

## Identification of forage tree species used in three animal husbandry farms of Granma province, Cuba

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### Abstract

**Objective:** To identify the use of forage tree species in three animal husbandry farms in the Macanacú valley of the Guisa municipality, Granma province.

**Materials and Methods:** In three animal husbandry farms (Macanacú, El Sao and La Gloria) three transects of 1 500 m<sup>2</sup> were made, subdivided into plots of 20 x 25 m. All the species were collected and taxonomically identified and were organized in alphabetical order and by family. The inventory of the existing forage tree species was carried out. The species present were characterized, according to their use and services offered in the studied zone.

**Results:** A total of 23 species that were used in the animal husbandry systems were recorded. The high representativeness of the family Fabaceae stands out, with 18 % of the total, for having legume and forage species, all of them of interest for animal husbandry. The forage tree species like *Samanea saman* (Jacq.) Merr, *Leucaena leucocephala* (Lam.) de Wit, *Guazuma ulmifolia* Lam and *Gliricidia sepium* (Jacq.) Kunth ex Walp, are the most widely used as feeding source for the livestock of the region.

**Conclusions:** Twenty three tree species, with potential for silvopastoral use, were identified. The high representativeness of the family Fabaceae was proven, with 18 % of the total species. Nine tree species that are consumed by cattle were recorded, among which *S. saman*, *A. lebbeck*, *L. leucocephala*, *G. ulmifolia*, and *G. sepium* stand out.

**Keywords:** animal husbandry, forage, silvopastoral system

### Introduction

Silvopastoral systems (SPS) play a crucial role in the reduction of the negative impacts of agriculture in the conservation of biodiversity (López-Vigoa *et al.*, 2017).

The SPS of Central America and the Caribbean hold 14-184 trees ha<sup>-1</sup> from a list of species that varies between 34 and 180 species ha<sup>-1</sup> (Pozo, 2019). The most utilized ones in Cuba are protein banks, associations of trees with grasses in the whole grazing area and living fences. Different authors indicate that the use of these systems constitutes a viable option for animal production (Russo, 2015; Iglesias *et al.*, 2017; López-Vigoa *et al.*, 2017).

Cuba is one of the countries of the Caribbean area that works significantly in the evaluation of tree species since the late 1980's. The Forestry Research Institute has developed a broad and varied work in the evaluation of trees. The results were obtained in the Forestry Stations of Guisa, Villa Clara, Itabo and Viñales, on different soil types. This experience has been transmitted to other countries of the area,

such as Mexico, Colombia, Venezuela, Dominican Republic. This fact is important, particularly in the Caribbean area, where small island states, which constitute fragile and vulnerable ecosystems to climate change, desertification and drought, prevail, (Febles and Ruiz, 2008).

The utilization of woody perennial plants in animal husbandry systems is visualized among the main actions defined in the goals for sustainable development until 2030 (ONU and CEPAL, 2018). This is due, among other aspects, to the sustained increase of animal production, which is supported on the rise of productivity and quality of the associated pasturelands, favored by the fixation of atmospheric nitrogen to the soil and the important contribution of easily-mineralized litter, which benefits nutrient recycling, carbon (CO<sub>2</sub>) capture and increase of flora and fauna diversity in the system. The above-explained facts positively increase the energy balance in the ecosystem and, in fact, improve productive and health indicators of herds (Pozo, 2019).

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Creating awareness of the importance of trees in the ecological and productive stability of pasturelands has motivated the application of technical guidelines of the animal husbandry area of the Ministry of Agriculture, which are mandatory, and aim at restoring living hedges, shade trees, and others.

From these conditions, the objective of this study was to identify the use of forage tree species in three animal husbandry farms in the Macanacú valley of the Guisa municipality, Granma province.

### Materials and Methods

*Location.* The studies were conducted in the Basic Unit of Cooperative Production (UBPC, for its initials in Spanish), of the Batalla de Guisa Agroforestry Enterprise, which is located in the Macanacú valley, in the pre-mountain of the Guisa municipality, Granma province.

*Recognition of the study zone.* The research was conducted from January to April, 2019. The study area comprises 280,54 ha under exploitation, made up by five animal production units, with a herd of 310 heads of cattle. Brown soils in their variants prevail. For their study the secondary information (Censo Agropecuario, 2018) and the data supplied by the Provincial Delegation of Agriculture (MINAG) were compiled and reviewed. Field visits were made and the study zone was observed.

