Reducing competition in crop-livestock-forest integrated system by thinning eucalyptus trees

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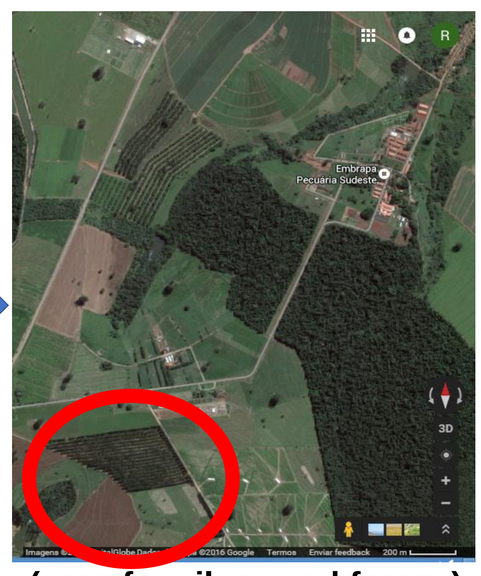
Introduction

- ✓ Integrated livestock production systems (iCLFS), in which trees and crops are cultivated in rotation, succession or association with pastures, are alternatives for the sustainability of agriculture.
- ✓ These systems present potential to mitigate GHG emissions by removing carbon from the atmosphere and storing it in biomass and in the soil.
- ✓ Depending on the arrangement and population of trees, strong competition may occur between the plant species in these systems, reducing yield of at least one of them. Trees thinning is considered a good management practice to reduce competition.
- ✓ This study aimed to evaluate the effects of eucalyptus trees thinning on yield and nutritive value of corn for silage and palisadegrass (*Urochloa brizantha* cv. Piata) in a crop-livestock-forest integrated system.

Material and methods

The study was carried out at Embrapa Southeast Livestock - Sao Carlos – Sao Paulo State - Brazil



Evaluations: Assessments of plant variables (corn for silage and forage), as well as of photosynthetically active radiation (PAR) incidence and soil moisture were performed between October 2016 and March 2018 in a crop-livestock-forest and, for comparison, in a crop-livestock system.

Integrated Crop-livestock-forest system: eucalyptus trees (*Eucalyptus urograndis* clone GG100) were planted in April 2011, in single rows, with a 15 x 2 m spacing. In 2016, trees were thinned and the spacing changed to 15 x 4 m.

March - 2016

July - 2016

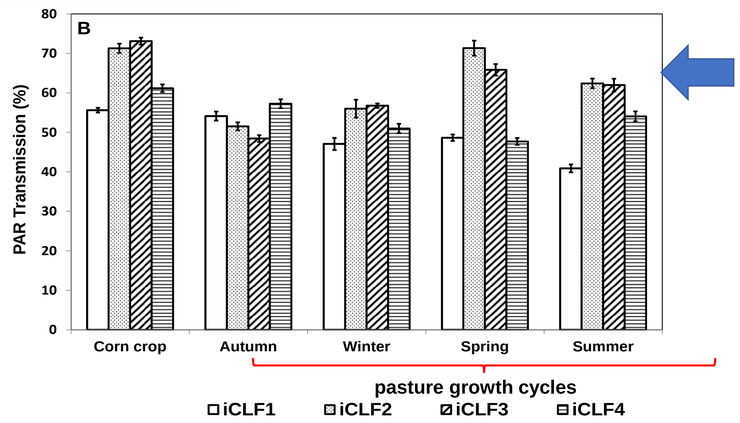
iCLF – Corn crop development

iCLF4 iCLF3 iCLF2 iCLF1

iCLF – distance from North eucalyptus rows evaluated

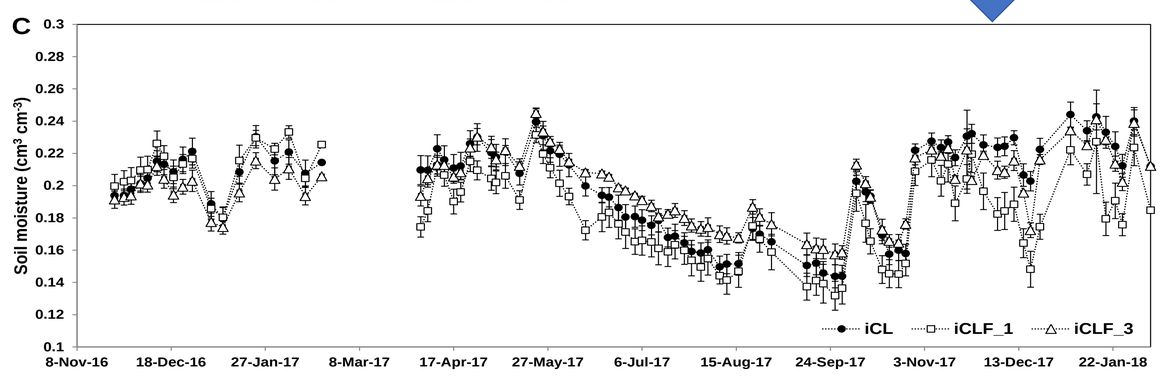
iCLF – Grazing was performed by Nelore and Canchim (3/8 Nelore + 5/8 Charolais) bulls

