Prospecting and collection of forage species in plant formations of the Rafael Freyre municipality, Holguín, Cuba

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ABSTRACT

A prospecting mission was conducted in order to identify and collect species from the natural and naturalized forage flora, distributed on a ferromagnesian reddish Brown Fersialitic soil of the Rafael Freyre municipality, Holguín. Three plant formations were taken into consideration: A) non-anthropic thorny brushwood, B) semi-anthropic savannas and C) anthropic savannas, all located on material of serpentinitic origin. Fifty species from 35 genres were collected, 26 from the Poaceae family and 24 from the *Fabaceae* family. Within Poaceae the genera *Dichanthium*, *Brachiaria*, *Cynodon* and *Cenchrus predominated*; and in *Fabaceae*, *Desmodium*, *Centrosema*, *Teramnus*, *Albizia*, *Pithecellobium* and *Leucaena* prevailed. The highest abundance of species in the anthropic and semi-anthropic savanna, with presence of improved accessions, demonstrated that the human intervention was beneficial, particularly where there was lower pasture exploitation (plant formation B). It is demonstrated that a wide germplasm of *Poaceae* and *Fabaceae* existed in the prospected plant formations and that the species showed a general or specific adaptability, for the number of collected individuals as well as their repetitiveness. It is recommended to conduct research with varied germplasm of the most recurrent species and particularly, of the introduced ones; as well as with germplasm whose species are akin to the naturalized ones.

Key words: plant formations, collection, forages.

INTRODUCTION

It has been demonstrated that any attempt to possess good pasturelands for rearing animals should start from the principle of the species' adaptability to the environment, which is considered –according to Paretas (1990) and Ruiz (2007)– the essential criterion for their dissemination in a specific territory. For this to be possible a profound knowledge of the livestock production agroecosystems and the predominant natural and naturalized forage flora is necessary. The violation of this principle has caused costly mistakes in many countries, which have been recurrent in the particular case of Cuba; with sensitive economic losses that have been generally associated with the little persistence of the established species and the consequent costs for their reposition.

In Holguín (in the eastern region of the country) this topic acquires particular interest; because it is one of the provinces that show higher soil and climate heterogeneity. According to studies developed by Oquendo (2006), some limiting factors like the soil salinity, acidity, basicity and depth and others of climate and physiographic character cause this territory to have few suitable characteristics for the promotion and exploitation of pasturelands; and, as consequence, to be very dependent on the correct adaptability of pastures to the environment. However, the works related to the prospecting and collection of its forage plants in the different zones of the province are few; in this sense it is only possible to mention the ones conducted by Oquendo et al. (2006); Olivera, Machado and Fung (2008) and Mestre (2009).

Around 15 % of the soils used in livestock production in this territory are classified as ferromagnesian reddish Brown Fersialitic and are supported on serpentinite rock. Particularly in the Rafael Freyre municipality these soils occupy more than 50 % of the agricultural area and have been dedicated mostly to livestock rearing (Sablón and Oquendo, 1996); however, there is not any record of species inventory or adaptability studies.

This reality has caused that the proposals of promoting forage areas come from extrapolated results of studies conducted on similar soils of the province, and not –as it should be– from varieties identified during the regionalization process, to which the information of prospecting and collection works should contribute, as well as the results of floristic inventories, in particular, of areas with anthropic intervention.

Based on such premises, the objective of this research was to identify and collect the species with forage characteristics which are part of the natural and naturalized flora, distributed in plant formations located on a ferromagnesian reddish Brown Fersialitic soil of the Holguín province.

MATERIALS AND METHODS

The prospecting and collection missions were conducted during 2007-2009 in the Rafael Freyre municipality, Holguín province, in the northern part of the center or savanna ecosystem, according to the classification proposed by Oquendo (2011). The sampling was conducted in an area of about 2 km^2. The forage importance of the species and the principles and techniques suggested in the "Metodología para la colecta, conservación y caracterización de especies herbáceas, arbóreas y arbustivas útiles para la ganadería" ("Methodology for the collection, conservation and characterization of herbaceous, tree and shrub species useful for livestock production") (Machado *et al*., 1999) were taken into consideration.

