Abstract #119108

Silvopastoral and Crop-Livestock Systems: An Alternative for the Sustainable Intensification of Tropical Forage-Based Systems

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Abstract Text:

The increase in global demand for animal protein will likely require changes in the agricultural sector, including greater diversification and efficiency. To meet this demand, sustainable intensification of existing animal production systems may be possible, especially through integration of livestock with crops or forestry. Thus, our objective was to compare forage production and animal performance in monoculture and integrated systems in the Brazilian Amazon Biome. The three systems were 1) livestock (L) with palisadegrass (*B. brizantha*cv. Marandu) in monoculture; 2) silvopastoral systems (SP) with palisadegrass pastures integrated with eucalyptus trees (*E. urograndis*) arranged in three-row groves with groves spaced 30-m apart; and 3) crop-livestock (CL) with palisadegrass after two years of soybean (*Glycine max*L.). From July 2015 to May 2018 all experimental units (2 ha area) were stocked continuously with Nellore steers using a variable stocking rate to maintain a Marandu canopy height of ~30 cm. Herbage accumulation and animal performance were measured every 28 days using the paired cage method and weighing following fasting, respectively. Greater herbage accumulation occurred in the CL (24260 kg ha^{-1}), as well as greater stocking rate (1390 kg BW [body weight] ha^{-1}) and average daily gain (0.685 kg day^{-1}), resulting in a greater gain per hectare (845 kg BW ha^{-1}) compared with L and SP. The SP herbage accumulation and animal productivity were similar to L (15520 kg DM $ha^{-1}$and 750kg BW ha^{-1}, respectively), while providing shade for livestock and also wood production. Based on these results, we conclude that integrated systems enhance (CL) or maintain (SP) pasture and animal productivity when compared with palisadegrass monoculture pastures. These results support the potential of integrated systems to increase plant species and economic diversity, enabling sustainable intensification of cattle production in the Brazilian Amazon Biome.

Title:	Silvopastoral and Crop-Livestock Systems: An Alternative for the Sustainable Intensification of Tropical Forage-Based Systems
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Division/Section:	C06 Forage and Grazinglands
Session:	Forage and Grazinglands Poster I:

Warm-Season Forages

Preferred Format: Poster

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Silvopastoral and Crop-Livestock Systems: an alternative for the sustainable intensification of tropical forage-based systems

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Introduction

The increase in global demand for animal protein will likely require changes in the agricultural sector, including greater diversification and efficiency. To meet this demand, sustainable intensification of existing animal production systems may be possible, especially through integration of livestock with crops or forestry. Thus, our objective was to compare forage production and animal performance in monoculture and integrated systems in the Brazilian Amazon Biome.

Material and Methods

The experiment was carried out at Embrapa Agrossilvipastoril, in Sinop - MT, Brazil, from July 2015 to May 2018.

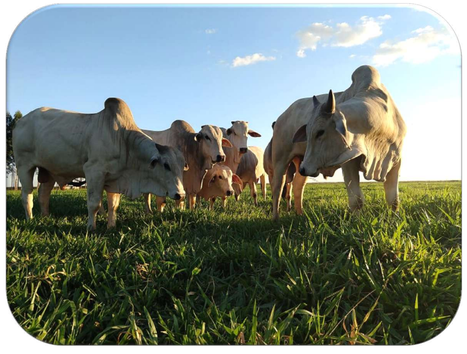
The three systems were:

1. Livestock, palisadegrass (*B. brizantha* cv. Marandu) in monoculture;
2. Silvopastoral, palisadegrass pastures integrated with eucalyptus trees (*E. urograndis*) arranged in three-row groves with groves spaced 30-m apart;
3. Crop-Livestock, palisadegrass after two years of soybean (*Glycine max* L.).

All experimental units (2 ha area) were stocked continuously with Nellore steers using a variable stocking rate to maintain a Marandu canopy height of ~30 cm.

Herbage accumulation and animal performance were measured every 28 days using the paired cage method and weighing following fasting, respectively.

At each cage site, paired sites were chosen with similar canopy height. A cage was placed at one of the paired sites and at the other the HM was measured by clipping all herbage to soil level inside a circular quadrat (0.64 m^2) and drying it at 55°C in a forced-air dryer until constant weight.



Animals were classified as either testers or grazers. Three tester (for average daily gain, ADG) were allocated to each pasture and remained on that experimental unit. The grazer animals were moved on and off pastures as needed to adjust the stocking rate (SR) so that canopy height target was kept constant.

Results and Discussion

Greater herbage accumulation occurred in the CL (24260 kg ha^{-1}), as well as greater stocking rate (1390 kg BW [body weight] ha^{-1}) and average daily gain (685 g day^{-1}), resulting in a greater gain per hectare (845 kg BW ha^{-1}) compared with L and SP. The SP herbage accumulation and animal productivity were similar to L (15520 kg DM ha^{-1} and 750kg BW ha^{-1}, respectively).

Table 1. Herbage and animal production in crop-livestock integrated systems evaluated throughout three years.

Variables	Systems L	LF	CL	MSE	P-value
Herbage accumulation (kg DM ha^{-1})	15380 b	15660 b	24260 a	1270	<0.0001
Stocking rate (kg BW ha^{-1})	1200 b	1260 b	1390 a	183	0.0025
Avg. daily gain (g BW day^{-1})	620 b	630 ab	685 a	35	0.0135
Gain per hectare (kg BW ha^{-1})	748 b	750 b	845 a	90	0.0017

Livestock (L), livestock-forestry (LF) and crop-livestock (CL) systems. MSE: mean standard error. Means followed by the same letter in the row do not differ by the Tukey-Kramer test (P <0.05).

Greatest palisadegrass HA and animal performance following two years of soybean production support the CL system as an alternative for sustainable intensification. The similar HA and gain per ha in the eight year of the silvopasture and livestock systems indicates tree-pastures systems need wider arrangements to warrant long-term productivity.

Conclusion

Based on these results, we conclude that integrated systems enhance (CL) or maintain (SP) pasture and animal productivity when compared with palisadegrass monoculture pastures. These results support the potential of integrated systems to increase plant species and economic diversity, enabling sustainable intensification of cattle production in the Brazilian Amazon Biome

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Acknowledgment:

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