AGROPASTORAL SYSTEMS AN ALTERNATIVE TO REVERT PASTURE DEGRADATION IN THE CERRADOS OF BRAZIL: PRELIMINARY RESULTS

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Abstract

A long term experiment was set to test the hypothesis that agropastoral systems could improve crop and animal production, being more profitable and sustainable relative to economical, biological and environmental aspects, than continuous and traditional crop and grazing pasture systems. Five farming systems are being tested: two traditional (continuous soybean annual cropping and continuous pasture cropping) and three agropastoral systems (two combinations of four by four years of rotational crop-pasture systems and one by three years of crop-pasture rotation). Animal production in continuous pasture cropping measured as liveweight gain/ha (LWG) are declining along the years in the sub-treatment without fertilizer maintenance. After five cycles of animal performance evaluation, average yields were 397 as compared to 444 kg of LWG/ha, in fertilized pasture. Agropastoral systems, in the other hand, have shown promising results of LWG, either in the one by three or in the four by four cropping combination, with animal production ranking from 547 to 789 kg of LWG/ha/year. Soil fertility in agropastoral systems increased substantially.

Keywords: Rotational crop-pasture system, cattle, liveweight gain, soil fertility, Brazilian savannas

Introduction

Savannas in the tropical world represent close to 43% of the arable land and in Tropical America represent close to 27%. Brazilian Savannas occupy an estimated area of 207 million ha (25% of total national territory) and potentially cultivated area is 127 million ha. Nowadays, introduced grass pasture cover close to 50 million ha (Macedo, 1999). Locally, Brazilian Savannas are called 'Cerrados'. Livestock production are close to 50% of the national production. Cerrados region experienced a large development since 1970 with special government programs of investment. Introduced grass pastures had a large increment when some *Brachiaria* species were introduced from Africa and showed to be well adapted to local environment and farming systems.

Soils are mainly Oxisols and Ultisols which are very acid and infertile (Adamoli et al., 1986). Levels of aluminum and manganese are high and base saturation and phosphorus levels are low for many grain crops and pastures. Pasture mismanagement has brought an important constraint to the region which is soil and pasture degradation. In order to overcome these problems many technologies are ready to be used and others need to be developed and adapted to farming systems in use. One new approach seems to be an innovative system to alleviate soil and pasture degradation: agropastoral systems.

Material and Methods

A long term experiment of continuous (traditional) and rotational agropastoral systems was set in 1993/94 in an Oxisol of Brazilian Savannas, Campo Grande, MS.

Five farming systems are being tested: two traditional (continuous soybean annual cropping and continuous pasture cropping) and three agropastoral systems (two combinations of four by four years of rotational crop-pasture systems and one by three years of crop-pasture rotation). Only systems involving animal production is reported here. Sub-treatments of different planting systems (traditional: disking only; dynamic and conservationist: disk plowing - moldboard plowing - subsoiling; and direct planting: no-tillage) and different tropical forages: *Brachiaria decumbens* cv. Basilisk (S1), *Brachiaria brizantha* cv. Marandu (S5) and *Panicum maximum* cv. Tanzania (S3), are also studied. Continuous pasture cropping of *Brachiaria decumbens* has two sub-treatments: with and without maintenance fertilizer. Two additional plots were included as treatment comparisons and checked for environmental impacts: an area of degraded pasture and one of natural vegetation.

The following description characterize the treatments (systems) and sub-treatments (fertilization, planting system):

S1.1- Continuous pasture - single and without maintenance fertilizer (CP);

S1.2- Continuous pasture - single and with maintenance fertilizer (CPF);

S3.7- Pasture four years followed by four years of soybean as summer crop (P4-CS4);

S3.8- Pasture four years followed by four years of soybean as summer crop and pearl millet as winter crop-grazed by animals (P4-CSW4);

S4.9- Cropping soybean as summer crop four years followed by four years of pasture (CS4-P4) ;

S4.10- Cropping soybean as summer crop and pearl millet for four years followed by four years of pasture(CSW4-P4);

S5.11- Cropping soybean as summer crop and pearl millet for one year followed by three years of pasture (CSW1-P3);

S5.12- Cropping soybean as summer crop and pearl millet for one year followed by three years of pasture established simultaneously with corn in the second year (CSW1-

C1+P3).

