Nota de Investigación

Preliminary evaluation of tropical forage legumes in Suakoko, Liberia

E. G. Smith*

Evaluating crude protein (CP) deficiency and increasing the yield of tropical grass pastures appear to be maior challenges for forage scientists. Grass pastures are often low in dry matter (DM) yields and nutritive values as they age over years or during the dry season. Such reduction severely limits ruminant production. In some tropical countries, the problem is overcome by grazing animals on grass-legume mixtures or supplementing their feed with legumes of high CP, or with concentrates containing high nitrogen (N) such as urea. Pastures are also given applications of commercial fertilizer (Humphreys, 1978). However, using legumes or grass-legume mixtures is more economical.

In addition to high CP, legume, when used as sole feed, should produce adequate DM. Inadequate DM yield, even if the nutritive value are high, will severely limit meat and milk production.

Generally, tropical legumes require phosphorus (P) for maximum performance. According to Skerman (1977a), P deficiency limits the production potential of forage legumes. Because tropical soil are low in P, this nutrient are commonly used for establishment (Skerman, 1977b). Legumes can generally acquire their N symbiotically, N fertilizer is not usually recommended in planting. According to Gohl (1981), applying N fertilizer may even retard N fixation by legumes.

In Liberia, Signal grass (*Brachiaria brizantha*), introduced from Colombia more than 25 years ago (A. Dorley, personal communication), is the most common pasture species for ruminant production. Visual observations show that its DM yield and quality decline significantly both during the dry season and over the years.

This experiment was designed to evaluate 11 legume accessions from CIAT, based on adaptability and viability; DM yield and content; weed suppression; and growth height. Those accessions that performed the best were selected for improved animal production and other farming systems.

Materials and methods

The experiment was conducted on Sinyea fine sandy loam soil (Table 1) at the Liberian Central Agricultural Research Institute (CARI), located at

Table 1. **The chemical and physical properties of Sinyea fine sandy loam soil on which the experiment was conducted. Suakoko, Liberia.**

Soil property	Dept (cm)	
	0-15	15-30
pH	4.8	4.4
Sand (%)	77.7	77.8
Silt (%)	11.7	9.6
Clay (%)	10.1	12.6
Organic matter (%)	1.2	1.2
Organic carbon (%)	0.65	0.73
Fe (ppm)	477.5	485.7
N total (%)	0.5	0.06
P (ppm)	2.0	1.5
K (ppm)	30.0	37.0
Na (ppm)	30.0	20.0
Ca (ppm)	40.0	60.0

* Forage Agronomist, Department of Agronomy, College of Agriculture and Forestry, University of Liberia, Monrovia, Liberia.

Suakoko, Bong County, about 222 km northwest of Monrovia. CARI lies between the moist monsoon and hot equatorial tropical regions, at about 163 m.a.s.l., with 1800 to 2700 mm and 20 to 35 °C.

The land with the signal grass as the major vegetation was cleared and plowed at a depth of 30 cm by two pairs of draft oxen. It was then levelled to ensure firm seedbeds.

The treatments contained 11 accessions (Table 2), each on a plot 5 m x 6.5 m in size. Seeds were sown on September 23, 1985. After seed emergence, 70 kg/ha of P was applied by the band method to all treatments.

A subsequent harvest interval of 9 weeks, proceeding the first harvest at establishment, was determined. During harvest, four samples were taken at random in quadrants 1 m x 1 m on each plot and the forage therein cut manually at about 15 cm above ground level. A randomized complete block design, comprising three blocks, was used.

Results and discussion

Visual assessment showed that *Desmodium ovalifolium* CIAT 3784, *D. incanum* CIAT 13032, *Macroptilium atropurpureum*, and *Stylosanthes macrocephala* CIAT 1582 y 1643 did not survive the second year of establishment.

