MUNKOLO (*RHYNCHOSIA SUBLOBATA*), A PROMISING PASTURE LEGUME FOR ZAMBIA

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ABSTRACT

Data is presented on the pasture legume Rhynchosia sublobata, *which occurs in natural grasslands over large areas of Zambia.*

Spaced plant and pasture studies showed that when cut three, four or six times a year the legume outyielded glycine (Glycine wightii) *and Siratro* (Macroptilium atropurpureum), *whether grown alone or with Rhodes grass* (Chloris gayana), *and that it makes significant growth in the pre-rains period when glycine and Siratro are largely dormant.*

Rhynchosia sublobata *is thought to have considerable promise as a component of a grass/legume mixture, or when sown into natural grassland. The common name "Munkolo" is proposed for the species.*

INTRODUCTION

One of the most important pasture problems in Zambia is considered to be the introduction of improved legumes into natural grasslands.

The present thinking is that a mixture of mainly perennial legumes should be used, but that within the mixture there should be some annual legumes whose more rapid growth will provide some grazing during the establishment year and take some of the grazing pressure from the slower growing perennial legumes. The perennial legumes should contain a range of species whose different growth patterns will provide balanced grazing throughout the year.

It is as a part of such a mixture that *Rhynchosia sublobata* is considered to have promise.

The climate of Zambia is sub-tropical with summer rains from November to April, varying from 1500 mm in the North and North-west to 500 mm in the South; a cold dry winter season from May to August with occasional radiation frosts in depressions, and a hot dry season from September to October. Most of the grazing lands lie between 900 mm and 1800 mm.

The Central Research Station (lat. 15°35′ S, 28°18′ E), where most of this work was carried out, is at an altitude of 1213 m with a mean annual rainfall of 794 mm. The soil type over the experimental area is a sandy clay loam.

Rhynchosia sublobata is an indigenous legume recorded most frequently from the southern and central parts of Zambia, but experimental plantings in other parts of the country have done well and it seems to favour the same conditions as glycine (*Glycine wightii*) or siratro (*Macroptilium atropurpureum* cv. Siratro). There have been no nodulation problems wherever the legume has been tried, except in the leached acid sands of Western Province, where an already nodulated plant will survive after transplanting but uninoculated seeds fail; there are, however, establishment problems in these sands unconnected with inoculation and nodulation.

Rhynchosia sublobata is frost and fire resistant in that there is regrowth from the larger stems and from below ground. The bright yellow flowers are very prominent on burnt ground during September/October and casual observation suggested that the plants carried more stem and leaf than glycine or Siratro growing under the same circumstances. At that time of the year it is freely grazed.

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A bibliography of refences covering the period 1930 to 1970 (Anon. 1971) contained very few references to *Rhynchosia sublobata*, to *Rhynchosia* spp., or to the genus *Rhynchosia* and few additional references have been found for the period 1971 to 1975. Possible synonyms have not been investigated. Generally the references are to taxonomic studies or to *Rhynchosia* spp. as a component of the natural grassland in many parts of the world.

To avoid the frequent confusion which exists in other tropical pasture genera, between botanical and common names, the common name "munkolo" is proposed for *Rhynchosia sublobata*.

The experiments described in the present paper were designed to provide agronomic data on the potential of munkolo as a pasture legume.

MATERIALS AND METHODS

During the dry season of 1970 seed of munkolo was collected, mostly on the Research Station, but elsewhere when the opportunity arose. An examination of the seeds showed a considerable range in size and only the larger seeds were retained. The bulk of this seed was used in pasture studies and 300 seeds were retained for single plant studies.

The object of the single plant studies was to get information on growth, flowering and seed production and to assess the variability in the population. The seeds were germinated in November 1970 in planting pockets and planted out in the field when eight weeks old. Two hundred single plants were put out at 2 m by 2 m spacing and substituted at every eighth planting station with either a glycine or Siratro seedling. There were twenty glycine plants (two plants from each of ten selections) and ten Siratro plants grown from seed from an unselected bulk. In Tables 1–3 the values for the individual glycine selections are combined.

