WCCLF 2021

II World Congress on Integrated Crop-Livestock-Forestry Systems

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WCCLF 2021 PROCEEDINGS

Embrapa

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II WORLD CONGRESS ON INTEGRATED CROP-LIVESTOCK-FORESTRY SYSTEMS

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PREFACE

Promoted by the Ministry of Agriculture, Livestock and Food Supply - MAPA; Brazilian Agricultural Research Corporation - Embrapa; ICLF Network Association; State Secretariat for the Environment, Economic Development, Production and Family Agriculture - SEMAGRO; Federation of Agriculture and Livestock of Mato Grosso do Sul - Famasul; and FB Eventos, the II World Congress on Integrated Crop-Livestock-Forestry Systems (WCCLF 2021) took place on the 4th and 5th May 2021 in a 100% digital format.

The objective of the Congress was to provide a forum for discussion, theoretical insights and practical applications related to technology as well as economic and environmental aspects of mixed agricultural systems that combine integrated production of crops, animals and trees in the same area, having an efficient use of inputs, all being essential for food security in the future.

ICLF is a production strategy that integrates crop, livestock, and forestry farming in the same area, in a consortium, rotated or in succession, so that there is interaction among components, generating mutual benefits.

For two days, we discussed issues related to challenges and opportunities for ICLF systems around the World; solutions and demands from Agribusiness Companies; scenarios and trends of ICLF in the World; current hot topics in ICLF; solutions and demands for ICLF from the farmer's view; Public Policies for Supporting ICLF; and innovation on ICLF systems.

The integrated agricultural production systems can be implemented combining two or three components, according to the particularities of each farm and region. They can also be adopted in small, medium, and large farms, in different biomes, using different crops, livestock and trees species. Among the many benefits of ICLF are increasing total yields of a given area, diversification of income sources, better use of inputs, improvement of soil chemical, physical and biological qualities, along with improvement of animal welfare as well as jobs and income generation. In addition, ICLF systems reduce pressure to clear new areas, it helps to recover degraded low yielding areas while mitigating greenhouse gas emissions, increasing carbon sequestration in soil and biomass. These benefits corroborate with three of the Sustainable Development Goals - SDGs:

- SDG 2 - End hunger, achieve food security and improved nutrition and promote sustainable agriculture;
- SDG 13 - Take urgent action to combat climate change and its impacts; and
- SDG 15 Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

These Proceedings report 166 scientific contributions approved by the scientific committee of the WCCLF 2021 and 18 papers from speakers that also contributed to this publication.

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Lucimara Chiari (Executive Secretary of the WCCLF 2021)

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HERBAGE MASS AND NUTRITIVE VALUE OF THE IPYPORÃ GRASS DURING ITS ESTABLISHMENT IN SILVOPASTORAL SYSTEMS IN SOUTHERN AMAZON

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ABSTRACT

The tolerance to the shade is the first characteristic to be observed in the choice of forage to form an integrated system with trees. This work aimed to evaluate the production and quality of forage in the establishment of *Ipyporã* grass in silvopastoral systems in southern Amazon. The experiment was carried out at Embrapa Agrossilvipastoril - MT - Brazil. Five treatments were evaluated: without trees; double rows eucalyptus in a density of 260 trees ha^{-1}; triple rows of 340 trees ha^{-1}; double rows in a density of 130 trees ha^{-1}; simple rows with a density of 120 trees ha^{-1}. In the Ipyporã grass formed under the treatments was evaluated the herbage, leaf, stem, and dead material mass, leaf protein, crude protein, NDF, ADF, canopy height, and volumetric density. The integrated system with the highest density of trees decreased the herbage and leaf mass, and increased the content of protein in the leaves. Crude protein, ADF, height, and leaf volumetric density were somewhat affected by the shade in the integrated systems and not only the tree density seemed to influence on them, but also the tree arrangement. Thus, tree density and arrangements should be carefully planned to better establishment of pasture in integrated systems.

Key words: Crude protein; iCLF; shading

INTRODUCTION

The ICLF strategy, in its several modalities, has sustainable agricultural technologies for the production of food with less environmental impact (ALMEIDA et al., 2019; BEHLING et al., 2013). In one of its modalities, the silvopastoral system, trees are included in the pasture, bringing improvements in microclimate and animal welfare, in the quality of forage and soil and in the mitigation of greenhouse gases (ALMEIDA et al., 2019). However, the trees alter the quantity and quality of the light that reaches the undergrowth, promoting changes in the establishment of the grass (PEZZOPANE et al., 2020). Information on the tolerance of materials available to the shading is still limited (ALMEIDA et al., 2019), and testing them in such conditions is essential for the correct management of forages in ICLF systems.

