Forage mass and stocking rate of elephant grass pastures managed under agroecological and conventional systems

Clair Jorge Olivo[1], Carlos Alberto Agnolin[2], Priscila Flôres Aguirre[2], Cláudia Marques de Bem[2], Tiago Luís da Ros de Araújo[1], Michelle Schalemberg Diehl[2], Gilmar Roberto Meinerz[2]

[1] Departamento de Zootecnia, Universidade Federal de Santa Maria - Santa Maria, RS, Brasil.
[2] Programa de Pós-Graduação em Zootecnia, Universidade Federal de Santa Maria - Santa Maria, RS, Brasil.

ABSTRACT - The objective was to evaluate elephant grass (*Pennisetum purpureum* Schum.) pastures, under the agroecological and conventional systems, as forage mass and stocking rate. In the agroecological system, the elephant grass was established in rows spaced by 3.0 m from each other. During the cool season ryegrass (*Lolium multiflorum* Lam.) was established between these rows, which allowed the development of spontaneous growth species during the warm season. In the conventional system the elephant grass was established singularly in rows spaced 1.4 m from each other. Organic and chemical fertilizers were applied at 150 kg of N/ha/year with in the pastures under agroecological and conventional systems, respectively. Lactating Holstein cows which received 5.0 kg/day supplementary concentrate feed were used for evaluation. The experimental design was completely randomized, with two treatments (agroecological and conventional systems) two replications (paddocks) and independent evaluations (grazing cycles). The pastures were used during the whole year for the agroecological system and for 195 days in the conventional year. The average values of forage mass were 3.5 and 4.2 t/ha and the stocking rates were 2.08 and 3.23 AU/ha for the respective systems. The results suggest that the use of the elephant grass under the agroecological system allows for best distribution of forage and stocking rate to be more uniform throughout the year than the use of elephant grass in conventional system.

Key Words: lactating cows, *Lolium multiflorum, Pennisetum purpureum*, production systems, rotational stocking

Introduction

Elephant grass has been used in different Brazilian regions, mainly because of its high potential for forage production. Its use in pasture conditions has increased due to the improvement in the quality of forage offered and reduction in the involved manpower compared with its use as cutting forage.

Elephant grass is usually established alone in conventional agricultural farms. The farms that use elephant grass adopt the conventional production strategy based on productivity, which is established singularly. Soil nutrients are replenished mainly with chemical fertilizers. In dairy small farms it is notable that elephant grass has been found as an alternative in animal nutrition. In different Brazilian regions high stocking rate was achieved, from 4 to 8 cows/ha (Deresz et al., 2001). Despite the high performance, research has many times revealed problems such as increase in production costs, mainly for nitrogen fertilizers and rangeland degradation (Dall'agnol et al., 2004; Deresz et al., 2006). It is worth noting that in this system the use is concentrated in the warm season in the south region, with a great variability in forage production between the grazing cycles.

The management forms, inputs and technologies used in the agroecological strategy based on optimization of production are usually more appropriate to preserve the natural resource base, providing higher stability for the productive system. This type of agriculture involves perennial grasses, mixture of species, organic fertilization, and no use of pesticides. Thus, the objective of this experiment was to evaluate the forage mass and the stocking rate of elephant grass pastures managed under agroecological and conventional systems throughout four years.

Material and Methods

The study was conducted according to ethical standards and approved by the Ethics and Biosafety Committee by Protocol 23081016073/2011-27, in number 113/2011.

The experiment was conducted in the Dairy Cattle Laboratory of the Department of Animal Science in Universidade Federal de Santa Maria (UFSM), located in the physiographic region called Central Depression of Rio Grande do Sul (Brazil), at the altitude of 95 m, South

latitude 29º43′ and West longitude 53º42′. The soil of the experimental area is classified as red eutrophic argisol, belonging to the Sao Pedro mapping unit (Streck et al., 2002). The climate of the region is Cfa (humid subtropical), according to the Köppen classification (Moreno, 1961). The average temperature and monthly precipitation in the region are 18.5 ºC and 142 mm, respectively.

