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EFFECT OF CUTTING FREQUENCY ON SEED AND FORAGE YIELD OF CANAVALIA ENSIFORMIS (L) D C (JACK BEAN)

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A trial was carried out on *Canavalia ensiformis* to evaluate the effect on seed and forage yield of four cutting treatments: A. 3 cuts:- at 3, 6 and 9 months; B. 2 cuts:- at 3 and 6 months; C. 1 cut:- at 3 months and D. No cuts (control).

Forage yields of 10.13, 7.28, 5.63 and 0 tonnes dry matter were obtained for treatments in which forage was cut 3, 2, 1 and 0 times respectively. Differences between treatments were significant at $P < 0.01$. The crude protein level of the integral forage was 11.0%.

There was a close inverse relationship ($r^2 = 0.92$) between number of cuts and seed yield. Yields of dried seed were 3531, 2554, 1540 and 146 kg/ha for 0, 1, 2 and 3 forage cut treatments respectively.

It is concluded that, particularly with regard to its seed yield, this promising tropical legume merits further interdisciplinary study.

Key words: legume, Canavalia ensiformis, Jack bean, forage, seed yield, protein

The scarcity of locally produced protein for inclusion in animal feeds in the tropics has led to the need to find alternative sources. Agroindustrial by-products such as oilseed meals, cereal residues, slaughterhouse wastes and chicken litter can be used where available, but transport and market fluctuations can make them costly and unreliable. High quality forages such as *Leucaena leucocephala*, cassava and sweet potato, have been investigated as sources of protein that can be produced on the farm, and have been shown to be adequate for ruminants (Meyreles et al 1982; Meyreles and Preston 1982, Backer et al 1980; Ffoukes and Preston 1978). Another possible on farm source of protein for the humid tropics is *Canavalia ensiformis*.

Canavalia ensiformis -commonly known as Jack Bean - is an annual legume which has shown promise both as a producer of forage and of seed (Skerman 1977; Mora and Parra 1980; Rachie(undated)). It is adapted to the humid tropics, and, unusually for a legume, is tolerant of acid and wet soils(National Academy of Sciences 1979). Other advantages of the plant include its resistance to pests and its good seed storage qualities. As with a number of other legumes,both the foliage and seed of *Canavalia ensiformis* contain toxins. The major toxins present are Canavanine (a thermostable free amino acid), and Co-Canavalin A (a glucoprotein). Work is in progress in Mexico (Machin 1982 personal communication) and Venezuela (Mora and Parra 1980) to identify techniques for reducing the toxic effects on livestock. The foliage also contains relatively large amounts of the enzyme urease which could be used to advantage in the conservation of forage in sealed silos with urea (in which case ammonia is produced and acts as a preservative).

The objective of the present work was to evaluate the forage and seed yield of canavalia when subjected to different cutting intensities.

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Materials and Methods

Environmental conditions: The trial was carried out in the Domini Republic at an altitude of 60 metres. Average rainfall is 1390mm, and maximum and minimum mean monthly temperatures 27.1 and 24.0°C re ectively . The soil was a fertile loam with a pH of 7.5, and medium drainage . The trial was planted in July 1981, which is the third month of the 7 month rainy season.

Planting and growing conditions: The land was prepared by disc ploughing followed by two disc harrowings. Plots of 5 m x 4 m were used. Spacing between rows was 1 m and between holes 20 cm. 2 seeds were planted per hole at a depth of 2 cm. 100 kg/ha triple superphosphate were broad - cast and worked in before planting, and 100 kg/ha urea were applied as a top dressing 6 months after planting when it was obvious that the plants were not nodulating naturally. The seeds were not innoculated. Hoe weeding was carried out at 3, 19 and 25 weeks after planting. No pest control was necessary.

