

CASSAVA FORAGE AS A SOURCE OF PROTEIN: EFFECT OF POPULATION DENSITY AND AGE AT CUTTING¹

Luz Meyrelles, N A MacLeod² and T R Preston³

*Centro Dominicano de Investigación Pecuaria con Caña de Azúcar
CEAGANA, Santo Domingo, R D*

Forage production, proportion of leaf, petiole and stalk and the composition of these fractions, were studied in a series of plots planted with cassava variety Zenon at different spacing. Plant population was related negatively to fresh weight per plant and positively to forage production per hectare on both a fresh and dry weight basis. With the highest population of 53,000 plants/ha, weight per plant was $.99 \pm .35$ kg and the fresh and dry weight production 52 470 and 10 861 kg/ha. There were indications that at the same age plants from high population densities had lower proportions of stalk and that this was less lignified. As the age at first cutting increased (from 3 to 5 months), the percent of stalk increased while the proportion of leaf fell as did the proportion of petiole. These relationships were similar on both a fresh and a dry matter basis. Both the DM content (29%) and the crude protein in DM (21%) in the leaf did not vary with age at first cutting, but CM in petiole and stalk increased while the protein content in these fractions decreased with age. In the total aerial part of the plant, DM content rose from 20 to 23% and crude protein in DM fell from 18 to 13% as age of first cutting increased from 3 to 5 months.

Key words: Cassava forage, composition, plant population, age at cutting

The use of sugar cane or molasses as the principle energy source in rations for ruminants requires supplementation first with urea (Alvarez & Preston 1976a) to supply the nitrogen needs of the rumen microorganisms and then with a source of "by-pass" protein to complement that produced by rumen microbial synthesis to the point that will support adequate levels of production (Leng and Preston 1976). Up to the present time the major sources of this true protein have been the byproducts of the cereal and oil seed processing industry, e.g. rice polishings (Preston et al 1976), rape seed meal (James 1973) cotton seed cake (Silvestre et al 1977). The demand for these by-products by the pig and poultry industry has increased steadily in recent years with the result that the price of these supplements has risen; they are also less readily available due to their being incorporated into compound and mixed feeds. In view of these developments it is important to examine potential protein sources which can be

¹ This work was supported in part by funds provided by the Organization of American States through the project Fondo Mar del Plata

² On secondment from Rowett Research Institute, Aberdeen, Scotland

³ Scientific Adviser to CEAGANA

grown on the farm itself with consequent advantages in both availability and cost. An example of this approach is the use of *Leucaena leucocephala*, a perennial legume tree readily adapted to the tropics (Alvarez & Preston 1976b).

Potential sources of forage protein which could be grown in the Dominican Republic include beside *Leucaena leucocephala*, gandul (*Cajanus cajan*) and cassava (*Manihot esculenta* Crantz). The first report on the potential value of the aerial part of cassava in sugar cane based diets came from CIAT, Colombia (Moore 1976). It was found that when planted at a high population density, cassava could be cut repeatedly for forage at 3 to 4 month intervals over a total growing period of up to 18 months.

The objective of the trials reported in this paper was to obtain preliminary information concerning the effect on yield and composition of the aerial part of cassava of different plant populations and age of first cutting.

Materials and Methods

Observations were made on a series of plots. The variety was Zenon, a sweet type commonly used for production of roots for export. The 9 plots that were used varied in size from 1000 to 3000 m². There were 5 different planting arrangements. These were: (A) 0.43 X 0.45 m (2 plots); (B) 1.00 X 0.60 (3 plots); (C) 1.10 X 0.66; (D) 1.20 X 0.60 ; (E) 1.20 X 0.80. These different populations were established in May 1976 without any fertilization on soil which previously had been growing pangola grass. In general, harvesting was carried out according to the forage requirements of the experimental cattle unit, however an attempt was made to maintain cutting intervals of approximately 4 months. Cutting was at an average height of 40 cm above the ground, with the objective of harvesting all the leaves, but leaving behind live buds. In all the plots, records were kept of the age at cutting, the number of plants that were harvested and the weight of each one. More detailed observations were made on one of the plots on treatment (B). The first cut was made at exactly 3 months of age, selecting 10 plants at random, weighing these individually and determining the proportions of leaf, petiole and stalk. These fractions were subsequently chopped and samples taken for determination of dry matter and nitrogen. This same procedure was repeated with other samples or plants from the same plot, at ages of 4 and 5 months respectively.

