Bioscience Research Communications
Vol. 14, No. 4, August 31, 2002
Printed in Nigeria

0795-8072/2002 $3.00 + 0.00

BRC 2001072/14403

Effect of cassava planting patterns on the growth and yield of cassava/maize/melon intercrop and relayed cowpea

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(Received May 2, 2001)

ABSTRACT: The effect of four cassava planting patterns on the growth and yield of cassava/maize/melon intercrop and relayed cowpea was investigated in the Teaching and Research Farm of the University of Ibadan. The cassava (cultivar 30572) planting patterns (treatments) used include 1 x 1m (10,000 plants/ha), 1.5 x 0.75m (8,800 plants/ha), 2 x 1m triangular planting (7,500 plants/ha) and 3 x 1.5 triangular planting (4,400 plants/ha).

The results showed that the patterns did not affect maize height, grain yield cassava leaf area, height and stem girth, length of tuber and number of roots per plants. However, the freshroot yield (29 ton/ha) from cassava planted at 7,500 plants/ha (2 x 1m triangular planting) was significantly higher than those obtained from other planting patterns. The cowpea grain yield (1004.06kg/ha) in cassava planted at 4,400 plants/ha was significantly higher than those in other planting arrangements.

Keywords: Cassava planting patterns; Intercrop; Crop competition.

Introduction

Cassava (*Manihot esculenta* Grants) is one of the most important root crops grown in most tropical countries. Cassava is commonly grown in mixtures with short duration crops like maize and curcurbits such as melon. Inadequate arable land in most tropical countries has necessitated intensifications of land for optimal productivity. It is seldom planted in pure sand. It has been shown to be more profitable to interplant improved cassava varieties with other short-duration food crops than pure stand (Roche, 1981). Traditionally, straight row cropping is not common with farmers' planting arrangements and little success has been made in orientating cropping patterns into straight rows in some parts of the country (Agboola and Tijani, 1990).

Farmers often plant cassava triangularly with wide spacing, this practice allows the introduction of a crop especially cowpea after harvesting the initial short duration crops (Maize and melon) before cassava closes canopy.

Cassava/cowpea association has been found suitable and beneficial both in land efficiency and dietary aspects. The association enables effective utilization of space while cowpea fixes nitrogen through its nodules and hence soil fertility is improved.

There is inadequate information on the best crop arrangement for cropping cassava, maize and melon that will improve their yield and at the same time surpress weeds and allows the introduction of a crop especially cowpea after harvesting the initial short duration crop (Maize and melon) before cassava closes canopy.

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This study was designed to investigate the effect of cassava planting patterns on cassava growth and yield as well as that of component intercrops of maize, melon and late season cowpea.

Materials and Methods

The experiment was conducted at the University of Ibadan Teaching and Research Farm between May 1994 and June 1996. Ibadan is located on Lat. 7°N and 7° 15', Long. 3° 45'E and with an altitude of 220m above sea level. The mean annual rainfall distributed over 7 months is about 1322mm and rainfall pattern is bimodal in nature.

The experimental site was first opened up for farming thirty years ago and the land has since been under alternation between 3 years of fallowing followed by four years of continuous cropping. The site has always been planted with cassava, maize, soybean, cowpea, melon and other arables. The soil of the site is a Rhodic Kandiustalf.

Treatments were four cassava planting patterns laid out in a randomized complete block design (RCBD) with three replicates. The plot size was 6 x 4m. Cassava (30572) was planted at 1 x 1m (regular planting) 1.5 x 0.75m, 2 x 1m (triangular) and 3m x 1.5m (triangular planting). While maize and melon were planted at 90 x 45cm and 90 x 60cm respectively. All crops were planted at the same time.

Prior to cropping, preliminary soil sampling was carried out. Samples were air-dried and pass through 2mm sieve for physico-chemical analysis. Some selected property of the site is showed in Table 1, the soil was low in available nutrients pH (soil:water) was 7.0 using.

PH meter (electrode), organic carbon, 1.63g/kg (Walkey and Black, 1934), total N 0.23g/kg through Micro-Kjeldahl digestion (Bremmer, 1965); available P by Bray PT method, while Ca, .Mg , K and Na were extracted with NH_4OAC. Thereafter, Ca, Na and K were read from the flame photometer and Mg from the Atomic Absorption Spectrophotometer (AAS). Their results were respectively 2.4, Mg 1.96, K 0.23, Na 0.32, H^+ 0.20, exchangeable bases and exchangeable acidity. Mechanical analysis was by hydrometer method; available P 10.2mg/kg by Bray PI method; while Ca, Mg, K and Na were extracted with NH_4OAC. Thereafter Ca, Na and K were read from the flame photometer as 2.4cmol/kg, Na 0.32cmol/kg and K 0.23cmol/kg. The Mg was read in an atomic absorption spectrophotometer (AAS) as 1.96cmol/kg. CEC 5.09cmol/kg was determined as the sum of exchangeable bases and exchangeable acidity. Mechanical analysis was by hydrometer method to obtain 60g/kg clay; 114g/kg silt and 826g/kg sand.