The areas are supported on a ferromagnesian reddish Brown Fersialitic soil, according to the Nueva versión de clasificación genética de los suelos de Cuba (New version of genetic classification of the soils in Cuba) (Hernández, Morales, Ascanio and Morel, 2006), which is acid or slightly acid, of poor OM content and low fertility.

Three plant formations were selected: A) non-anthropic thorny brushwood, B) semi-anthropic savannas and C) anthropic savannas.

In formation A the collection was performed in the zone known as Loma del Burro, located at 120 masl, in which the charrascales and a generally endemic xerophytic vegetation predominate. Although this formation is of little or null importance for livestock production, the scarce intervention of man confers to these areas an important value for the search of the forage plant life adapted to these soils.

Formation B was selected in the place known as La Jucarera, located between 50 and 100 masl. It stands out for the presence of many trees that have escaped the human intervention and for being areas with little intensive exploitation

Formation C was located between 0 and 50 masl, in the zone known as Nueva Aurora, where man has caused higher floristic disturbances to the ecosystem because the rearing methods used have been more intensive, with predominance of the introduction of foreign species, parcelling and use of high stocking rate.

RESULTS AND DISCUSSION

A total of 50 species were collected, all with a higher or lower forage value. From them, 26 belong to the Poaceae family and 24 to the *Fabaceae* family (tables 1 and 2).

Among the identified species in Poaceae (table 1), the ones from the *Brachiaria* and *Dichanthium* genera were the most represented ones (three in each case). This is important in the case of *Brachiaria*, due to the potential that some of its species have shown in tropical livestock production, as well as its favorable adaptive and productive characteristics under the most difficult environmental and management conditions –including soils of moderate fertility– as indicated by Machado (1998) and Olivera and Machado (2004).

It is important to emphasize that the species from the *Dichanthium* genus, for their adaptability and extension in livestock production areas of the municipality –particularly in the studied ecosystem–, should be taken into account, integrated as much as possible to exploitation systems which include trees that could complement the low productivity and quality of their forage biomass.

In the case of *Fabaceae* (table 2), the existing diversity was mainly represented by the twining, tree and semi-shrubby types. Among the species found, the ones from the *Desmodium* and

Table 1. Collected taxa from the *Poaceae* family.

No.	Taxon	Common name
1	*Axonopus compressus*	cañamazo
2	*Bothriochloa pertusa*	pelo de burro o jiribilla
3	*Brachiaria fasciculata*	-
4	*Brachiaria purpurascens*	paraná
5	*Brachiaria* sp.	-
6	*Chloris* sp.	-
7	*Cenchrus echinatus*	guisaso
8	*Cenchrus tribuloides*	guisaso
9	*Cynodon dactylon*	yerba fina
10	*Cynodon dactylon*	bermuda cruzada
11	*Cynodon nlemfuensis*	pasto estrella
12	*Dichanthium annulatum*	pitilla
13	*Dichanthium aristatum*	angleton
14	*Dichanthium* sp.	-
15	*Digitaria sanguinalis*	pata de gallina
16	*Hyparrhenia rufa*	faragua
17	*Panicum maximum*	guinea
18	*Paspalum notatum*	tejana
19	*Paspalum plicatulum*	pajilla
20	*Pennisetum purpureum*	napier
21	*Pennisetum purpureum*	king grass
22	*Saccharum* spp.	caña de azúcar
23	*Schizachyrium* sp.	pajón
24	*Sorghum halepense*	Don Carlos
25	*Sporobulus indicus*	espartillo
26	*Trichachne insularis*	rabo de zorra

Table 2. Collected taxa from the *Fabaceae* family.