Animal production was estimated using weaned Nellore females (8-10 months old) managed in continuous grazing pattern. Two animals (testers) per paddock (0.7 ha) are fixed and used to estimate individual animal gain. Additional animals are added or taken away in order to maintain equal forage availability in *Brachiaria* and *Panicum* pastures equivalent to: 3.0 and 2.0 t of total dry matter, respectively, throughout the year. Animals are changed yearly, beginning May-June to start a new period of evaluation. Animals of the agropastoral systems graze the pearl millet planted after soybean for 45-65 days (ending May-early July) depending upon precipitation. This strategy promotes better animal gain and alleviates grazing in *Brachiaria* and *Panicum* paddocks.

Results and Discussion

Liveweight gain/ha (LWG) in continuously grazed pastures are declining along the years in the sub-treatment without fertilizer maintenance. After five cycles of animal performance evaluation, average yields were 397 as compared to 444 kg of LWG/ha, in fertilized pasture. Agropastoral systems, in the other hand, have shown promising results of LWG, either in the one by three or in the four by four cropping combination, with animal production ranking from 547 to 789 kg of LWG/ha/year (Table 1). One of the advantages reported for agropastoral systems is related to changes in soil fertility after annual crops planting. Since natural soil fertility in Cerrados of Brazil is very low, specially in base saturation and available P, pasture seeded after crops in a combined rotation of agropastoral systems can use residual fertilizer applied and improve animal production in an efficient way.

Soil fertility in the arable layer, estimated by measuring base saturation, organic matter and available P (Mehlich-1 and Resin) under annual crops increased substantially, either in continuous cropping or in crop/pasture rotation. Base saturation and available phosphorus

(Mehlich-1) increased from 3% and 1.20 mg/dm^3 to 40-58% and 2.46-11.75 $mg/dm^{3.}$, respectively, when comparing native vegetation and degraded pasture to treatments which received fertilizer (Table 2). Technologies for direct liming, fertilization and increasing soil fertility are available for Cerrados soils but economic constraints may pose difficulties to producers in many cases (Euclides et al., 1999). Thus, agropastoral systems may be an efficient strategy to improve animal production, avoiding pasture and soil degradation. Degraded pasture of Brazilian savannas can be recuperated by introduction of agropastoral systems and improve substantially animal production. Soil fertility can be highly increased by using agropastoral systems and pearl millet used as ley-cropping in winter (dry season) can be grazed as by-product for animal production and used as protection against weed proliferation in agropastoral systems.

References

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Table 1 - Animal liveweight gain in continuously grazed pastures (traditional), agropastoral systems and degraded pasture (15-16 years old) in Campo Grande, MS, Brazil.

Treatments	Years					Totals
	94/95*	95/96”	96/97”	97/98”	98/99”	
	Liveweight gain kg/ha					
CP	342	556	404	360	325	1987
CPF	385	497	379	497	464	2222
SC4- P4	-	-	-	-	789	789
SWC4- P4	-	-	-	-	686	686
SWC1- P3	-	591	503	-	-	1094
SWC1- C1+P3	-	842	522	-	-	1364
DEG. PAST.	68	90	116	111	177	562

* 282 grazing days; “ 337-340 grazing days.

Table 2 - Base saturation, organic matter content, and available P measured in the arable layer after six years of continuously grazed pastures, degraded pasture, natural vegetation, and agropastoral systems. Campo Grande, MS, Brazil.(May,1999)

Treatment	Base Saturation	Organic Matter	P- Mehlich-1	P- Resin
	%		mg/dm^3	
CP	39	3.55	2.2	4.1
CPF	45	3.45	2.8	6.0
SC4- P4	50	3.14	3.0	5.5
SW4- P4	55	3.10	3.1	6.3
SWC1- P3	40	3.54	3.8	7.4
SWC1- C1+P3	36	3.49	4.4	8.7
Degraded Pasture	9	2.99	1.2	2.5
Native Vegetation	2	3.16	1.2	3.0