At three weeks after planting, NPK 15-15-15 was applied at the rate of 450g/ha and the second application was at the tasselling stage with CAN at 250kg/ha.

The growth parameters of the crops were measured on weekly basis. Harvest of maize was immediately followed by the planting of cowpea (Ife brown) at 60 x 30cm spacing.

Pest control was carried out mostly against cowpea flower pests using cymbush 10EC at 2.5ml per litre of water.

Heights of maize, cassava and cowpea plants as well as vine length of melon were measured. Other parameters measured include number of leaves per plant, leaf area for cassava, weed density using $1m^2$ quadrat, pod length, number of cowpea seed per pod, and number of maize cobs per plots.

Data collected were subjected to analysis of variance and means were separated using least significant differences (LSD) test at 5% level of probability.

Results and Discussion

Cassava planting patterns did not significantly affect maize height at various growth stages (3 – 9 WAP) Figure 1. It was observed that maize established earlier thereby dominating other component crops. Maize when grown with these component crops tended to dominate them irrespective of their growth habit as demonstrated by Ezumah et al (1990). Similarly, at harvest, maize grain yield and number of cobs per hectare were not significantly influenced by the planting patterns (table 2) indicating that maize received less competition for light, water and nutrients and melon because maize grew faster than other component crops. This observation is consistent with the reports by Agboola and Fayemi (1971) and Agboola (1980).

The planting patterns of cassava has no significant effects on the growth and performance of melon. Table3 indicate that the number of leaves, vine length and grain yield of melon were not affected by the cassava planting arrangements. This has been attributed to the absence of excessive shading from maize and cassava at the early stages of growth as no etiolation was observed.

There were no significant differences observed among the four planting arrangements in terms of plant height from 3 to 16 WAP (Fig. 2), the number of leaves per plant, stem girth and leaf area (Table 4). Widely spaced cassava (4,400 and 7,500 plants/ha) respectively tended to be shorter than those in plots carrying 10,000 and 8,800 plants/ha. This could be as a result of higher intraspecific competition in closely planted plots than in widely spaced cassava plots. The influence of cassava planting arrangements on leaf area was inconsistent, at 4 to 10 WAP, the effect seemed significant while at 6, 8, 12, 14 and 16 WAP, the effect was not significant. In a similar work, Adeyemi (1991) noted considerable effect of cassava planting patterns on leaf area than any other growth parameters.

However, there are conflicting reports on the effect of cassava planting arrangements on other cassava yield parameters. Mangoon et al (1970), had earlier reported that the yield of cassava was closely related to the number of storage roots and this inversely related to the root size, number of root per plant and harvest index. In this present study, we observed that cassava planting patterns in terms of plant population significantly affected the fresh root yield. It was observed that 2 x 1m triangular arrangement (7,500 plants/ha) gave the highest (29.89 tons/ha) fresh root yield while 3 x 1m triangular (4,400 plants/ha) gave the least (12.47 tons/ha) out of the four cassava arrangement (Table 4). The reduction up to 140% in tuber yield could be attributed to very lower cassava population of plots carrying 4,400 plants/ha.

Cassava planting patterns did not significantly influence cowpea vine length at early growth stages (3, 4 and 5 WAP). The shading effect of cassava was minimal as the canopy was not closed completely coupled with the fact that maize had already been harvested thus allowing enough insolation. This seems contrary to the view earlier expressed by Cenpukdee and Fukai (1992) that early stages of cowpea can be negatively affected when intercropped with cassava particularly under close arrangements. Nevertheless, the effect of the planting patterns of established cassava on dry grain yield was found to be highly significant. The highest grain yield (1004.6kg/ha) was obtained from cassava planted at 3 x 1.5 triangular while the least yield (492kg/ha) was obtained from cassava planted at a spacing of 1 x 1m (10,000 plants/ha) (Table 1).

This difference in yield may be attributed to higher light interception of cowpea under widely spaced cassava as in the case of 3 x 1.5 triangular planting (4,400 plants/ha) than under closely arranged ones (Othman and Welsh, 1989).

Furthermore, the interspecific competition for nutrients and water could have been higher in closely planted cassava than what obtains in widely spaced cassava arrangements.

