflect in part the nutritive value of the forage and are important in animal feeding.

Since most of these results were obtained under artificial shading and/or under temperate climate conditions, the aim of this work was to evaluate how shading by pines can affect the biomass yield and the mineral content 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, 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 comparisons between the agroforestry and open pasture plots were intended, so only trends are discussed.

The pasture species in both conditions were planted at same time and managed similarly. Before planting, limestone was applied 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 mineral composition. The results reported 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. In Table 1 it can be observed that there was significant differences in the dry matter yield among tree densities and among grasses. The forage yield was higher in the full sunlight, with tanzania and green panic producing around 16 t DM/ha. Under shading conditions, the largest yield was observed with tanzania and brizanta, presenting 78 and 58% of the production in full sunlight, respectively in D1 and D2. Both grasses were the less sensitive to shading. On the other hand, humidicola and tifton-85 were the most affected by it, presenting a steep decrease in yield under the trees. Aruana and green panic had an intermediate performance.

A higher DM yield in full sunlight was also obtained by Eriksen and Whitney (1981), by Knowles et al. (1994) and by Carvalho et al. (1997), although this was not the tendency observed by other authors (Wilson et al., 1986; Wilson et al., 1990; Samarakoon et al., 1990; Wilson, 1996).

Under shading conditions, our forage yield was similar or even higher than that obtained by some other authors (Eriksen and Whitney, 1991; Carvalho et al., 1997).

As it was expected, the N concentration increased with the increase of the shading, being in agreement with the observations done by other authors (Eriksen and Whitney, 1981; Wilson et al., 1986; Carvalho et al., 1997). Wilson (1996) stated that this was due to a shade effect enhancing organic matter breakdown and N cycling.

However, the N yield in our trial was still higher in grasses grown in the open, probably due to higher soil acidity originated from decomposing pine needles. The authors already mentioned did not observe this result. Even those that obtained a higher DM yield under full sunlight had a higher N yield under shade conditions, what compensated the lower forage production.

Other minerals concentrations in grasses were not affected by the two tree densities tested, but when comparing these values with those obtained in the full sunlight, it is verified that with shading there was an increase in the contents of P, K, Mg and S and a decrease in the Ca content. Other authors also observed a higher concentration of P, K, Ca, Mg and S in the shaded areas, although Wilson (1996) observed higher P and Knowles et al. (1994) higher Ca concentrations in the open areas. The increase in minerals concentration in shaded plants can be ascribed to the lower growth rate of forages when under shade.

In general, all elements were at adequate level, except for a high content of Mg in shaded brizanta, a high content of Ca in brizanta under full sunlight and for tifton-85 that presented a low content of N and a high content of S, both in the shade and in the open, probably due to the fact that this grass is more demanding in soil N.

It was concluded that there was another factor besides light acting on DM and N yields, but even so, it was possible to obtain a satisfactory biomass production under shading conditions.

References

Carvalho, M.M., Silva J.L.O. and Campos Junior B.A. (1997) Produção de matéria seca e composição mineral da forragem de seis gramíneas tropicais estabelecidas em um sub-bosque de angico-vermelho. R. Bras. Zootec., **26**: 213-218.

Castro, C.R.T., Carvalho M.M. and Garcia R. (1998) Composição mineral de gramíneas forrageiras tropicais cultivadas à sombra. Proc. 35. Reunião da SBZ, Botucatu, Brazil. pp. 554-556.

Eriksen, F.I. and Whitney A.S. (1981) Effects of light intensity on growth of some tropical forage species. 1. Interaction of light intensity and nitrogen fertilization on six forage grasses. Agronomy Journal, **73**: 427-433.

Garcia, R. and Couto L. (1997) Silvipastoral systems: emergent technology of sustainability. Proc. International Symposium on Animal Production under Grazing, Viçosa, Brazil. pp. 281-302.

Knowles, R.L., Hawke M.F. and MacLaren J.P. (1994) Agroforestry research at Tikitere. Research Report, Forest Research Institute, Rotorua, NZ. 27p.

Samarakoon, S.P., Shelton H.M. and Wilson J.R. (1990) Voluntary feed intake by sheep and digestibility of shaded *Stenotaphrum secundatum* and *Penisetum clandestinum* herbage. J. of Agric. Science, **114**: 143-150.

Wilson, J.R., Catchpoole V.R. and Weier K.L. (1986) Stimulation of growth and nitrogen uptake by shading a rundown green panic pasture on brigalow clay soil. Tropical Grassland, **20**: 134-143.

Wilson, J.R., Hill K., Cameron D.M. and Shelton H.M. (1990) The growth of *Paspalum notatum* under the shade of a *Eucalyptus grandis* plantation canopy or in full sun. Tropical Grasslands, **24**: 24-28.

Wilson, J.R. (1996) Shade-stimulated growth and nitrogen uptake by pasture grasses in a subtropical environment. Aust. J. Agric. Res., **47**: 1075-1093.

Table 1 - Effect of tree densities (shading conditions) on grasses annual dry matter and N yields (kg/ha) and mean mineral composition (%), compared with the production under full sunlight.

	DM yield	N yield	N	P	K	Ca	Mg	S
	(kg/ha)					(%)		
SHADING								
Grasses								
Tanzania	10.961 a	226,9	2,07 a	0,21 bc	2,47 a	0,67 b	0,38 b	0,17 d
Aruana	8.376 b	164,2	1,96 abc	0,23 ab	2,12 bc	0,66 b	0,34 bc	0,25 b
Green Panic	8.942 b	179,7	2,01 ab	0,24 a	2,29 ab	0,73 a	0,37 bc	0,24 b
Brizanta	9.382 ab	169,8	1,81 bc	0,24 ab	2,10 bc	0,51 c	0,43 a	0,21 c
Humidicola	4.277 c	74,8	1,75 c	0,19 c	1,99 bc	0,30 d	0,34 c	0,19 cd
Tifton 85	5.332 c	106,1	1,99 ab	0,19 c	1,86 c	0,56 c	0,30 d	0,43 a
CV (%)	14,1		8,1	9,9	7,3	2,1	4,6	2,8
Means	7.878	153,6	1,93	0,22	2,14	0,57	0,36	0,25
Densities								
D1	9029 a	167,0	1,85 b	0,22 a	2,10 a	0,58 a	0,35 a	0,25 a
D2	6727 b	135,9	2,02 a	0,21 a	2,18 a	0,56 a	0,37 a	0,24 a
CV (%)	16,0		7,8	10,2	9,8	5,5	6,4	7,8
SUNLIGHT								
Grasses								
Tanzania	16.047 a	271,2	1,69 a	0,18 a	1,99 ab	0,71 a	0,25 b	0,15 c
Aruana	13.556 ab	206,1	1,52 a	0,21 a	2,11 a	0,71 a	0,27 b	0,20 b
Green Panic	16.139 a	264,7	1,64 a	0,22 a	1,83 ab	0,76 a	0,26 b	0,18 bc
Brizanta	13.979 ab	188,7	1,35 a	0,18 a	1,73 ab	0,65 ab	0,38 a	0,15 c
Humidicola	10.032 b	155,5	1,55 a	0,17 a	2,10 a	0,46 b	0,29 b	0,14 c
Tifton 85	9.927 b	144,9	1,46 a	0,17 a	1,50 b	0,62 ab	0,22 b	0,35 a
CV (%)	14,7		11,8	16,2	14,0	12,4	13,0	8,9
Means	13.280	205,2	1,54	0,19	1,88	0,65	0,28	0,20

* 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.