The research was conducted from May 2006 to April 2010. The average temperature, monthly precipitation and the number of frosts were 19.1 ºC; 141 mm and 20, respectively (Figure 1). From April to November the average temperature, monthly precipitation and number of frosts were 15.9 ºC, 107 mm and 11 in 2006; 16.7 ºC, 120 mm and 22 in 2007; 15.7 ºC, 140 mm and 11 in 2008; and 15.5 ºC, 174 mm and 22 in 2009. The data was collected at the UFSM Meteorological Experiment Station, located about 500 m away from the experimental site.

For the experiment, four paddocks of 0.12 ha each were managed separately during four years, each one in its production system (agroecological and conventional), stated in the treatment of the present study.

In the agroecological system managed according to principles contained in Instruction 46 of the Ministry of Agriculture Livestock and Food Supply (Brasil, 2011), the elephant grass (*Pennisetum purpureum* Schum.), cultivar Merckeron Pinda, was established for twelve years in rows spaced by 3.0 m from each other. In May of each year ryegrass common cultivar (*Lolium multiflorum* Lam.) was sown between the rows of elephant grass, at a rate of 30 kg/ha, by scarifying the soil. In the warm season, the development of spontaneous growth species was allowed.

Soil analysis presented the following mean values at the beginning of the experimental period: SMP Index 6.4; P, 8.4 mg dm^{-3}; K, 48 mg/dm³; Al^{3+}, 0.0 cmol$_c$ dm^{-3}; Ca^{2+}, 6.6 cmol$_c$ dm^{-3}; Mg^{2+}, 3.6 cmol$_c$ dm^{-3}; OM, 2.3%; base
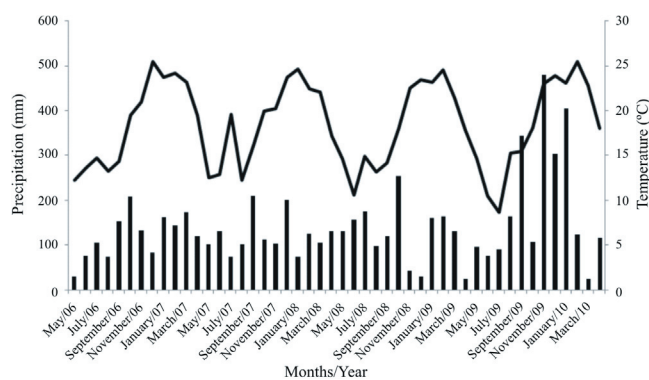

Figure 1 - Monthly precipitation (mm) and average temperature (°C) from May 2006 to May 2010.

saturation, 78.3% and aluminum saturation, 0.0%. The fertilizer used had a N-P$_2$O$_5$-K$_2$O rate of 150-80-70 kg/ha/year, consisting of cattle manure, collected from the standby hose, with 35% of dry matter (DM), and of pig slurry with 5% of DM. The chemical composition of cattle manure, on a DM basis, was 1.20, 0.45 and 0.62% of N, P$_2$O$_5$ and K$_2$O, respectively. The chemical composition of pig slurry, on a DM basis, was 2.80, 1.90 and 0.90% of N, P$_2$O$_5$ and K$_2$O, respectively. Fertilization was performed twice a year: in the cool season (30%) and in the warm season (70% of the volume).

In the conventional system the elephant grass was established singularly in rows spaced by 1.4 m from each other. Fertilization was performed in September of each year, based on the soil analysis, in which on average 40-80-70 kg/ha of N-P$_2$O$_5$-K$_2$O were used; the urea-based nitrogen fertilization was 110 kg/ha fractionated into four applications.

The rotational grazing method was adopted, with occupation time of one to two days. The criteria for the grazing onset in the warm season (in both pastures) was the sward height of elephant grass, when it was around 1.2 m; in the cool season (in the agroecological system), the criteria was the height of ryegrass (about 20 cm). Before the beginning of grazing, samples were collected to estimate forage mass using the double sampling technique with 5 cuts and 20 visual estimates (Mannetje et al., 1978). The elephant grass was cut at 50 cm from the soil. In the agroecological system the forage between the elephant grass rows were sampled at the ground level. The samples were weighed and homogenized, collecting a sub sample to determine the botanical composition of the pastures and of the structural components of the elephant grass. The levels of dry matter were determined for all samples, by oven drying at 105 ºC for 8 hours.

