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**Front cover:**

Cattle grazing *Gliricidia sepium*

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# Biodiversity and genetic resources of forage legumes in Brazil

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**Abstract:** The use of forage legumes in tropical areas, besides the biological fixation capacity of atmospheric nitrogen, contributes to improve the nutritive value of animal diets. Despite its importance in various production systems, the adoption of new tropical legume germplasm has been inexpressive in several Latin American countries, even when germplasm lines and improved cultivars are available, as the case of Brazil, where more than 2500 germplasm accessions were tested and 50 cultivars are registered for commercialization. Regarding the tree legumes, much of the work that was developed was concentrated in only four genera: *Cratylia*, *Leucaena*, *Gliricidia* and *Sesbania*, which resulted in 10 cultivars releases. However, the level of adoption of these cultivars is very low.

Biodiversity can be defined as the total variability found within all living organisms and their habitats. It can be accessed at three

different levels: communities (environment), species, and genes. When accessing biodiversity at the species level, we are interested in observing differences among individuals or populations of that particular species.

Since very early in the history of the world, humans have exploited the genetic diversity of plants, primarily as sources of food, and then to improve their landraces and cultivars. With the advance of modern agriculture, plant breeders around the world began to collect genetic diversity of the most important food crops and to store these materials at national research institutes and local institutions. Because of these efforts, FAO estimated that 6.2 million accessions of 80 different crop species were stored in 1,320 genebanks and related facilities in 131 countries (1).

Studies of genetic diversity are important because they are a tool for genetic improvement allowing the efficient use of the available germplasm of a species. Germplasm characterization consists of studies of eco-geographic and demographic

adaptation, and involves mostly the parameters of the vital cycle of the organism, genetic and physiological studies, plant pathology, and yield evaluation, among other studies. Breeding programs should begin only after appropriate germplasm characterization (2).

In summary, characterization is the best way to understand the variability contained in a germplasm collection and to increase the use of the germplasm by plant breeders. It is also important in monitoring the genetic stability of the germplasm storage processes. Characterization of germplasm can be based on molecular, biochemical, morphological, and agronomic features.

Despite the importance of the forage legumes in various production systems, the adoption of new tropical legume germplasm has been inexpressive in several Latin American countries (3). However, according to Kretschmer (4), there are about 18,000 species of forage legumes and at least 1000 to 2000 species with potential for cultivation.

The use of legumes in tropical areas, besides the biological fixation capacity of

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atmospheric nitrogen, contributes to improve nutritive value of the animal diet. In general, its use is more widespread in temperate regions.

Spain (5) pointed out some barriers to the adoption of forage legumes, including the lack of adapted germplasm, insufficient knowledge on grazing management, and lack of credibility among specialists (extensionists, researchers and professors) and users (cattle ranchers and entrepreneurs in the field of seed production and marketing), mainly due to failures in the recent past.

Paradoxically, the reduced use of forage legumes in the Brazilian production system does not reflect the great genetic variability available and evaluated in national research institutions. Thousands of introductions have been tested in the last 30 years.

At Embrapa Cerrados, in Planaltina, DF, more than two thousand accessions of legumes with forage potential were introduced and evaluated. In Table 1 there is information about the number of available accessions and level of characterization of the germplasm stored at the Embrapa Cerrados Genebank. Most of the germplasm was agronomically characterized, focusing on herbage accumulation, pests and disease occurrence and general adaptation to the edaphoclimatic conditions to the Cerrado region.

Tree legume available germplasm is much more restricted than the herbaceous legumes species. For this reason, much of the work that was developed in Brazil concentrated on only four genera: *Cratylia*, *Leucaena*, *Gliricidia* and *Sesbania*.

*Cratylia argentea* is a leguminous species that occurs in the Cerrados and semi-arid regions of Brazil. It grows as a small shrub, ranging from 1.5 to 3 meter, presenting numerous branches emerging from the base of the plant with persistent leaves during periods of drought.

In research conducted in Minas Gerais State in areas of the Atlantic forest, the dry matter yield of the *Cratylia argentea* cultivar Ceci, with 10 months of age was 4.90 Mg/ha. After this first cut, with 3 and 6 months, this legume produced 4 Mg/ha and 14.9 Mg/ha of dry matter, respectively. It is important to note that the later occurred during the dry season when the growth of tropical forages cease, thus confirming its drought tolerance. Crude protein values were high, ranging from 25 to 28%. The estimated value for DM digestibility was 56.7% (6).

Pizarro *et al.* (7), working with 88 accessions from a collection of 10 genera of

**Table 1. Information about the number of available accessions and characterization from germplasm stored at the Embrapa Cerrados Genebank.**

Genus	# Accessions	Characterization		
		Morphological	Molecular	Agronomical
<i>Bauhinia</i>	20			20
<i>Cajanus</i>	19			19
<i>Calliandra</i>	12			12
<i>Cratylia</i> spp.	59	47	3	59
<i>Flemingia</i>	15			15
<i>Gliricidia</i>	1			1
<i>Leucaena</i>	123			123
<i>Sesbania</i>	44			44
Herbaceous legumes	2519	615	45	1965
<b>TOTAL</b>	<b>2812</b>	<b>662</b>	<b>48</b>	<b>2258</b>



**Figure 1. *Cratylia argentea* plants**

shrub legumes in the Cerrado, observed annual dry matter yields ranging from 500 to 2500 Mg/ha. The results obtained during 5 years concluded that the genera *Cratylia*, *Gliricidia* and *Mimosa* are the most promising.

The genus *Leucaena* is pointed as one of the most important tropical forage legumes being evaluated and tested in Australia, Asia, Central and North America. In Brazil, nine cultivars of *L. leucocephala* were registered for commercialization. Most of them are cultivars selected in Australia, USA and other

countries, including cultivars Cunningham, Peru, El Salvador, Gigante, K4, K8, K29, K67 and K132. Although some of them are adapted, they are not used widely.

In Brazil, a breeding program implemented by CIAT and Embrapa focused on cultivars with tolerance to acid soils and quick establishment. To achieve this goal, the strategy implemented was based in the use of the interbreeding among the *Leucaena* species: *L. leucocephala* crossed with *L. esculenta*, *L. shannoni*, *L. pallida* and *L.*




Figure 2. *Cratylia argentea* plants



Figure 3. *Cratylia argentea* plants

*diversifolia*. After several years of work, about 90 bulks and families were selected that showed good growth in acid soils with low Ca. A selection line of the crossing between *L. leucocephala* and *L. diversifolia* is in the final evaluation process for registration and protection.

Although there are thousands of forage legume germplasm accessions available, as January 2019, there were only 53 cultivars registered at the Ministry of Agriculture, Livestock and Supply (MAPA), for commercialization and use for the Brazilian producers. These cultivars belong to the genera *Arachis* (7), *Cajanus* (14), *Calopogonium* (3), *Centrosema* (5), *Cratylia* (1), *Leucaena* (9), *Macroptilium* (1), *Macrotyloma* (1), *Neonotonia* (5), *Pueraria* (1) and *Stylosanthes* (6). Of these 53 cultivars, seeds of only 10 to 15 are currently produced and traded - mostly for use as green manure. 

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Figure 4. *Cratylia argentea* plants



Figure 5. *Gliricidia sepium* plants



Figure 6. *Gliricidia sepium* plants