During the growing season records were kept of shoot length, shoot number, protein content, flowering, seed production and regrowth after cutting. Shoot number was determined by summing the number of shoot tips lying between concentric circles of 30, 60, 90 and 120 cm from the centre of the plant. Shoot length was recorded as the length, in cm, of the longest shoot. In the cutting trials plants were cut back to 30 cm and then cut again after a one month or two month interval. Protein content was determined using a standard micro-kjeldahl technique and digestibility by the method of Clancey and Wilson (1966).

The effect of fertilizer on single plants was not studied, the whole area receiving an overall dressing of 200 kg ha^{-1} single superphosphate (8.8% P). Later work suggested this was too low for maximum growth.

In the pasture studies munkolo was compared with glycine and Siratro in two unreplicated trials; the first was designed to build up a picture of the growth pattern and chemical composition during the wet and dry season, and the second was designed to test the response under different cutting managements. Single superphosphate was applied at 200 kg ha^{-1} at the start of each growing season.

Seasonal production was followed in thirteen 40 m^2 plots of munkolo, glycine and Siratro which were sown in late 1970 into recently ploughed grassland. During the establishment year the plots were clean weeded and seed was collected during the following dry season. The pure stands of the legumes were cut in January and June 1972 and thereafter the herbage was cut every eight weeks, each time from a different plot in order to follow seasonal production.

For cutting management trials eight 30 m^2 plots of pure stands of the three legumes were established from seed at the same time as the previous trial, and in early 1971 Rhodes grass (*Chloris gayana*) splits were planted into half of each plot to compare the production in a pure legume plot with the production in a grass/legume stand. The plots were kept clean weeded and the herbage was cut twice before

the start of the trial in February 1972; the plots were then cut at a height of 5 or 10 cm every 4, 8, 12 or 16 weeks until the trial ended in July 1974.

RESULTS

Single plant studies

Botanical

Flowering begins in March and continues until the rains begin in October/November; an inflorescence is produced successively from each node as the shoot grows. The flowers are carried on a peduncle 15 to 20 cm long and when mature carry 14 to 16 flowers. The flowers open from the base upwards and it takes eight to ten days to complete flowering. Individual flowers are the same size as Siratro and are bright yellow when open. Flowering begins daily at 1400 hr, with a peak at 1600 hr, and ends at dusk.

In the field the flowers are visited by three species of large bee of the family *Xylocopidae* and these seem essential for pollination. Sixteen peduncles carrying an average of 14 unopened flowers were bagged for two weeks and only 19 pods were obtained from a possible 224. Unbagged peduncles usually carried eight to twelve seed pods at maturity. Twenty bagged flowers, tripped by hand when open, failed to set seed. Deliberate cross-pollination was not attempted.

Flowering began on March 10 and the first ripe pods were harvested two months later. Pod collection continued at three to four day intervals until October 25. The pods are two seeded and in the field are attacked by a Bruchid fly, but only rarely are both seeds in a pod damaged. Twenty plants were sprayed weekly to control the fly; this increased the yield of seed from the June flowering but over the whole harvest gave little advantage. Seed was harvested from May 4 to October 15 and over that period the sprayed plants gave an average of 81% good seed, whereas twenty unsprayed plants gave 73% good seed. Total seed production was closely correlated with shoot number up to shoot numbers of 80 to 90 per plant, but above that seed production stayed steady at 1800 to 1900 seeds per plant while shoot number increased to 140.

One thousand seed weight varied from 45.0 g to 71.0 g, with a mean over 180 plants of 59.6 g. Using data from seed production plots the corresponding values for Siratro are 14.0 g (12.9–14.7 g), and for glycine 7.8 g (7.0–8.5 g).

Agronomic

Uninterrupted growth followed the same pattern as for glycine or Siratro except that the values for munkolo were always lower (Table 1). Growth measurements were terminated when flowering began.

TABLE 1

Length of longest shoot (cm) and mean shoot number.

