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**Nutritive value of brachiaria forage intercropping with eucalyptus in a
silvopastoral system in the Brazilian cerrado biome**

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**Valor nutritivo de los cultivos de forraje de Brachiaria con eucalipto en una
Sistema silvopastoral en el bioma del cerrado brasileño.**

Abstract. The objective of this study was to evaluate a SPS located in the Cerrado, in relation to forage production characteristics and forage nutritive value during the drought summer period and beginning of the rainy season. An experiment was conducted in Confins, Minas Gerais, Brazil in order to evaluate the forage produced by a silvopastoral system. The system was composed of *Eucalyptus* tree species (150 trees/ha) and *Brachiaria brizantha* cv. Marandu forage. The pasture was sampled during the months of May, July and November of 2009, and production (quantitative and qualitative) and bromatological composition were determined. This silvopastoral system appeared to be a sustainable option for animal production in areas with little rainfall. This study suggests that it is possible to observe a considerable increase in nutrient concentrations in shaded forage using silvopastoral systems. This increase was witnessed even in drought conditions, where forage protein values were high, which is important in meeting the maintenance requirements of ruminants. This is especially important in the Cerrado biome, which frequently experiences droughts. The presence of the tree species *Eucalyptus* did not interfere in forage dry matter production. Trees appeared to reduce forage water stress while simultaneously increasing mineral concentrations. This silvopastoral system appeared to be a sustainable option for animal production in areas with little rainfall.

Key words: tree species; fodder; degraded areas; shading

Resumen. El objetivo de este estudio fue evaluar un SPS ubicado en el Cerrado, en relación con las características de producción de forraje y el valor nutritivo del forraje durante el período de verano de sequía y el comienzo de la temporada de lluvias. Se realizó un experimento en Confins, Minas Gerais, Brasil, para evaluar el forraje producido por un sistema silvopastoral. El sistema estaba compuesto por especies de árboles de eucalipto (150 árbol/ha) y *Brachiaria brizantha* cv. Marandu. El pasto fue muestreado durante los meses de mayo, julio y noviembre de 2009, y se determinó la producción (cuantitativa y cualitativa) y la composición bromatológica. Este sistema silvopastoral parecía ser una opción sostenible para la producción animal en áreas con poca lluvia. Este estudio sugiere que es posible observar un aumento considerable en las concentraciones de nutrientes en el forraje sombreado utilizando sistemas silvopastorales. Este aumento se observó incluso en condiciones de sequía, donde los valores de proteína de forraje eran altos, lo cual es importante para cumplir con los requisitos de mantenimiento de los rumiantes. Esto es especialmente importante en el bioma Cerrado, que con frecuencia experimenta sequías. La presencia de la especie arbórea *Eucalyptus* no interfirió en la producción de materia seca forrajera. Los árboles parecían reducir el estrés hídrico forrajero al mismo tiempo que aumentaban las concentraciones de minerales. Este sistema silvopastoral parecía ser una opción sostenible para la producción animal en áreas con poca lluvia.

Palabras clave: especies arbóreas; forraje; áreas degradadas; sombreado

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Introduction

Silvopastoral systems have the potential to replace benefits of the current cultivated grassland ecosystems, which mostly consist of monocultures of grasses, making the activity more sustainable economically and environmentally (Franke et al., 2001). The Cerrado biome which is sensitive to rainfall changes, could increase animal production by the use of SPS's (Brassard et al., 2005). However, the impact of animal production in AFSs on global climate change has not been investigated. Indeed, if sustainable silvopastoral systems could be developed as viable alternatives to conversion of forest lands to support animal production, the above-stated high levels of "carbon footprint" of animal production in developing countries could be reduced considerably (NAIR et al., 2008).

The profitability of silvopastoral systems has been demonstrated by several studies, exemplified by the study conducted by Marlats et al. (1995), quoted by Silva (2003), who compared monoculture pastures and silvopastoral system with approximately 250 and 416 trees per hectare. This system showed the best internal rates of return on the investment made, exceeding the net income obtained in monocultures. In agroforestry systems need to choose fodder they can be used under conditions of low light (Castro et al., 1999). The *Brachiaria* is largely used to pasture in tropical America and according to Carvalho et al. (1997), can be used in shading conditions natural. The objective of this study was to evaluate a SPS in relation to forage nutritive value during the drought summer period and beginning of the rainy season.

