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Forage legumes in the Western Llanos of Venezuela

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In the Western Llanos of Venezuela, attempts to identify productive and persistent grass - legume associations have not, so far, been wholly successful. In view of the difficulties involved in the management under grazing of legumes in association, a programme of research was developed to evaluate the potential of a range of 10 legume species for hay making. When cut at the pre-, or early bloom stage, the leaf to stem ratio ranged from 0.69 to 2.23, while after drying, the range was from 0.39 to 1.63. The CP content of the leaf (16.4 to 33.1%) and stem (7.0 to 14.8%) resulted in whole plant contents from 12.9 to 26.1%. Best species for hay making were *Desmodium ovalifolium*, *Centrosema pubescens*, *Alysicarpus vaginalis* and *Macroptilium atropurpureum*, although brittleness of the dry stems makes *D. ovalifolium* risky. Annual species regrew if cut in the pre-bloom stage, provided that moisture and nutrient supply were both adequate.

Keywords: Forage legumes; Legume hay; Leaf-stem ratios

Introduction

In Venezuela, with few exceptions, well fertilized grasses harvested after 30 to 35 days of regrowth have from 10 to 14 percent crude protein (CP) and about 60 percent digestibility. However, as has been reported for tropical grasses from other areas (Minson and Milford 1965; Hutton 1974; Silva and Da Silva 1976), these parameters decrease rapidly, mainly due to an increase in fibre content and a decrease in the digestibility of both the fibre and the CP. Protein deficiency is critical and poses a problem in animal production, especially for fast growing and intermediate to highly productive dairy animals. Many Venezuelan farmers have to feed protein concentrates on a daily basis, with a consequent increase in production costs, especially since the Government has reduced the subsidy on feed concentrates.

Venezuela is rich in native forage legumes, the nutritive value of which, in general, changes little with age. More intensive and systematic use of legumes in animal production can eliminate, or at least minimize the use of concentrates, and consequently decrease production costs, Numerous reports from tropical Australia, Colombia, Brazil and Venezuela show that legumes, either alone or mixed with grasses, can produce acceptable weight gains and milk yields (Hutton 1974; Stobbs and Thompson 1975; Silva and Da Silva 1976; Mendez 1977; Chacon and Betancourt 1986; Tergas and Lascano 1986).

In Venezuela, attempts have been made to identify productive, long term grass-legume mixtures. With few exceptions, results have not been satisfactory and in most cases this work has remained at the experimental level. Grass-legume mixtures require a high degree of managerial skill. Lack of development of the extension services may explain, in part, why farmers are reluctant to incorporate legumes into their forage systems.

In an attempt to minimise grazing management problems, the present work concentrated on the use of legumes as dry forage. One difficulty with legume hay is that many species tend to lose leaves during the drying process. Leaf to stem ratio is one of the most important factors in the determination of hay quality (Sullivan 1975). Mowat et al (1965) considered that this ratio could be used as a selection criterion to improve the quality of hay of alfalfa (*Medicago sativa*) and similar legumes.

In Portuguesa state, a programme of research was developed to determine, for a range of legumes, the proportion of leaf to stem, the retention of leaf material after drying, the nutritive value of each fraction and the consumption of hay when fed as part of a balanced animal ration.

Materials and methods

The study was started at several farms in May 1985 during the rainy season. The following legumes were planted; *Indigofera hirsuta, Alysicarpus vaginalis, Macroptilium lathyroides, Macroptilium atropurpureum, Calopogonium mucunoides, Teramnus uncinatum, Centrosema pubescens, Stylosanthes hamata, Desmodium ovalifolium* and *Canavalia ensiformis*. They were seeded at 10 or 15 kg/ha, so that high plant density and rapid cover would minimize weed problems. High density would also produce taller plants with thinner stems, especially in species such as *I.hirsuta, A. vaginalis, M. lathyroides, D. ovalifolium* and *C. ensiformis*. Seeds were broadcast, disced in to a depth of from 2 to 4 cm and fertilized with 92 kg $P_2 O_5$ per ha as triple super-phosphate and 50 kg K/ha as potassium sulphate. The experimental plot for each species was 0.25 ha. All legumes were evaluated at the pre-bloom stage. This varied from 50 days (*M. lathyroides*), to 150 - 180 days (*C. mucunoides, C. pubescens* and *T. uncinatum*).

Results and discussion

Preliminary results are shown in Table 1. With the exception of *S. hamata*, the leaves of all the legume species evaluated contributed at least 49 percent to the total dry matter yield at the time of harvest (pre-bloom or early flowering). These figures are high compared with data presented by Villaquiran and Lascano (1986) who reported leaf yields at 10 percent flowering of 43.4, 34.6 and 17.5 percent respectively for *Centrosema macrocarpum, Stylosanthes guianensis* var. pauciflora and *S. macrocephala* respectively. Belcazar and Schultze - Kraft (1986), in seven ecotypes of *Centrosema brasilianum*, reported leaf proportions ranging from 41.0 to 49.5 percent. From the point of view of the ratio of leaf to stem, *Macroptilium spp, D. ovalifolium* and *C. pubescens* appear to be better than other *Centrosema* spp. *Stylosanthes* spp, *C. mucunoides* or *I. hirsuta*.