Some damage was caused to persistent legumes by fungal diseases (10% according ILCA (1985) rating) mainly during rainy season. *Centrosema* accessions were mainly affected by *Rhizoctonia solani* and *Cercospora* leaf spot while *S. guianensis* CIAT 136 was affected by anthracnose. Damage was very low in *C. pubescens* CIAT 5189 and *Centrosema* sp. CIAT 5112, at 10% and 20%, respectively. The infestation of *C. macrocarpum* CIAT 5062 and 5065 by these fungal diseases was moderate, at 40% and 35%, respectively. These diseases have also been reported in *Centrosema* species (CIAT, 1981). Except for *C. brasilianum* CIAT 5234 with 50% fungal damage, attack by *R. solani* and *Cercospora* leaf spot did not impair the growth of *Centrosema* accessions as these species rapidly branched.

The rate of anthracnose damage to *S. guianensis* CIAT 136 was severe during the dry season. Anthracnose has been reported to eliminate stands of *Stylosanthes* (Lazier, 1984; Burt et al., 1983; CIAT, 1981 and 1983).

Mean DM production and weed composition in total DM produced of legumes at nine weeds of growth are presented in Table 2.

Stylosanthes guianensis CIAT 136 produced the highest ($P < 0.01$) DM in the first year and thereafter declined consistently over the years, giving the lowest DM yield in the third year. It was also the best weed suppressor during the first year, but the weed content in total DM yield of this legume increased over the years. This continuous decline in DM yield must have resulted from attack of anthracnose, thus leading a high percentage of weeds. *Centrosema brasilianum* CIAT 5234 yielded the lowest DM in 1986 and 1987, and contained the highest weed percentage throughout the study. This may have been a result of high infestation of *R. solani*, which killed most of the leaves. The other *Centrosema* accessions, *C. pubescens* CIAT 5189, *Centrosema* sp. CIAT 5112, and *C. macrocarpum* CIAT 5062 and 5065, consistently increased DM yield and suppressed weeds best over the years, an indication that *Centrosema* established very slowly, but, once established,

Table 2. **Dry matter yield (t/ha) and percentage of weeds of six tropical forages legumes at 9 weeks of growth. Suakoko, Liberia.**

Species	CIAT	DM/year			Weeds (% DM total)		
	no.	1986	1987	1988	1986	1987	1988
C. pubescens	5189	2.73 b*	2.92	3.36 abc	11.4	9.6	23.7
Centrosema sp.	5112	2.39 bc	2.35	3.98 abc	16.2	12.1	16.1
C. brasilianum	5234	1.24 d	1.64	2.04 d	38.7	31.6	45.3
C. macrocarpum	5062	2.40 bc	2.56	4.33 a	13.7	15.1	16.2
C. macrocarpum	5065	2.64 bc	2.45	4.29 ab	19.4	9.9	18.6
S. guianensis	136	5.41 a	1.86	1.17 e	3.9	12.9	42.2

* Means followed by the same letter in each column did not differ significantly ($P < 0.05$).

became vigorous. No significant differences ($P < 0.01$) existed between treatments for DM content during the study.

Growth was more highly significant ($P < 0.01$) for *S. guianensis* (75 cm) than for other legumes in the first year. This legume also maintained the most growth in the second year (45 cm), although it was different ($P < 0.01$) only from *C. brasilianum* CIAT 5234 (25 cm) and *Centrosema* sp. CIAT 5112 (31 cm). *Centrosema macrocarpum* CIAT 5062 was the highest in the third year (61 cm), while *C. brasilianum* CIAT 5234 was the lowest throughout the trial (25 cm). Except for *S. guianensis* CIAT 136, the other legumes generally increased in height over year, the highest being *C. macrocarpum* CIAT 5062.

Conclusions

Centrosema pubescens CIAT 5189, *Centrosema* sp. CIAT 5112 and *C. macrocarpum* CIAT 5062 and 5065 adapted well, yielding adequate DM, even though they were attacked by fungal diseases (*R. solani* and *Cercospora* leaf spot). These accessions also proved to be more highly weed suppressive than the others. *Centrosema brasilianum* CIAT 5234 was highly susceptible to fungal diseases, which reduced its yield and encouraged weed invasion.