The stocking rate in the conventional pasture was calculated based on leaf blade allowance of elephant grass at 4 kg of dry matter per 100 kg body weight; in the agroecological system the same forage allowance was used considering one-third of the area occupied by the elephant grass; for the remaining two-thirds the proportional stocking rate was calculated aiming to maintain the forage allowance between 8 and 10 kg of dry forage mass per 100 kg of body weight. Lactating Holstein cows with 543 kg average body weight and 20.4 kg/day milk production which received 5.0 kg/day supplementary concentrate feed were used for the evaluation.

The experimental design was completely randomized with two treatments (forage systems), two replicated areas (paddocks) and independent evaluations (grazing cycles).

The production systems were analyzed in each year. All data were subjected to analysis of variance and the means were compared by the F test at 5% probability. The analyses were made with the SAS (Statistical Analysis System, version 9.2) statistical package (2001). The statistical model referring to the analyzed variables was represented as:

$$Y_{ijkl} = m + T_i + R_j(T_i) + G_k + (TG)_{ik} + C_l + (GC)_{kl} + \varepsilon_{ijkl},$$

in which: Y_{ijkl} = dependent variables; i = treatment indexes (forage systems); j = repetition indexes (paddocks); k = grazing cycle indexes; l = crop year; m = average for all reports; T_i = effect caused by the treatments; $R_j(T_i)$ = effect of repetition in treatments (error a); G_k = effect of grazing cycles; $(TG)_{ik}$ = interaction between treatments and the grazing cycles; C_l = effect of crop year; $(GC)_{kl}$ = interaction between treatments and the crop year; and ε_{ijkl} = residual experimental error (error b).

Results and Discussion

During the experimental period in the agroecological system, seven, six, eight and seven grazing cycles occurred in the respective crop years between May 2006 and April 2010; in the cool season there were three, two, four and four grazing cycles, respectively (Table 1).

The forage mass over the four years evaluated was varied, proven by the year × grazing cycle interaction (P<0.05).

For the elephant grass managed under conventional system, there were four and seven grazing cycles in the crop years 2006-2008 and 2008-2010, respectively (Table 1). The lower number of grazing cycles in the cool season between 2006 and 2007 was due to low rainfall between February and May, an average of 56.5 mm, 42% lower than the normal values, and also due to the low temperatures and high number of frosts observed in this period. In the next year (2007-2008) the lower number of grazing cycles in the cool season was also due to the low temperatures. In the following two crop years there was a possibility of elephant grass use due to mild temperature conditions, where frosts occurred much later.

Evaluating the agroecological system in the cool season, the association between ryegrass and elephant grass is beneficial for the animals, since while the winter culture initially contains a highly value of protein and digestibility and lower fiber, the warm season shows an inverse trend for these variables (Olivo et al., 2007). This condition is appropriate for the animals that have better possibilities of balancing their diet. It is also observed that an occurrence of cumulative frosts, searing the elephant grass leaves and the top of the stems, contributes to the protection of clumps and perpetuation of culture, since the animals consume little

elephant grass in these phenological conditions. In contrast, one of the ways to increase the number of grazing cycles in the cool season is introducing oats (Sobczack et al., 2005) due to their precocity in association with ryegrass, which is a later culture.

During the evaluation of the pastures in the warm season, the grazing cycles varied from 30 to 37 days, considered appropriate (Fonseca et al., 1998). Grazing cycles with an occupation period of two to three days for tropical species, associated with rest periods of 30 days, are related to the higher forage quality and to the better animal performance (Deresz et al., 2001; Soares et al., 2004).

For the forage mass in the agroecological system there was little variability between the evaluations and crop years, compared with the conventional system, where the average was 3.6 t/ha in the cool season and 3.8 t/ha in the warm season. It should be noted, however, that the elephant grass, occupying about one-third of the area during the cool season, showed 38.4% of leaf blades as the average of four years (Table 2). This proportion is important in this forage system, since, despite the low development rate in this period, it shows an increase in the nutritive value of green forage (Olivo et al., 2007). The high levels of straw observed in the dead material fraction may also constitute a major component for balancing the fibrous diet of cattle as well as protecting some stem parts from the frosts. Strategically, we emphasize the importance of elephant grass production in the fall, due to the low availability of forage that normally is verified in this period on dairy farms in the South of Brazil. In the warm season the values of forage mass were higher due to the contribution of elephant grass (Table 1).

