# CONVENTIONAL AND MULTIPLE CROPPING SYSTEMS OF UPLAND RICE FOR RECLAMATION OF DEGRADED *Brachiaria decumbens* PASTURES

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## ABSTRACT

It was conducted a study of reclamation of a degraded pasture of *Brachiaria decumbens*, comparing the following treatments: 1) conventional broadcasting of fertilizer and disking; 2) reclamation as in 1, plus the introduction of *Calopogonium mucunoides* and *Stylosanthes guianensis*; 3) "Barreirão" system (recuperation using upland rice, cropped simultaneously with the grass); 4) conventional system of upland rice (soil preparation using a heavy plougher and disking, low level of fertilizer, without liming); 5) modified Barreirão-1 (including liming and increasing fertilizer level); 6) modified Barreirão-2 (as in treatment 5, but weeding 20 days after rice emergence); and 7) control. There was a significant increase in the grass dry matter production in the treatments without rice compared to the control, specially the green fraction of leaves and stems. The grass production was afected by the rice in the remaining treatments, due to a significant increase of its biomass. The benefits of the rice grain yield were not enough to account fully for the recuperation costs, but helped substantially in that matter. The real benefits of the pasture reclamation, however, would be truly available only over time.

**Additional index words**: Cerrados, *Oryza sativa*, tropical grasses.

## RESUMO

### Sistemas de cultivo simultâneo de arroz de sequeiro com *Brachiaria decumbens* e recuperação direta de pastagens degradadas

Foi conduzido um estudo de recuperação de pastagem degradada de *Brachiaria decumbens* cv. Basilisk, comparando-se os seguintes tratamentos: 1) recuperação direta da pastagem, com fertilização a lanço e incorporação com grade pesada; 2) recuperação direta da pastagem com a introdução de *Calopogonium mucunoides* e *Stylosanthes guianensis*; 3) sistema "barreirão" (recuperação da pastagem com cultivo de arroz de sequeiro); 4) sistema convencional de plantio do arroz (preparo de solo com grade pesada e grade niveladora, baixa adubação, sem calagem); 5) sistema "barreirão" modificado-1 (uso de calagem e maior nível de adubação); 6) sistema "barreirão" modificado-2 (calagem e adubação como em 5, porém com capina 20 dias após a emergência); 7) pasto degradado. Os tratamentos de recuperação da pastagem sem arroz resultaram numa produção de matéria seca da gramínea significativamente maior do que o controle, especialmente quanto à proporção de material verde. Nos tratamentos com plantio simultâneo de arroz, a produção da gramínea foi afetada pelo aumento da produção de biomassa do arroz, causada proporcionalmente pelos fertilizantes usados nos tratamentos. Os benefícios da produção de arroz não foram suficientes para cobrir todos os custos da recuperação da pastagem, mas contribuiram substancialmente para sua diminuição. Os benefícios reais da recuperação só poderão ser medidos a médio e longo prazo, nos efeitos residuais da adubação e persistência da pastagem.

**Palavras-chave**: Cerrados, gramíneas tropicais, *Oryza sativa*.

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## INTRODUCTION

The Cerrados region of Central Brazil are suitable for husbandry. However, most of the soils in the area are acidic and of low natural fertility (Goedert, 1983; Lopes & Cox, 1977; Malavolta & Kliemann, 1985). The introduction of *Brachiaria* in the 70's led to a wide land usage, and nowadays the area is one of the largest beef production in Brazil. Unfortunately, those pastures were established with low technology, without the introduction of pasture legumes, for example, or any maintenance fertilization, and have been exploited inadequately ever since. As a result, most of the pastures in the area are on an advanced stage of degradation, with a very low carrying capacity. There are several studies on the subject of pasture reclamation in the area (Macedo & Zimmer, 1990; Zimmer *et al.*, 1994), being the most known the "Barreirão" system (Oliveira *et al.*, 1995). In such a system, degraded pastures are reclamated through the use of an inverted soil preparation, by harrowing and ploughing, with a simultaneous cropping of upland rice and replacement of *B. decumbens* by *B. brizantha*, a more productive grass. Thus the rice crop is helping to reduce the costs. However, as the system was developed at first hand to increase the rice production, there are doubts about its capability upon the pasture yield maintenance over time. Specially considering that the upland rice varieties used in the area are not so responsive to high levels of fertilizers, and the levels used are not always enough for a full pasture recuperation, or to replace a less exigent grass as *B. decumbens*, for example, by a larger but more exigent producer like *B. brizantha*.

This paper reports the results of a study conducted at EMBRAPA's Centro Nacional de Gado de Corte (National Beef Cattle Research Centre), Campo Grande, MS, where different treatments of pasture recuperation were compared.