		10/2/1971	8/3/1971
Munkolo	Length	28.5(13.6)†	51.9(16.6)
159 plants	Number	12.9 (5.3)	26.6(10.7)
Glycine	Length	49.1 (9.2)	71.0(10.2)
20 plants	Number	39.1(10.3)	60.5(19.2)
Siratro	Length	44.9(18.3)	74.6(29.5)
10 plants	Number	41.8(18.2)	75.2(47.9)

( )†=Standard deviation.

When cut back munkolo exhibited a different type of apical dominance from that of glycine or Siratro. Removal of the tip of a shoot of glycine or Siratro resulted in the growth of secondary shoots from very many nodes on the stem, whereas removal of the apical shoot of a munkolo stem resulted in the growth of secondary shoots from only the four or five nodes nearest the decapitated tip. Munkolo produced fewer, longer shoots and this is very obvious in first year plants although less obvious in older plants.

Stem: leaf ratio, taken just before flowering and determined from the dry weights of the separated stem and leaves plus petioles, from 25 plants, averaged 1:2.96, with a range of 1:2.3 to 1:3.5. Twenty glycine plants averaged 1:1.17, with a range of 1:0.7 to 1:1.6.

Internode length, measured towards the base of the plant from the node closest to a point 30 cm from the shoot tip, was very variable. The mean value for ten shoots from each of twenty plants, was 7.0 cm, with a range of 5.6 cm to 9.1 cm.

The main interest in this legume is in its growth from August to the beginning of the rains in October/November. Table 2 gives the dry weight of the regrowth from plants cut back in August and Table 3 gives the mean per cent protein and per cent digestibility of the regrowth after one and two months. It can be seen that munkolo compares very favourably with glycine in the amount of regrowth, but both protein and digestibility values are lower. This may be a consequence of the stronger apical dominance shown by munkolo; the regrowth after cutting always contains fewer shoots than glycine and a higher proportion of older stems. Siratro is not included in these Tables as it responded very poorly to cutting back.

TABLE 2

Dry weight per plant (g), of the regrowth cut at one month and two month intervals after cutting back on August 20, 1971. (*means of* 20 *plants*).

	23/9/71	18/10/71	15/11/71	13/12/71
Cut monthly				
Munkolo	84.1(40.1)†	52.8(20.3)	115.9(39.6)	161.4(43.6)
Glycine	76.3(32.7)	52.0(20.7)	64.8(19.6)	229.7(41.5)
Cut two monthly				
Munkolo		166.6(58.2)		619.4(179.2)
Glycine		142.1(51.3)		428.6(78.2)

( )†=Standard deviation.

TABLE 3

Protein content and digestibilty of regrowth cut at one and two month intervals after cutting back on August 20, 1971 (*Munkolo—mean of* 20 *plants, Glycine—mean of* 10 *plants*).

	23/9/71	18/10/71	15/11/71	13/12/71
% protein				
Cut monthly				
Munkolo	15.8(1.7)†	16.4(1.3)	15.1(1.0)	17.1(1.4)
Glycine	17.5(1.6)	17.9(1.2)	16.7(2.2)	20.2(1.0)
Cut two monthly				
Munkolo		13.0(1.6)		15.5(1.3)
Glycine		14.5(1.3)		17.6(0.9)
% digestibility.				
Cut monthly				
Munkolo	57.5(4.3)	54.6(4.4)	48.1(3.7)	
Glycine	63.5(5.5)	61.1(5.1)	55.8(4.0)	
Cut two monthly.				
Munkolo		49.6(5.5)		
Glycine		61.7(4.9)		

( )†=Standard deviation.

