

AGRONOMIC AND ECONOMIC STUDIES OF CASSAVA—LEGUME INTERCROPPING SYSTEMS

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INTRODUCTION

Cassava exhibits slow initial growth where sunlight and other available resources are poorly utilized for a period of about 3 months after planting. Intercropping, which implies the growing of two or more crops simultaneously, should therefore be a feasible proposition to fully exploit the available inputs and environmental resources which cassava is unable to utilize during the early phase of establishment.

Intercropping, besides giving early monetary returns, has several agronomic advantages like a rapid ground cover to arrest erosion, reduce excessive loss of moisture and also have a suppressing effect of weed growth. Intercrops offer divergent genetic material that are not conducive to the spread of pests and diseases in epidemic proportions.

In Colombia 40% of the farmers growing cassava practice intercropping (Dias and Anderson, 1977). Okigbo (1976) estimated that in Africa about half the cassava acreage is grown in a mixed cropping system. In Thailand intercropping cassava is practised to a limited extent with corn in the uplands and also with young coconut or rubber (Sinthupran, 1978). In Central America cassava intercropped with maize is common in low lying areas (Moreno and Hart, 1978) while beans are intercropped at higher elevations. In Coimbatore, South India, of the several intercrops tried out onion (*Allium cepa L.*) was found to be the most profitable giving an extra net income of Rupees 1036 per ha in 85 days after planting (Muthukrishnam and Thamburaj, 1978).

Andrews (1970, 1975), Kassam and Stockinger (1973) reported that yields of relay and intercropping systems are highest when there is a competitive gap between the periods when the crops involved are making maximum demands on environmental resources mainly light, nutrients and moisture. Some agronomic considerations to the designing of cassava based intercropping as stated by Zandstra (1978) are;

- (a) cassava varieties should be tolerant to early shading and of late branching types (after 3 1/2 months).
- (b) ideally, cassava should remain below the intercrop canopy for about 120 days after planting.
- (c) cassava should form the superior canopy during its peak production after 120 days.

While a number of crops have been grown in an intercropping system with cassava, its association with legumes appears significant owing to the combination producing both carbohydrate and protein simultaneously. Furthermore, intercropping with legumes could make available an extra source of nitrogen for cassava and in addition, the subsequent incorporation of such legume plant residues into the soil will increase its fertility.

Thus, considering the feasibility of such advantages gained by a cassava legume intercropping system, an experiment was initiated using 5 commonly grown legumes and 2 cassava varieties with branching and non branching habits, to ascertain their agronomic and economic implications.

MATERIALS AND METHODS

The experiment was conducted at the Central Agricultural Research Institute, Peradeniya during yala 1979. The soil was a silt clay loam and contained 0.14% total nitrogen; 33.6 kg/ha. P_2O_5 and 0.38me potassium per 100 gm soil. The pH was 5.3.

The climatic data are given in Table 1. The treatments consisted of two cassava varieties, Llanera (branching type) and MU-22 (non branching type) and 5 legumes namely Bushitao (*Vigna sinensis* var. *sesquipedal* L.); Soybean (*Glycine max* L.); Black gram (*Phaseolus mungo* L.); Green gram, Type 51 (*Phaseolus aureus* Roxb.) and Cowpea var. 9/35 (*Vigna unguiculata* L.)

The treatments were arranged in randomized blocks, replicated 3 times. Each plot measured 4.5m x 7.2m (32.4 m²). Cassava was planted at a spacing of 90 cm x 90 cm on 12th May 1979, with 5 rows of 8 plants per row, and a total of 40 plants per plot. Apparently disease free cuttings, 22 cm long, were planted erect at one per hill and the soil was subsequently earthed up to form a mound at each planting hill, leaving about 2 to 3 buds exposed. Two rows of legumes were dibbled at 2 to 3 seeds per hill, 30 cm away from each cassava row, on 13th May 1979. The within row spacings were 15 cm for Bushitao, Soybean and Cowpea and 7.4 cm for Black gram and Green gram. After emergence the legumes were thinned out to one plant per hill.

Cassava received a basal fertilizer application of 84 kg/ha urea (46% N), 126 kg/ha muriate of potash (60% K_2O) and 126 kg/ha concentrated super phosphate (42% P_2O_5); while the legumes received a uniform mixture of 35.5 kg/ha urea; 126 kg/ha concentrated super phosphate and 63 kg/ha muriate of potash. Cassava was top dressed at 3 1/2 months after planting with 84 kg/ha urea and 63 kg/ha muriate of potash and at 5 months with 84 kg/ha urea. All legume crops received 63 kg/ha urea at 3 weeks after planting. Weekly spraying of an insecticide "Monitor" was done on the legume crops.