No.	Taxon	Common name
1	*Aeschynomene americana*	tamarindillo
2	*Albizia lebbeck*	algarrobo de olor
3	*Alysicarpus vaginalis*	maní cimarrón
4	*Bauhinia variegata*	pata de vaca
5	*Centrosema plumieri*	gallito
6	*Centrosema molle*	bejuco culebra
7	*Centrosema virginianum*	-
8	*Clitoria ternatea*	conchita
9	*Crotalaria retusa*	maraquita
10	*Desmanthus virgatus*	-
11	*Desmodium discolor*	-
12	*Desmodium sp.*	empanadilla
13	*Desmodium scorpiurus*	pega pega
14	*Desmodium triflorum*	-
15	*Gliricidia sepium*	júpiter, bien vestido
16	*Indigofera suffruticosa*	añil
17	*Indigofera sp.*	-
18	*Leucaena leucocephala*	periquillo, aroma blanca
19	*Macroptilium lathyroides*	contramaligna, maribari
20	*Pithecellobium dulce*	guinga
21	*Samanea saman*	algarrobo del país
22	*Stylosanthes hamata*	-
23	*Tephrosia candida*	-
24	*Teramnus labialis*	chonchoué, tripa de jutia

Centrosema genera, stood out, for their presence, from which four and three species were identified, respectively.

Barreto, Catasús and Acosta (1998), when determining the natural and naturalized grasses and legumes of the Camagüey province, showed the floristic value of the ferromagnesian reddish Brown Fersialitic soil, by finding a large diversity of taxa from the *Poaceae* (79) y Fabaceae (49) families, which were considered prominent in that aspect with regards to the other families.

When analyzing casuistically the floristic diversity in the different plant formations, it was found that in A there was a relatively scarce number of forage *Poaceae* species (table 3a) and none of them has high potential for animal feeding according to their productivity and/or quality, for which they are classified as of regular and low potential. This could be associated to the little productive characteristics of these soils, especially when these species were located in hilly places.

McIvor and Howden (1992) indicated that the species *B.pertusa* is highly cosmopolitan, because it adapts well to acid and infertile soils (pH~ 5), but with the limitation of having low production of forage biomass in all habitats. However, in Colombia it is a plant that has to be taken into consideration in the diverse feeding systems, because it is widely distributed in large livestock production regions of that country (Mejía, 2011).

It is interesting to emphasize that *Hyparrhenia* rufa, in spite of having good development in other plant formations, in this case showed small size and aciculate leaves. A similar situation was presented by *C. dactylon*, which could be related to the information reported by Harlan et al. (1970)

regarding its edaphic demands, preferentially of basic origin.

In spite of having limitations as forage plants, *Schizachyrium* sp. and P. plicatulum were collected, the latter due to its repetitiveness under these conditions and for being a plant genetic resource of possible use in ruminant feeding under extreme conditions of biomass scarcity. Something similar happened with the species commonly named rabo de zorra (Trichachne insularis), which has an important use as feedstuff reserve for the dry season; because the animals reject it during the rainy period, when biomass with higher acceptability is abundant. This species occupies long areas in farmyards of cattle rearing, in ideal association with Teramnus labialis, and constitutes a reserve of excellent quality.

In the formation of semi-anthropic savannas (table 3b), *Fabaceae* showed a similar behavior to *Poaceae* according to the number of genera, which did not occur with the number of species, whose presence was higher in 28 % (11 vs. 8); this aspect is important if their decisive role in animal nutrition is taken into account.

Machado et al. (1999) pointed out that from the 25 existing tribes –with 100 genera and 432 species in the *Poaceae* family of the Cuban flora– very few have a high value for the exploitation of pasturelands and none of the important species are endemic. In the *Fabaceae* family the contrary occurs, because from the 433 existing species, 305 are endemic of the neotropical flora and 158 are endemic of Cuba with acceptable forage value (Barreto, 1990).

Table 3a. Collected genera, species and accessions of the *Poaceae* family in plant formation A.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Axonopus	*compressus*	1	3	Prostrate			x
Bothriochloa	*pertusa*	1	9	Prostrate		x	
Brachiaria	sp.	2	8	Prostrate			x
Cynodon	*dactylon*	1	3	Prostrate		x	
Hyparrhenia	*rufa*	1	3	Erect		x	
Paspalum	*plicatulum*	1	7	Semi-erect			x
Schizachyrium	sp.	1	10	Semi-erect			x
Trichachne	*insularis*	1	6	Erect			x

