Nutritive value of Crotalaria Ochroleuca: I chemical composition and in vitro dry matter digestibility at different stages of growth

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Abstract

A study was carried out to determine dry matter (DM) yield, chemical composition, and in vitro dry matter digestibility (IVDMD) of Crotalaria ochroleuca ("marejea") at different stages of growth. "Marejea" was planted and harvested at 2 weeks intervals up to 16 weeks stage of growth.

The DM yields increased from 60 kg/ha at 2 weeks to 4670 kg/ha at 16 weeks. The total digestible dry matter (DDM) increased from 38.8 at 2 weeks to 3007 kg/ha at 10th weeks and then decreased to 2624.5 kg/ha at the 16th week. The crude protein content decreased with advancing plant growth while crude fibre increased. The IVDMD for the whole plant and leaf increased with advancing stage of growth, peaked at the 10th week, and declined thereafter. The IVDMD for the stem decreased with advancing plant growth. From this study it was concluded that, the best stage of maximum yield and nutrient content for "marejea" is during the 10th week of growth.

Introduction

Crotalaria ochroleuca is widely distributed in Africa as an indigenous legume (Pohill, 1982). The plant has been adopted in the farming systems of the southern part of Tanzania particularly for the purpose of improving soil fertility and weed control in the farms. According to Gerold (1984) the legume was first sown in 1942 by German missionaries who were actually the force behind its adoption in this part of the country. Since then the legume has been integrated in the farming system by the farmers in many parts of the country, and the legume "marejea" is locally named. The potential of "marejea" as a livestock feed has been well reviewed by Sarwatt and Mkiwa (1987; 1988). Its toxic effects have also been pointed out. Although people have been feeding "marejea" to goats and dairy cattle (Gerold, 1984) there are no documented studies in Tanzania and only very limited elsewhere on the feed value of this plant for livestock. In a series of experiments designed to evaluate the nutritive value of "marejea" as a feed for livestock it was decided to first determine dry matter yield, chemical

composition and IVDMD of "marejea" at different stages of growth. This paper reports on the initial stages of this work.

Materials and methods

During the rainy period of March, 1986 an area of one hectare was ploughed, harrowed and "marejea" seeds broadcasted at a rate of 15 kg/ha and 40 kg/ha of triple superphospahte (TSP) was applied. The seeds were neither scarified nor innoculated.

Samples for determination of dry DM yield, chemical composition and IVDMD were collected at two-weeks intervals. A 1 m^2 quadrat was thrown at random six times in the field. All the plants which were enclosed in the quadrat were cut, collected and weighed to obtain the fresh matter yield. Sub-samples were oven-dried to obtain DM content and other chemical components in the plant. Other sub-samples were separated into leaf and stem fractions which were later weighed, oven-dried and analysed in the same way as for the whole plant samples.

Chemical analysis for the DM organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE), total ash, calcium and phosphorus contents of the forage samples were carried out according to A.O.A.C. (1965). The IVDMD was determined according to the procedure of Tilley and Terry (1963). Statistical analysis of variance was done according to Snedecor and Cochran (1980). Differences among treatment means were determined using LSD.

Results and discussion

DM and OM contents and yields of "marejea" with advancing plant growth are shown in Table 1. Both the DM and OM contents increased with advancing plant growth. The DM yield of 4.5 tons/ha observed on the 10th week in this study is lower than that of 5.2 tons/ha (Mkiwa, 1988) sod 12 tons/ha (Mukurasi, 1986). However, these differences would be due to seeding rate and environmental conditions e.g. weather and soils. During the 10th weeks of growth a few of the plants were observed to flower. For feeding purposes cutting on the 10th week should be the best time when the yields are maximum. Rocha (1965) and Martin et al (1976) reported that the DM yield of Crotolaria species peaks at early flowering period. Yields of leaf and stem with advancing plant growth are shown in Table 2.

The stem yields were lower during the first four weeks and increased rapidly and remained high throughout the experimental period. Crowder and Cheddar (1982) observed that stems yield more DM than leaf. This is normally the case because with advancing plant growth, the proportion of stem increases at the expense of leaf due to an increase in the proportion of lignified structural tissues.

Table 1. DM and OM contents and yields of "marejea" with advancing plant growth.

	WEEKS								
Contents	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**Mean**
DM contents (%)	5.4	11.3	15.5	17.5	243	26.4	30.2	33.4	20.7
DM yield (kg/ha)	60	450	1800	3364	4515	4210	4486	4670	2919.4
OM content (%)	6.8	8.5	10.7	11.8	15.1	19	25.7	29.7	15.7
OM yield (kg/ha)	58	430	1774	3180	3712	3217	3415	3528	2262.1

Table 2. Yields and proportions of plants parts of "marejea" with advancing plant growth.

	WEEKS								
Plant part	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**Mean**
DM yields (kg/ha)									
Green leaf	50	250	880	1520	1820	1530	1345	1136	1066.4
Stem	52	244	1167	1300	3044	2451	2814	2948	1873.8
Proportions of plant parts 0 (% of total DM yield)									
Green leaf	27.7	60.8	52.2	46.3	38.1	37.8	36.5	33.6	47.3
Stem	27.3	39.2	47.8	53.7	61.9	62.2	63.5	66.4	58.8

Table 3. Chemical composition of "marejea" whole plant with advancing plant growth (%/DM.

