NIGER AGRIC. J. 36 (2005)88-96

EFFECT OF CASSAVA GENOTYPE AND PLANTING PATTERN OF VEGETABLE COWPEA ON GROWTH, YIELD AND PRODUCTIVITY OF CASSAVA/ VEGETABLE COWPEA INTERCROPPING SYSTEM.

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ABSTRACT

Field experiments were conducted at the National Root Crops Research Institute, Umudike in 1997 and 1998 cropping seasons to assess the effects of three cassava genotypes with different canopy architecture and three vegetable cowpea planting patterns. Growth, as implicit in leaf area index (LAI) and dry matter production, was not significantly affected by cassava genotype and planting pattern of vegetable cowpea. NR8082 cassava genotype gave the highest LAI from 16- 52 WAP. Similarly planting vegetable cowpea in double rows gave the highest LAI at the same period. Though planting pattern of vegetable cowpea did not significantly influence the total dry matter (TDM), and root dry matter of cassava, the TDM and root dry matter significantly differed among the cassava genotypes in the order of NR 8082 > Nwibibio > TMS 91943. Planting pattern did not significantly affect the vegetable cowpea green pod yield, cassava root yield and Land equivalent ratio (LER). Though vegetable cowpea green pod yield was not also influence by cassava genotype, cassava root yield and LER were significantly highest under NR8082 cassava genotype.

INTRODUCTION:

Intercropping has been defined as the growing of two or more crops together on the same piece of land such that their period of overlap is long enough to include their vegetative stages (Gomez and Gomez, 1983). Intercropping is a common practice in Africa, and Asia, particularly among small-scale farmers, where it provides food and cash at different periods of the year for the farm

Family. Intercropping also ensures complementary and efficient use of environmental resources such as light, nutrients and water (Trenbath, 1976). Okoli *et al.* (1996) showed that the total dry matter yield was higher under intercropping than under monocropping systems.

Farmers in West Africa, especially in the semi-arid regions often intercrop cassava (Manihot esculenta Crantz) and cowpea, particularly grain cowpea (Vigna unguiculata L. Walp). In the humid rain forest region, the cultivation of grain cowpea encounters disease and drying problems. However, the farming systems of the humid rainforest areas of southeastern Nigeria have evolved the vegetable cowpea, which is commonly cultivated and well adapted to the

Prevailing weather conditions (Ezueh and Nwaffiah, 1984). Two types of vegetable cowpeas have been identified, the climbing type called Vigna unguiculata *sub-*species *sesquipedalis* (Redden, 1981) and those with prostrate habit named *V. unguiculata* sub- species *dekintiana* and *mensensis* (Steele and Mehra, 1980). The climbing type is mostly grown in compound farms along farm boundaries where they are staked to some form of support. The prostrate types are found in distant farms in yam and cassava farms. They are, however not planted with any definite spatial arrangement.

Cassava has a slow growth during the first three months of planting (IITA, 1990). During this period, several short duration crops such as maize, sweet potato, assorted vegetables and cowpeas are intercropped. Many new genotypes of cassava have been developed at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria (Stifel, 1988) and National Root Crops Research Institute, Umudike, Nigeria (NRCRI, 1998). These cassava genotypes have differing branching habits ranging from low to profuse. Though Holmes and Wilson (1977) reported significant and positive correlations between total dry matter yields and number of leaves and leaf area, genotypes with large number of leaves and branches tend to shade the intercrops. No quantitative data exist on the performance of these new improved cassava genotypes with vegetable cowpea especially with respect to planting pattern. For the new cassava genotypes to be accepted by small-scale farmers, who account for over 90% of food production in Nigeria (Abalu 1988), they must be compatible with the farming systems. The objective of this study was to assess the effects of new cassava genotypes and vegetable cowpea planting patterns on the growth, yield and productivity of cassava/ vegetable cowpea intercropping system.

MATERIALS AND METHODS:

The experiment was carried out at the National Root Crops Research Institute (NRCRI) Umudike, Nigeria (05° 29′ N, 07° 33′ and 122m above sea level). The climate is that of a humid tropical rainforest with a 63-year average annual rainfall of 2162.7mm. The monthly minimum and maximum temperatures on a 63-year average are in the range of 21-25° C and 29-35° C, respectively, while the monthly relative humidity ranges from 74% in January to 87% in July and August at 0900hrs and 51% in January to 80% in July at 0300hr. The soil is a typic paleudult and being formed from coastal sands, is well drained and deep, with red to yellow sandy clay top soil (Ano, 1990).

