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OBSERVATIONS ON THE FORAGE POTENTIAL OF VELVET BEAN

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Abstract: A field trial was conducted with velvet bean (*Mucuna* spp.) planted during the Maha season of 1983/84. Whole crop samples of the above ground dry matter were taken at four different stages of growth (60, 90, 120 and 150 days) to assess the interaction of dry matter yield and forage quality during maturity. Dry matter yield increased with maturity, but quality parameters steadily declined. The results suggest that the velvet bean forage should be harvested around 90 days. Harvested at this maturity, a dry matter yield of 3.1 tonnes per hectare, with a crude protein content of 20.6% and 55.4% *in vitro* digestibility, could be obtained.

1. Introduction

The usefulness of legumes as components in forage mixtures is well recognised. The beneficial effects attributed to the legume derive partly from its ability to fix atmopheric nitrogen and partly from the high protein contents of its dry matter.[14,20] In Sri Lanka, at least on account of the latter reason, establishment of legumes is justified.

Velvet bean (*Mucuna* spp; *Syn Stizolobium* spp),[20] which was originally introduced as a cover crop in coconut plantations, has the potential as a forage crop. The major characteristics of this forage legume has been recently reviewed[11] and, in fact, its use is recommended for the hill country region.[12] The study reported herein is a preliminary attempt to assess the productivity and nutritive value of velvet bean forage at four different growth stages. Such assessment has not been reported previously for velvet bean grown in Sri Lanka.

2. Materials and Methods

2.1 Description

Several selections of velvet bean are known to exist in Sri Lanka,[16] but the exact classification is difficult as the taxonomy of the species is confusing.[6] They are all annual-perennial legumes with vigorously growing vines which may extend up to 6 m in length. The leaves are trifoliate with large, ovate leaflets. The white to dark purple flowers appear in long pendant clusters. Pods, 10 to 14 in a cluster, are borne singly and have a greyish-white pubescence of short, silky hairs. Three seedcoat colour types, namely black, white and mottled, are common.[15,20,23]

Originating in India, it is now naturalized in all tropical countries. Their distribution has been extended into the temperate countries by breeding.[23] The legume is tolerant to drought due to its deep roots.[6,15]

The velvet bean variety used in the present evaluation was black-seeded. The seeds were obtained from the Coconut Research Institute, Lunuwila.

2.2 Growing conditions

Velvet beans were planted (three seeds per hill) at a spacing of 60 x 60 cm during the 1983/84 Maha season in an experimental plot (6.0 x 12.0 m) at the Department of Animal Science, University of Peradeniya. The soil at the site was reddish brown latasolic soil with a pH of 6.1. A well distributed rainfall was received during the experimental period.

The plot received a basal application of one tonne of poultry litter/ha (equivalent to approximately 52 kg N, 36 kg P_2O_5 and 35 kg K_2O per hectare) at planting. The stand was thinned to two plants per hill after one month and bamboo trellises were provided for support. The supports were given mainly to prevent matting of plants from adjacent hills and to facilitate the yield estimations.

2.3 Sampling procedures

The flowering in velvet beans commences around 90 days and continues for another 50 — 70 days. The sampling of the forage was done at 60 days (pre-bloom), 90 days (start of bloom), 120 days (mid-bloom) and 150 days (post-bloom). At each age of harvesting, twenty plants (from ten hills) were randomly selected and cut 10 cm above ground. Leaves and stems (and pods at 120 and 150 days of age) from each plant were hand-separated, and weights were recorded. Sub-samples (ca 500 g) of the different anatomical parts were removed to the laboratory for dry matter determination. Further sub-samples (ca 2 kg) were taken and dried at 60^{0}C in an unitherm oven for 36 — 48 hours. The dried samples were then ground and stored in air tight plastic jars for subsequent laboratory evaluation.

Velvet bean pods and seeds are also reported to have been used for livestock feeding.[6,15] For this reason, samples of green pods (immature and mature), seeds and pod husks were also collected for analysis.

2.4 Analytical procedures

The dry matter, crude protein, ether extract and ash contents were determined according to standard procedures.[2] The detergent fibre composition was determined using the method of Goering and Van Soest.[9] *In vitro* organic matter digestibility (IVOMD) was determined according to the method of Tilley and Terry[22] as modified by Barnes.[3] Rumen liquor was collected from two fistulated cattle which have been previously fed a mixture of straw and legumes. Five standard samples of known *in vivo* digestibility were used in each *in vitro* run to correct for run-to-run variation. The standard samples consisted of legume and straw samples.

3. Results and Discussion

The forage dry matter yields of velvet bean increased with maturity (Table 1). The observed yields are in the same range as those reported by King *et al.*[13] in Australia and by Takahashi and Ripperton[21] in Hawaii.

Table 1. Some productive parameters of velvet bean forage.