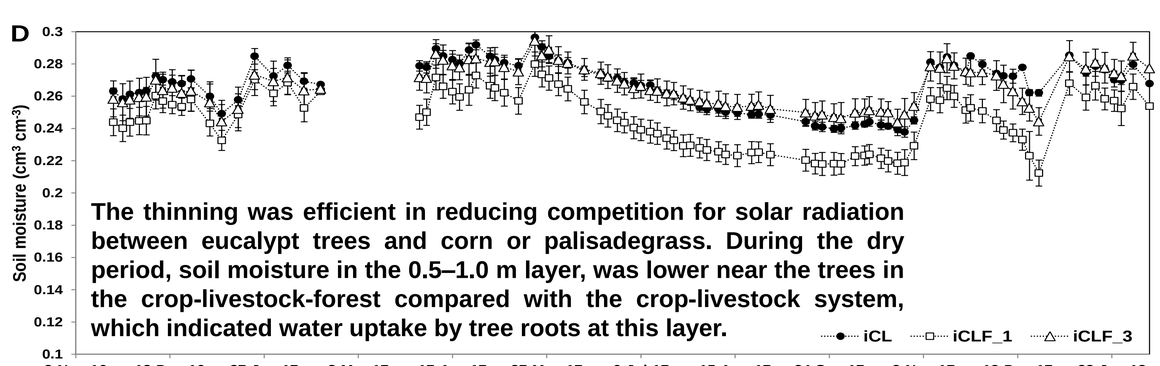
Results



Photosynthetically active radiation transmission (B) and in four positions within the integrated crop-livestock-forest system

Soil moisture in the layers 0.0–0.5 m (C), and 0.5–1.0 m (D) during the corn for silage cycle (corn crop) and pasture growth cycles in the integrated crop-livestock system (iCL) and in two positions (1.9 m, iCLF_1 and 7.5 m, iCLF_3)





The thinning was efficient in reducing competition for solar radiation between eucalypt trees and corn or palisadegrass. During the dry period, soil moisture in the 0.5–1.0 m layer, was lower near the trees in the crop-livestock-forest compared with the crop-livestock system, which indicated water uptake by tree roots at this layer.

Vegetative and productive characteristics of corn for silage in an integrated crop-livestock system (iCL) and four positions within an integrated crop-livestock-forest system during the 2016/2017 crop

Position	Plant height cm	Ear insertion height cm	Dry matter content %	Yield Mg ha^{-1}	Proportion of grain	Crude protein %	IVDMD[2] %
iCL	263.80 C[1]	115.90 B	32.24 A	13.07 A	35.26 B	4.51 C	67.45 A
iCLF_1	277.25 BC	129.70 B	26.68 B	12.79 A	37.95 AB	7.29 AB	65.35 A
iCLF_2	296.68 AB	154.13 A	29.33 B	13.99 A	40.98 A	6.77 B	68.65 A
iCLF_3	300.20 AB	149.05 A	28.67 B	13.94 A	40.06 A	6.98 B	65.18 A
iCLF_4	301.28 A	150.05 A	28.35 B	14.07 A	41.33 A	7.87 A	65.00 A
Average	287.84	139.77	29.06	13.57	39.12	6.68	66.33
P value	0.0175	0.0009	0.0152	0.7595	0.0411	<.0001	0.7430

Productive characteristics of palisadegrass in an integrated crop-livestock system (iCL) and in four positions within an integrated crop-livestock-forest system during four growth cycles

Position	Season				Season			
	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
	Forage accumulation (kg ha^{-1} cycle^{-1})				Crude protein content (%)			
iCL	1874.0 A	391.3 A	2564.6 A	2134.4 A	10.8 B	5.9 B	8.1 B	9.5 A
iCLF_1	1722.7 A	557.8 A	1884.1 A	1951.5 A	15.1 A	7.9 A	12.1 A	12.8 A
iCLF_2	1651.2 A	552.0 A	1867.5 A	2057.7 A	15.5 A	8.0 A	11.8 A	11.9 A
iCLF_3	1826.0 A	107.9 A	2808.7 A	2361.5 A	15.8 A	8.5 A	11.8 A	11.1 A
iCLF_4	1958.5 A	266.3 A	2187.2 A	2156.7 A	14.6 A	8.7 A	12.3 A	11.2 A
Average	1806.5	375.1	2262.4	2132.4	14.4	7.8	11.2	11.3
P value	0.7325	0.5758	0.8487	0.9867	<.0001	0.0008	0.0049	0.5857

Yields of corn for silage and palisade grass were similar between the crop-livestock-forest and the crop-livestock system, which indicated that thinning maintained competition within a level that did not decrease understory plant yield. Additionally, the nutritive value of corn for silage and palisadegrass was higher in the crop-livestock-forest compared with the crop-livestock system.

Conclusions

- ✓ Such results indicate that tree thinning was favorable for production in the crop-livestock-forest system.

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