*Prioritization of the farms.* From the compilation and analysis of the information, three farms were prioritized, with similar characteristics regarding landscapes and territory, in order to decrease the differences that are related to biophysical factors. To typify the soils the classification proposed by Hernández-Jiménez *et al.* (2015) was followed.

Each one of the farms is described below:

- Macanacú has an area of 96,6 ha; 95,3 are dedicated to grazing. Brown soils with carbonates prevail. It has a herd of 91 heads.
- El Sao shows an area of 54,0 ha; 52,5 are aimed at grazing. Brown soils with carbonates are predominant. It has a herd of 40 heads.
- La Gloria has an area of 36,0 ha; 33,7 are dedicated to grazing. There is predominance of brown soils without carbonates. Its herd has 46 heads.

*Floristic composition.* After the recognition of the forage tree species found in each one of the farms, an inventory was made with the design of transects. For the floristic inventory, three transects were made, of 75 x 20 m, randomly distributed. On each one three plots of 20 x 25 m (225 m<sup>2</sup>) were

erected. In them the species were collected and taxonomically identified and were organized by alphabetical order and by family. They were characterized according to their use and the services they offered in the studied zone.

*Statistical analysis.* For the interpretation of the results the percentage comparison per species and per families was applied (Toral-Pérez *et al.*, 2019).

### Results and Discussion

After making the transects in each one of the farms, 23 tree species with forage potential were found, which coincide with those currently used by farmers for animal feeding (table 1). These results indicate that in the prospected zones relative generic and specific diversity is concentrated.

Fig. 1 shows the percentage of species per family with regards to the total number of identified species. These species correspond to 13 botanical families. The families Fabaceae and Meliaceae (18 %) showed four species each, followed by Arecaceae (13 %) with three; Boraginaceae and Mimosaceae (9 %) with two families, respectively.

The high representativeness of the family Fabaceae, with 18 % of the total species, legume and forage ones, all of them of high interest for animal husbandry, should be emphasized.

These results corroborate the report by López-Toledo and Valdéz-Hernández (2011), who in their study indicated that the family Fabaceae represents the one with the highest cultural importance. Likewise, ranchers acknowledge that one of the values of this plant family lies on its use for animal feeding, as they constitute forage species. Roman *et al.* (2011) refer its importance due to the protein content present in its leaves and young stems, mainly, with regards to non-leguminous species.

The highest number of families and species is found in the animal husbandry farms El Sao with 14, followed by Macanacú with 12. The one with lower diversity was La Gloria, with a representation of eight species (table 2). This can be related to the availability of resources for the crop, characteristics of the area and marked potentiality of adaptation of some species (Iglesias *et al.*, 2017).

Table 1 shows the use and services offered by the forage tree species, such as shade, animal feeding, reforestation, among others. The presence of tree species with forage potential, because of their foliage or their fruits, was identified. They are acknowledged due to their multipurpose character, because their foliage is feed source for cattle

Table 1. Diversity, uses and services of tree species present in animal husbandry farms.

