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Leucaena feeding systems in Cuba

Sistemas de alimentación con leucaena en Cuba

TOMÁS E. RUIZ[1], GUSTAVO J. FEBLES[1], EMILIO CASTILLO[1], LEONEL SIMÓN[2], LUIS LAMELA[2], ISMAEL HERNÁNDEZ[2], HUMBERTO JORDÁN[1], JUANA L. GALINDO[1], BERTHA B. CHONGO[1], DENIA C. DELGADO[1], GUSTAVO JACINTO CRESPO[1], NURYS VALENCIAGA[1], ORESTES LA O[1], JATNEL ALONSO[1], DELIA M. CINO[1], SANDRA LOK[1], FRANCISCO REYES[2], MARCOS ESPERANCE[2], JESÚS IGLESIAS[2], MARTA HERNÁNDEZ[2], TANIA SÁNCHEZ[2], ARÍSTIDES PÉREZ[2] AND MILDREY SOCA[2]

[1]*Instituto de Ciencia Animal, Ministerio de Educación Superior, San José de las Lajas, Cuba.* ica.edu.cu
[2]*Estación Experimental de Pastos y Forrajes Indio Hatuey, Perico, Matanzas, Cuba.* ihatuey.cu

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Introduction

The utilization of leucaena (*Leucaena leucocephala*) for ruminant production by farmers in Cuba began during the 1980s based on the concept of protein banks covering 100% of the grazing area. In the last decade, a National Program to promote silvopastoral systems with leucaena in the livestock production sector was developed with the participation of 1,543 cattle farms with an emphasis on milk production. The cattle farms occupied 20,000 ha of which 7,000 ha was as protein banks, while the remaining area was planted with leucaena in association with grasses. Most of the work was carried out within the research agenda of the Instituto de Ciencia Animal (ICA).

The commercial varieties of leucaena used were mainly cv. Peru and to a lesser extent cv. Cunningham. The area of each livestock farm ranged from 20 to 70 ha. The work was developed with producers from both the State and non-State sector.

Establishment and plant management

Soil preparation for sowing was with strips when the existing grass was retained (star grass – *Cynodon nlemfuensis*) or with full cultivation when a new grass was introduced (guinea grass – *Megathyrsus maximus*). Following inoculation of the seed planting occurred in double rows 0.70 m apart, with 3–4 m inter-row spacing to achieve plant populations of 7,000–8,000 trees/ha; fertilizer was not used. There were problems with weediness during the establishment phase, and with overgrazing and general management of the pastures, partly due to a lack of economic resources. The first grazing after sowing occurred when a plant height of 120–140 cm was reached (Ruiz and Febles 2012).

After 4 years of growth, plants were pruned to limit woody growth and maximize edible biomass production. The height of pruning was 0.5 m with decumbent star grass and 1 m with the more erect guinea grass. Pruning occurred from January to March to maximize availability of forage during the dry season or from April to June when quicker regrowth was required.

Physiology of the rumen

Ruminal bacteria capable of degrading mimosine and DHP were isolated for the first time in Cuba (Galindo et al. 1995), and their persistence in the rumen of animals under normal feeding conditions was confirmed. Other studies showed that there was no mimosine in the rumen of the cattle, sheep and goats consuming leucaena, and levels of DHP were non-toxic (Galindo et al. 2012). Hence, the inclusion of leucaena in the ration of animals even at levels up to 100% are considered not to represent a potential danger for animal feeding in Cuba.

The effects of the inclusion of 4 levels of leucaena (0, 20, 40 and 60%) in a ration with star grass for rams was evaluated and it was shown that it was possible to include

Correspondence: T.E. Ruiz, Instituto de Ciencia Animal, Carretera Central Km 47 1/2, San José de las Lajas, La Habana, CP 32700, Cuba. Email: teruizv@gmail.com

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high levels of leucaena in the diet (Galindo 2001). The legume inclusion improved total digestibility of both fiber and dry matter consumed, and the nitrogenous fractions of the rumen contents suggested that conditions for microbial protein synthesis and by-pass protein availability for post-ruminal absorption were enhanced (Galindo et al. 2012).

Analysis of blood metabolites in fattening bulls with free access to grazing of 100% leucaena showed normal values of the thyroxine and tri-iodothyronine hormones (Castillo et al. 2012).

Animal production based on leucaena

Dairy production

With leucaena, associated with guinea grass, production per milking cow was 8–9 L/day (Jordán 2001); annual production increased from 2,790 to 6,344 L/ha, and total milk production from the project area rose from 53,056 to 119,136 L. The Holstein cows were supplemented with 196 g concentrate/L of milk and stocking rate increased from 2 to 2.7 animals/ha. Milk production per cow in the leucaena-guinea grass system was similar to that of cows fed N-fertilized guinea grass pasture and supplemented with 588 g concentrate/L milk. The milk contained adequate levels of total solids (12–13%), fat (3.5–3.7%) and protein (3.2–3.3%) (Jordán 2001). Likewise, with crossbred animals (more than 66% Holstein) production ranged between 8 and 10 L/cow/d (Figure 1). There was a close link between the increase in milk production and biomass of leucaena on offer (Jordán 2012).