Treatments and design: The treatments used were as follows:

A. 3 forage harvests; At 3, 6 and 9 months after planting

B. 2 forage harvests; At 3 and 6 months after planting

C. 1 forage harvest; At 3 months after planting

D. No forage harvest (control)

The design was a randomised block with 4 replicates.

Harvest methods and measurements: Forage harvests were carried out by machete at 40 cm above ground level. This corresponded roughly to a point just above the second stem dichotomy, which left sufficient points for forage regrowth. Samples were taken for dry matter (DM) and crude protein (CP) determinations. Seed was harvested as the pods turned yellow and were sun dried to the final weight (14% moisture content). First flowering occurred at 14 weeks, and 7 seed harvests were taken;at 2 weekly intervals between 36 and 49 weeks after planting.

Results

Forage yields: Germination was excellent and initial growth very vigorous , leading to a good first forage harvest at 3 months ($\bar{x}$ = 5.5 tonnes DM/ha Figure 1)). Regrowth was good but the second harvest at 6 months after planting yielded less forage ($\bar{x}$ = 2.32 tonnes DM/ha). The third harvest at 9 months again yielded less with 1.88 tonnes DM/ha.

Total yields of forage for the four cutting treatments were 10.13 , 7.28, 5.63 and 0.0 tonnes DM/ha for 3,2,1 and 0 cuts respectively. Differeces between individual treatments were significant at the $P < 0.01$ level.

Dry matter and crude protein levels for both forage and seed are given in Table 1, as are stem:leaf ratios for plants of 3 and 6 months of age.

Seed yields: Figure 2 presents the yield of dried seed (at 14% moisture content) for the 4 cutting treatments. There was a strong relationship between seed yield and the number of forage cuts taken ($r^2 = 0.92$). A mean

Figure 1:
Forage yields (t DM/ha) of Canavalia ensiformis *according to harvest and number of cuts*