For the forage between the rows (occupying two-thirds of the area) there is a uniformity of forage mass during the evaluations of each crop year. The participation was 36.7% in the cool season, consisting mainly of ryegrass; in the warm season it was 28.4% based on species of the genus *Paspalum* spp., along with others such as *Urochloa plantaginea* (Link) Hitchc and *Sida santaremnensis* H. Monteiro.

In the conventional system the forage mass is concentrated in the period of higher development rates of the crop in summer, superior for the mean values (P<0.05) in relation to the agroecological system, due to this behavior and its higher production yield. Evaluating the forage mass during the crop years, we observed that the highest measures occurred between 2006 and 2007, partly due to the non-use of the pasture during the cool season (Table 1); between December and January, both in 2007-2008 and 2008-2009, there was lower availability of forage due to the attack by spittlebug (*Deois flavopicta* Stal, Homoptera: Cercopidae), which infested both pasture systems. Control

was performed with a biological insecticide (METARRIL®) that uses spores of *Metarhizium anisopliae* fungal as an active ingredient.

The average values obtained in both systems (Table 1) are similar to that found by Restle et al. (2002), in Rio Grande do Sul in a forage system with Taiwan A-146 cultivar elephant grass alone, evaluated between December and April but fertilized with 500 kg/ha of nitrogen. A similar response

was also observed by Lima et al. (2004), in Sao Paulo, who evaluated the Guaçu cultivar fertilized with 250 kg/ha of nitrogen in the same period.

For the stocking rate (Table 1), the mean values were 2.1 and 3.3 AU/ha considering the crop year for the agroecological system and 198 days for the conventional system. Considering the average time on the agroecological system (365 days), the stocking rate for the conventional

Table 1 - Forage mass stocking rate and structural composition of elephant grass under agroecological (AGR) and conventional (CNV) systems in four years of evaluation (2006-2010)

