EFFECT OF THREE CUTTING FREQUENCIES ON YIELD, CRUDE PROTEIN AND MINERAL CONTENTS OF CENTROSEMA MACROCARPUM

J . Faría-Mármol [1,2,] D.E. Morillo1, R. González[2] and Z. Chirinos[2]
[1]Fondo Nacional de Investigaciones Agropecuarias (FONAIAP), 1316, Maracaibo, Venezuela
[2]La Universidad del Zulia (LUZ), 15205, Maracaibo, Venezuela

ABSTRACT
Dry matter (DM) yield, crude protein (CP) and mineral composition of *Centrosema macrocarpum* as affected by three cutting frequencies (28, 42 and 56 days) were compared in a tropical dry forest of Venezuela. DM yield and plant height were increased (P<0.05) by increasing the cutting intervals, whereas CP, ash and most minerals were not affected (P<0.05). Only P concentration declined (P<0.05) with increasing plant maturity. The lowest P concentration (0.18%) resulted from the longest cutting interval. Average CP concentration and mineral contents of *C. macrocarpum* were adequate with grazing ruminant requirements with exception of P (0.21%) and Na (0.073%).

KEYWORDS
Centrosema, cutting, yield, protein, minerals

INTRODUCTION
Centrosema macrocarpum is a promising legume for a wide range of ecological conditions throughout the tropics (CIAT, 1990). Excellent forage yield, drought tolerance and high nutritive value are considered to be of particular importance (CIAT, 1992) but little information is available about management practices, effect on production and nutrient contents in the tropical dry forest ecosystem. Further research on this plant is needed in order to assess their forage yield quality and mineral composition in this environment. This study was conducted to evaluate yield, crude protein content and mineral composition of *Centrosema macrocarpum* as affected by three cutting frequencies in the tropical dry forest.

MATERIALS AND METHODS
The experiment was conducted in 1992 and 1993 at a farm located in Zulia State, western region of Venezuela (10½ 32' 32" N and 72½ 12' 30" W), with climate and vegetation corresponding to a tropical dry forest. Mean annual rainfall is 1063 mm, distributed in alternate dry (four and two months) and rainy (two and four months) seasons. Average annual temperature is 28 ½C. Soil is a sandy loam Typic Haplustalf with pH=5.2, 2.68 % organic matter, and 8, 60, 100 and 324 ppm of P, K, Ca and Mg, respectively.

Twelve experimental plots (3x4 m) of *Centrosema macrocarpum* were used to evaluate three cutting frequencies, 28, 42 and 56 days, in a randomized complete block design with three replications. Before each cutting, plant height was measured at three randomly selected sites in the plots to be cut. The available forage 10 cm above the ground in the central 2x2-m area from each plot was cut using hand shears, weighed, and a sample (ca. 500 g) consisting of 10 grab samples was taken to determine DM content at 60 ½C and to estimate DM yield. Samples from the first, mid and last cuttings for each frequency in two replications, corresponding to rainy, intermediate and dry periods, respectively, were analyzed for CP content (AOAC, 1980), and Ca, P, Mg, K, Na, Cu, Fe and Mn concentrations using the methods compiled by Fick *et al*. (1979).

Analysis of variance for dry matter yield per cutting and total production, plant height data from 12, 6 and 4 cuttings for 28, 42 and 56 days, respectively, over the total experimental period (336 days), and CP and mineral data, were carried out and least-square means were compared using Duncan's multiple range test. Forage composition results are discussed in relation to nutritional requirements of grazing ruminants.

RESULTS AND DISCUSSION
Dry matter (DM) yield, crude protein (CP) content and plant height (PH). Average *Centrosema macrocarpum* DM yield, CP content and PH as affected by defoliation frequencies are presented in Table 1. DM yield results are comparable to those reported in savannas ecosystem but lower than those found in the humid tropics (CIAT, 1990). Average DM yield per cutting increased (P<0.05) from 42 to 56 days in similar form to those reported by Moreno *et al*.. (1993) who obtained an increase of yield with maturity for 3-9 week regrowth range. The average CP content was very similar within frequencies but no significant differences (P<0.05) were observed. Similar results were shown by Castañeda (1991), who noted a similar CP concentration at 6- and 12-week regrowth. Average CP (17.8%) was lower than the values recorded in humid tropics (CIAT, 1990) and may have been a consequence of extended low rainfall periods in the experimental site, which increased the detrimental effect of water deficit on most processes associated with plant growth and development (Buxton and Fales, 1994). However this value is considerably higher than 7%, which is the minimum CP content indicated by Minson (1990) to avoid a depression in forage voluntary intake by grazing livestock. Average plant height was higher (P<0.05) for the longest cutting interval, and it is within reported values for *C. macrocarpum* (CIAT, 1990).