The intercropping experiment was set up on a plot of land that was under a two-year fallow following a sole cassava multiplication project. The field was slashed, disc-ploughed, harrowed ridged and demarcated into plots of 7m x 6m with 1.0m between adjacent plots.

The treatments consisted of a-3 x 3 factorial arrangements of three cassava genotypes and three vegetable cowpea-planting patterns. The cassava genotypes were NR 8082 with profuse branching habit, TMS 91934 with medium branching habit and "Nwibibio" a local genotype with no branches at all. The three vegetable cowpea planting patterns were (a) Intra- row pattern, where one stand of cassava was followed by four stands of vegetable cowpea sown on the crest of the ridge. (b) Alternate row pattern in which one row of cassava was followed by one row of vegetable cowpea. (c) Double row pattern, where each row of cassava was followed by two rows of vegetable cowpea.

The crop geometries of each of the intercropping patterns are shown in figure 1. Sole crops of each cassava genotype and vegetable cowpea at each planting pattern were also added as treatments. The fifteen treatments were laid out in a randomized complete block (RCB) design with three replications. Cassava was planted at 10,000 plants ha^{-1} (100cm x 100cm), while the prostrate type of vegetable cowpea was planted at 80,000 plants ha^{-1} (100cm x 25cm x 4 seeds $hole^{-1}$ and later thinned down to 2 seeds $hole^{-1}$). Two weeding operations were carried out at 4 and 12 weeks after planting (WAP). The vegetable cowpea was sprayed with Cymbush (ó-cyano-3-phenoxybenzyl-3-(2,2chlorovinyl)2,2 dimethylcyclopropane carboxylate) at 800g a.i. ha^{-1} (Singh and Allen, 1979) at 2WAP, when the attack was first noticed and subsequently at 4 and 6 WAP. This served to control the leaf hoppers (*Empoasca spp)*, cowpea aphids (*Aphis craccivora*), foliage beetles *othaeca mutabilis*) and flower thrips (*Megalurothrips sjostedti*). The leaf area of two cassava plants $plot^{-1}$ was measured at four weekly intervals between 8 and 16 WAP and at 52 WAP by the rapid method described by Spencer (1962), which involves the use of linear measurements as summarized by the equation,

LA=0.407la+11.38, where,

LA=total leaf area,

la = product of length x largest breadth of the median leaflet x number of leaflets and

11.38 = a constant.

The leaf area of two vegetable cowpea plants $plot^{-1}$, chosen at random was measured at two weekly intervals

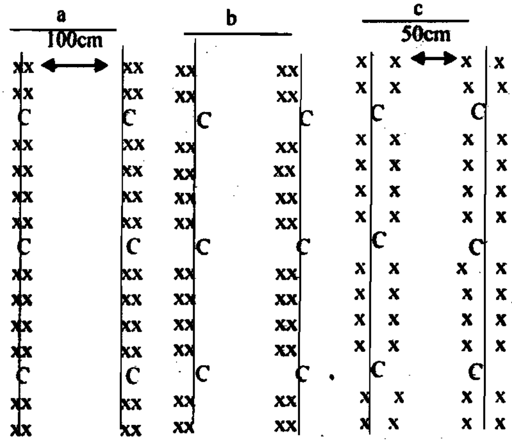

Fig.1:
Diagrammatic representation of the crop geometry.

(a) Intra row of cowpea.

(b) Single alternate rows of cowpea and cassava.

(c) Double row of cowpea alternating with single row of cassava

C= Cassava stand.

Xx= 2 vegetable cowpea seeds per hole.

Between 6 and 10 WAP with a C1-202 automatic leaf area meter. The leaf areas thus measured were used to calculate the leaf area index (LAI). Sub-samples of the root, stem, and leaf fractions of both cassava and vegetable cowpea were dried in an oven at 60°C and weighed after attaining constant dry weight. These were used to determine the dry weights of the plant parts and total plant dry weight. Mature green pods of vegetable cowpea were harvested sequentially between 7 and 14 WAP. Cassava roots (tubers) were harvested at 52 WAP. Land equivalent ratio (LER) was computed a

soutlined by Willey (1979). All data were subjected to analysis of variance (Gomez and Gomez, 1984). The means were compared using least significant difference (LSD) at $p=0.05$.

