CHANGES IN SOIL FERTILITY AND PLANT NUTRIENT CONTENTS IN DEGRADED TROPICAL PASTURE AFTER RENOVATION

M.C. Macedo[1,2] and V.P.B. Euclides[1,2]
[1] EMBRAPA-CNPGC, CP 154 ,79002-970 ,Campo Grande, MS, Brazil.
[2] Researchers of CNPq, Brazil, Email: macedo@cnpgc.embrapa.br

ABSTRACT
A grazing experiment was conducted on an Oxisol testing five degraded tropical grasses renovated with two levels of fertilizer with the objective to study seasonal changes in plant nutrient contents and soil fertility. Total dry matter availability, green and dead matter availabilities, nutrient concentration in leaf tissue and soil fertility were the parameters measured. Availability of forage and leaf nutrients was significantly dependent on seasonal changes with green matter on offer decreasing over years. Soil fertility increased after renovation and declined thereafter. Soil available-P decreased and it was related to sustainability of green matter on offer. Soil organic matter mineralization was the greater N source to plants. Lack of regular N supply plus soil-P decline would be responsible for decreasing of stocking rate and animal production.

KEYWORDS
Oxisol, Savannas, fertilization, organic matter, phosphorus, *Brachiaria*, *Panicum.*

INTRODUCTION
Degradation of cultivated tropical pastures in the Savannas of Brazil is nowadays the most important problem of sustainability of animal production (Macedo,1995). This ecosystem is called 'Cerrados' and it is responsible for almost 50 % of beef production in Brazil. Since grazing is the economically most important way to feed the animals, pasture degradation must be avoided. In order to monitor degradation, some parameters of soil and plant which are related to forage yield should be studied to guide farmers and researchers to choose alternatives to sustain animal production throughout the time. This work had the objectives to estimate soil fertility, plant nutrient changes and to relate them to pasture degradation after renovation.

MATERIAL AND METHODS
This trial was situated at EMBRAPA-CNPGC (National Beef Cattle Research Center), Campo Grande, Brazil, and it was carried out from November 1991 to October 1994, on a clayed and distrofic Dark Red Latosol (Oxisol), with an ustic soil moisture regime. Experimental plots were 1.5 ha-paddocks of the following grasses: *Brachiaria decumbens* cv. Basilisk, *B.brizantha* cv. Marandu, *Panicum maximum* cvs. Colonião, Tobiatã and Tanzânia. In February of 1991, paddocks were divided, plowed,disked and fertilized with two fertilization levels: LF1 = 1.5, 400 and 50; LF2= 3.0 t/ha, 800 kg/ha and 50 kg/ha, of dolomitic limestone, 0-16-18 (N-P2O5-K20), and FTE, respectively. The experimental design was a RCB. Treatments were arranged as a factorial and analysed as a split-plot in space and time. Soil samples were taken yearly at the end of the rainy season (May) in the 0-15 cm layer, in three marked transects, and analysed for pH, OM, Ca, Mg, K, H+Al, Al and available P (Mehlich-1 and Resin). Leaf samples were taken on four periods: January (1),April (4), July (7) and October (10). The first fully expanded leaves were used as reference and sampled in each of the soil transects. Leaves were analysed for N, P, K, Ca, Mg and S contents. Total dry matter (TDM), green (GDM) and dead matter (DM) availabilities were obtained but considered only at the four cited sampling periods. Animal management and other sampling details are presented in Euclides,V.P. et al., 1997 (this volume). Data were analysed by GLM and ANOVA procedures from SAS software.

RESULTS AND DISCUSSION
Rainfall and temperature affected directly forage yield, leaf nutrient concentration and soil organic matter mineralization. Rainfall was quite effective in the dry period (May - September) but especially in July (Figure 1). For this reason, there was an increasing trend in leaf nutrient concentration from 1992 to 1994. In the rainy season of 1992/93 rainfall was lower than normal and pastures showed a build up of dead matter. A residual effect on dead matter produced and subsequent organic matter degradation was observed.