The forage tolerance to the shade is the first characteristic to be observed in the choice of a forage to form an integrated system with trees (ALMEIDA et al., 2019). The stage of establishing the pasture is the phase in which forage grasses are more sensitive to shading, however, grasses of the genus *Urochloa* can tolerate up to 50% of shade, maintaining satisfactory production (ALMEIDA et al., 2019). Thus, this work aimed to evaluate the production and quality of forage in the establishment of Ipyporã grass in silvopastoral systems in southern Amazon.

MATERIAL AND METHODS

This work was carried out at the experimental field of the Embrapa Agrossilvipastoril, Sinop, state of Mato Grosso – Brazil. The climate of the region following the Köppen classification is Aw. The soil was classified as Hapludox (Soil Taxonomy, 1999), with clay textures, in flat relief.

The evaluated treatments were: A – Control (without trees); B - double rows of eucalyptus (*Eucalyptus urograndis* clone H13) in a density of 260 trees ha^{-1} planted at the edges of the pasture with 50 m between the double rows of eucalyptus; C - triple rows of eucalyptus spaced 15 m apart at a density of 340 trees ha^{-1} within the pasture; D - double rows of eucalyptus in a density of 130 trees ha^{-1} planted at the edges of the pasture with 50 m between the double rows of eucalyptus; E - simple rows of eucalyptus spaced 21 m apart, with a density of 120 trees ha^{-1} within the pasture (Figure 1). The eucalyptus trees were planted in 2011.

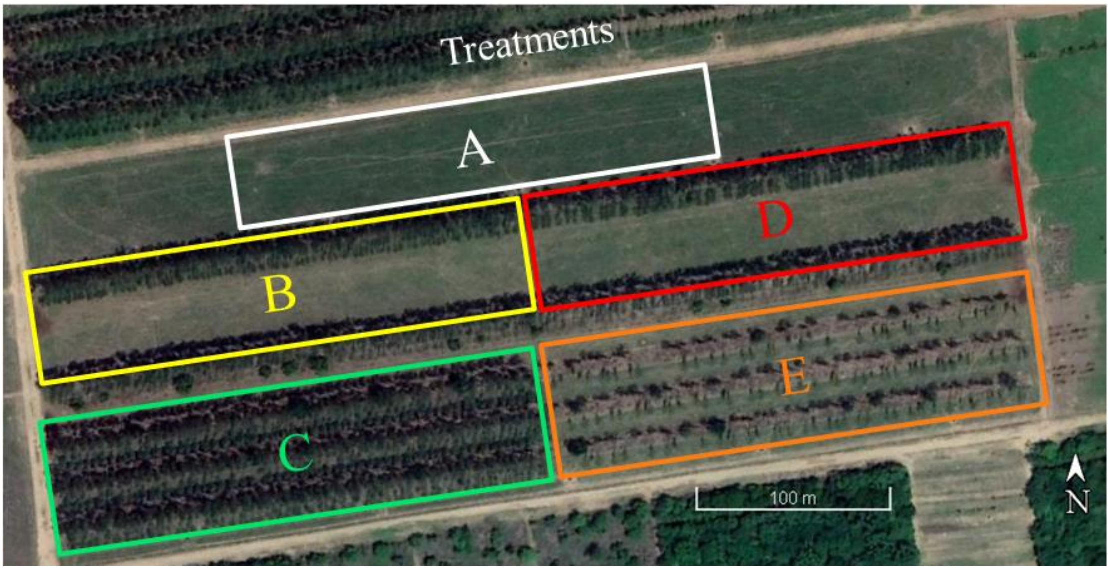

Figure 1. Distribution of treatments assessed in one of the experimental blocks.

The Ipyporã grass (BRS Ipyporã) is a hybrid developed by crossing *Urochloa ruziziensis* with *Urochloa brizantha* (VALLE et al., 2017). It was sowed in no-tillage between the last week of January and the first week of February, 2020, with spacing between rows of 0.45 m and sowing rate of 7 kg ha^{-1} of viable pure seeds, according to the minimum recommendations contained in Valle et al. (2017). The fertilization in the sowing line was 16 kg ha^{-1} of N, 56 kg ha^{-1} of P_2O_5, and 36 kg ha^{-1} of K_2O.

The experimental design was a complete randomized block with two replicates. Each plot of 1.5 ha was divided in 5 paddocks. Two samples of the forage mass from 1 m² template were collected in the 3 central paddocks of each treatment, making 12 samples for each treatment (2 blocks x 2 samples per paddock x 3 paddocks). The height of the grass at the time of the sampling was measured from 20 points per paddock with the aid of a graduated ruler. The forage collection was carried out at 15 cm (residue) from the soil surface at 70 days after the sowing of the grass, before the animals entered for uniformization grazing. The mass from 1 m² was weighed in the field with the aid of a digital scale, thus obtaining the green mass. A subsample was collected, taken to the laboratory, and separated into leaf, stem, and dead material, which were submitted to 65 °C until constant weight in a forced air circulation oven. Leaf and stem were subsequently milled at 1 mm of mesh size in the Willy mill and submitted to analysis for the determination of Protein, using the Dumas combustion method (SWEENEY, 1987), and NDF and ADF, according to the methodology described by Silva and Queiroz (2002). Data were subjected to variance analysis and means were compared by the Duncan test at 0.10 level of probability.