Parameter	System	Grazing cycles								Average	CV (%)
		Cool season			Warm season						
		1st (Jul)	2nd (Aug)	3rd (Oct)	1st (Dec)	2nd (Jan)	3rd (Feb)	4th (Mar)	5th (Apr)		
2006-2007											
Forage mass (kg DM/ha)	AGR	3284C	4237B	4495B	6479A	6361A	6306A	5559A	-	5246b	17.7
	CNV	-	-	-	10945C	14339B	18785A	16768A	-	15209a	10.5
	CV(%)	-	-	-	7.6	6.4	5.3	5.9	-		
EGFM (kg DM/ha)	AGR	2601C	2972C	3224C	5373A	5433A	5475A	4314B	-	4199b	23.3
	CNV	-	-	-	10945C	14339B	18785A	16768A	-	15209a	10.8
	CV(%)	-	-	-	8.4	6.9	5.6	6.5	-		
FMBR (kg DM/ha)	AGR	683C	1265A	1271A	1106B	929B	830B	1245A	-	1047	23.5
Stocking rate (kg BW/ha)	AGR	27387E	39469D	34526D	49713C	44867C	65230A	55040B	-	45176a	7.4
	CNV	-	-	-	6073C	7904B	11820A	7702B	-	8375b	8.3
	CV(%)	-	-	-	4.7	5.0	3.4	4.2			
2007-2008											
Forage mass (kg DM/ha)	AGR	-	2737C	6952A	3537B	-	-	1790D	1879D	3379	17.7
	CNV	-	-	-	1871C	-	2188B	2491A	2013B	2141	10.5
	CV(%)	-	-	-	24.4	-	20.8	23.9			
EGFM (kg DM/ha)	AGR	-	1999D	6952A	2110B	-	2188B	1790C	1778C	2803	23.3
	CNV	-	-	-	1871C	-	-	2491A	2013B	2125	10.8
	CV(%)	-	-	-	24.2	-	-	21.8	25.9		
FMBR (kg DM/ha)	AGR	-	739C	-	1427A	-	-	1268B	100D	884	23.5
Stocking rate (kg BW/ha)	AGR	-	25631C	48326A	36331B	-	-	19662D	12202D	28430a	7.4
	CNV	-	-	-	918B	-	1053B	1191A	914B	962b	8.3
	CV(%)	-	-	-	7.1	-	12.6	20.1			
2008-2009											
Forage mass (kg DM/ha)	AGR	2914B	2486C	3454Ba	4119 Aa	2739Ba	2993Bb	3816Ab	2863B	3173	17.7
	CNV	4430C	-	740Eb	2170Db	535Eb	6192B	6621Aa	3051D	3391	10.5
	CV(%)	18.0	-	21.5	21.0	20.3	14.4	12.6	22.3		
EGFM (kg DM/ha)	AGR	2361Ab	1442C	2254A	2765A	2187Aa	1948Bb	2615Ab	1509C	2135	23.3
	CNV	4430Ca	-	740F	2170E	535Fb	6192Ba	6621Aa	3051D	3391	10.8
	CV(%)	20.0	-	25.5	27.6	20.1	16.7	14.7	29.9		
FMBR (kg DM/ha)	AGR	553B	1045A	1200A	1353A	553B	1045A	1200A	1353A	1038	23.5
Stocking rate (kg BW/ha)	AGR	2017Aa	560C	729B	1210A	458C	1202Ab	1203A	1061Ab	1055	7.4
	CNV	377Db	-	738C	862C	629C	3648Aa	4196A	1850Ba	1757	8.3
	CV(%)	10.0	-	18.0	12.7	24.3	5.4	4.9	9.0		
2009-2010											
Forage mass (kg DM/ha)	AGR	-	3241B	2266C	2837C	2318Cb	2582C	5474A	3744B	3209	17.7
	CNV	-	5695Ba	3055D	4295C	7809Aa	2685D	5368B	2330E	4462	10.5
	CV(%)	-	14.8	24.8	18.5	13.0	25.0	12.2	21.7		
EGFM (kg DM/ha)	AGR	-	1930Cb	1312Cb	1406Cb	1219Cb	1551C	3637A	2951B	2001	23.3
	CNV	-	5695Ba	3054Da	4295Ca	7809Aa	2685D	5368B	2330D	4462	10.8
	CV(%)	-	17.9	21.2	23.9	15.1	22.1	15.1	25.8		
FMBR (kg DM/ha)	AGR	-	1311A	954B	1432A	1099A	1032A	1837A	793B	1208	23.5
Stocking rate (kg BW/ha)	AGR	-	419Cb	767Bb	885B	1180A	1183A	1452A	464C	907	7.4
	CNV	-	800Da	1202Ca	1679B	2265A	1025C	1598B	350E	1274	8.3
	CV(%)	-	21.6	13.4	10.3	7.7	11.9	8.6	22.4		

DM - dry matter; EGFM - elephant grass forage mass; FMBR - forage mass between the rows of elephant grass; BW - body weight; CV - coefficient variation.
Means followed by the same lowercase letters (column) and uppercase letters (row) differ significantly at 5% probability.

Table 2 - Structural composition of elephant grass under agroecological (AGR) and conventional (CNV) systems in four years of evaluation (2006-2010)

