DOI: 10.17138/TGFT(7)143-145

*ILC2018 Poster and Producer paper**

A preliminary study of spatial distribution and plant density in a leucaena-grass planting in north Corrientes, Argentina

Estudio preliminar de la distribución espacial y densidad de plantas de leucaena en asociación con una gramínea en el norte de Corrientes, Argentina

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Keywords: *Brachiaria brizantha*, forage quality, forage yield, *Leucaena leucocephala***,** subtropics.

Introduction

In northeast Argentina, most beef cattle graze naturalized range pastures continuously, with limited winter supplementation and restricted access to improved pastures. Calving rates are low, averaging 40–50% annually and calf weaning weights average 150–170 kg at 6 months. Overall, productivity remains low (30–40 kg LW/ha/yr), mainly due to poor cattle nutrition (Goldfarb et al. 1993; Goldfarb and Casco 1994). In past decades, several improved grass and legume species were evaluated as a strategy to overcome this problem (Goldfarb et al. 1993; Goldfarb and Casco 1998) with *Leucaena leucocephala* (leucaena) showing definite potential. It was introduced in the 1970s into Corrientes Province and displayed good adaptation to the environmental conditions. When leucaena was evaluated as a protein bank and sown into natural grassland or established with a sown grasses, it has shown excellent potential by increasing productivity of these systems (Gándara et al. 1986; 1993). However, these evaluations were done using much lower densities of leucaena than recommended to maximize yield of leucaena (Pachas et al. 2018). Therefore, the objective of this study was to evaluate the effects of leucaena density, taking into account light interception, on both legume and total pasture yield and forage quality in a leucaena-grass pasture system.

Materials and Methods

Experimental site

The study was conducted at the National Agricultural Technology Institute (INTA EEA Corrientes) in Corrientes Province, Argentina (27º40´25.84 S, 58º45´13.59 W). The soil at the site is characterized as an Aquic Argiudol soil (pH: 5.9; OM: 1.93%; P: 2 ppm). Monthly rainfall recorded during the study period and monthly average temperature are presented in Table 1.

Experimental design

Leucaena (cv. Cunningham) was sown in October 2016 using a twin-row configuration (twin rows 1 m apart) with 2, 4 and 8 m spacings between the outer rows of the twin hedge-rows (treatments D-2, D-4 and D-8, respectively). Each hedge-row plot was 15 m long and 42 m wide. The experimental design was a randomized complete block with 3 replications. Leucaena was sown manually at a seeding density of 7–10 g per linear meter (objective: 10 plants/m of row). In this way, plant densities for D-2, D-4 and D-8 should be: 66,666, 40,000 and 22,222 plants/ha, respectively. In October 2017, leucaena plants were cut to 1 m height and *Brachiaria brizantha* cv. Marandú (brachiaria) was sown between hedge-rows at a seeding rate of 13.3, 8.0 and 4.443 kg/ha for D-2, D-4 and D-8, respectively.

Measurements

Accumulation of biomass of leucaena and brachiaria was measured in June 2018 (236 days after trimming in October 2017). Figure 1 provides an image of a D-2 plot at that time. Biomass of leucaena above 1 m was measured by harvesting subplots of leucaena (5 linear m of twin-row) and biomass of brachiaria above 10 cm (4 samples/treatment of 0.25 m^2). Before harvesting leucaena, average height, number of plants, shoots and branches of leucaena were measured.

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*Poster presented at the International Leucaena Conference, 1–3 November 2018, Brisbane, Queensland, Australia.

Table 1. Monthly rainfall (mm) and monthly average temperature (ºC) at INTA EEA Corrientes.

Year	Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	172	95	122	355	12	210	28	86	19	285	126	320
2017	180	106	151	548	193	1	10	80	93	80	124	26
2018	329	52	231	0	220	26						
	Average temperature (ºC)											
2017	27.4	26.1	24.7	20.2	18.9	17.7	17.9	18.6	20.4	21.4	2.8	27.4

Then, leucaena was cut to 1 m above ground level and biomass partitioned into edible biomass (leaves, tender/ herbaceous stems <6 mm in diameter) and lignified/ woody stems (>6 mm in diameter).

Figure 1. Treatment D-2 (2 m distance between twin hedgerows) of leucaena with brachiaria.

Dry matter concentration of both leucaena and brachiaria was determined by drying fresh material (subsamples) in an oven at 65–70 ºC for 72 h to constant weight. For each treatment, representative subsamples (200 g of fresh biomass) of leucaena and brachiaria were selected and taken to the lab for determining N concentration by the Kjeldahl method. Percentage of crude protein (CP = N × 6.25) of leucaena-grass pasture for each treatment was then determined by weighting its contribution according to the proportion of leucaena and grass biomass (t DM/ha).

Pasture photosynthetically active radiation interception (light interception - LI) was determined by measuring incident light in the open sky (OS) and within the inter-rows (IR) with a ceptometer (Cavadevice, Buenos Aires, Argentina) and was expressed as percentage of shade using the following expression: shade % = 100 (OS – IR). LI measurements were taken on a sunny day between 11:00 h and 13:00 h in February 2018. Thirty measurements were recorded within each plot by placing the ceptometer along an equidistant transect between the middle points of the inter-rows.

Statistical analysis

Above-ground biomass, edible biomass, proportion of grass and legume, CP concentration and light interception (shade) were analyzed by ANOVA, and means were compared by the Tukey test (P<0.05). Statistical analysis was carried out using InfoStat® software.