## MATERIAL AND METHODS

The experiment was conducted on a degraded *B. decumbens* pasture, on a clay Dark Red Latosol (5,4 pH in water; 30.88 % OM; 0.63, 0.31, 0.07, 0,41, 1.01, e 7.26 cmol/kg of Ca, Mg, K, Al, BS e CEC, respectively; 14 e 31% of bases and Al saturation, respectively; and 1.7 ppm of P Mehlich-1). Field plots of 6.3 x 10m each in randomized blocks, with four replications, were prepared for the following treatments: 1) conventional fertilizer broadcastting (90 kg/ha simple superphosphate-SSP, 400 kg/ha of 4-20-20 plus 50 kg/ha FTE BR-16, 2.0 ton/ha lime) and disking (direct); 2) reclamation as in 1 plus the introduction of *Calopogonium mucunoides* e *Stylosanthes guianensis*; 3) "Barreirão" system (using upland rice, 12, 90, and 48 kg/ha of N, $P_2O_5$, and $K_2O$, plus 30 kg/ha of FTE BR-16, 20 kg/ha zinc sulphate and 45 kg/ha urea applied 45 days after planting - DAP, introduced simultaneously with 3.0 kg/ha of *B. brizantha* seeds); 4) conventional system of upland rice cropping (soil preparation using a heavy harrow and disking, fertilized with 150 kg/ha of 4-20-20, no lime); 5) modified Barreirão-1 (2.0 ton/ha lime, 225 kg/ha of SSP, 12, 90, 48 of N, $P_2O_5$, and $K_2O$, respectively, 30 kg/ha FTE BR-16, 50 kg/ha urea 15 DAP plus 50 kg/ha urea 35 DAP); 6) modified Barreirão-2 (as in treatment 5 but weeding 20 days after rice emergence); and 7) control. Excluding treatment 4, in all others an inverse soil preparation system was used, firstly using a heavy plougher followed by harrowing (30-35 cm depth). The rice variety used was "Caiapó", planted on November 21, 1994, and harvested (22.4 $m^2$/replication) on March 27, 1995.

**TABLE 1 - Dry matter (kg/ha) of *B. decumbens* and grain yield of the upland rice cv. Caiapó in different pasture reclamation treatments. Each value is the mean of four replications.**

| Treatment | B. decumbens | | | | Rice | | |
|---|---|---|---|---|---|---|---|
| | Green leaves | Stems | Dead leaves | Total | Straw | Grain shell | Grain |
| Control | 1212b | 1330b | 3987a | 6529b[1] | | | |
| Direct reclamation | 1712a | 5226a | 3124b | 10062a | | | |
| Direct + legume | 1555[2]a | 5093[2]a | 2812[2]b | 9449[2]a | | | |
| Conventional rice planting | 537c | 850b | 599c | 1988c | 4354c | 2366c | 993c |
| Barreirão | 604c | 956b | 475c | 2035c | 6234b | 4197b | 2225b |
| Modified barreirão-1 | 368c | 688b | 334c | 1391c | 7850a | 6459a | 2594ab |
| Modified barreirão-2 | 330c | 428b | 286c | 744c | 6842ab | 5878ab | 2788a |

[1] 300 days of growth in the season. All other treatments: 135 days.
[2] including the legumes
Values followed by the same letter in the column are not different (Tukey, p>0.05)

Samples of *B. decumbens* were harvested (2 m²/replication) on May 15, 1995. The harvested rice was separated in straw, grain shell, and grain. *B. decumbens* was separated in live and dead leaves and stems. The legumes in treatment 2 were separated similarly.

## RESULTS AND DISCUSSION

For some reason beyond experimental control, *B. brizantha* seeds failed to germinate. However, a prior determination of available *B. decumbens* seeds in the arable soil layer indicated the presence of 75 kg/ha, with a 50% germination power, meaning 37.5 kg/ha of viable seeds of *B. decumbens*. This is highly significant, since the recommended planting is 2-3 kg/ha of viable seeds of this species. For that reason, no re-seeding of *B. brizantha* was done, and the experiment was carried over with *B. decumbens*. The number of emergent plants in treatments 1,2,3,4,5 and 6, at 20 days after rice emergence, were 17, 29, 23, 65, 25, 28 and 29 plants/m², respectively. The largest plant emergence occurred, as it would be expected, on the upland rice conventional planting system (treatment 4), without plowing. The inverse soil preparation system reduced about 50% the number of emergent *B. decumbens* plants, which is not so important, as the number of germinated plants is more than enough for a good pasture establishment. There was an emergence of 12 and 82 plants/m² of *C. mucunoides* and *S. guyanensis* in treatment 2, respectively. Such a result indicated a good pasture formation in all treatments, with a good legume introduction.

*B. decumbens* total dry matter production in treatments 1 and 2 was significantly higher than the control (Table 1). The distribuition of plant fractions was also variable within these treatments, with a larger amount of dead leaves on the control and green leaves in the direct grass recuperation treatment. Total dry matter of the grass was greatly reduced in those treatments where rice was included, as compared to the control.

Rice yield increased proportionally with the increase on the fertilizer and liming, from the conventional rice planting system to modified Barreirão-2. However, there was a larger increase in the straw and grain shell than in grain production; this increase in rice biomass may result in rice bedding and shaddowing of the grass, retarding its establishment.

Table 2 present the overall balance of each treatment costs. The introduction of legumes resulted in a big increase of costs, due to the large costs of *S. guyanensis* seeds recently released by EMBRAPA. The rice grain yield was not enough, in any of the treatments, to cover all the costs of the respective treatment, although accounted for reducing overall costs. On the other hand, it has to be considered that the residual effect of each treatment would be seen only in the long run.

**TABLE 2 - Cost of the pasture recuperation treatments, receipt and benefit (US$/ha) of the rice grain production.**

| Treatment | Cost | Receipt | Benefit |
|---|---|---|---|
| Control | | | |
| Direct reclamation | 272 | | |
| Direct + legume | 350 | | |
| Conventional rice planting | 163 | 115 | -48 |
| Barreirão | 303 | 258 | -44 |
| Modified barreirão-1 | 390 | 302 | -88 |
| Modified barreirão-2 | 397 | 325 | -72 |

## CONCLUSIONS

Liming and fertilization did increase rice grain yield planted simultaneously with *Brachiaria* grass. On the other hand, grasses had its dry matter production decreased.

Benefits received by grain yield of rice did not account to cover all the costs but responded up to 70-80% of the total expenses of pasture reclamation.

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