Results and Discussion

Data on plant population and forage production for the first cut in all the different plots are summarised in table 1. As plant population increased there was a linear decrease in fresh matter yield per plant ($r = -.85$; figure 1), while total fresh and dry forage yield per hectare increased ($r = .79$ and $.77$; figures 2 and 3). Although it was not possible to relate the composition of the forage with plant population it was noted that at the lower densities there was a relatively high proportion of mature woody stalk; this was not seen in the higher density plots.

Table 1:
Effect of plant population on production of cassava forage (x - SEx)

Planting Distance (m)	No of plots	Plant density (plants/ha)	Fresh weight		Dry matter yield (kg/ha)
			kg/plant	Kg/ha	
1.20 X 0.80	2	10 000	1.89 ± .09	19687 ± 938	3821 ± 182
1.20 X 0.60	1	14 000	1.87	25972	5041
1.10 X 0.60	1	15 000	1.83	27756	6730
1.00 X 0.60	3	17 000	1.63 ± .10	27087 ± 1641	5832 ± 683
0.45 X 0.43	2	53 000	0.99 ± .35	52470 ± 18550	10861 ± 3840

¹ The data were adjusted to a mean age of 4 month using the conversion factor
 $\text{weight at 4 mth} = \frac{4}{X} (\text{weight at X mth})$

Figure 1:
Relation between population and yield per plant

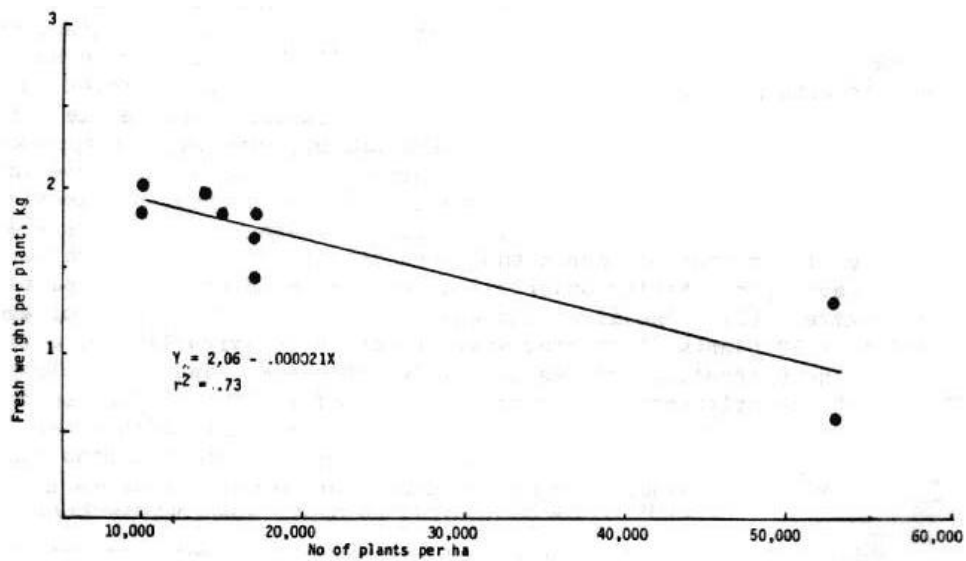


Figure 2:
Relation between plant population and forage yield per ha (fresh basis)