Sward evaluation

Production of glycine and Siratro closely followed the rainfall pattern, with the first appreciable growth in December; in contrast munkolo started growth in

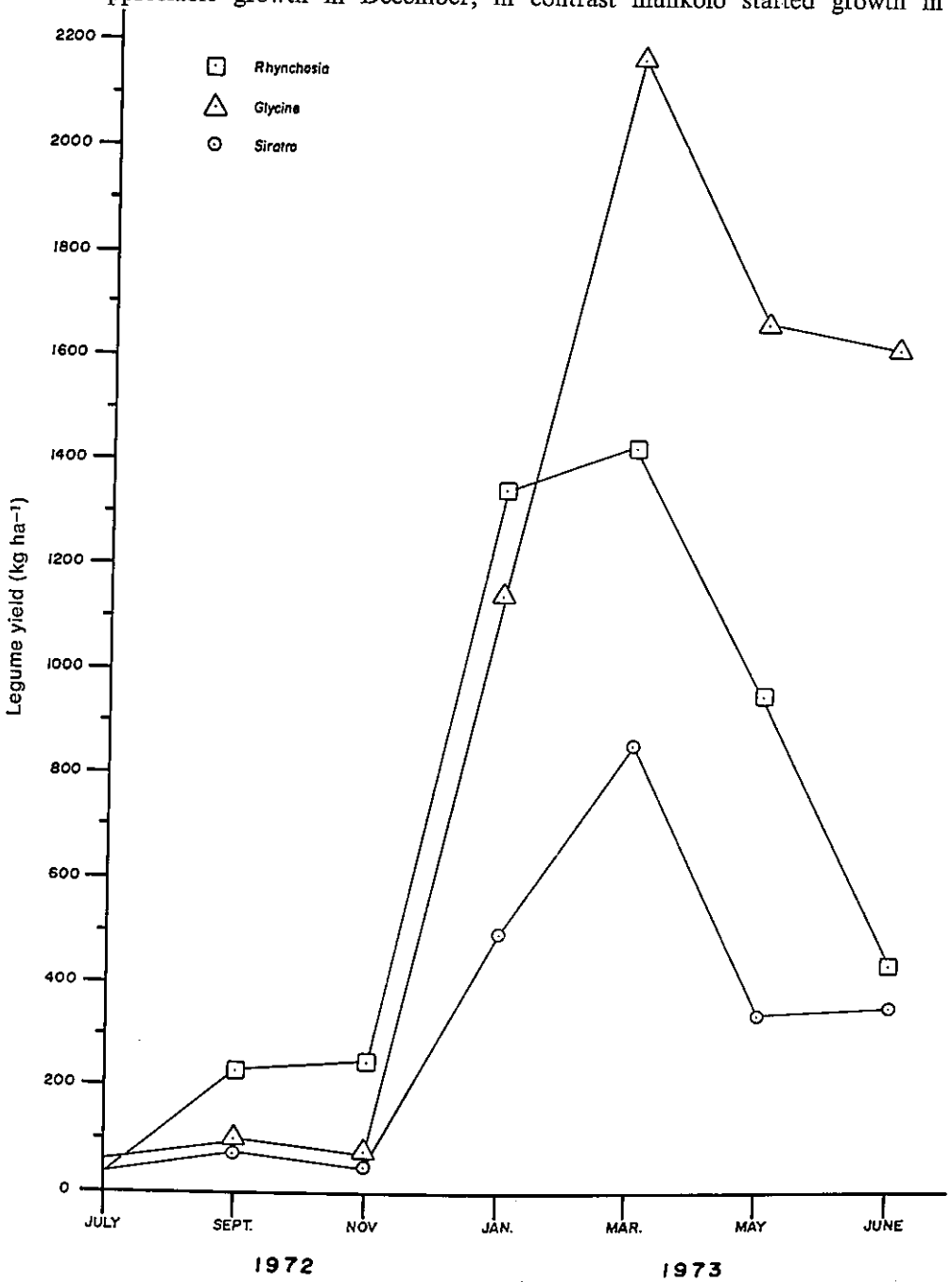

FIGURE 1
Dry matter production of munkolo, glycine and Siratro (kg ha^{-1}).

September. Peak production of glycine and Siratro was in early March with 2.1 and 0.9 tonnes ha^{-1} dry matter respectively and with munkolo the peak production came in February/March with 1.4 tonnes ha^{-1} dry matter (Figure 1).