At the time of harvest of the present study, the leaves of *S. hamata* and *D. ovalifolium* were relatively low in CP content (18.7 and 16.4% respectively), while the other species ranged from 20.0 to 33.1 percent. Similar data have been reported in the literature (Belcazar and Schultze-Kraft 1986; Chacon and Betancourt 1986; Villaquiran and Lascano 1986) for a range of tropical forage legumes. The leaves of *C. pubescens, A. vaginalis* and *T. uncinatum* are of much higher feeding quality than other legumes such as *Stylosanthes spp* and *D. ovalifolium*.

The CP content of the stems varied between wide limits, with lower results obtained with *D. ovalifolium*, *I. hirsuta* and *S. hamata* Similar results were reported by Chacon and Betancourt (1986), who found 9.0 and 14.9 percent CP in the stems of *S. guianensis* and *C. pubescens* respectively.

Table 1 Ratio of leaf to stem (L:S) and crude protein contents (%) of common legumes in the Western Llanos of Venezuela

Species	At cutting (pre- and early bloom)				Hay
	Ratio L:S	Crude Protein % Leaf	Stem	Whole	Ratio L:S
I. hirsuta	1.00	26.1	9.4	17.8	0.92
A. vaginalis	1.44	32.6	11.0	23.7	1.04
M. lathyroides	1.50	27.7	14.3	22.3	0.49
M. atropurpureum	2.23	22.2	11.6	18.9	1.04
C. mucunoides	0.96	24.5	11.6	17.9	0.79
T. uncinatum	1.22	30.6	14.5	23.4	0.92
C. pubescens	1.63	33.1	14.8	26.1	1.17
S. hamata	0.69	18.7	9.5	13.3	0.54
D. ovalifolium	1.70	16.4	7.2	12.9	1.63
C. ensiformis	1.56	20.0	7.0	14.9	0.39

When the CP content of the whole plant was considered, this study showed that the best legumes were *C. pubescens*, *A. vaginalis*, *T. uncinatum* and *M. lathyroides*. Under a grazing situation where the animal would be free to select a higher proportion of leaf in the diet, *I. hirsuta*, *M. atropurpureum* and *D. ovalifolium* could also be classed as legumes of good quality.

Macroptilium spp. and *C. ensiformis* lost a high proportion of leaf material during the drying process. The best legumes for hay making would be those that retain their leaf. These would be *D. ovalifolium*, *C. pubescens*, *A. vaginalis* and *M. atropurpureum*. *T. uncinatum* and *mucunoides* have thin, twining stems and acceptable leaf retention during hay making. They could be better for this purpose than legumes with thicker woody stems such as *I. hirsuta* and *A. vaginalis*. Although both the proportion of leaf in the cut material and the leaf retention during the drying process are high in *D. ovalifolium*, the dry stems are very brittle and this could lead to unacceptable losses during baling of the dry material.

This study showed that *M. lathyroides*, *S. hamata* and *C. ensiformis* are poor species from which to make hay. The thick stems of *M. lathyroides* dry out slowly, even though they are hollow, and leaf losses are high during the extended drying period. A conditioner may accelerate the drying of the stems and such a machine should be evaluated with this species. Both the proportion of leaf and the CP content are low in *S. hamata* and reports in the literature (Chacon and Betancourt 1986; Villaquiran and Lascano 1986) suggest that other species of *Stylosanthes* have the same problem. *C. ensiformis* has a thick, woody stem. Poor leaf retention during the drying process creates a serious limitation to the use of this species for the production of hay of good quality.

Preliminary results show that the annual species *M. lathyroides*, *I. hirsuta*, *A. vaginalis* and *C. mucunoides* will recover after the first cut to produce one, or even two regrowths before the end of the growing season. In the present study, the first cut of the four species yielded 2.1, 2.4, 4.2 and 2.9 t/ha of dry matter respectively. In general, yields of from 0.5 to 1.0 t/ha were obtained from each regrowth provided that the first cut was taken at the pre-bloom stage and that adequate moisture and nutrients were available.

The present work has demonstrated that legume hay of high quality can be made under tropical conditions. This can be used to complement grass pastures or to provide the protein component of a balanced ration. In the latter case, the amount of fibre in the legume would have to be considered during the formulation of the ration. Fibre content varies between wide limits. Leaf material of *A. vaginalis* contained 27 percent fibre, *M. lathyroides* had intermediate levels (17 percent) while *I. hirsuta*, at 10 percent, can be considered as being low in fibre. This feature could influence the choice of legume sown for a particular purpose. Other factors that need to be taken into account in the use of legumes could include the presence of antimetabolites and the amino acid profile of the selected species. These could be of importance when the legume is to constitute a high proportion of the total ration.

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