G: good, R: regular, B: bad

Table 3b. Collected genera, species and accessions of the *Fabaceae* family in plant formation A.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Alysicarpus	*vaginalis*	1	5	Prostrated	x		
Centrosema	molle	1	2	Twining	x		
	virginianum	2	8	Twining		x	
Crotalaria	*retusa*	1	2	Erect			x
	scorpiurus	1	4	Prostrated	x		
Desmodium	*triflorum*	1	4	Prostrated	x		
	sp.	1	5	Prostrated	x		
Indigofera	sp.	1	3	Erect			x
Stylosanthes	*hamata*	1	7	Semi-shrub	x		
Tephrosia	*candida*	1	6	Prostrated	x		
Teramnus	*labialis*	1	3	Twining	x		

G: good, R: regular, B: bad

The presence of *C. molle* in natural form in plant formation A, in which man has not intervened with livestock rearing systems, is of great interest, because this species is one of the most relevant as forage species on the acid soils of the South American plains and some areas of Central America.

Table 4a indicates the Poaceae species collected in plant formation B; two species from the *Cenchrus* (*C. echinatus* y *C. tribuloides*) genera were included, due to their repetitiveness in this plant formation. This could be considered an indicator of their adaptability to these soils, for which it would be prudent to study some varieties of akin species (very morphologically closed) but of higher forage importance, like *Cenchrus ciliaris*, which is widely naturalized in tropical arid ecosystems ('t Mannetje and Kersen, 1992).

The fact that the *Desmodium* and *Centrosema* genera (table 4b) have stood out for the higher number of species and accessions coincides with the reported criteria, about the adaptability of these species to acid and infertile soils (Hacker, 1992; Pengelly, 1992; Fantz, 1996; Peters, Tarawali and Schultze-Kraft, 2000), and constitutes an indicator to be taken into consideration, by proposing species from the *Fabaceae* families for their study under these conditions.

In this formation as well as in formation A –and even in C– the species *S. hamata* was detected and collected, by virtue of its occurrence frequency.

The species of this genus, as they are relevant for their tolerance to drought and to poor and acid soils, tend to be highly interesting for the conditions under which livestock production is developed in the Rafael Freyre municipality, where the annual rainfall does not exceed 900 mm and more than 50% of the soils are considered acid and infertile. Paretas (1990) recommendad these species for similar soil and climate conditions and indicated their capacity to stand, unlike other legumes, stocking rates from 2 to 4 animals per hectare without irrigation, with live weight gains of 450 kg/ha^{-1} in the case of *S. guianensis*.

Table 4a. Collected genera, species and accessions of the *Poaceae* family in plant formation B.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Bothriochloa	*pertusa*	1	7	Prostrated		x	
Brachiaria	*fasciculata*	1	4	Prostrated		x	
	purpurascens	1	2	Prostrated	x		
Cenchrus	*echinatus*	1	5	Semi-erect			x
	tribuloides	1	6	Semi-erect			x
Chloris	sp.	2	3	Erect		x	
Cynodon	*nlemfuensis*	1	2	Prostrated	x		
	dactylon	2	4	Prostrated	x		
Dichanthium	*annulatum*	1	2	Prostrated		x	
	aristatum	1	2	Semi-erect		x	
Digitaria	*sanguinalis*	1	2	Prostrated		x	
Hyparrhenia	*rufa*	1	2	Erect		x	
Panicum	*maximum*	1	2	Erect	x		
Paspalum	*notatum*	1	1	Prostrated		x	
Pennisetum	*purpureum*	2	3	Erect	x		
Saccharum	sp.	1	2	Erect	x		
Sorghum	*halepense*	1	3	Erect		x	
Sporobolus	*indicus*	1	1	Erect			x

