DAMAGE AND IMPACTS BY DAIRY CALVES IN FRUIT TREES OF SILVOPASTORAL SYSTEMS

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ABSTRACT
Compatibility between fruit trees and animals is fundamental to the success of silvopastoral systems. The aim was evaluating the compatibility between fruit trees and dairy calves in silvopastoral systems. The experiment was carried out on the experimental basis of milk production in integrated systems, at Embrapa Agrossilvipastoril, located in Sinop, Mato Grosso state, Brazil, during 2018, when the fruit species already were 48 months old after planting. Five silvopastoral systems with fruit tree species were evaluated, being: caja fruit, red guava, cashew tree var. Embrapa 51 and cashew tree var. CCP76 and acerola fruit with Tifton-85 grass, under a complete block design, with two repetitions, under continuous stocking. All fruit trees had some damage to their structure by consuming the animal. The *acerola* fruit was the most damaged, reaching levels of unfeasibility, the *caja* fruit had slight damages and no impact on its architecture and the cashew trees had substantial damages, however, the impacts of these damages were null on the architecture of the treetops. The guava had some damages but had positive impacts on the architecture of the treetops. We recommend red guava and cashews like the best species to intercrop with dairy calves in silvopastoral systems.
Key words: intercropped; architecture; browse

INTRODUCTION

Population growth has been accompanied by several environmental and social impacts, among which the biggest impacts have been climate change and increased deforestation, however what has been required are agricultural systems that aim at sustainability, food security and bring economic power to the rural producer (BALBINO et al., 2011).

Brazil is one of the largest food producers in the world, so several technologies have been developed to obtain greater productivity per hectare, such as silvopastoral systems, where it is possible to integrate trees with the livestock, which promote animal welfare with the use of natural shading provided by trees, increases the income of the producer with the production of goods that can be traded, intensifies productivity and guarantees the production of food while respecting environmental sustainability (FEY et al., 2015).

Following, silvopastoral systems with tree species has been valued, by addition extra income to the producer, have kept the tree upright, without the need to cut it down to obtain income, like is the case of fruit tree species (GIUSTINA et al., 2017). However, these species have structures that can be attractive to the animal's consumption, which would make it unfeasible. In this way, studies that confirm the animal's preferences and compatibility between the coexistence of the species is urgent in the productive environment.

In the experiment, five silvopastoral systems were tested, composed of five fruit trees intercropped with Tifton 85 (*Cynodon* spp), as follows: *caja*, red guava var. *Paluma*, cashew var. *Embrapa* 51 and var. CCP 76, and *acerola* var. *Sertaneja*, focusing on the compatibility between fruit species and animals and their respective damages and impacts, indicating which species would be better adapted to the integrated system.

MATERIAL AND METHODS

The experiment was carried out on the experimental basis of milk production in integrated systems, at *Embrapa Agrossilvipastoril*, located in Sinop, Mato Grosso state, Brazil (11º51'43" S, 55º35'27" W, 384 m asl). The climate of the region is classified as a tropical humid or sub-humid Am type (Köppen) (ALVARES et al., 2013), with an average annual temperature of 25ºC, relative air humidity of 76%, and precipitation of 2,020 mm (INMET).

The experimental area measured 3.75 ha, where the five silvopastoral systems were distributed. These systems were composed of eight fruit trees intercropped with Tifton-85 (*Cynodon spp*), as follows: *caja* (*Spondias mombin*); red guava (*Psidium guajava*) cv. *Paluma*; cashew (*Anacardium occidentale*) var. *Embrapa 51* (*EMB51*) and var. *CCP76* and *acerola* (*Malpighia glabra*) var. *Sertaneja*.

A completely randomized block design was adopted, with two replications of area per treatment. Each 1,650 m^2 experimental unit received different numbers of fruit tree seedlings, according to the canopy architecture and the spacing recommended for single cultivation. The plots with *caja*, and guava trees and the two cashew varieties received 27 plants spaced 4 × 10 m. The plots with *acerola* received 36 plants distributed in a double center row with 4 × 4 × 10 m spacing. Only the central plants in the inter-rows were evaluated in each plot disregarding the borders.

The forage was planted using seedlings after allocation, correction, furrowing, fertilization, and planting of the fruit species. Both the forage plant and the fruit tree were fertilized following basic recommendations for the species.

In this study, we evaluated the damage and impacts of these damages on the canopy tree architecture caused by dairy calves in silvipastoral systems.

The fruit trees were monitored to assess the degree of damage caused by the presence and actions of the animals. The initial method used was Porfírio-da-Silva et al. (2012) and had to be adapted to assist in the assessments caused by the animals' browse. They were described as: breakage of the main stem or trunk (Tq); lesion of the trunk reaching the wood through the removal of the foreign exchange tissue(T1); breaking of branches / secondary branches (Gq); skin lesion, without reaching the exchange rate (C1); breaking of thin branches and consumption of leaves or branching (Rq) and lesion greater than 5 cm in diameter (D1).