Age (days)	Dry matter (%)	Total dry matter production[a]		Major anatomical fractions (%)		
		g/plant/cut[b]	kg/ha/cut[c]	Leaf	Stem	Reproductive parts
60	18.2	61	1660	54.6	45.4	–
90	21.1	114	3103	47.9	52.1	–
120	23.7	161	4383	41.1	55.1	3.8
150	20.4	194	5282	30.3	60.4	9.3

a Includes reproductive parts in plants harvested at 120 and 150 days of age.
b Mean of twenty plants.
c Extrapolated yield based on a plant density of 27,225/ha.

The relative dry weight distribution of different anatomical parts (Table 1) show that at 60 days the leaves constituted 55% whereas only 45% was stems. This changed during growth to 30% leaves and 61% stems by 150 days. The reproductive parts, mainly pods, constituted the balance 9%. The general tendency of a decreasing leaf:stem ratio during growth is in agreement with previous studies reported for other tropical and temperate legumes.[1,20]

Table 2. Chemical composition and IVOMD of velvet bean forage at four different stages of growth (percentage DM basis).

Parameter	Plant age (days)			
	60	90	120	150
Crude protein	24.80	20.61	14.75	12.84
Ether extract	2.78	2.72	2.51	2.39
Ash	5.52	5.79	4.55	6.43
Acid detergent fibre	33.15	40.12	45.83	47.91
Cell wall	40.26	51.35	56.78	59.15
Cell contents	59.74	48.65	43.22	40.85
Hemicellulose	7.11	11.23	10.95	11.24
Cellulose	27.85	31.12	36.24	37.50
Permanganate lignin	3.87	5.92	7.75	8.96
Silica	0.65	1.07	1.63	1.85
IVOMD	66.41	55.35	50.60	42.23

As shown in Table 2, the velvet bean forage contained 20.6 – 24.8% crude protein during the pre-bloom stage. The crude protein content declined rapidly with flowering, due to a redistribution of nitrogen to the seeds.[5] Despite this decline, the crude protein content of the legume herbage (even at 150 days) remained at a higher level than of common grasses available in Sri Lanka.[10]

Cell walls are a major part of the plant. The amount and composition of the cell walls is probably the most important factor influencing the nutritive value of forages.[4] But studies of the composition of the cell walls in tropical forages are scanty. As such, comparison of the present data with other work is not possible. The data (Table 2) shows that all cell wall components steadily increased with maturity.

The *in vitro* digestibility of the velvet bean forage decreased from 66.4% to 42.2% as the plant matured. This is to be expected, since the general trend of decline in the digestibility of forage crops with plant maturity is well documented.[8,19] This decrease can be attributed to a combination of factors *inter alia* decreasing leaf to stem ratio, decreasing amount of crude protein, increasing amount of cell walls and increasing lignification. Although not reported separately in the present data, the fact that the chemical composition of leaves and stems during crop maturity followed distinctly different patterns needs a special mention. The contents of crude protein, cell walls and lignin and *in vitro* digestibility of the leaf fraction changed only a small extent during maturity, while in the stems all these parameters decreased rapidly.

Table 3. Chemical composition and IVOMD of some reproductive parts of velvet bean.

Parameter	Immature green pod	Mature green pod	Mature seed	Pod husk
DM (%)	30.66	41.56	88.50	91.60
% DM basis				
Crude protein	14.68	19.29	26.45	3.13
Ether extract	4.21	4.80	4.32	3.88
Ash	3.94	3.85	3.46	4.87
ADF	27.33	31.89	10.91	40.70
Cell wall	53.96	59.11	21.90	64.81
Cell contents	46.04	40.89	78.10	35.19
Hemicellulose	22.63	27.22	10.99	24.11
Cellulose	20.10	23.81	9.34	29.80
Permanganate lignin	6.39	7.03	0.80	8.60
Silica	0.60	0.65	0.40	1.10
IVOMD %	67.50	58.10	70.70	40.50

Surprisingly the mature green pods had a higher crude protein content than tender green pods (Table 3), but the IVOMD of mature pods was lower. The crude protein and IVOMD values of mature velvet bean seeds were 26.4% and 70.7%, respectively. These values compare closely to those reported for the common food legumes grown in the Asian continent.[7] Recent reports suggest that the velvet bean seeds have potential as a protein source both in human and animal nutrition.[17,18] The data show pod husks to be a poor quality roughage. The crude protein content and IVOMD value of pod husks are similar to those generally quoted for paddy straw.[10]

On the strength of these preliminary results, the forage potential of velvet bean appears good. The data indicate that the velvet bean forage should be harvested around 90 days. Harvested at this age, velvet bean would provide a yield of 3100 kg/ha of moderate quality (20.6% crude protein and 55.3% IVOMD) forage dry matter. The productivity of velvet bean forage is sufficiently encouraging to warrant further field trials. The persistency of the legume under repeated harvesting and its compatibility with companion grasses are aspects that need be evaluated in future studies.

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