RESULTS:

Leaf area index (LAI).

In both 1997 and 1998, cassava genotype, planting pattern of vegetable cowpea and the cassava genotype x vegetable cowpea planting pattern interaction did not significantly affect the LAI of vegetable cowpea. Cassava genotype did not significantly influence the LAI of cassava until at 16 to 52 WAP in 1997 and 12 to 52 WAP in 1998, when NR 8082 cassava genotype gave the highest LAI (Table 1). Double row of vegetable cowpea to one row of cassava gave significantly the highest LAI of cassava when compared with intra row and alternate row planting patterns at 1652. WAP in 1997 and 1998. The cassava genotype x cowpea planting pattern interaction effect was not significant.

Dry Matter Production

In both 1997 and 1998, cassava genotype and planting pattern of vegetable cowpea did not significantly influence the total dry matter (TDM), pod dry matter (PDM) and Harvest index (HI), (Table 2). The TDM, and tuber dry matter of cassava component differed significantly among the three cassava genotypes in the order of NR 8082 > Nwibibio > TMS 91934. However, the HI of the three cassava genotypes was also similar (71.8%-78.4%). The planting pattern and the cassava genotype x vegetable cowpea planting pattern interaction did not influence the TDM, RDM and HI of cassava.

Table 1: Effect of cassava genotype and planting pattern of vegetable cowpea on the leaf area index (LAI) of vegetable cowpea and cassava at different ages of growth in 1997 and 1998.

	Vegetable cowpea			Cassava			
	6 WAP	8 WAP	10 WAP	8 WAP	12 WAP	16 WAP	52 WAP
Cassava genotype							
NR 8082	0.07	1.02	1.73	0.21	0.98	2.22	2.80
TMS 91934	0.06	1.08	1.39	0.20	0.75	1.20	2.11
Nwibibio	0.08	0.82	1.84	0.21	0.94	1.52	2.14
Planting pattern							
Mixed row	0.07	1.12	1.15	0.25	0.77	1.71	1.81
Alternate row	0.08	0.82	2.01	0.18	0.83	1.41	1.94
Double row	0.07	0.96	1.79	0.19	1.00	2.03	1.24
Sole	0.14	1.16	1.54	0.26	1.05	2.03	2.95
LSD (p=0.05)	0.14	0.45	0.46	0.15	0.58	0.61	1.21
Cassava genotype							
NR 8082	0.59	0.95	1.71	0.11	0.56	2.31	2.63
TMS 91934	0.53	1.08	1.51	0.04	0.21	1.52	1.88
Nwibibio	0.53	1.57	2.24	0.05	0.32	1.82	2.39
Planting pattern							
Mixed row	0.44	0.86	1.27	0.07	0.31	1.76	1.89
Alternate row	0.46	1.53	2.38	0.06	0.34	2.12	2.20
Double row	0.53	1.22	2.02	0.06	0.41	2.04	2.81
Sole	0.40	1.02	1.93	0.08	0.52	2.09	2.40
LSD (p=0.05)	0.18	0.58	0.68	0.05	0.18	0.49	0.63

Table 2: Effects of cassava genotype and vegetable cowpea planting pattern on the dry matter accumulation and Harvest index of cassava and vegetable cowpea mixture in 1997 and 1998.

	Vegetable Cowpea						Cassava					
	g plant^{-1}						kg plant^{-1}					
	Total DM		Pod DM		HI		Total DM		Tuber DM		HI	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Cassava genotype												
NR 8082	24.0	31.7	3.0	4.8	0.13	0.15	2.00	1.53	1.48	1.26	0.74	0.82
TMS 91934	24.8	31.0	3.1	5.0	0.13	0.16	0.85	0.72	0.67	0.52	0.78	0.72
Nwibibio	25.7	32.5	3.3	4.7	0.13	0.14	1.54	0.83	1.10	0.58	0.71	0.66
L.S.D (p = 0.05)	2.58	3.65	0.20	1.21	-	-	0.031	0.032	0.070	0.071	-	-
Planting pattern												
Mixed row	21.4	22.4	2.6	3.0	0.12	0.13	1.46	0.99	1.10	0.74	0.76	0.74
Alternate row	29.9	37.7	3.4	5.7	0.11	0.15	1.42	1.10	1.06	0.84	0.75	0.76
Double row	27.3	33.6	3.4	5.9	0.13	0.18	1.56	1.04	1.09	0.78	0.70	0.75
L.S.D (p = 0.05)	2.58	3.65	0.20	1.21	-	-	0.307	*Yield* 0.031	0.076	0.071	-	-

DM = Dry Matter; HI = Harvest Index

genotype x cowpea planting pattern interaction effect was not significant.

