The Effect of *Leucaena leucocephala* on Beef Production and Toxicity in the Chaco Region of Argentina

Alejandro Radrizzani
Instituto Nacional de Tecnología Agropecuaria, Argentina

José A. Nasca
Instituto Nacional de Tecnología Agropecuaria, Argentina

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Alejandro Radrizzani and José A Nasca

Instituto Nacional de Tecnología Agropecuaria (INTA), Instituto de Investigación Animal del Chaco Semiárido, Leales (4113), Tucumán, Argentina, www.inta.gob.ar/unidades/153000
Contact email: aradrizzani@correo.inta.gov.ar

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Introduction

Hedgerows of the fodder tree legume, *Leucaena leucocephala* (Lam.) de Wit ssp. *glabrata* (Rose Zárate) (leucaena), planted with companion grass, provide productive, profitable and sustainable tropical pasture (Shelton and Dalzell 2007). Although leucaena can improve beef production from tropical pastures, poor grower adoption has limited development of leucaena in the Chaco Region of Argentina. This can be partly attributed to: (1) unsuccessful establishment; (2) limited understanding of leucaena management as a forage resource; and (3) concerns about mimosine toxicity. These 3 limitations have been overcome in other regions of the world (*e.g.* northern Australia and the Chaco Region of Paraguay), but little is known about leucaena management and the protection status of ruminants against mimosine toxicosis in Argentina.

The objective of this study was to evaluate the effect of leucaena on beef production and toxicity in the west of the Argentinean Chaco Region. We hypothesise that the introduction of leucaena into grass pastures will significantly increase beef productivity if mimosine toxicosis does not appear.

Methods

Site description and treatments

The experiment was established at the Animal Research Institute of the Semiarid Chaco Region, operated by the National Institute of Agricultural Technology (INTA), located at Leales, Tucumán (27º11´S, 65º14´W, altitude 335 m above sea level), in north-west Argentina. The climate is subtropical sub-humid with a dry season from April to September and average annual rainfall of 880 mm (75% from October to March). Average maximum/minimum temperatures are 32/20ºC in January and 22/7ºC in July; on average 16 frosts occur each year, with an average ground surface temperature of -2.2ºC and minimum temperature of -7ºC). Mean evaporation exceeds mean rainfall in all months.

The experiment used 6 hectares (ha) of *Brachiaria brizantha* cv. Marandú (brachiaria) pasture, established in 1995 on Ustipsamment aquic and Fluvaquentic Haplustoll soil types (US Soil Taxonomy system). A stand of leucaena cv. K636 was zero till-planted into this pasture in hedgerows 5 m apart in December 2009 to form 3 treatments with different proportions of leucaena in the animal diet (2 ha each): (1) leucaena in twin rows (LLB); (2) leucaena planted in single rows (LB); and (3) brachiaria only (BB).

Fodder availability, animal production and signs of toxicosis

Leucaena and brachiaria dry matter availability was estimated at the beginning of each grazing period by adapting the comparative yield method of ‘t Mannetje and Jones (2000). Animal production was determined using 10-month-old Braford steers with an initial bodyweight of 217±7 kg over 98 days (09/12/10 to 16/03/11), divided into 5 consecutive grazing periods (P): P1 (12 days) 09/12-20/12; P2 (16 days) 21/12-05/01; P3 (20 days) 06/01-25/01; P4 (28 days): 26/01-22/02; P5 (22 days): 23/02-16/03. Before the first grazing period, the steers were familiarised with leucaena by grazing for 16 days (23/11-08/12). Steers were randomly allocated to each treatment in a variable stocking rate, according to fodder availability. At the end of each grazing period steers were individually weighed to determine mean liveweight gains per day (LWG), expressed per unit area (LWG/ha) and per head (LWG/head). Steers were observed daily to record any of the typical signs of leucaena toxicosis, such as lethargy and depressed appetite, excessive salivation, skin sores, and hair loss from the pizzle and switching of the tail, reported by Jones and Jones (1984). Urine was unable to be collected and tested for mimosine and its derived DHP, as described by Dalzell *et al.* (2012).