Parameter	System	Grazing cycles								Average	CV (%)
		Cool season			Warm season						
		1st (Jul)	2nd (Aug)	3rd (Oct)	1st (Dec)	2nd (Jan)	3rd (Feb)	4th (Mar)	5th (Apr)		
2006-2007											
LBM (kg DM/ha)	AGR	727C	518C	686C	1732B	2452A	2603A	1481B	-	1457b	16.9
	CNV	-	-	-	4386B	7026A	8097A	4566B	-	6019a	6.4
	CV(%)	-	-	-	10.4	6.7	5.9	10.5	-		
Leaf blades (%)	AGR	28.9D	17.4E	21.2D	32.0Cb	46.8A	47.5Aa	34.4B	-	32.6	2.5
	CNV	-	-	-	40.1Ca	49.1A	43.1Bb	27.5D	-	39.9	2.1
	CV(%)	-	-	-	11.6	8.7	9.2	13.5	-		
Stem + sheath (%)	AGR	53.8C	56.6B	52.1C	51.7C	41.2D	46.9D	58.3A	-	51.5	2.8
	CNV	-	-	-	51.2A	43.7B	51.6A	63.4A	-	52.5	3.5
	CV(%)	-	-	-	8.2	11.6	8.6	6.9	-		
Dead material (%)	AGR	17.4B	26.0A	26.7A	16.3Ba	12.0C	5.62D	7.3D	-	15.9	7.9
	CNV	-	-	-	8.71Ab	7.29A	5.32B	9.13A	-	7.6	8.0
	CV(%)	-	-	-	11.6	20.0	28.2	12.3	-		
2007-2008											
LBM (kg DM/ha)	AGR	-	989A	655C	433D	-	-	718Bb	717B	702	16.9
	CNV	-	-	-	327C	-	993A	1028Aa	791B	785	6.4
	CV(%)	-	-	-	8.3	-	-	3.6	4.2		
Leaf blades (%)	AGR	-	49.0A	9.2D	21.8Ca	-	38.1B	41.1A	42.7A	33.6	2.5
	CNV	-	-	-	16.1Cb	-	45.3A	35.7B	38.6B	33.9	2.1
	CV(%)	-	-	-	22.0	-	10.0	10.9	10.3		
Stem + sheath (%)	AGR	-	48.4B	90.2A	17.3Db	-	38.8C	43.2B	44.3B	47.1	2.8
	CNV	-	-	-	45.2Ba	-	52.5A	53.5A	36.9C	47.0	3.5
	CV(%)	-	-	-	13.51	-	9.24	8.73	10.40		
Dead material (%)	AGR	-	2.6C	0.6C	61.0Aa	-	23.1Ba	15.7B	13.0B	19.3	7.9
	CNV	-	-	-	38.70Ab	-	2.18Db	10.80C	24.54B	19.1	8.0
	CV(%)	-	-	-	7.9	-	15.2	20.0	22.5		
2008-2009											
LBM (kg DM/ha)	AGR	749Bb	454C	681Ba	1103Aa	698Ba	614Bb	842Bb	603Bb	718	16.9
	CNV	1268Ba	-	144Db	356Cb	360Cb	4826Aa	5252Aa	1861Ba	2010	6.4
	CV(%)	31.4	-	7.7	4.3	6.0	11.6	10.4	25.7		
Leaf blades (%)	AGR	31.9B	31.5B	30.4Ba	39.7Aa	31.9Bb	31.5B	31.5Bb	39.7Ab	33.5	2.5
	CNV	28.63C	-	19.36Db	16.32Db	67.14Aa	31.53B	79.43Aa	61.88Aa	43.5	2.1
	CV(%)	13.8	-	16.8	14.9	8.4	7.6	7.5	8.2		
Stem + sheath (%)	AGR	41.24Cb	57.72A	53.40B	41.58C	49.75Ba	57.72Aa	57.73Aa	41.58Ca	50.1	2.8
	CNV	49.75Ba	-	53.92A	39.00C	31.56Cb	44.76Bb	18.18Db	28.98Db	38.0	3.5
	CV(%)	9.3	-	7.9	10.5	10.4	10.6	11.0	12.0		
Dead material (%)	AGR	26.9A	10.8C	16.2B	18.7Ab	18.4Aa	10.7Bb	10.7Ca	18.7Aa	16.4	7.9
	CNV	21.6B	-	26.7B	44.7Aa	1.3Cb	23.7Ba	2.4Cb	9.1Cb	18.5	8.01
	CV(%)	3.6	-	15.2	11.9	11.9	6.6	7.9	6.2		
2009-2010											
LBM (kg DM/ha)	AGR	-	409Cb	218Cb	912Cb	990Cb	1334B	2129Ab	1392B	1055	16.9
	CNV	-	3671Aa	2248Ca	3207Ba	3980Aa	1858D	3773Aa	1301D	2863	6.4
	CV(%)	-	15.5	25.7	15.4	12.74	19.8	10.7	23.5		
Leaf blades (%)	AGR	-	21.23Db	16.61Eb	64.61B	80.85Aa	86.14Aa	58.56Bb	48.21C	53.7	2.5
	CNV	-	64.5Aa	73.6Aa	74.7A	51.0B	69.3Ab	71.0A	55.6B	65.7	2.1
	CV(%)	-	9.8	9.3	6.0	6.3	5.4	6.4	8.1		
Stem + sheath (%)	AGR	-	69.64Ba	80.01Aa	15.86D	13.38Db	10.00Db	36.66C	38.39C	37.7	2.8
	CNV	-	9.52Db	8.82Db	19.05C	23.84Ba	25.77Ba	22.99B	31.39A	20.2	3.5
	CV(%)	-	10.7	9.5	24.2	22.7	23.6	14.2	12.1		
Dead material (%)	AGR	-	9.1Cb	3.4Db	19.5Aa	5.8Db	3.9D	4.8D	13.4B	8.6	7.9
	CNV	-	26.00Aa	17.55Ba	6.21Cb	25.16Aa	4.90C	5.93C	12.99B	14.1	8.0
	CV(%)	-	2.2	4.1	4.4	15.2	17.5	20.0	23.2		