Significant effects on TDM, GDM and DM were observed for grasses, levels of fertilization, periods and years ($P< 0.01$). As discussed by Euclides et al. (1993) and Macedo et al. (1993), ADG and GDM were closely related. Also, there was a relationship between GDM and leaf P concentration in the previous study. However, this last correlation was not observed in the present trial, probably because residual soil-P available from fertilizer and organic fractions were sufficient to keep P-leaf concentration at higher levels than those observed by Macedo et al.(1993). P-leaf should be above a supposed critical level to affect GDM. Thus, to use P-leaf concentration as reference to monitor this pasture degradation was not valid. In order to reach critical levels, soil-P, probably, should be lower. Further studies must pay attention to this relantionship.

Grasses were significantly different ($P<0.01$) in N, P, K, Ca, Mg and S leaf concentration. Levels of fertilizer affected only P,K and S ($P<0.05$). Periods of year and experimental years were statistically different at $P<0.01$ (Table 2).

Soil fertility levels as related to the grasses tested were only different ($P<0.05$) for Ca^{++} and available soil-P (Mehlich-1 and Resin). Levels of fertilizer affected all variables measured ($P<0.01$), but K^{+}. Experimental years were significantly different ($P<0.01$) for all soil variables, except for Ca (Table 2). The importance of interaction of soil organic matter (SOM) and LF should be emphasized. SOM in LF2 decreased at higher rates than LF1 immediately after pasture renovation. First results in 1991, showed SOM in LF1= 4.30 and LF2 = 3.84 %. However, at the end of the trial (1994) SOM was: LF1= 2.91 and LF2= 2.94 %. This is likely to be caused by the high level of limestone applied which improved SOM mineralization and releasing N, P and S.

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Table 1
Means of total dry matter availability (TDM), green dry matter (GDM), average daily gain (ADG), N, P, K, Ca, Mg and S leaf tissue in observed periods, over three years.

PERIOD	DM	GM	ADG	N	P	K	Ca	Mg	S
	kg/ha		g/an/day			%			
JANUARY	2457	1079	587	1.30	0.16	1.47	0.41	0.34	0.14
APRIL	2672	979	342	1.61	0.18	1.54	0.46	0.37	0.17
JULY	2482	569	105	1.37	0.16	1.74	0.65	0.44	0.17
OCTOBER	2713	1028	711	1.92	0.18	2.04	0.44	0.32	0.18
F test sig.	1%	1%	1%	1%	1%	1%	1%	1%	1%

Table 2
Means for soil variables and stocking rate in an Oxisol under three years grazing, over five tropical grasses and two levels of fertilization (0-15 cm soil layer) .

YEAR	pH H2O	Org. Matter	Base Sat.	Alum. Sat.	Ca^{++}	Mg^{++}	K^{+}	Al^{+++}	CTC	P-Mel.	P-Res.	Stock. Rate
			%			meq / 100 cc				mg /kg		st./ ha[w]
1990 [z]	5.36	4.41	19	39	0.71	0.33	0.11	0.73	6.22	1.68	3.33	—-
1991	5.74	4.07	36	12	1.44	0.95	0.13	0.29	6.85	2.60	6.24	—-
1992	5.55	3.64	33	11	1.43	1.11	0.14	0.28	7.90	2.46	4.80	3.30
1993	5.55	3.39	32	9	1.45	1.08	0.12	0.23	8.16	2.76	4.05	3.08
1994	5.65	2.93	34	14	1.36	0.91	0.11	0.34	6.85	2.25	4.58	2.10
F test [x]	1%	1%	1%	1%	n.s.	1%	1%	1%	1%	1%	1%	1%

[z] Soil fertility before pasture renovation; [x] F test valid for 1991 to 1994, except SR 1992 to 1994;
[w] Average number of 250 kg steer/ha.

Figure 1
Monthly rainfall (mm) during experimental cycle and 20 years normal pattern for Campo Grande, MS, Brazil 20° 27' S.