Statistical analysis

Twelve, 8 and 4 steers in the LLB, LB and BB treatments, respectively, were evaluated by longitudinal data analysis according to the time-sequential measurements collected. The repeated measures in time were analyzed using mixed models (with treatment as fixed effect) and using the auto-correlation structure produced by the sequentially repeated measures on the same animals during the 5 periods.

Table 1. Animal production (LWG/head.day) during the 5 grazing periods (P1-P5) in 3 treatments: leucaena in twin rows with brachiaria (LLB), leucaena in a single row with brachiaria (LB), and brachiaria pasture alone (BB). Different letters within each period indicate a significant difference.

Grazing period	Accumulated grazing days	LLB (kg LW/head.day)	LB (kg LW/head.day)	BB (kg LW/head.day)	*P* value
First period (P1)	12	1.07a	1.00a	0.65b	0.008
Second period (P2)	28	0.62b	1.33a	0.97ab	0.050
Third period (P3)	48	0.55b	0.64b	1.18a	0.012
Forth period (P4)	76	0.10b	0.24ab	0.48a	0.063
Fifth period (P5)	98	0.02b	0.09b	0.53a	0.001

Results

Rainfall data and fodder availability

Accumulated rainfall from the first fall (07/10) to the end of the trial (17/03) was 774 mm; 202 mm before the first grazing period, 0 mm in P1, 41 mm in P2, 79 mm in P3, 327 mm in P4 and 125 mm in P5. Leucaena availability continuously increased during the experiment and was double in the LLB, compared to the LB treatment in all periods, ranging from 680 and 240 kg of dry matter(DM)/ha in P1 to 2570 and 1290 kg DM/ha in P5 for the LLB and LB treatments, respectively. Brachiaria availability was similar in all treatments throughout the experiment, so that the proportion of leucaena in the total available fodder ranged from 40-60% and from 20-30% in the LLB and LB treatments, respectively. Consequently, the differences in cattle LWG can be attributed to differences in leucaena availability.

Animal production and signs of toxicosis

Steers with access to leucaena (LLB and LB) had higher LWG/ha than steers without access (BB) at the end of the first period, P1, (4.32, 3.08 and 1.33 kg LWG/ha.day, respectively). However, LWG/ha decreased towards the end of the experiment, at a rate inversely proportional to leucaena availability. The LWG/ha were 1.89, 2.72 and 1.99 in P2, 2.51, 1.97 and 2.41 in P3, 0.60, 0.97 and 0.99 in P4 and 0.12, 0.37 and 1.10 in P5 for the LLB, LB and BB treatments, respectively. LWG/head followed a similar trend, being higher on leucaena pastures (1.07 and 1.00 kg LWG/head.day for LLB and LB, respectively) than brachiaria pasture alone (0.62 kg LWG/head.day) at the end of P1. However, thereafter LWG/head on LLB pasture declined continuously (Table 1). Steers on the LB pasture exhibited the highest LWG (1.33 kg LWG/head.day) at the end of P2, but then followed the same trend of declining LWG as those on the LLB pasture. Visible signs of mimosine toxicosis first appeared during P4 and P5 in LLB and LB treatments, respectively. At the end of the trial, after 98 days grazing leucaena, 5 steers (41% of the herd) on LLB and 2 steers (25% of the herd) on LB pastures exhibited visible signs. The main symptoms, apart from lethargy and depressed appetite, were excessive salivation, skin sores and hair loss from the pizzle and switching of the tail.

Conclusions

The introduction of leucaena into grass pastures could increase beef cattle productivity (LWG per unit area and per head) in the Chaco Region of Argentina, if mimosine toxicosis is controlled. Animals on pastures with high levels of leucaena did not perform as well as expected. Sub-clinical mimosine toxicosis may have contributed to this, because clinical signs of mimosine toxicosis were apparent after 13 weeks of exposure to leucaena. The benefits of ruminal inoculation of mimosine (DHP)-degrading bacteria need to be tested in animals grazing leucaena pastures in the Chaco Region of Argentina.

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