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Cassava was harvested after 12 months, discarding border rows of each plot. Entire rows of legumes were harvested at maturity except Bushitao which was taken as green pods. No data was collected for Soybean due to severe pest damage. It must necessarily be emphasized that the legumes were harvested either as green pods or dry seed depending on their popular mode of local consumption.

RESULTS AND DISCUSSION

Flowering data. Bushitao showed 100% flowering at 30 days after planting (DAP) while Green gram, Black gram and Cowpea took 35, 51 and 62 DAP respectively. This quicker flowering habit of Bushitao (Table, 2) and consequently its earlier harvest could make it an ideal intercrop with cassava, as there is no serious competition on the part of either crop for environmental resources, mainly sunlight. This assumption was based on the unhampered growth and good stand of both crops seen throughout.

Yield of legumes. Bushitao intercropped with cassava variety Llanera gave significantly higher green pod yields (5.9 tons/ha) compared to other legumes (Table 3). This could be attributed to the quick growth habit of Bushitao which showed the earliest 100% flowering, together with the narrow and dissected foliage with short petioles and medium height of the cassava variety Llanera, which permitted more sunlight penetration for the intercrop. Bushitao intercropped with the cassava variety MU-22 which recorded the second highest yield (4.3 tons/ha) confirms its quick growth habit compared with other legumes intercropped. However, its inability to attain greater yield was a consequence of the taller growth habit and undissected foliage with long petioles in the cassava variety MU-22 which during later growth provided more shading and reduced sunlight reaching the intercrop. The similar yield trends recorded for Green gram under both cassava varieties may be the result of comparatively scanty foliage observed in the crop and consequently impaired photosynthesis.

Yield of cassava. The cassava variety Llanera (15.38 tons/ha) intercropped with Bushitao significantly outyielded other combinations except Llanera with no intercrop (control) or Llanera interplanted with Cowpea which gave root yields of 14.66 and 13.54 tons/ha respectively. Llanera in combination with the other two legumes Green gram and Black gram also recorded higher root yields compared with the cassava variety MU-22 (Table, 4).

It therefore appears that the growth habits of cassava variety Llanera and the legume intercrops are complementary, where an increase in yield of one reflected an yield increase of the other. However, the cassava variety MU-22 intercropped with legumes indicated that both crops were adversely affected, due perhaps to the competition for nutrients and sunlight, as a consequence of conflicting growth patterns.

Economics of intercropping. Bushitao intercropped with the cassava variety Llanera and harvested for green pods gave significantly higher monetary returns (Rs. 11,714/- per ha at Rs. 2/- per kg.) compared to all other legumes. This was followed by the combination of Llanera and Black gram (Rs. 7,130/- per ha) Llanera and Cowpea (Rs. 5,590/- per ha) and Llanera with Green gram (Rs. 3,414/- per ha) which were harvested as dry seed and valued at Rs. 5/-, Rs. 5/- and Rs. 6/- per kg. respectively (Table 5). Cassava was valued at Rs. 2/- per kg.

Legumes intercropped with the cassava variety MU-22 revealed that Bushitao gave a significantly greater income (Rs. 8,654/- per ha) compared with MU -22 and Black gram (Rs. 4,800/- per ha); MU-22 and Green gram (Rs. 3,660/- per ha) and MU-22 with Cowpea (Rs. 3,600/- per ha)

Thus, considering the total income from cassava in combination with different legumes, the variety Llanera intercropped with Bushitao appeared the most profitable giving a gross return of Rs. 27,093/- ha compared with the monoculture of cassava variety Llanera which resulted in an income of Rs. 14,656/- ha. Similarly, for the cassava variety MU-22, monoculture reflected an income Rs. 9,404/- per ha whereas when intercropped with Bushitao the gross return was Rs. 19,335/- ha. The significant increase in income by intercropping Bushitao with Llanera may be attributed to the highly dissected foliage and other characters described earlier which could have contributed to more sunlight reaching the intercrop.