Stylosanthes guianensis CIAT 136 was high yielding, especially in the first year, but declined in performance as a result of anthracnose attack. Its ability to control weeds was also high in the first year, but lost this potential when infested by anthracnose.

Centrosema accessions are slow to establish but, once established, may become vigorous to a point where attack by fungal diseases will not adversely affect their yield potential.

Desmodium ovalifolium CIAT 3784, *D. incanum* CIAT 13032, *M. atropurpureum*, and *S. macrocephala* CIAT 1643, which perished after the first year, be used in short-term leys, followed by food crops, in a legume-livestock-food crops production system.

Resumen

Entre 1986 y 1988, en un suelo franco-arenoso del Instituto Central de Investigación Agrícola de Liberia, Suakoko (1800 a 2700 mm, 27 °C), se evaluaron la producción de MS y la resistencia a patógenos de 11 accesiones de leguminosas forrajeras provenientes del CIAT (*Desmodium ovalifolium* CIAT 3784, *D. incanum* CIAT 13032, *Centrosema pubescens* CIAT 5189, *Centrosema* sp. CIAT 5112, *C. brasilianum* CIAT 5234, *C. macrocarpum* CIAT 5062, 5065 y 5234, *Macroptilium atropurpureum*, *Stylosanthes guianensis* CIAT 136, *S. macrocephala* CIAT 1582 y 1643).

Los tratamientos (accesiones) se dispusieron en bloques completos al azar con tres repeticiones, en parcelas de 5.0 x 6.5 m, y a 50 cm entre plantas. Al momento de la emergencia de las plántulas se aplicaron 70 kg/ha de P. Los cortes se hicieron cada 9 semanas.

Se observó una alta incidencia de *Rhizoctonia solani* y mancha de la hoja por *Cercospora* en *C. brasilianum* CIAT 5234 y de antracnosis en *S. guianensis* CIAT 136. Aunque estos patógenos también se presentaron en *C. pubescens* CIAT 5189, *Centrosema* sp. CIAT 5112 y *C. macrocarpum* CIAT 5062, 5065, no limitaron su persistencia y producción. *Centrosema macrocarpum* CIAT 5062 presentó la mayor producción de MS durante los 3 años que duró el ensayo, mientras que *C. brasilianum* CIAT 5234 presentó la menor producción. La producción de MS aumentó en todas las accesiones a través del tiempo experimental, excepto en *S. guianensis* CIAT 136.

References

Burt, R. L.; Cameron, D. G.; t'Mannetje, L.; and Lenné, J. 1983. *Stylosanthes*. En: Burt, R. L.; Rotar, P. P.; Walker, J. L.; and Silvey, M. W (eds.). 1983. The role of *Centrosema*, *Desmodium*, and *Stylosanthes* in improving tropical pastures. Westview Press, Boulder, Colorado. p. 141-181.

CIAT (Centro Internacional de Agricultura Tropical). 1981. Informe anual 1980. Programa de Pastos Tropicales. Cali, Colombia.

_____. 1983. Informe anual 1982. Programa de Pastos Tropicales. Cali, Colombia.

Gohl, B. 1981. Tropical feed: Feed information summaries and nutritive values. FAO. Animal production and health service 12:121.

Humphreys, L. R. 1978. Tropical pastures and fodder crops. Intermed. Trop. Agric. Ser., Longman Group Ltd., Londres.

ILCA (International Livestock Centre for Africa). 1985. Introduction plots or strips of annual legumes, grass and cereals in pure sward. Observation sheet no. 1.

Lazier, J. R. 1984. Global ventures in *Stylosanthes*; 4: West Africa. En: Burt, R. L.; Rotar, P. P.; Wlaker, J. L.; and Silvey, M. W (eds.). 1983. The role of *Centrosema, Desmodium* and *Stylosanthes* in improving tropical pastures. Westview Press, Boulder, Colorado. p. 141-189.

Skerman, P. J. 1977a. Mineral nutrition of tropical legumes. En: Tropical forage legumes. FAO. Plant production and protection service 2:72-85.

_____. 1977b. Pasture establishment. En: Tropical forage legumes. FAO. Plant production and protection service 2:72-85.