RESULTS AND DISCUSSIONS

The production of herbage mass was higher in A, B, and D treatments and the C showed the lowest value, around 3,000 kg DM ha^{-1} (Table 1). The highest value of herbage mass was around 3,600 kg ha^{-1}. Values like those also were observed by Echeverria et al. (2016) with the same material in pasture without trees. In the treatment C, a system with a higher density of trees, also had the lowest leaf production in relation to another treatments, and also lower stem production compared to the Control. The amount of dead material did not differ between treatments.

Table 1. Herbage, leaf, stem, and dead material mass, leaf protein, NDF, ADF, and crude protein of the *Ipyporã* grass in the assessed treatment.

Variable	Treatment					SEM*
	A	B	C	D	E	
Herbage mass (kg DM ha^{-1})	3,612 A	3,525 A	2,963 B	3,351 A	3,630 A	99.40
Leaf mass (kg DM ha^{-1})	1,931 A	1,950 A	1,568 B	1,837 A	1,953 A	49.70
Stem mass (kg DM ha^{-1})	1,160 A	1,033 AB	883 B	995 AB	1,048 AB	42.57
Dead mass (kg DM ha^{-1})	521 A	542 A	512 A	519 A	629 A	31.66
Leaf protein (%)	17.3 B	19.5 A	19.2 A	17.8 B	18.0 B	0.24
Crude protein (%)	13.1 B	14.8 A	14.1 AB	13.5 B	13.2 B	0.22
NDF (%)	44.3 A	44.0 A	43.6 A	44.2 A	42.8 A	0.41
ADF (%)	21.4 A	20.4 AB	20.6 AB	20.8 AB	19.9 B	0.22
Canopy height (cm)	48.8 A	44.9 B	44.3 B	44.3 B	44.6 B	0.84
Herbage volumetric density (kg cm^{-1} ha^{-1})	74.4 A	78.8 A	70.1 A	77.5 A	82.0 A	2.44
Leaf volumetric density (kg cm^{-1} ha^{-1})	39.8 AB	43.9 A	36.5 B	42.9 AB	44.4 A	1.31
Stem volumetric density (kg cm^{-1} ha^{-1})	24.0 A	22.8 A	21.1 A	22.7 A	23.4 A	0.95

Means with the same letter in the line are not significantly different by the Duncan test at level of $p<0.10$. *Standard error of the mean.

Treatments Control, D, and E had the lowest leaf protein content compared to the treatments B and C (Table 1). The crude protein content was higher in treatment B, which differed from Control, D, and E. The levels of NDF did not differ between treatments, but the ADF was lower in the treatment E in relation to the Control. The Control was the treatment with the highest canopy height of *Ipyporã* grass, differing from all integrated systems, which presented the same average of height. Herbage and stem volumetric density were similar between the treatments, however, leaf volumetric density was higher in the treatments B and E, differing of the C. Herbage and stem volumetric density did not differ between the treatments, only leaf had different volumetric density in the treatment C compared to B and D.

The mass production of herbage and leaf in the establishment of the *Ipyporã* grass was influenced by shade in the integrated system with more tree density. As almost 10 years have passed since eucalyptus planting, the shade is more present and can affect more the plants growing under it, as here observed. Geremia et al. (2018) assessing the same treatment C, 3 years after eucalyptus planting, observed a decreasing of around 50% in term of herbage mass of *Urochloa brizantha* cv. Piatã under grazing compared to the Control treatment, without shade. Geremia et al. (2018) also observed increase in the crude protein in pasture shaded formed by Piatã, and no difference of NDF between the treatments. The increase in nutritional value of shaded grasses, especially in protein content, has been reported by some researches (ALMEIDA et al., 2019; PEZZOPANE et al., 2020). Treatment E showed the lower value of ADF than the Control, indicating a possible influence of the shade in the decrease of the components of lower digestibility in the Ipyporã grass. Leaf volumetric density indicated that the level of shade may influence the grass structure in terms of leaves, what should be a point of future investigations, mainly its effects on the animal production. The results presented here are initials, collected in a time in which the grass structure is not well-formed. Thus, only future evaluations will allow validating this material under grazing to compose iCLF systems.

CONCLUSIONS

The integrated system with the highest density of trees decreased the herbage and leaf mass of the Ipyporã grass in establishment and increased the content of protein in the leaves. In different ways, crude protein, ADF, and leaf volumetric density were somewhat affected by the shade in the integrated systems, in these cases, not only the tree density seemed to influence on them, but also the tree arrangement. All shaded systems reduced the height of the grass. Thus, tree density and arrangements should be carefully planned to better establishment of pasture in integrated systems.

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