The crude protein content of the uninterrupted growth of the legume, averaged over two consecutive cuts, is shown in Table 4. As in the spaced plant studies, the protein content of munkolo is lower than that of glycine or Siratro. It should be noted that the protein contents of the first cuts in this trial are above normal as they include regrowth after cutting in June. The protein contents for the last cuts in June 1973 reflect normal values for these legumes in the dry season.

TABLE 4

Crude protein contents of munkolo, glycine and Siratro, from 25-7-72 to 24-7-73 averaged over two consecutive cuts.

	Munkolo	Glycine	Siratro
25/7 – 21/8	11.4	12.9	13.2
19/9 – 18/10	15.9	15.5	17.0
15/11 – 12/12	14.0	15.7	16.5
10/1 – 6/2	12.8	15.0	17.2
5/3 – 3/4	12.2	15.0	15.0
30/4 – 28/5	11.9	13.5	13.9
25/6 – 24/7	10.7	11.4	10.7

The observations on dry matter production can be divided into three consecutive periods of 24, 48 and 48 weeks respectively. Attention is focussed on the cutting frequency as the trial did not show a constant pattern in the effect of cutting height.

Period 1—February 1972 to September 1972 (24 weeks).

In this period munkolo growing alone or with Rhodes grass was outyielded by both glycine and Siratro at each cutting frequency. At cutting frequencies of 12 and 16 weeks legume yields were higher when grown with Rhodes grass than when grown alone (Figure 2).

Period 2—September 1972 to August 1973 (48 weeks).

Dry matter production of the legumes, alone or with Rhodes grass, increased with a lower cutting frequency up to cutting every twelve or sixteen weeks when yields were almost equal. Munkolo outyielded glycine and Siratro, except at the highest cutting frequency.

Glycine and Siratro yields were the same when growing alone or with Rhodes grass. However, munkolo yielded substantially higher when grown with Rhodes grass. During this period it was difficult to keep the plots completely clean weeded and this may have caused some variation in the yields.

Period 3—August 1973 to July 1974 (48 weeks).

In this period the Rhodes grass could not be controlled as it was spreading into the pure legume plots; the results for the pure legumes have been omitted and in Figure 2 only the dry matter production of the grass/legume mixture is shown. Munkolo gave some eight to ten times the yield of glycine or Siratro while the yield of Rhodes grass was similar with all three legumes. Yields were reduced during this period because of heavy weed growth.

DISCUSSION

The main objective of the trials was to study the legume itself and to study the production under sward conditions.

The results from single plants showed that munkolo was only sightly inferior to the glycine selections; a closer examination of a wider range of material, in an attempt to find genetically superior ecotypes, would be worthwhile.