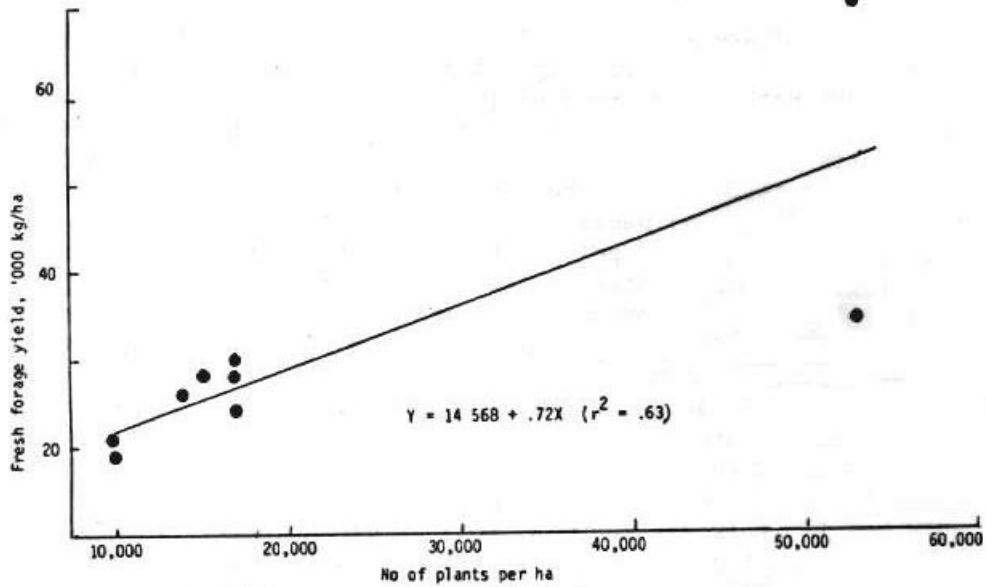
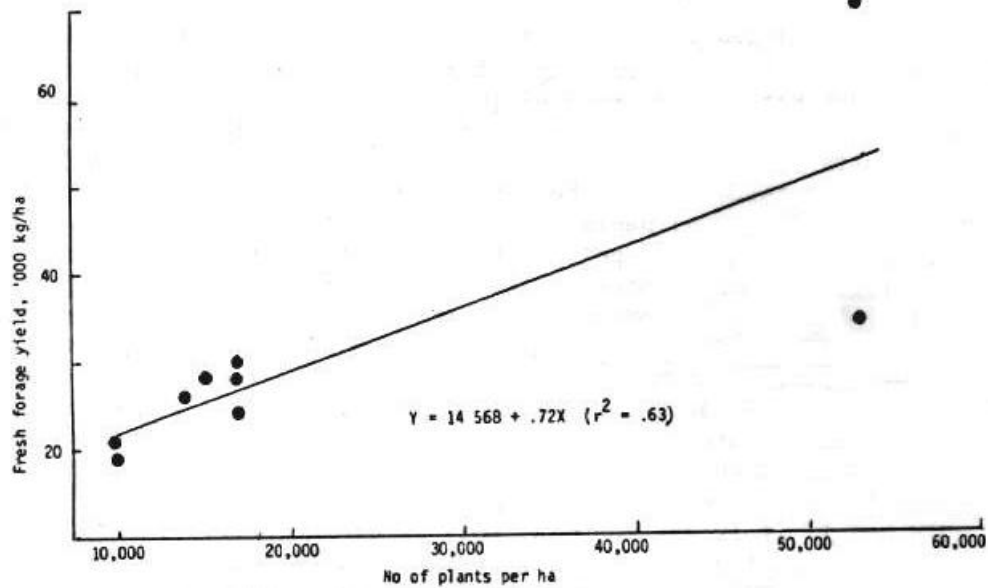


Figure 3:
Relation between plant population and forage dry matter yield per ha



The effect of age at first cutting on the proportions of the different fractions of the aerial part of the plant and its composition in terms of dry matter and crude protein are

shown in table 2 and figures 4 to 8. There was a rapid decline in proportion of leaf and of petiole with age at first cutting while the proportion of stalk increased. This tendency was the same on both a fresh (figure 4) and dry matter (figure 5) basis. The content of dry matter (figure 6) increased in both stalk and petiole with age at first cutting, but there appeared to be no change in the dry matter content of the leaf. The content of crude protein in dry matter decreased in the stalk, and to a lesser extent in the petiole but there was little change in the leaf (figure 7). Combining the data for the total aerial part of the plant (figure 8), it can be seen that dry matter content increased while the protein content of the dry matter decreased, with increase in the age at first cutting.