Ash and mineral concentrations. *C. macrocarpum* ash and mineral concentrations general means as affected by cutting frequencies are shown on table 2. No differences (P<0.05) were observed for ash and most mineral concentrations for cutting frequencies. Only P concentration tended to decline with increasing plant maturity. The lowest (P<0.05) P concentrations (0.18%) were obtained with the highest cutting interval. A general P, K, Na and microelements concentrations decline trend with increasing plant maturity has been divulged by some researchers (Spear, 1994; Underwood, 1981) while others (Minson, 1990; Reid *et al*., 1979) have pointed out that except for Cu, which usually follows the general trend, plant age has had conflicting or inconsistent effect on microelement concentrations. Most mean mineral concentration as well as all the individual values are regarded as adequate for ruminants (McDowell, 1992). Only P and K concentration would be considered inadequate according to the same reference values. Mean forage P might have been affected by the low P soil concentration at the experimental site as indicated by McDowell (1992). In spite of this concentration is higher than internal P requirement of *C. macrocarpum* for 80% maximum DM yield (0.16%) according to CIAT (1992). Legumes usually contain insufficient Na. These low Na concentration are associated with genetic adaptation to low K level soils and also are unaffected by Na and K level changes (Minson, 1990).

REFERENCES
Buxton, D.R. and S. Fales. 1994. Plant environment and quality. Pages 155-199 *in* G.C. Fahey, Jr., ed. Forage Quality, Evaluation and Utilization. Madison, Wisconsin, USA.

Castañeda, H. 1991. Caracterización y experimentación en sistemas mixtos de producción en San Gil. Colombia. Turrialba **41** (1): 22-30.

CIAT. (Centro Internacional de Agricultura Tropical). 1990. Centrosema: Biology, Agronomy, and Utilization. Shultze-Kraft, R and Clements, R.J. (tech.eds). Cali. Colombia. 668p.

CIAT. (Centro Internacional de Agricultura Tropical). 1992. Pasture of the Tropical Lowlands: CIAT'S Contributions. Cali, Colombia. 238 p.

McDowell, L.R. 1992. Minerals in Animal and Human Nutrition. Academic Press, Inc., San Diego.

Minson, D. J. 1990. Forage in Ruminant Nutrition. Academic Press, Inc., San Diego, C.A.

Moreno, M., G.R. Silva y J.A. Silva. 1993. Evaluación de gramineas y leguminosas forrajeras en el agrosistema Itapetinga Bahia, Brasil. Pasturas Tropicales **15** (2):13-16.

Reid, R. L., A. J. Post and F. J. Olsen. 1979. Chemical Composition and Quality of Tropical Forages, Bull. 669T. West Virginia University, Morgantown, WV.

Spears, J. 1994. Minerals in forages. Pages 281-317 *in* G. Fahey, Jr, ed. Forage Quality Evaluation and Utilization. ASA; CSSA, SSSA, Madison, Wisconsin, USA.

Underwood, E.J. 1981. The Mineral Nutrition of Livestock (2nd ed.). Commonwealth Agricultural Bureau, London.

Table 1
Average dry matter (DM) yield, plant height (PH) and crude protein (CP) content of *Centrosema macrocarpum* as affected by the defoliation frequency

Defoliation frequency	Number observation	DM yield kg/ha/cutting		HP, cm		PC, %	
days	n	Mean[z]	SE[y]	Mean	SE	Mean	SE
28	34	307.9[a]	92.1	24.3[a]	17	17.7	0.4
42	21	525.6[a]	109.4	29.0[ab]	21	18.1	0.4
56	17	1018.5[b]	134.2	33.4b	26	17.5	0.4
Overall	72	533.7	-	27.8	-	17.8	-

[z] Least-square means based on 12, 8 and 6 cutting every 28, 42 and 56 days respectively, and three replications.

[y] Standard error of the mean.

[a,b] Values on the same column with different superscripts are different, P<0.05

Table 2
Overall mean ash and mineral concentrations of *Centrosema macrocarpum*

	Ash, %	Ca, %	P, %	Mg, %	K, %	Na, %	Ca:P, ratio	Cu, ppm	Fe, ppm	Mn, ppm
Overall	8.69	1.55	0.21	0.54	1.62	0.073	7.5:1	13.3	213	188
SE[z]	0.17	0.21	0.006	0.02	0.20	0.005	1.0	1.44	10	12
MER[y]	-	0.30	0.25	0.18	0.60	0.08	-	8.0	50	40

z Standard error of the mean (18 observation per mean).
y Minimum element requirement or critical concentration for deficiency (McDowell, 1992).