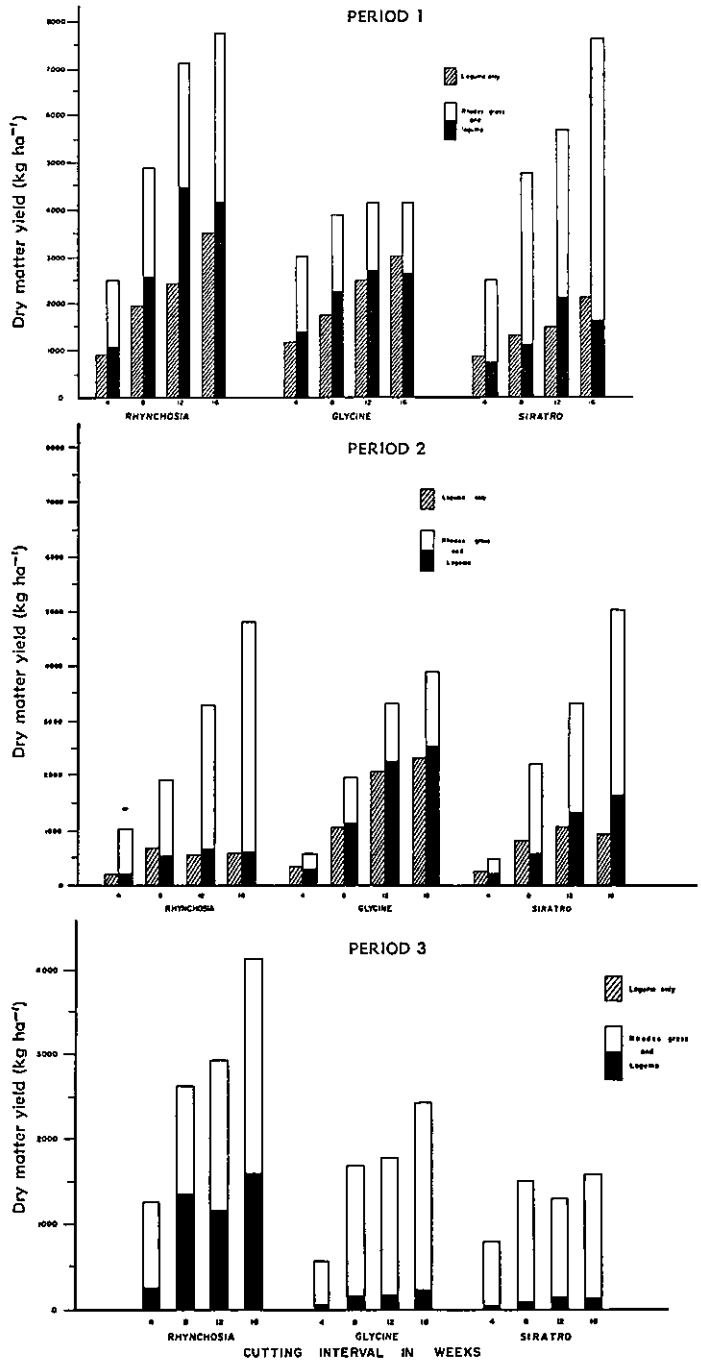

FIGURE 2

Dry matter yields of munkolo, glycine and Siratro, at four cutting frequencies (kg ha^{-1}).
Period 1, February 1972 to September 1972.
Period 2, September 1972 to August 1973.
Period 3, August 1973 to July 1974.

The two seeded pod is a disadvantage compared with the six to ten seeds per pod of glycine and the ten to fourteen seeds per pod of Siratro, but a plot of 100 munkolo plants at one metre spacing gave over 3 kg seed. In Zambia the first rains are often interrupted by dry spells and it can be postulated that munkolo, with its larger seed, can be sown deeper and will survive when glycine or Siratro would die.

The pasture studies demonstrated the value of munkolo in providing up to 250 kg ha^{-1} dry matter between September and November when production of the other legumes is very low. In the last months of the dry season cattle suffer because of the low quality of the veld grasses and munkolo can provide some of the necessary dietary protein to help cattle through this period. Also, when grown as a companion legume to Rhodes grass, munkolo gave higher yields of legume than glycine or Siratro. This did not occur until the third wet season after sowing and was not anticipated. Unfortunately yields were low in these trials because of competition from weeds; Siratro was particularly affected. When grown in the natural grassland these legumes suffer less competition from weeds than when sown into old arable land.

The best cutting management of the legumes, either grown alone or with Rhodes grass, is cutting back every twelve or sixteen weeks. With more frequent cutting dry matter production falls and the yield figures shown in Figure 2a (for cutting over 24 weeks) and in Figure 2b (for cutting over 48 weeks) are in general agreement with those reported by Jones (1971) for Siratro; at the higher cutting height, 10 cm, there was little leaf but plenty of stem left. During September and October, when the contribution of munkolo is most needed, it is very heavily grazed, particularly if the cattle are on burnt ground as is often the case in Zambia, but no studies have been made of the recovery rate during the succeeding wet months when other legumes provide the bulk of the grazing.

Trials are now in progress to investigate the potential of munkolo when sown directly into natural grassland, and future work will include regional testing and grazing trials.

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