DM - dry matter; LBM - biomass of leaf blades of the elephant grass; CV - coefficient variation.

- : absence of the component.

Means followed by the same uppercase letters (column) and lowercase letters (row) differ significantly at 5% probability.
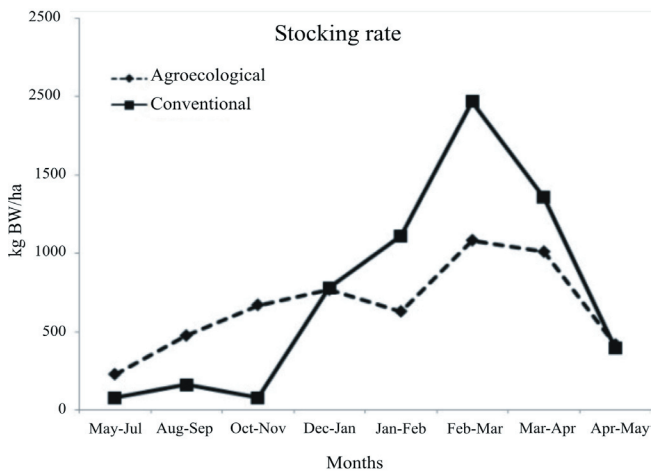
Average of four years of evaluation.

Figure 2 - Stocking rate (AU/ha) during the crop year in elephant grass pastures under conventional and agroecological systems.

system was 1.8 AU/ha. A higher variability was observed in the cool season due to the dependency of elephant grass on the environmental conditions; the highest stocking rate is found in the agroecological pasture due to the contribution of ryegrass, mainly. Similar value to that of the present study was obtained by Sobczak et al. (2005), with 1.53 AU/ha in pasture managed under the organic production. An average stocking rate of 1.64 AU/ha was obtained in the cool season under the conventional system by Marchezan et al. (2002) in mixed pastures with ryegrass, white clover and birdsfoot trefoil with diverse levels of fertilization, used by beef cattle. In the warm season the stocking rate values are higher (Figure 2) due to the higher contribution of elephant grass. The average stocking rate value of 1.99 AU/ha is lower than the 3.01 AU/ha obtained by Olivo et al. (2009) in elephant grass pasture and forage peanut (*Arachis pintoi* Krap. & Greg.) subjected to an agroecological transition management.

For the pasture managed under the conventional system the stocking rate is associated with the forage availability. A higher stocking rate, of 4.5 AU/ha was found by Deresz et al. (2001) in a pasture with Napier elephant grass alone, but using a higher level of fertilization during a shorter period of evaluation managed with lactating cows.

Conclusions

The values of forage mass and stocking rate show that pastures subjected to agroecological management are more frequent used, with a higher number of grazing cycles and a lower dependency on weather conditions. In the conventional production, forage distribution is more irregular in elephant grass alone.

References

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. 2011. Instrução Normativa n. 46, de 6 de outubro de 2011. Substitui a IN 64 no Regulamento Técnico para os Sistemas Orgânicos de Produção Animal e Vegetal com anexos de insumos permitidos para a produção orgânica. Diário Oficial da República Federativa do Brasil, Brasília, DF, 6 out. 2011.

Dall'Agnol, M.; Scheffer-Basso, S. M.; Nascimento, J. A. L.; Silveira, C. A. M. and Fischer, R. G. 2004. Produção de forragem de capim-elefante sob clima frio. Curva de crescimento e valor nutritivo. Revista Brasileira de Zootecnia 33:1110-1117.

Deresz, F.; Lopes, F. C. F. and Aroeira, L. J. M. 2001. Influência de estratégias de manejo em pastagem de capim elefante na produção de leite de vacas Holandês x Zebu. Arquivo Brasileiro de Medicina Veterinária e Zootecnia 53:482-491.