G: good, R: regular, B: bad

Table 4b. Collected genera, species and accessions of the *Fabaceae* family in plant formation B.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Teramnus	*labialis*	1	10	Twining	x		
Stylosanthes	*hamata*	1	7	Semi-shrubby	x		
Tephrosia	*candida*	1	6	Erect	x		
Indigofera	*suffruticosa*	1	2	Erect			x
Desmodium	*scorpiurus*	1	2	Prostrate		x	
	sp.	1	1	Prostrate		x	
	discolor	1	3	Erect	x		
	triflorum	1	2	Prostrate		x	
Centrosema	*molle*	1	2	Twining	x		
	virginianum	1	3	Twining		x	
	plumieri	1	1	Twining	x		
Alysicarpus	*vaginalis*	1	4	Prostrate		x	
Crotalaria	*retusa*	1	2	Semi-shrubby			x
Clitoria	*ternatea*	1	2	Twining	x		
Bauhinia	*variegata*	1	1	Tree	x		
Desmanthus	*virgatus*	1	3	Shrubby	x		
Leucaena	*leucocephala*	1	5	Tree	x		
Albizia	*lebbeck*	1	7	Tree	x		
Aeschynomene	*americana*	1	3	Semi-shrubby	x		
Gliricidia	*sepium*	1	3	Tree	x		
Samanea	*saman*	1	2	Tree	x		
Macropthilium	*lathyroides*	1	4	Semi-shrubby	x		
Pithecellobium	*dulce*	2	8	Tree	x		

G: good, R: regular, B: bad

On the other hand, on acid soils of Pinares de Mayarí, also supported on serpentinite rock, *S. guianensis* stood out in regionalization studies conducted by Rodríguez *et al*. (2009), when compared with other species from the same family.

The results of table 5a indicate that the number of species from Poaceae in plant formation C was very similar to the one found in B and higher than the one detected in A. If compared to formation B, in it neither *S. halepense* nor the *Cenchrus* species were found, but one more of *Dichanthium* was found, which indicates a certain degree of specificity for these species.

In formation C, for the case of the species from the Fabaceae family (table 5b), the creeping herbaceous or small-size legumes predominated, among them the ones from the *Desmodium* genus, with three accessions. The finding of *S. hamata*, as explained above, constitutes an important outcome if the studies by Edye and Topark-Ngarm (1992), Jingura *et al*. (2001) and Chakraborty (2004), who considered it outstanding for its adaptability to poor and non-heavy or clayey soils are taken into consideration; its recognized efficiency in the extraction of the little available phosphorus in these soil types is also significant.

The presence of this species in all the plant formations demonstrated its adaptability to the ecosystem. *S. hamata* is very persistent to grazing and it is found together with *T. candida* and some small-size species, such as those from the *Desmodium* genus, and sometimes mixed with *T. labialis* and associated to the natural pasture.

An aspect that has not yet been studied is the role of these small-size native legumes in the improvement of natural grasses, in general of low

Table 5a. Collected genera, species and accessions of the *Poaceae* family in plant formation C.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Bothriochloa	*pertusa*	1	7	Prostrated		x	
Brachiaria	sp.	1	4	Prostrated		x	
Chloris	sp.	2	3	Erect		x	
Cynodon	*nlemfuensis*	1	2	Prostrated	x		
	dactylon	2	4	Prostrated	x		
Dichanthium	*annulatum*	1	2	Prostrated		x	
	aristatum	1	2	Prostrated		x	
	sp.	1	1	Semi-erect		x	
Digitaria	*sanguinalis*	1	2	Prostrated		x	
Hyparrhenia	*rufa*	1	2	Erect		x	
Panicum	*maximum*	1	2	Erect	x		
Paspalum	*notatum*	1	1	Prostrated		x	
Pennisetum	*purpureum*	1	1	Erect	x		
	purpureum	1	2	Erect	x		
Saccharum	spp.	1	2	Erect	x		
Sporobolus	*indicus*	1	1	Erect			x
Trichachne	*insularis*	1	2	Erect			x

G: good, R: regular, B: bad

Tabla 5b. Collected genera, species and accessions of the *Fabaceae* family in plant formation C.