There is no information on the likely fall in yield with successive cuts but if it is assumed that this is of the order of 20% then it can be expected that with a plant population of 53,000/ha, the yield in 12 months for 3 cuts at 4 mth intervals will be of the order of 26,000 kg. This yield estimate is similar to that reported by Moore (1976) in Colombia. With a plant population of 110 000/ha he obtained a dry matter yield of 30,000 kg in 4 cuts during 11 months and 25,000 kg in 3 cuts. With lower populations of 28,000 plants/ha production was 16,000 kg of dry matter per year.

Our data on the composition of the aerial part of cassava agree very closely with those recorded in Colombia (table 2), particularly with respect to the protein content of the different fractions.

Table 2:
Composition of the aerial part of cassava cut at 90 days

	CIAT ¹			CDIPCA ²		
	Leaf	Petiole	Stalk	Leaf	Petiole	Stalk
Proportions, % DM basis	52	15	33	47.2	14.8	37.9
Dry matter, %	29.0	18.0	15.7	28.8	14.8	17.2
N X 6.25,% in DM	28.0	11.3	11.0	27.5	11.5	10.8

¹ Moore (1976)

² This experiment

Figure 4:
Age at first cutting on composition of the aerial part of cassava

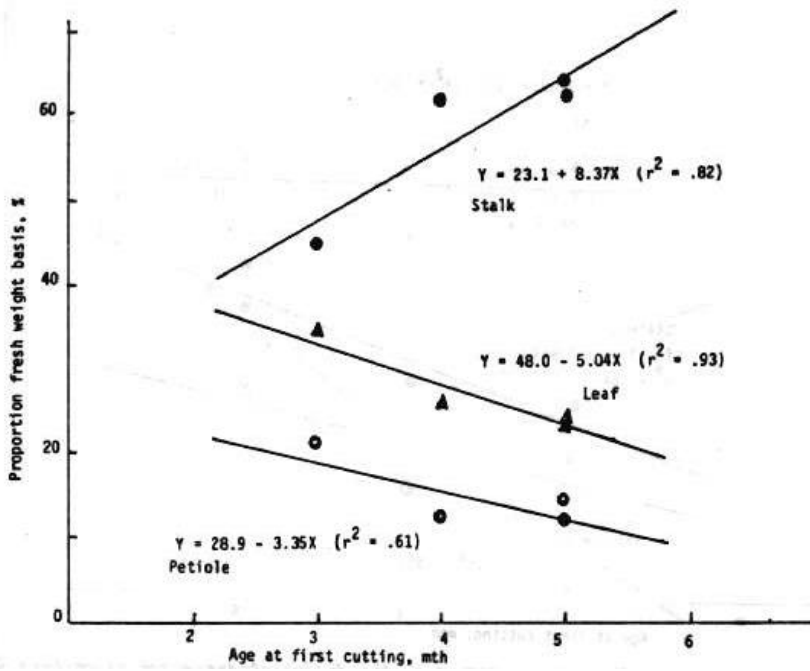


Figure 5:
Age at first cutting on dry matter composition of the aerial part of cassava