Deresz, F.; Paim-Costa, M. L.; Cóser, A. C.; Martins, C. E. and Abreu, J. B. R. 2006. Composição química, digestibilidade e disponibilidade de capim-elefante cv. Napier manejado sob pastejo rotativo. Revista Brasileira de Zootecnia 35:863-869.

Fonseca, D. M.; Salgado, L. T.; Queiroz, D. S.; Cóser, A. C.; Martins, C. E. and Bonjour, S. C. M. 1998. Produção de leite em pastagem de capim-elefante sob diferentes períodos de ocupação dos piquetes. Revista Brasileira de Zootecnia 27:848-856.

Lima, M. L. P.; Berchielli, T. T.; Leme, P. R.; Nogueira, J. R. and Pinheiro, M. G. 2004. Concentração de nitrogênio uréico plasmático (NUP) e produção de leite de vacas mestiças mantidas em gramíneas tropicais sob pastejo rotacionado. Revista Brasileira de Zootecnia 33:1616-1626.

Mannetje, L.'t. 1978. Measuring biomass of grassland vegetation. p.151-178. In: Field and laboratory methods for grassland and animal production research. Mannetje, L.'t and Jones, R. M., eds. CABI Publishing, Cambridge.

Marchesan, E.; Vizzotto, V. R.; Rocha, M. G.; Moojen, E. L. and Silva, J. H. S. 2002. Produção animal em várzea sistematizada cultivada com forrageiras de estação fria submetidas a diferentes níveis de adubação. Ciência Rural 33:303-308.

Moreno, J. A. 1961. Clima do Rio Grande do Sul. Secretaria da Agricultura, Porto Alegre.

Olivo, C. J.; Sobczak, M. F.; Santini Charão, P.; Ziech, M. F.; Rossarolla, G.; Alves Machado, E.; Uberty, L. F. and Schwendler, E. 2006. Evaluation of an elephantgrass pasture, managed under agroecology principles, during the summer period. Livestock Research for Rural Development 18(2). Available at: <http://www.lrrd.org/lrrd18/2/oliv18021.htm>. Accessed on: Dec. 7, 2011.

Olivo, C. J.; Charão, P. S.; Pereira, L. E. T.; Ziech, M. F.; Mainerz, G. and Tyska, D. 2007. Produtividade e valor nutritivo de pasto de capim-elefante manejado sob princípios agroecológicos. Revista Brasileira de Zootecnia 36:1729-1735.

Olivo, C. J.; Ziech, M. F.; Meinerz, G. R.; Agnolin, C. A.; Tyska, D. and Both, J. F. 2009. Valor nutritivo de pastagens consorciadas com diferentes espécies de leguminosas. Revista Brasileira de Zootecnia 38:1543-1552.

Restle, J.; Roso, C.; Aita, V.; Nörnberg, J. L.; Brondani, I. L.; Cerdótes, L. and Carrilho, C. O. 2002. Produção animal em pastagem com gramíneas de estação quente. Revista Brasileira de Zootecnia 31:1491-1500.

Soares, J. P. G.; Berchielli, T. T.; Aroeira, L. J. M.; Deresz, F. and Verneque, R. S. 2004. Estimativas de consumo do capim elefante (*Pennisetum purpureum* Schum.), fornecido picado para vacas lactantes utilizando a técnica do óxido crômico. Revista Brasileira de Zootecnia 33:811-820.

Sobczak, M. F.; Olivo, C. J.; Gabbi, A. M.; Charão Santini, P.; Heimerdinger, A.; Souza da Silva, J. H.; Pereira, L. E. T.; Ziech, M. F. and Rossarolla, G. 2005. Evaluation of an elephantgrass pasture mixed with black oat managed under agroecological principles in winter period. Livestock Research for Rural Development 17(6). Available at: <http://www.lrrd.org/lrrd17/6/fati17071.htm>. Accessed on: Dec. 7, 2012.

Streck, E. V.; Kampf, N.; Dalmolin, R. S. D.; Klamt, E.; Nascimento, P. C. and Shnetder, P. 2002. Solos do Rio Grande do Sul. EMATER/RS, Universidade Federal do Rio Grande do Sul, Porto Alegre.