Genus	Species	Number of accessions	Occurrence frequency	Growth habit	Forage value		
					G	R	B
Aeschynomene	*americana*	1	2	Shrubby	x		
Albizia	*lebbeck*	1	6	Tree	x		
Alysicarpus	*vaginalis*	1	3	Prostrated		x	
Centrosema	*virginianum*	1	2	Twining	x		
Desmanthus	*virgatus*	1	1	Shrubby	x		
	scorpiurus	1	4	Prostrated		x	
Desmodium	*triflorum*	1	1	Prostrated		x	
	discolor	1	3	Erect	x		
Gliricidia	*sepium*	1	2	Tree	x		
Leucaena	*leucocephala*	1	6	Tree	x		
Pithecellobium	*dulce*	1	4	Tree	x		
Stylosanthes	*hamata*	1	6	Semi-shrubby		x	
Tephrosia	*candida*	1	6	Erect		x	
Teramnus	*labialis*	1	8	Prostrated	x		

G: good, R: regular, B: bad

productivity and quality under these conditions; as well as the role they could play in the sustenance of the animal stock that graze in these formations.

The prospecting and collection work demonstrated that in these formations there is a wide and rich diversity of genera and species, from Poaceae as well as Fabaceae, which allows to have enough genetic material to establish animal feeding systems suitable for each formation, based on their production potential.

It is concluded that, casuistically, a general or specific adaptability existed in the plant formations where the germplasm was collected. The most represented species were the ones from the *Dichanthium*, *Brachiaria*, *Cynodon* and *Cenchrus* genera, among the Poaceae family and *Desmodium*, *Centrosema*, *Stylosanthes*, *Teramnus*, *Albizia, Pithecellobium* and *Leucaena* among the *Fabaceae* family, for the number of collected taxa as well as for their repetitiveness. The anthropic intervention was beneficial due to the introduction of species that have been naturalized in these ecosystems.

It is recommended to conduct studies in this ecosystem with varied germplasm that includes the most recurrent important species, particularly, the introduced ones or those which are closely related to the naturalized; as well as to widen the collection activity in larger areas.

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ESTACIÓN EXPERIMENTAL DE PASTOS Y FORRAJES "INDIO HATUEY" PROGRAMA DE MAESTRÍA EN PASTOS Y FORRAJES

Resumen de Tesis

Título: Patógenos fungosos que afectan a las gramíneas pratenses en la Estación Experimental de Pastos y Forrajes de Las Tunas

Autora: *Ing.* Giselle Mariela Rodríguez Gutiérrez

Se realizaron muestreos semanales en los meses comprendidos entre mayo de 2008 y abril de 2010, con el objetivo de conocer las principales especies de patógenos fungosos que afectaban a seis gramíneas pratenses; así como evaluar la influencia de los factores del clima, en áreas de la Estación Experimental de Pastos y Forrajes de la provincia de Las Tunas. Para ello se empleó la metodología de señalización y pronóstico del INISAV (2003). Las especies consideradas en el estudio fueron: *Cynodon dactylon* (L) Pers cv. Tifton 85, *Brachiaria decumbens* Stapt cv. *Basilisk*, *Brachiaria brizantha* Hochst ex A., Rich Stapt cv. Marandú, Brachiaria híbrido mulato, Chloris gayana Kunth cv. Callide y Digitaria decumbens Stent cv PA-32. En estas se colectaron partes de las plantas con síntomas atribuibles a hongos, y se enviaron al laboratorio provincial de sanidad vegetal para el análisis y determinación de las especies de hongos presentes. Se determinaron 13 especies de hongos, pertenecientes a 10 géneros. Puccinia graminis, Pyricularia grisea, Bipolaris cynodontis, Bipolaris stenospila y Colletotrichum gloesporioides fueron las que más se hallaron y las que mayor afectación causaron en los cultivos evaluados. Alternaria alternata, Periconia sp., Choanephora sp., Cladosporium sp. y Colletotrichum gloesporioides se informaron por primera vez afectando a estos cultivos en la provincia Las Tunas. Las gramíneas Brachiaria híbrido mulato, C. gayana y C. dactylon resultaron las más afectadas. Las temperaturas fueron las variables climáticas que más influyeron en el comportamiento de Bipolaris cynodontis, Bipolaris stenospila y Colletotrichum gloesporioides, y la humedad relativa constituyó la variable del clima con mayor influencia en el desarrollo de *Puccinia graminis* y *Pyricularia grisea*.