SUMMARY

As cassava occupies the land for periods of over 9 months prior to harvest, it was thought feasible to utilize the wide spacing between rows to raise an intercrop that could give an earlier extra income. Legume intercrops were preferred, owing to their ability to fix atmospheric nitrogen and also supply protein which is lacking in cassava. The combination of cassava variety Llanera and the legume intercrop Bushitao recorded significantly higher yield and monetary return. Thus, intercropping cassava with legumes appeared a profitable agronomic practice.

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Table 1—Climatic data 1979/80, Peradeniya

Period	Temperature °C		Rainfall mm	Rainfall days
	Min.	Max.		
1979				
May 1st-15th	22.01	30.0	185.0	09
May 16th-31st	21.11	31.26	6.2	04
June 1st-15th	21.45	29.91	190.8	05
June 16th-30th	21.93	28.14	72.3	11
July 1st-15th	22.31	27.73	52.1	09
July 16th-31st	21.13	27.92	154.3	12
Aug. 1st-15th	20.28	28.58	24.6	06
Aug. 16th-31st	20.55	29.59	31.04	07
Sept. 1st-15th	20.01	27.56	61.2	08
Sept. 16th-28th	21.17	24.74	163.6	10
Oct. 1st-15th	20.41	28.19	69.7	06
Oct. 16th-31st	20.83	26.15	292.8	13
Nov. 1st-15th	20.77	25.86	224.0	14
Nov. 16th-30th	20.69	25.92	117.6	11
Dec. 1st-15th	20.62	26.99	161.8	08
Dec. 16th-31st	19.43	27.57	23.6	05
1980				
Jan. 1st-15th	20.0	28.03	1.3	02
Jan. 16th-31st	17.91	29.94	—	—
Feb. 1st-15th	18.46	30.74	—	—
Feb. 16th-29th	17.55	31.71	—	—
Mar. 1st-15th	18.66	31.91	59.4	03
Mar. 16th-31st	19.46	21.28	26.6	02
April 1st-15th	21.27	29.25	153.7	11

Table 2—Flowering data of legumes

<i>Legume</i>		<i>Percentage flowering</i>	<i>Date of flowering</i>
1. Green gram	...	25 100	11.06.79 18.06.79
2. Black gram	...	25 100	24.06.79 04.07.79
3. Cowpea	...	25 100	04.07.79 15.07.79
4. Bushitao	...	25 100	11.06.79 14.06.79

Table 3—Yield of legume intercrops

<i>Treatment Combinations</i>		<i>Yield tons/ha</i>
1. Bushitao+Llanera		5.90*
2. Blackgram+Llanera	...	1.40
3. Cowpea+Llanera		1.10
4. Green gram+Llanera	...	0.60
5. Bushitao+MU-22	...	4.30*
6. Black gram+MU-22		0.96
7. Cowpea+MU-22	...	0.70
8. Green gram+MU 22	...	0.60
L.S.D. (P=0.05)		1.29 tons/ha
* Fresh pod weight		

Table 4—Yield of cassava varieties in combination with legume crops

<i>Treatment combination</i>			<i>Cassava fresh weight yield tons/ha</i>
1. Llanera+Bushitao	...	...	15.38
2. Llanera (Control)	...	...	14.66
3. Llanera+Cowpea	...	...	13.54
4. Llanera+Green gram	...	...	12.58
5. Llanera+Black gram	...	...	11.07
6. MU-22+Bushitao	...	...	10.68
7. MU-22+Cow pea	...	...	10.56
8. MU-22+Black gram	...	...	9.91
9. MU-22 (Control)	...	...	9.40
10. MU-22+Green gram	...	...	8.74
L.S.D. (F=0.05)			1.89 tons/ha

Table 5—Economics of cassava and legume crops

<i>Treatment combination</i>	<i>Income in rupees per ha.</i>		
	<i>Cassava</i>	<i>Legume</i>	<i>Combined</i>
Llanera (Control)	14,656
Llanera+Bushitao	15,379
Llanera+Cowpea	13,356
Llanera+Green gram	12,517
Llanera+Black gram	11,071
MU-22 (control)	9,404
MU-22+Bushitao	10,679
MU-22+Cowpea	10,560
MU-22+Black gram	9,907
MU-22+Green gram	8,743
			—
			11,714
			5,590
			3,414
			7,130
			—
			8,654
			3,600
			4,800
			3,660
			—
			27,093
			18,946
			15,931
			18,201
			—
			19,333
			14,160
			14,707
			12,403