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Use and performance of leucaena (*Leucaena leucocephala*) in Venezuelan animal production systems

Uso de leucaena (Leucaena leucocephala) en sistemas de producción ganadera venezolanos

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Silvopastoral systems

One of the limitations for the efficient production of meat and milk in livestock systems of Venezuela is the scarcity of high-protein forage from plants adapted to the acid soils and prolonged droughts of the Llanos (savannas). The Llanos cover an estimated area of 15–20 M ha predominantly in the southeast and southwest of the country. They are mainly covered with native grasses (*Trachypogon* spp.), which have low carrying capacity (0.10–0.25 AU/ha; 1 AU = 450 kg bovine).

In Venezuela silvopastoral systems are found mainly in the tropical dry forest (1,000–1,200 mm average annual rainfall, AAR) of the savanna plains and the very dry tropical forest (800–900 mm AAR) and semi-arid (700 mm AAR) environments of the country ([Escalante 1985](#)). Other important production areas are south of Lake Maracaibo in Zulia State and the intra-montane valleys in the central states of Aragua, Carabobo, Yaracuy, Portuguesa and Cojedes, as well as the highland dairy cattle ranch areas in the states of Táchira, Mérida and Trujillo.

Despite the presence of some forage tree species that are well adapted to savanna conditions, such as samán (*Samanea saman*), matarratón (*Gliricidia sepium*) and guácimo (*Guazuma ulmifolia*), their potential for intensive use in agroforestry systems has not been realized. Use of these species has been limited to living fences and providing shade for livestock. Only *G. sepium* has been used in alley/hedgerow pastoral systems to a limited extent ([Escalante 1985](#)).

Use of leucaena

Livestock systems utilizing leucaena (*Leucaena leucocephala*) were developed and promoted in the 1970s and 1980s by various organizations, including the National Center of Agricultural Research (CENIAP), the Venezuelan Central University (UCV) and Zulia University (LUZ). Leucaena was used as a protein bank, alley/hedgerow grazing systems and living fences and more recently in intensive silvopastoral systems. The uptake of leucaena as a strategic component for dairy cattle has allowed farmers to increase the carrying capacity of their land as well as animal productivity.

In 2003 it was estimated that 800–1,500 ha of leucaena forage systems had been established in Venezuela, distributed mainly in the states of the western central zone: states of Zulia, Falcón, Lara, Yaracuy, Táchira, Trujillo, Barinas, Portuguesa, Cojedes and Aragua ([Espinoza et al. 2003](#)). At the present time it is estimated that the area planted with leucaena has significantly increased due to farmers's interest.

A significant limitation in the adoption of leucaena forage systems has been the limited availability and high cost of planting material. This is particularly the case for protein banks where high densities of 10,000–20,000 plants/ha are required. Farmers have identified reduced establishment costs, increased availability of high quality seed and of affordable good quality nursery seedling stock as options for accelerating the adoption of leucaena planting. In an attempt to reduce cost of seed and improve its availability, they often obtain seeds from neighbors and

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establish their own nurseries to develop seedlings to transplant at the beginning of the wet season. Seeds are inoculated with *Rhizobium* spp. provided by either commercial companies or government agencies. Before planting, weed control is carried out and fertilizer is applied. First grazing commences 4–5 months after planting, when plants have reached a height of 150–200 cm.

Dairy producers who establish protein banks usually introduce the cattle for direct browsing of a small plot (e.g. 1,000 m², depending on the size of the herd) for 2 hours after milking. After the plot has been browsed sufficiently the leucaena plants are pruned at a height of 90–120 cm and allowed to regrow for 75–90 days before they are grazed again.

The alley/hedgerow system is also used in dairy production areas. Twin rows (100 cm apart) of leucaena plants are established, with 50–100 cm between plants within rows. The twin hedgerows are usually separated by grass alleys (inter-row space) of 4 m wide. The estimated plant density of leucaena in these systems is 4,000–8,000 plants/ha (Figure 1). Animals graze the grass and browse the leucaena plants; after that the trees are pruned.