Common name	Scientific name	Family	Farms			Uses
			1	2	3	
Spanish elm	<i>Cordia gerascanthus</i> L.	<i>Boraginaceae</i>	x	x	x	timber
Rain tree	<i>Samanea saman</i> (Jacq.) Merr.	<i>Fabaceae</i>	x	x		fruits / shade
Woman's tongue tree	<i>Albizia lebbbeck</i> (L.) Benth	<i>Mimosaceae</i>	x	x	x	foliage / reforestation
Cuban belly palm	<i>Acrocomia crispa</i> (Kunth) C.F. Baker Ex. Becc.	<i>Areceaceae</i>	x			fruit / feed
Manila tamarind	<i>Pithecellobium dulce</i> (Roxb.) Benth.	<i>Mimosaceae</i>	x	x		fruit / reforestation
Red cedar	<i>Trichilia hirta</i> L.	<i>Meliaceae</i>	x	x		Feed
Yamagua	<i>Guarea guidonia</i> (L.) Sleumer	<i>Meliaceae</i>	x	x		Timber
Martinique prickly ash	<i>Zanthoxylum martinicense</i> (Lam.) DC.	<i>Rutaceae</i>	x	x		Timber/ reforestation
Wild lime	<i>Adelia ricinella</i> L.	<i>Euphorbiaceae</i>	x			Timber
Soursop	<i>Annona muricata</i> L.	<i>Annonaceae</i>	x			Fruits
Guavaberry	<i>Myrciaria floribunda</i> (H. West ex Willd.) O. Berg	<i>Myrtaceae</i>	x			fruits / reforestation
West Indian elm	<i>Guazuma ulmifolia</i> Lam.	<i>Malvaceae</i>	x	x		foliage, fruit / shade
Copey	<i>Clusia rosea</i> Jacq.	<i>Clusiaceae</i>		x		timber
Pink shower tree	<i>Cassia grandis</i> L.f	<i>Fabaceae</i>		x		fruit / shade
Clammy cherry	<i>Cordia collococca</i> L.	<i>Boraginaceae</i>		x		fruit / reforestation
Leucaena	<i>Leucaena leucocephala</i> (Lam.) de Wit	<i>Fabaceae</i>		x	x	Foliage / shade
Cuban cedar	<i>Cedrela odorata</i> L.	<i>Meliaceae</i>		x		timber
Quick stick	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp	<i>Fabaceae</i>		x		forage, living fence, shade
Perto Rican hat palm	<i>Sabal causiarum</i> (O.F. Cook) Becc.	<i>Areceaceae</i>			x	Palm foliage
Satinleaf	<i>Chrysophyllum oliviforme</i> L.	<i>Sapotaceae</i>			x	fruits
Cuban mahogany	<i>Swietenia mahagoni</i> (L.) Jacq.	<i>Meliaceae</i>			x	timber
Cuban royal palm	<i>Roystonea regia</i> (Kunth.) O.F. Cook	<i>Areceaceae</i>			x	timber / reforestation
Copperwood	<i>Bursera simaruba</i> (L.) Sarg.	<i>Burseraceae</i>			x	timber

Farm 1-Macanacú; Farm 2-El Sao; Farm 3- La Gloria

during the rains, just like their fruit in dry seasons, for which their conservation and management in animal husbandry farms are important (Juárez-García and Saragos-Méndez, 2019). These species include *L. leucocephala*, *A. lebbbeck*, *C. grandis* and *S. saman*, the most common in the pasturelands of Cuba, whose fruit is consumed with avidity by cattle, because it has a high protein and energy content. Besides the environmental services, of shade provision, wind control and contribution of nutrients to the associated plants, they offer up to 7 t of sugar and 2,4 t of protein per hectare per year, which come from its fruits. The supplementation

with fruits of tree legumes improves the productive response of cattle (Roig and Mesa, 1965).

The foliage of trees with forage use is characterized by having high content of crude protein (up to 35 %). The species *G. ulmifolia* stands out, because its foliage is consumed by small ruminants. The livestock eat its leaves and fruits, and the latter are palatable for pigs. *G. sepium* is used as forage, living fence and as shade. *C. collococca* is identified as preferred feed by birds, just like *P. dulce*.

Forage tree species, such as rain tree, leucaena, West Indian elm and quick stick, are the most