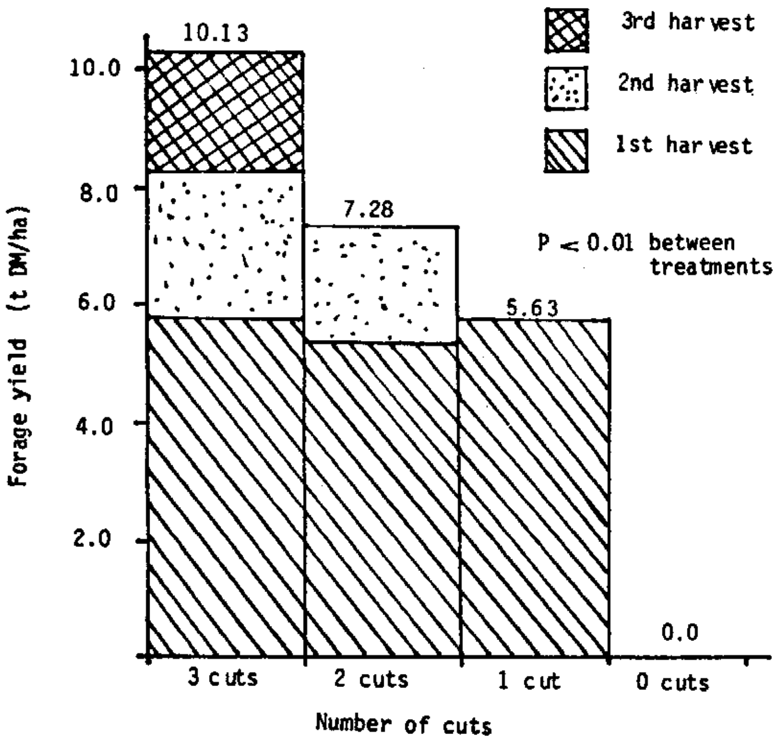


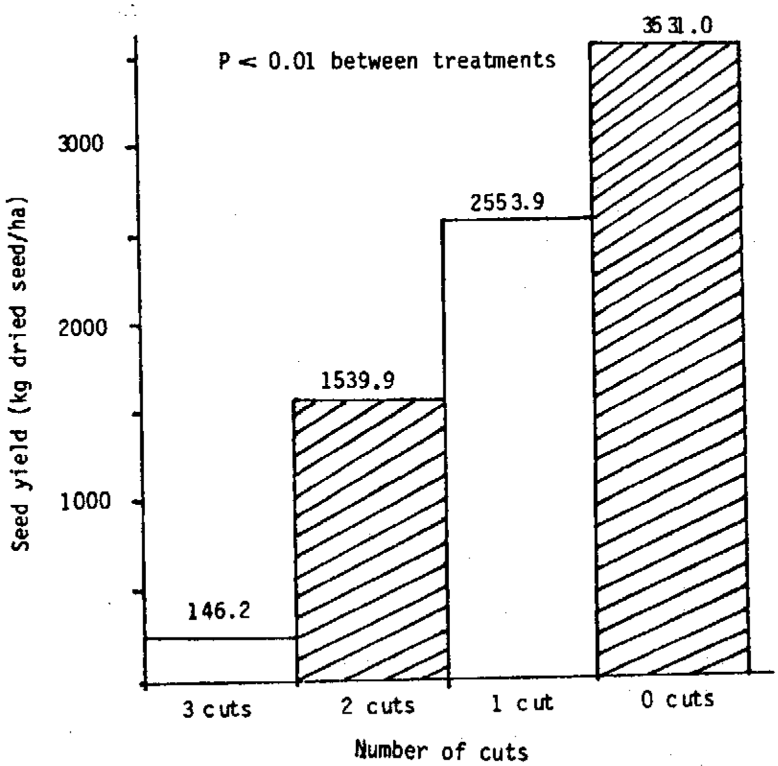
Table 1:
Characteristics of forage and seed

Integral forage dry matter	27.0 ± 0.9%	Means for the three harvests
Leaf crude protein	18.0 ± 2.0%	
Stem crude protein	5.7 ± 0.9%	
Integral forage crude protein	11.0 ± 0.4%	
Stem:leaf ratio (DM basis)		
3 months	1.0:1	
6 months	2.4:1	
Seed:		
Dry matter	86.0%	
Crude protein	29.0%	

yield of 3531 kg/ha of dried seed was obtained for the non-cut control treatment. Differences in seed yields between individual cutting treatments were significant at the $P < 0.01$ level.

Figure 2:

Seed yield of Canavalia ensiformis *(kg dried seed/ha) according to number of forage cuts*



Discussion

The excellent germination and vigorous initial growth make the establishment of this legume relatively easy, even under adverse conditions such as stony soils where conventional land preparation is not possible (Herrera 1982 personal communication).

Forage yields were lower then those reported by Mora and Parra 1980, and the average crude protein content of 11.0% for the integral forage reflects the increasing stem:leaf ratio with time. This is similar to values reported by Otero (1952) of 11.1 - 19.2%, and is well below that of many forage legumes. However, fertilizer levels were probably not optimum and there was no observed nodulation of the plants, probably leading to a deficiency of nitrogen for optimum forage yields. *Canavalia ensiformis* is specific in its requirements for *Rhizobium* (NITRAGIN 1980).Although first flowers were observed after 14 weeks, the first seed harvest was taken at 36 weeks. A high percentage of flower abortion was observed which may have Been due to the density of the foliage. A wider spacing sould probably result in higher seed yields,as indicated by Herrera (1982 personal communication).

The seed yield of the no cut treatment (3531 kg/ha) is comparable to that of soya grown under temperate conditions, It should be borne in mind however, that *Canavalia ensiformis* has been subjected to very little varietal selection.

Canavalia ensiformis shows great promise, particularly as a source of seed protein for inclusion in animal feed, and merits intensive interdisciplinary study of the genetic, agronomic, biochemical and animal feeding aspects associated with its production and use.

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