Figure 1. Pasture alley/hedgerow system of African star grass (*Cynodon nlemfuensis*) with twin hedgerow of *Leucaena leucocephala* at Fundación para el Desarrollo Agrícola, DANAC Foundation, Yaracuy State, Venezuela. Photo: E.E. Escalante.

In 2002, a diversified multi-stratified intensive silvopastoral system of 4.2 ha was established at the DANAC Foundation, Yaracuy State. In plots 20 m wide a central row of leguminous trees, e.g. samán, cují (*Prosopis juliflora*) and cañafistola (*Cassia moschata*), was established to provide shade, comfort and edible pods. Five rows of leucaena were planted on each side of the central leguminous tree row, at a spacing of 1 × 1 m within a guinea grass (*Megathyrsus maximus* syn. *Panicum maximum*) pasture. This system requires a leucaena plant density of 5,000 plants/ha. Teak (*Tectona*

grandis) and other valuable wood species were planted in the borders around the plots as living fences (Figure 2). The system increased the carrying capacity from 1 AU/ha to 3 AU/ha (Escalante et al. 2011) and daily milk yields by 1.5 L/cow.



Figure 2. Intensive multi-stratified silvopastoral system of 5 leucaena rows in a guinea grass (*Megathyrsus maximus* syn. *Panicum maximum*) pasture with teak (*Tectona grandis*) planted around the border and samán (*Samanea saman*) in the middle of the grazing plot, established at the DANAC Foundation, Yaracuy State, Venezuela. Photo: E.E. Escalante.

Selected scientific studies

In studies conducted by FONAIAP (Fondo Nacional de Investigaciones Agropecuarias) in Zulia State, the agronomic performance of 90 leucaena accessions was evaluated (Faría-Mármol 1994). Dry matter (DM) yields of up to 10.4 t/ha were obtained for accessions CIAT 17129 and 10.9 t/ha for CIAT 17128, subjected to 9 harvests over a period of 315 days. CIAT 17129 produced almost 4 times as much edible DM in the rainy season as in the dry season (8.5 t/ha vs. 2.2 t/ha) and crude protein (CP) concentration was 27.3% in the wet and 21% in the dry season.

A survey of 60 randomly selected dual-purpose farms in Trujillo State determined the level of adoption of leucaena as a grassland improvement strategy (Osechas et al. 2008). Pastures on most of the farms were based upon either guinea grass or African star grass (*Cynodon nlemfuensis*). The survey found 21.1% of the farmers used *L. leucocephala* as a protein supplement for grazing livestock. Leucaena pastures were intensively grazed for 2–4 days, then rested for 30–40 days. Mean milk yields of cows and animal liveweight gains of beef cattle were 5.12 L/cow/d and 389 g/hd/d, respectively during the rainy season.

A study carried out by Torres et al. (2002) determined the optimal distance of sowing configuration for leucaena seed production. A planting configuration of 2 × 2 m increased seed yields and seed size and weight in comparison with 1 × 1 m. Seed quality (germination percentage) was not affected.

The forage quality of leucaena, matarratón and casco de vaca (*Bauhinia forficata*) was compared in terms of crude protein, ash and ether extract concentrations (Blanco et al. 2015). Leucaena had the highest values for crude protein (28.6%), ash (17.2%) and ether extract (7.3%) concentrations. This demonstrates the excellent nutritive value of leucaena as a protein supplement to tropical grass forage.

Rodríguez et al. (2015) conducted a study to compare the agronomic performance of leucaena and mulberry (*Morus* spp.). Leucaena grew taller than mulberry (124 vs. 94 cm; $P < 0.01$) and produced higher DM yields (295 vs. 210 g/plant; $P < 0.01$); it was most productive when harvested at a cutting height of 50 cm.

Conclusions

The review of literature and the author's personal experience suggest that there is still great potential for leucaena to improve the carrying capacity and productivity of beef and dairy systems in the Venezuelan savannas and other milk production areas. Additional research effort is required to determine if leucaena systems are adapted to the acid infertile savanna soils, where a marked dry season combined with poor quality grasses is a severe limitation for efficient livestock production.

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

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