Results

The numbers of leucaena plants/m, shoots per leucaena plant and height of leucaena plants did not differ significantly between treatments. Average numbers of leucaena plants per linear meter of individual rows were 9.1 plants/m, with 20.5 primary shoots/m and 2.1 m height. The levels of shading increased as spacings decreased (P<0.05). Average values of the measured variables are shown in Table 2.

Table 2. Total accumulated biomass of leucaena (L) and brachiaria (G), edible biomass (L+G), proportions of legume and grass in edible biomass, crude protein (CP) of the edible forage and shade.

Treatment	Total biomass (t DM/ha)	Edible biomass (L+G) (t DM/ha)	Proportion of legume (%)	Proportion of grass (%)	CP (%)	Shade (%)
D-2	13.6a[1]	8.7a (6.2+2.5)	71a	29c	17.9a	82a
D-4	10.1b	7.8a (2.9+4.9)	38b	62b	14.4b	43b
D-8	9.2b	8.0a (1.2+6.8)	15c	85a	11.6c	23c

[1]Means followed by different letters within columns differ significantly at P<0.05.

Discussion and Conclusions

This study has provided valuable information on the vexing question of how far apart the twin rows of leucaena should be planted. As was expected, leucaena yield was related to initial planting density with highest yields occurring at the highest density, i.e. the narrowest inter-row spacing, while grass yield was inversely proportional to leucaena density. Interestingly, total edible forage from the leucaena-brachiaria pasture was independent of planting configuration, with only the proportion of legume and grass varying along with the inter-row spacing. At narrow inter-row spacing, grass biomass decreased, presumably due mainly to increased shading, and to a lesser extent to competition for nutrients and possibly water as high rainfall was registered during the experiment. This reduction of grass growth was compensated for by increased edible biomass of leucaena with the result that crude protein concentration of the available edible forage increased with higher densities of leucaena. One might expect that animal performance would benefit from the higher quality of the forage.

Pachas et al. (2018) also reported that higher biomass of leucaena and total biomass and reduced biomass of grass were associated with higher density of leucaena.

The high primary production obtained in this experiment suggests that animals grazing leucaena-grass pasture can be expected to achieve enhanced liveweight gains or that higher stocking rates can be maintained compared with unimproved grass pastures. Grazing studies are needed to confirm these hypotheses although Gándara et al. (1986) in a 2-year study showed a 171% increment in beef production (kg LW gain/ha/yr) when beef cattle grazed leucaena-grass pasture (*L. leucocephala* + *Digitaria decumbens*) compared with a naturalized pasture of *Sorghastrum agrostoides, Paspalum notatum, Paspalum plicatulum* and *Paspalum urvillei.*

The preliminary conclusion from this study is that narrower inter-row spacing will not reduce overall yield of edible forage but will increase the crude protein concentration of the forage under conditions similar to those in this study. Similar studies in a range of environments and a range of seasons are needed to confirm these preliminary findings. It is important to continue monitoring this experiment as we expect that growth of leucaena will increase relative to grass, which will be negatively impacted by increased shading and greater competition for water in drier years.

Acknowledgments

The authors thank Dr Silvana C. Ferrari Usandizaga, Dr Cristina Goldfarb, M.Sc. Fernando Gándara, Dr José Casco, Dr Alejandro Radrizzani and Dr Nahuel Pachas for their contributions in the conduct of the study and preparation of the manuscript.

References

(Note of the editors: All hyperlinks were verified 3 May 2019.)

Gándara FR; Goldfarb MC; Arias AA; Ramírez WM. 1986. *Leucaena leucocephala* (Lam.) de Wit como banco de proteína invernal de un campo natural de la provincia de Corrientes. Revista Argentina de Producción Animal 6:562−572.

Gándara FR; Goldfarb MC; Arias AA; Ramírez WM. 1993. Valor alimenticio de una asociación Pangola (*Digitaria decumbens*) y *Leucaena leucocephala*. Revista Argentina de Producción Animal 13(Supl. 1):41.

Goldfarb MC; Casco JF; Gándara FR. 1993. Introducción de especies y cultivares forrajeras para el noroeste de la Provincia de Corrientes, período 1978–1990. Producción Animal, Serie Técnica Nº 6. INTA Corrientes, Argentina.

Goldfarb MC; Casco JF. 1994. Leucaena in the Northwest Region of Corrientes Province, Argentina. In: Shelton HM; Piggin CM; Brewbaker JL, eds. Leucaena - Opportunities and limitations. Proceedings of a Workshop held in Bogor, Indonesia, 24–29 January 1994. ACIAR Proceedings 57. ACIAR, Canberra, Australia. p. 159–162. bit.ly/2UphJVM

Goldfarb MC; Casco JF. 1998. Selection and agronomic characterisation of *Leucaena* genotypes for cold tolerance. In: Shelton HM; Gutteridge RC; Mullen BF; Bray RA, eds. Leucaena – adaptation, quality and farming systems. Proceedings of a workshop held in Hanoi, Vietnam, 9–14 February 1998. ACIAR Proceedings 86. ACIAR, Canberra, Australia. p. 172–173. purl.umn.edu/135197

Pachas AN; Shelton HM; Lambrides CJ; Dalzell SA; Murtagh JG. 2018. Effect of tree density on competition between *Leucaena leucocephala* and *Chloris gayana* using a Nelder Wheel trial. I. Aboveground interactions. Crop & Pasture Science 69:419–429. doi: 10.1071/CP17311

(Accepted 28 January 2019 by the ILC2018 Editorial Panel and the Journal editors; published 31 May 2019)