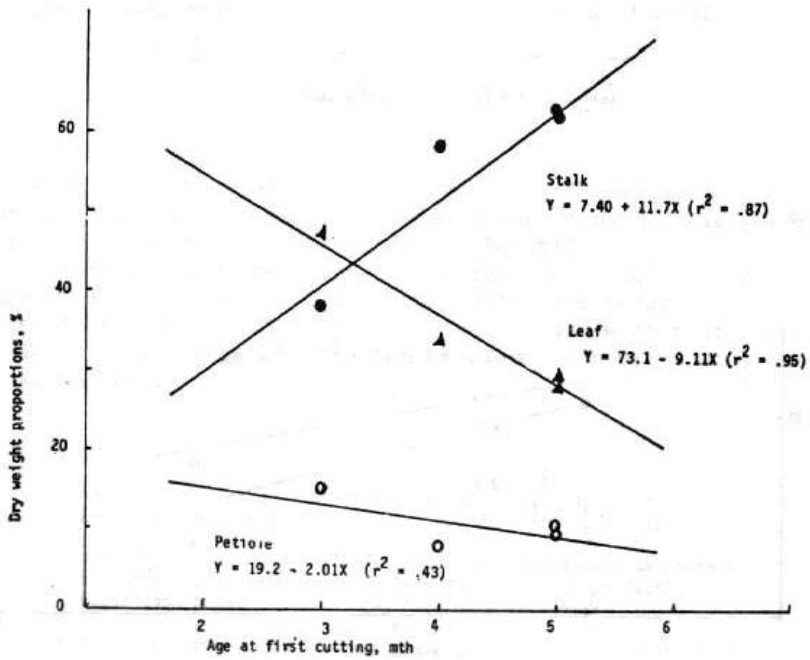


Figure 6:
Age at first cutting and dry matter percent in the different fractions of cassava forage

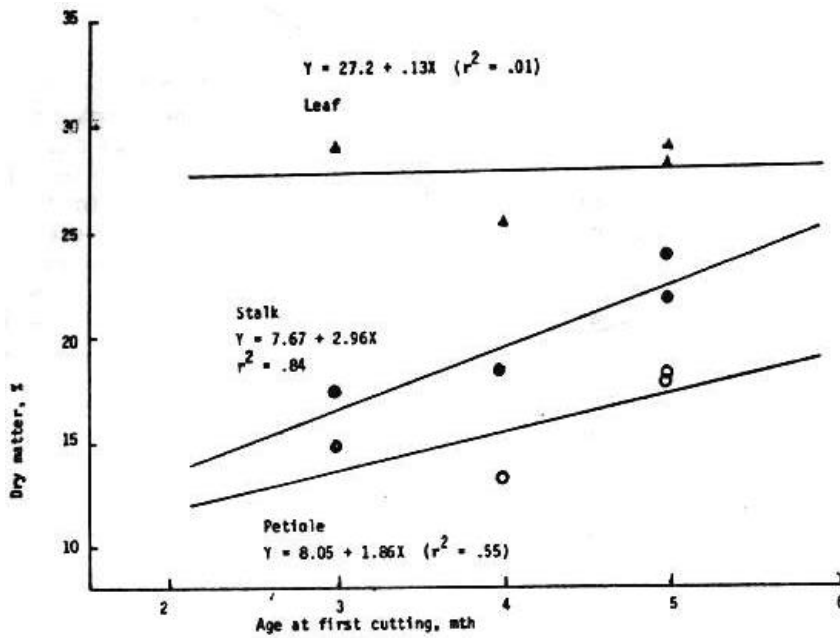


Figure 7:
Age at first cutting and protein content of the different fractions of cassava forage