Both weed density and weight were found not to be significantly affected by cassava planting arrangements with various component crops (Table 6). This result may be due to the natural abundance of weed seeds present in the site (Fadayomi, 1979). The weed situation in terms of dry weight and density is similar to the findings of IITA (1988) and contrary to Castro et al (1976) that the greater the cassava density, the less the weed competition. The dry matter and density weeds were generally high in all plots and were not affected by the planting arrangements of cassava. The land used for this study had been under cultivation for over 30 years and is proned to excessive weed growth.

High weed dry matter and density were an indication that the crop combination could not provide effective antidote against weed infestation. However, Akobundu (1980) had contrary view that when cassava are intercropped with maize, cowpea, melon and other arables, they have tendency to reduce weed growth.

The findings in this study so far have shown that planting patterns did not negatively affect the growth of the other crops in the intercrop.

Table 1: Some selected physical and chemical properties of the soil of experimental site.

Mechanical Analysis	
% Sand	71.2
% Silt	7.4
% Clay	21.4
pH (H_2O)	7.0
Exchangeable cations Cmol/kg soil	
K	0.23
Ca	1.67
Mg	1.96
Total N	0.23g/kg
Organic C	1.63g/kg
C/N ratio	7.09
Av. P (ppm)	2.4

Table 2: Effect of cassava planting patterns on yield of intercropped early maize.

Treatments	No. of cassava per hectare	Grain yield (ton/ha)	No. of cobs per hectare
Planting density			
1 x 1m (regular spacing)	10,000	4.87	38,000
1.5 x 0.75m	8,800	4.73	40,000
2 x 1m triangular	7,500	4.03	31,330
3 x 1.5 triangular	4,400	4.72	38,670
	NS	NS	NS

N.S. = Not significant; C.V = 11.22%
Means in the same column are not significantly different at P = 0.05.

Table 3: Melon growth and yield parameters as influenced by cassava planting patterns.

Number of plants/ha	4 WAP		6 WAP		8 WAP		Seed yield (kg/ha)
	Number of leaves	Vinelength (cm)	Number of leaves	Vinelength (cm)	Number of leaves	Vinelength (cm)	
10,000	12.44	(21.50)	15.03	(41.25)	27.17	(108.97)	289
8,800	10.07	(16.10)	14.95	(34.85)	22.98	(83.47)	235
7,500	10.52	16.12)	13.95	(41.92)	25.93	(110.87)	250
4,400	9.26	17.23)	13.17	(35.55)	22.17	(96.22)	333
C.V. (%)	13.41	0.24)	9.47	(26.06)	9.63	(11.57)	
	NS	NS	NS	NS	NS	NS	NS

NS = Not significant.

Table 4: Influence of cassava planting patterns on cassava tuber parameters.

Planting density (plants/ha)	Number of tuber per plant	Tuber Diameter (cm)	Length of tuber (cm)	Tuber yield ton/ha
10.000	8.15	4.81	30.27	29.89
8,800	8.30	5.69	34.88	23.57
7,500	8.81	5.83	34.61	25.36
4,000	10.83	5.34	38.85	12.47
LSD (5%)	NS	NS	NS	6.24
C.V. (%)	18.19	9.51	10.87	

NS = Not significant.

Table 5: Effect of cassava planting patterns on the performance of relayed cowpea.

Plant density	Pod length (cm)	Number of seeds per pod	Grain yield kg/ha	Vine Length (cm)			
				4 WAP	6 WAP	8 WAP	10 WAP
10,000	11.74	8	492.30	16.68	19.50	23.75	35.67
8,800	11.84	7	534.60	16.98	20.17	21.20	30.04
7,500	11.38	8	613.00	17.88	18.48	25.79	38.23
4,400	11.74	7	1004.60	17.44	19.67	26.57	41.04
LSD	NS	NS	336.20**	NS	NS	NS	NS
C.V. (%)				10.69	8.02	12.58	12.62

N.S. = Not significant; ** = Highly significant at 1% level of probability.

Table 6: Effect of cassava planting patterns on weed growth per 1m^2 quadrat.

Plant density (plants/ha)	Weed Density		Weed Dry Weight (g)		
	6 WAP	12 WAP	6 WAP	12 WAP	18 WAP
10,000	286.00	74.33	131.09	77.08	166.67
8,800	468.70	62.66	133.14	50.85	136.67
7,500	545.36	196.33	170.69	121.40	166.67
4,400	462.00	107.67	171.35	82.98	320.00
LSD	NS	NS	NS	NS	NS

Values in the columns are not significant; N.S. = Not significant.

ACKNOWLEDGEMENTS: The authors gratefully appreciate the assistance of the Department of Agronomy, University of Ibadan for providing labour for this experiment.

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