Figure 1. Grazing of leucaena-star grass pasture by dairy animals.

Performance of females

F1 animals (10 months of age and 150 kg mean weight), in 6–8 rotationally grazed leucaena-star grass paddocks (5–6 days occupancy) without fertilizer application or supplementation, and with a stocking rate of 2.0–2.5 animals/ha, gained 450 g/d (Mejías 2004; 2008). The results were similar to those obtained by a second group under equal grazing conditions on a grass-only pasture but supplemented with 2 kg concentrate/animal/day. *Bos taurus* animals with an initial weight of 285–300 kg reached puberty at 22 months with 77% first service conception rate. Calf birth weights were greater than 35 kg. In these systems more than 90% of the animals reached a body condition between 3.0 and 3.5 (Zarragoitia et al. 1992). As above, results were similar to those obtained by a group under equal grazing conditions on grass-only pastures but supplemented with 2 kg concentrate/animal/day.

Beef production

Gains of 620 g/animal/day were recorded in a rotationally grazed leucaena-guinea grass pasture with a stocking rate of 2 animals/ha. These gains were 147% higher than on the grass-only paddocks (Castillo et al. 1989).

When using natural grasses associated with leucaena at a stocking rate of 2 animals/ha and rotationally grazing 4 paddocks, weight gains were 600 g/animal/day, when supplemented during the dry period with sugarcane or molasses and urea to 3%. Without leucaena, weight gains were 500 g/animal/day (Castillo et al. 1999).

On a leucaena-star grass pasture, grazed at 3 animals/ha, daily gains of 781 g/animal were achieved without supplementation (Castillo et al. 2012). Slaughter of the animals occurred at 400 kg live weight and 26–27 months of age with a hot carcass yield of 54% and 7–8% of fat (Figure 2). The results obtained were similar to those obtained on star grass without leucaena but fertilized with 100 kg N/ha/year.

Figure 2. Grazing of leucaena-star grass for beef production.

Improvement of the environment

In a leucaena-guinea grass system, the initial plant population of approximately 1,100 leucaena plants/ha was adjusted to 400–600 plants/ha after 4 years to avoid the negative effects of shade on the growth of the grass. The chemical composition of the soil was improved by the recycling of nutrients, and there was an appreciable contribution of N from biological fixation and decomposition of the litter (Lok et al. 2005). The structural stability of the soil increased with time as soil carbon storage was increased (Lok 2012), with the added environmental benefit of reduced methane gas emissions (Galindo et al. 2012).

Biodiversity increased when leucaena was present (Lok 2005), and earthworms reached highest frequency with predominance of the species *Polypheretima elongata*, *Onychochaeta elegans* and *Diplotrema* spp. Other indicators of biodiversity were the increased frequency of Arthropoda followed by Annelida in the brown soils planted with a mixture of guinea and star grasses and leucaena; and of Arthropoda, followed by Annelida, in red soils planted with guinea grass and leucaena (Lok 2012).

With time, there was an increase in predatory *Heteropsylla cubana*, but the population did not reach harmful thresholds. The incidence and stability of the bio-regulating *Chilocorus cacti* increased as well (Valenciaga 2003).

Animal health

There was no harmful effect of mimosine or its derived product DHP (hydroxipyridone) on vital organs such as the liver, thyroid, heart and thymus, and blood indicators were not affected when leucaena-star grass was fed to livestock (Castillo et al. 2012). In comparison with grass-only diets, gastrointestinal nematode infestations were reduced by 66% when leucaena was included. The main genera of parasites found were, in order of importance, *Haemonchus*, *Oesophagostomum*, *Cooperia* and *Ostertagia* (Soca et al. 2007). Body composition was also improved with a decrease of diarrhea and respiratory diseases (Soca 2005).

Economic impact on production systems

In the livestock farms where this legume has been introduced, gross returns/ha/year ranged from 1,898 to 4,056 Cuban pesos, and the benefit:cost ratio increased in the range of 2.5–4.5. The economic analysis indicated that a lower proportion of income was needed to cover production expenses (Cino et al. 2006; 2011). Particularly positive aspects were savings in the use of concentrates and a decrease in production costs.

The results obtained suggest that the present leucaena technology is an economically viable option for livestock production in Cuba and other tropical countries. Further research on its application and adoption is indicated.

Dissemination of knowledge

All personnel in the productive sector who participated in the technology transfer process were systematically trained. Particularly the need for systematic technical assistance in the early stages of technology transfer became evident.

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(Note of the editors: All hyperlinks were verified 11 August 2019.)

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