	WEEKS								
Nutrient (%)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**Mean**
Crude protein	38.8	33.7	30.2	28.6	26.9	18.4	14.2	9.9	25.1
Crude fibre	18.4	22.7	25.3	32.1	36.5	38.2	40.4	42.7	32.1
Ether extract	4.3	2.7	3.3	3.2	3.0	2.4	1.9	1.8	2.9
Ash	2.6	4.8	5.9	8.2	7.4	4.5	3.6	4.9	4.9
Phosphorus	0.38	0.36	0.37	0.32	0.35	0.27	0.23	0.32	0.32
Calcium	1.2	1.1	0.72	0.73	0.80	1.26	0.85	0.77	0.93

Table 4. Chemical composition of "marejea" leaf with advancing plant growth (% DM)

	WEEKS								
Nutrient (%)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**Mean**
Crude protein	38.4	36.2	35.0	34.1	34.6	30.5	28.3	24.7	32.7
Crude fibre	10.5	11.9	12.6	13.8	14.6	17.2	21.5	23.6	15.7
Ether extract	9.5	9.3	8.7	8.3	7.2	6.1	4.7	4.6	
Ash	3.8	4.4	6.7	7.3	8.8	8.2	6.9	6.2	6.5
Phosphorus	0.32	0.34	0.34	0.32	0.36	0.34	0.38	0.30	0.29
Calcium	1.30	0.92	0.81	0.75	0.84	0.92	0.62	0.76	0.77

Table 5. Chemical composition of "marejea" stem with advancing plant growth (% DM)

	WEEKS								
Nutrient (%)	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**Mean**
Crude protein	12.7	12.2	9.2	7.8	6.4	6.0	5.4	5.2	8.1
Crude fibre	30.6	34.7	39.2	44.7	52.4	52.7	53.1	53.5	45.1
Ether extract	3.8	3.1	2.1	1.4	1.2	1.1	1.0	4.7	5.2
Ash	4.7	5.2	5.8	6.1	6.8	6.4	4.2	4.0	5.4
Phosphorus	0.14	0.13	0.16	0.20	0.22	0.17	0.15	0.14	0.16
Calcium	0.92	0.81	0.74	0.78	0.80	0.74	0.70	0.83	0.79

Table 6. In vitro DM digestibility of "marejea" plant parts with advancing plant growth

	WEEKS								
Plant part	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**Mean**	

Dry matter digestibility (%)									
Whole plant	64.6	65.9	66.2	66.5	64.8	58.4	56.2	64.7	
Green leaf	66.4	66.8	67.2	68.2	70.2	68.5	65.8	62.3	58.4
Stem	62.7	60.1	59.2	56.4	54.7	40.9	38.7	34.6	44.1
Digestibility DM yield (DDMO) (kg/ha)									
Whole plant	38.8	296.5	1191.6	2237.1	3007.	2728.1	2619.8	2625.5	1842.9
Green leaf	33.2	167	591.4	1036.6	1277.6	1048.1	885	707.7	718.3
Stem	13.8	146.6	690.8	1297.2	1665.1	1002.5	1089	1020	865.6

The chemical composition of the "marejea" plant, leaves and stem with advancing plant growth is shown in Tables 3, 4 and 5 respectively. The CP contents were observed to decrease with advancing plant growth. The decrease was remarkably higher in the whole plant and stem. Reddy et al. (1970) observed a decrease in the CP content of the whole plant sunnhemp from 29.3% at 2.6 days to 24.8% at 35 days. Krishna et al. (1985) reported a decrease in the CP content of sunnhemp plant from 22.6% at week 4 to 17.8% at week 8. The mean CP content of the "marejea" plant in this study was 25.1%. This is in close range with those of 24.9% reported by Balaraman and Venkatakrishnan (1974) and 23.7% by Mkiwa (1988), at about flowering stage. The CF content in the whole plant, leaf and stem increased with advancing plant growth. The same trend has also been observed by Krishna et al. (1985) who reported a CF increase of 28.9% at week 4 to 44.5% at week 8. The ash content was also observed to increase with advancing plant growth while the ether extract was declining. The same trend for both ash and ether extract has been observed by Whiteman (1980). Advancing plant growth had no consistent effect on the calcium and phosphorus contents.

The results of IVDMD and the yield of DM of the whole plant, leaf and stem as influenced by advancing plant growth is shown in Table 6. The DMD in the plant and leaf was observed to increase with advancing plant growth, reaching a peak value at 10th week and declining thereafter. The DMD of the stem was observed to decline from 62.7% at the 2nd week to 34.6% at the 16th week. The results agree with those by Terry and Tilley (1963) who showed that the in vitro digestibility of lucerne stems declined from 85 to 56% at maturity. The low digestibility of the stem is attributed to indigestible components which increase with advancing plant growth (Minson, 1977). The DDM yield increased with advancing plant growth. Chauhan and Tiwana (1983) using cowpea reported a DDM yield increase from 19 kg/ha on day 45 to 25 kg/ha on day 94.

From the results of this experiment, harvesting "marejea" at early flowering stage (corresponding to 10th week under Morogoro conditions) seems to offer the maximum yield of digestible nutrientes.

Acknowledgements

The authors are very grateful to PANESA, NORAD and SUA for financial support which enabled this study to be carried out. We are also grateful to J.S. Lugole of Sokoine University of Agriculture for assistance with statistical analysis.

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