Materials and Methods

The experiment was conducted in a silvopastoral system, located in a farm called Fidalgo in the county of Confins in Minas Gerais, Brasil. The geographic coordinates of the experimental area of this typical Cerrado biome are 19°54'32" South and 43°58'18" West and the average maximum daily temperature in the SPS was 31.4°C and relative humidity averaged 42%. The pasture in the SPS and in the adjacent control area, were planted at the same time as the silvopasture establishment. This SPS was established in 1994, without the use of fire.

The land was cleared, and eucalyptus seedlings were planted at a density of 150 trees/hectare. The trees used in the experiment were 15 to 25 meters high, with diameter at breast height (DBH) of 40 to 60 cm. The soil in the SPS is a Latossolo Vermelho Amarelo (Oxisol), with 651 g/kg of clay, 211 g/kg of silt and 138 g/kg of sand. *Brachiaria brizantha* cv. Marandu productivity was measured quantitatively and qualitatively for three distinctive periods: the beginning of the drought (May 15th, 2009), the middle of drought (July 25th, 2009), period of greatest drought stress, and after the drought (November 23rd, 2009). In the implantation of the experiment was done a cut for standardization of forage at 30 cm above soil. Twelve random points were selected in each system (SPS

and pasture), with a total of 24 points. One meter squared collectors made of steel grids were used to prevent animal interference and were placed at each identified location for forage evaluation. After collection, the forage was weighed, dry mass in an oven at 60°C for 72 hours, and then ground to pass through a 1 mm sieve. All bromatologic compositions of crude protein (CP) were analyzed by Kjeldahl's methodology (Cunniff, 1995). Calcium (Ca), phosphorus (P) and potassium (K) were determined using permanganometric techniques, colorimetric and flame photometry, respectively. Forage composition was evaluated for neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin separately (Robertson et al., 1982).

Acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP) and calcium (Ca) variables had an interaction effect between the production systems and the months of collection (Table 3). Kephart and Buxton (1993), observed that forage subjected to shading had a significant positive correlation between SLA (Specific Leaf Area) and in vitro organic matter digestibility and N content in leaf blades, and a negative correlation between SLA and cell-wall lignin and neutral-detergent fiber.

Results and Discussion

It is notable that NDF and CP in both cropping systems and ADF in the full sun, were significantly higher in May (beginning of the drought period) compared to the forage collected in July and November (during and immediately after the drought). However, Ca was significantly different in the forage collected in July in both cropping systems. But ADF in

SPS and Ca, in full sun, was not significantly different during the three periods in this study ($P < 0.05$). In this present work, levels of ADF were higher in SPS in the forage collected in November while NDF did not differ among systems during any of the collection periods (Table 1). Crude Protein and Ca levels were the highest in forage under shade in the SPS,

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compared to forage in full sun, during the drought and immediately after the drought seasons. To Ca, levels were higher for SPS in July, but the contrary in November. ADF

was higher in the forage in the SPS only after the dry period ($P<0.05$).

Table 1 – Means of acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP) and calcium in silvopastoral (SPSs) and forage production in the full sun (FPSs) systems during the beginning, middle, and end of the drought periods.

Collect	ADF(%)		NDF(%)		CP(%)		Ca(%)	
	SPS	FPS	SPS	FPS	SPS	FPS	SPS	FPS
May	36.56aA	38.1aA	79.07aA	79.17aA	9.34aA	8.69aA	0.66aB	0.64aA
July	34.84aA	34.83aB	65.49aC	71.44aC	7.48aB	5.74bB	0.82aA	0.66bA
November	35.62aA	31.02bC	76.53aB	74.47aB	8.98aA	6.00bB	0.38bC	0.58aA
CV(%)	6.02		4.88		27.15		18.57	

Means followed by different letters differ ($P<0.05$) by SNK test. SPS (Silvopastoral system);

FPS (Forage production system, without trees).