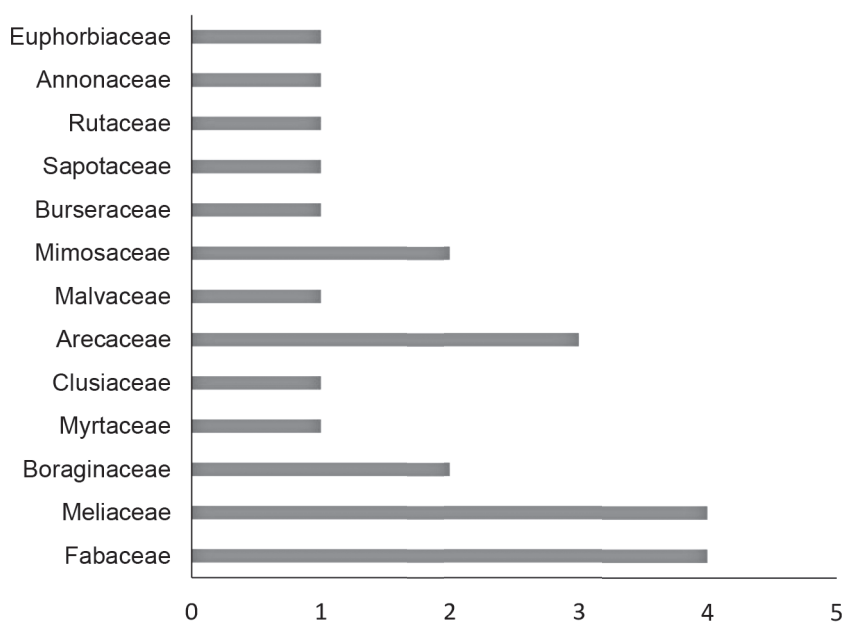


Figure 1. Percentage of species per botanical families in the study area.

Table 2. Number of species and botanical families per animal husbandry farms.

Farm	Quantity of species	Quantity of families
1	12	10
2	14	7
3	8	7

Farm 1-Macanacú; Farm 2-El Sao; Farm 3- La Gloria

widely used ones as feed source for the livestock of the region.

The obtained results coincide with a study conducted by Toral-Pérez *et al.* (2019), who analyzed the diversity of trees and shrubs in different regions of the northeast Yaguajay municipality, Cuba. These authors identified nine woody species consumed by cattle, among which *G. ulmifolia*, *C. collococca* stand out; followed by *A. lebeck*, *L. leucocephala* and *G. sepium*.

Diverse studies confirm that farmers know the benefits of the species and they select and manage them according to their criteria of value and importance, which influences their repopulation in degraded areas (Ángel-Sánchez *et al.*, 2017; Milián-García *et al.*, 2018).

In the study area trees of high timber value are present, among them *C. odorata*, priority species in conservation, whose forestry exploitation makes it categorized as globally vulnerable (Ángel-Sánchez *et al.*, 2017). *S. mahagoni* is also identified. Other

recognized species, of lower economic value, are *B. simaruba* and *A. lebeck*. The above-cited species also have other uses, such as their shade contribution and the mitigation of climate change.

The presence of fruit species was also observed, like *C. oliviforme*, *C. grandis*, *A. muricata*, which provides the system with another use value.

Associated to trees, in the pastureland, are palm trees. The plants of the family Arecaceae have multiple uses, among them ornamental, industrial, medicinal, nutritional and cosmetic. *R. regia*, our national tree, which has traditionally been given uses as feeding source and construction material, stands out. It fructifies throughout the year and produces up to eight racemes (40-50 kg). Its fruit is known as *palmiche* and constitutes one of the most abundant natural feedstuffs in the nation with high nutritional values, especially for fattening pig and other animals (Milián-García *et al.*, 2018). In addition, *A. crispa* and *S. causiarum* are found, which are strategic

for many species of the native fauna. Hence they serve as refuge for diverse insects and, especially, for the birds that take it as nest.

Palma-García and González-Rebeles-Islas (2018) state that it is important to maintain or increase the trees dispersed in paddocks in animal husbandry landscapes, because they are seed source, provide habitat and feed to fauna species, besides offering additional benefits, such as timber, firewood, feed for livestock, ecosystemic services. Likewise, they have potential as adaptive or mitigating strategy against the climate change.

The use of the species shows the advantages of including trees in production systems, which is proven by the different services they provide to the productive system and the environment. For such reason, the studies focused on the incorporation of trees in animal husbandry, involve the possibility of incorporating native species in multiple options, which allow to overcome the current adverse environmental and economic conditions.

### Conclusions

Twenty three tree species with potential for silvopastoral use were identified, from which nine forage species that are consumed by cattle were found, with *S. saman*, *A. lebeck*, *L. leucocephala*, *G. ulmifolia*, and *G. sepium* standing out. The family Fabaceae also prevailed with 18 % of the total species.

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### Conflict of interests

The authors declare that there is no conflict of interests among them.

### Authors' contribution

- Liudmila Jiménez-Mariña. Executed the experiments with the corresponding measurements, searched for bibliographic information, as well as wrote and revised the manuscript.
- Diocles Guillermo Benítez-Jiménez. Generated the idea of the research, searched for bibliographic information and revised the manuscript.
- Ana Beatriz Pérez-Suárez. Conducted the experiments in field, data taking and processing, searched for bibliographic information.

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