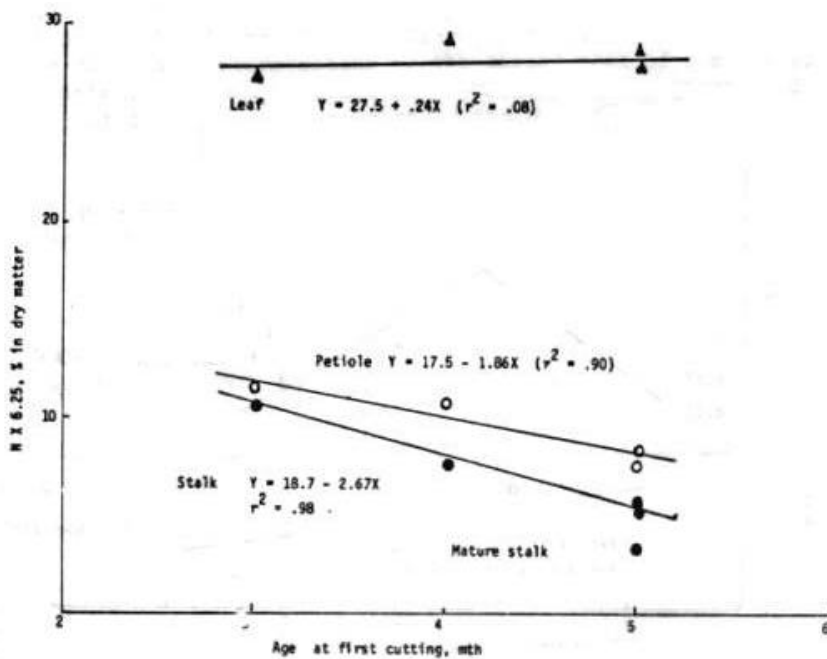
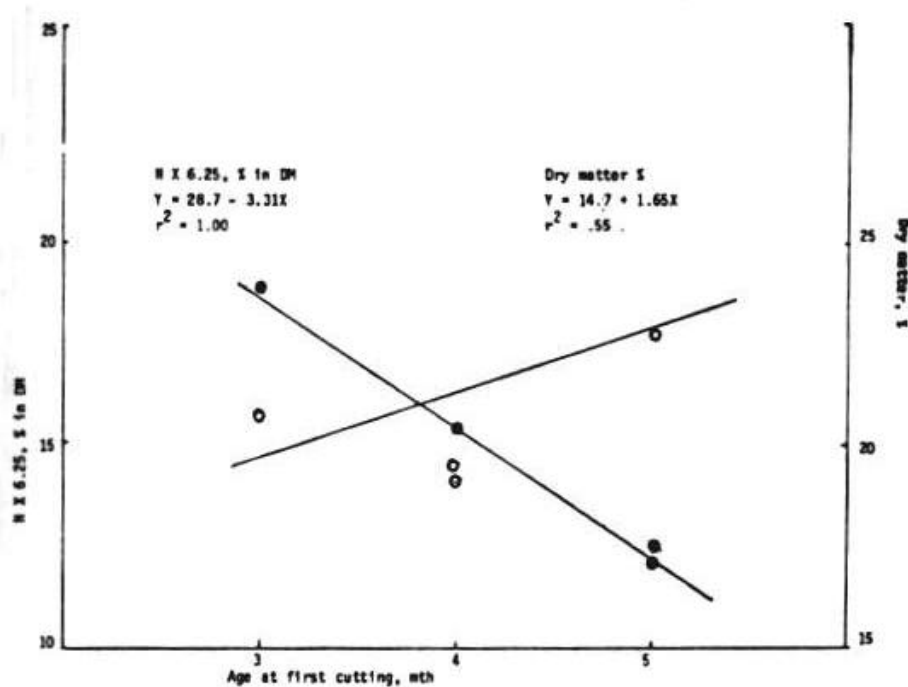


Figure 8:

Age at first cutting and protein and dry matter content of total aerial part of cassava



Conclusions

Preliminary observations on the growing of cassava as a source of forage indicate that this plant has a very considerable potential for protein production in the Dominican Republic. There were no problems in establishing the plant and it remained completely free of disease during the 6 month period when data were recorded. It can be expected that under conditions of irrigation and with plant populations of at least 50,000 per hectare, the total protein yield will exceed 4,000 kg/ha/year.

References

Alvarez F J & Preston T R 1965a Studies on urea utilization in sugar cane diets: effect of level Trop Anim Prod 1:194-201

Alvarez F J & Preston T R 1976b *Leucaena leucocephala* as protein supplement for dual purpose milk and weaned calf production on sugar cane based rations Trop Anim Prod 1:122-119

Leng R A & Preston T R 1976 Sugar cane for cattle production :present constraints, perspectives and research priorities Trop Anim Prod 1:1-22

Moore C P 1976 El uso de forraje de yuca en la alimentacion de rumiantes Seminario Internacional de Ganaderia Tropical, Acapulco, Mexico

Preston T R, Carcaño C, Alvarez FJ & Gutierrez D G 1976 Rice polishings as a supplement in a sugar cane diet: effect of level of rice polishings and of processing the sugar cane by derinding or chopping *Trop Anim Prod* 1:150-161

Silvestre R, MacLeod N A & Preston T R 1977 Voluntary intake and live weight gain of cattle given chopped sugar cane and solutions of molasses containing different concentrations of urea *Trop Anim Prod* 2:1-12

Received 14 December 1976