For each damage, a system of weights and grades was established, being: Tq = 10.0; T1 = 4.0; Gq = 2.0; Cl = 1.5; Rq = 1.0; and Dl = 1.0 (Figure 1). The final score for everyone was calculated as the sum of the respective incident damages.

Figure 1. Types of damage to fruit trees caused by dairy calves in silvopastoral systems. a) Tq (break of the main stem or trunk), b) Tl (injury of the trunk reaching the wood through the removal of the exchange tissue), c) Gq (breaking of branches / secondary branches), d) Cl (bark injury, without reach the exchange rate), e), Rq (breaking of thin branches and leaf consumption, or browse) and f) Dl (lesion greater than 5 cm in diameter).

During the experiment, it was noted that the method adopted at the beginning did not show the reality obtained during the study observed in the field, with the need to create a new methodology that would be able to meet the analyzed damages. The new evaluation methodology was created after intense training of the evaluator, through visual and tactile observation of the fruit trees for an average period of six months. The impacts caused by the damage to the architecture of the trees were considered on a scale that varied from "-3 to +3", where the damage evaluated with "-3" would be where the action of the animals had a negative impact on the fruit tree canopy (Figure 2a); the value "0" was considered when the animals' branching did not change significantly in the canopy shape (Figure 2b), and "+3" would be evaluated when the presence of the animals brought benefits to the development of the fruit tree canopy (Figure 2c) , increasing the "skirt height" and eliminating undesirable shoots (GUIMARÃES FILHO and SOARES 2003).

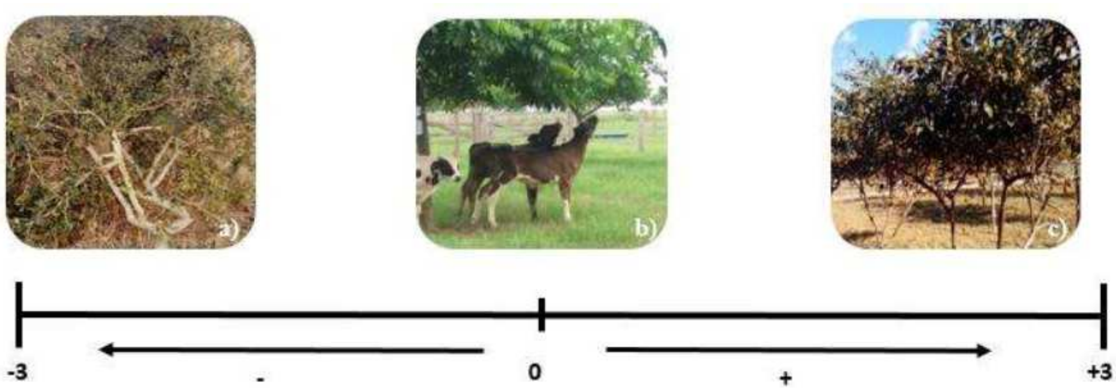

Figure 2. Impact degree of animal damage on architecture of fruit trees canopy. a) Unviable fruit tree, b) fruit tree with zero impact and c) fruit tree benefited by the branching process.

The data were subjected to Kolmogoroff-Smirnoff-based normality tests to evaluate data distribution via a normal PROC univariate procedure. The analysis of variance was performed using the PROC Mixed procedure. Means were compared using PDIFF at 5% probability. The software utilized for statistical analysis was SAS 9.2 (SAS Institute, 2008).

RESULTS AND DISCUSSIONS

The coexistence of calves with fruit trees promoted damage that was dependent only on the silvopastoral system (P = 0.0013). Cashew trees were the fruit trees that suffered the most damage (cashew *CCP76* with 3.7 and cashew EMB51 with 4.3), followed by acerola fruit (3.0), while for cashew and guava the least damage was observed (1.3 and 1.7, respectively).

In both cashew varieties (*CCP76* and *EMB51*), the damage “damage to the trunk reaching the wood by removing the foreign exchange tissue”, “skin damage, without reaching the exchange” and “injury greater than 5 cm in diameter” were identified, caused mainly by chewing, but the impacts to canopy architecture were close to zero. Although chewing the bark of trees by cattle is considered an unusual damage, according to Porfírio-Da-Silva et al. (2012), this was observed in these fruit trees during the experimental period.

The damage degree caused after the adoption of a new “fruit tree damage impact” methodology, there was an effect only from the silvopastoral system (P <0.0001). The *acerola* fruit was the tree species most negatively impacted (-2.4) to its architecture, while the cashew trees and the cashew tree were not affected by the damage caused by the animals (-0.1; on average), and the guava tree was positively impacted (0.9).

CONCLUSIONS

The use of *caja* fruit intercropped with Tifton-85 grass grazed by dairy herd calves did not suffer negative by animal action in the coexistence. Despite to the damage by animals, the impacts to architecture of the cashew trees (var. *CCP76* and *EMB51*) were null and can used to intercropped. Red guava var. *Paluma*, can be indicated for silvopastoral systems in the north of Mato Grosso, with positive action of the browse in the architecture of the tree canopy.

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