The high protein value observed in forage in shaded SPS is of great importance for animal nutrition. In general, the forage production system, in cerrado, has low protein values in the dry season. The SPS has shown that even in times of drought this value has not decreased, showing its potential beneficial effect in improving nutrition of shaded pastures for cattle. According to Van Soest (1994) 1% of nitrogen (N) is equal to 6.25% of CP considering this to be the minimum which satisfies rumen fermentation.

Study on availability of shade for dairy cows led by Carvalho (1991), showed increases in milk production and the percentage concentration of solids not fat. The results of this

work are in agreement with Reis (2007), who found that shaded pasture with Ipê Felpudo (*Zeyheria tuberculosa*) had 8.62% CP compared to a (B. brizantha) pasture with 5.19% CP. Andrade *et al.* (2002), found in shaded pasture a level of CP 50% higher than that found in full sun areas, suggesting increase in soil N with increase in OM under trees. This study suggests that it is possible to observe a considerable increase in nutrient concentrations in shaded forage using silvopastoral systems. This increase was witnessed even in drought conditions, where forage protein values were high, which is important in meeting the maintenance requirements of ruminants.

Literature Cited

- Brassard, M.; A. O. Barcellos. 2005. Convers3o do Cerrado em pastagens cultivadas e funcionamento de latossolos. *Cadernos. de Ci4ncia e tecnologia*, v.22, n.1, p. 153-168,
- Carvalho, M. M.; Barros, J. C.; Xavier, D. F.; Freitas, V. P.; Aroeira, F. L. J. M. Composi3n qu4mica Del forraje de Brachiaria decumbens asociada com tr4s esp4cies de leguminosas arb3reas. In: Semin3rio Internacional Sobre Sistemas Agropecuarios Sostenibles, 6., 1999, Cali, Colombia. *Mem3rias...* Cali: CIPAV, 1999. 10 P. 1 cd-rom. M3dulo II: Sistemas Silvopastoriles em Tr3pico H3medo.
- Castro, C.R.T.; Garcia, R.; Carvalho, M.M. et al. 1999. Produ3n forrageira de gram4neas cultivadas sob luminosidade reduzida. *Rev. Bras. Zootec.*, 28:919-927.
- Cunniff, P. 1995. Official methods of analysis of AOAC International. 16th edn. AOAC International, Arlington 1016 pp
- Franke, I.L.; Lunz, A.M.P.; Valentim, J.F.; Amaral, E.F.; Miranda, E.M. Situa3n atual e potencial dos sistemas silvipastoris no Estado do Acre. In: Carvalho, M.M.;
- Alvim, M.J.; Carneiro, J.C. (Ed.). Sistemas agroflorestais pecu3rios: op33es de sustentabilidade para 3reas tropicais e subtropicais. Juiz de Fora: Embrapa-CNPGL; FAO, 2001. p.19-40.
- Nair, P. K. R., Gordon, A. M., And Mosquera-Losada, M.-R. 2008. Agroforestry. In: Jorgensen, S. E. and Fath B. D. (eds), *Ecological Engineering*, Vol [1] of Encyclopedia of Ecology, 5 vols., pp. 101 – 110. Elsevier, Oxford, U.K.
- Silva, V. P. da, 2003. Sistemas silvipastoris em Mato Grosso do Sul - Para que adot3los? In: Semin3rio Sistemas Agroflorestais E Desenvolvimento Sustent3vel, 2003, Campo Grande. *Anais...* Embrapa, 2003. CD-ROM.
- Van Soest, P.J. 1994. *Nutritional ecology of the ruminants*. 2.ed. Ithaca: Cornell University Press, 476p.
- Robertson, J.B., Van Soest, P.J. 1982. The detergent system of analysis and its application to human foods. In: James, W. P. T., Theander, O. (Ed.) *The analysis of dietary fiber in food*. New York: Marcel Dekter, p. 123-158.