Dry Matter Production

In both 1997 and 1998, cassava genotype and planting pattern of vegetable cowpea did not significantly influence the total dry matter (TDM), pod dry matter (PDM) and Harvest index (HI), (Table 2). The TDM, and tuber dry matter of cassava component differed significantly among the three cassava genotypes in the order of NR 8082 > Nwibibio > TMS 91934. However, the HI of the three cassava genotypes was also similar (71.8%-78.4%). The planting pattern and the cassava genotype x vegetable cowpea planting pattern interaction did not influence the TDM, RDM and HI of cassava. significantly influence tuberous root yields. The differences in the green pod yield under intercropping and monocropping systems were not significant in both years, irrespective of the planting pattern. For cassava, however, the root yield of intercropped cassava was higher than the sole crop yield.

Land Equivalent Ratio (LER)

In both 1997 and 1998, NR 8082 gave significantly the highest LER with a yield advantage of 100% compared to "Nwibibio" with 75% and TMS 91934 with 67% yield advantages (Table 3). Planting pattern of cowpea did not significantly affect LER. The 1997 and 1998 average showed that intercropping NR 8082 with cowpea using double row planting pattern gave the highest LER of 2.18 (a yield advantage of 118%).

DISCUSSION:

Planting pattern of vegetable cowpea did not influence growth and yield of cassava and vegetable cowpea, as well as the mixture efficiency parameters in cassava/vegetable cowpea intercrop. CIAT (1976) showed that bean yield were not significantly affected whether it was planted in one-single bean row on each side of maize plant or in one double bean rows on one side of the maize with planting densities being kept constant. This non-significant effect of planting pattern on the yields of component crops was reported for sorghum/pigeon mixture (Osiru and Kibira, 1981), sorghum/rice mixture (Olofintoye and Olaoye, 1992) and for okra/maize (Muoneke and Asiegbu, 1997). However, Kalu *et al.* (1998) obtained significant response of yam/maize and yam/sorghum to varying spatial arrangements. *Cock et al.* (1978) and CIAT (1976) explained that this non-response to spatial arrangement could be possible if the total plant population was kept constant. In the work of Kalu *et al.* (1998), the spatial arrangements determined the populations of each crop component indicating that their total plant populations were not constant, hence the apparent response to spatial arrangement. In the present study, however the vegetable cowpea and cassava populations were constant at all levels of planting pattern. Therefore, different planting patterns may be used in intercropping systems depending on the other crop component, genotype and, Practical convenience without reduction in the yields, provided of course, the total population was constant.

Though planting pattern did not influence the LER, intercropping produced a yield advantage of 118% (LER=2.18). Olasantan (1988) showed that when cassava and grain cowpea were intercropped, the LER increased significantly irrespective of the spatial arrangement (planting pattern) of the component crops. Muoneke and Asiegbu (1997) obtained greater LER when okra and maize were intercropped than under monocropping situation. These reports and the findings in the present study may be explained by the fact that the crops occupied different spaces, competed for different resources such as light and nutrients and hence had adequate utilization of land and sunlight because of non-similar growth periods.

In conclusion, cassava and vegetable cowpea are quite compatible with each other, with NR 8082 showing the greatest compatibility. Cassava/vegetable cowpea mixture was not sensitive to the planting pattern of vegetable cowpea.

Table 3: Effects of cassava genotype and planting pattern of vegetable cowpea on the yield of vegetable cowpea, cassava roots and land equivalent ratio (LER) in 1997 and1998.

	Yields (t/ha)					
	Vegetable cowpea		cassava		LER	
Treatment	1997	1998	1997	1998	1997	1998
Cassava genotype mean						
NR8082	1.31	1.41	26.7	28.3	2.00	2.28
TMS91934	1.31	1.46	18.9	18.9	1.67	2.24
"Nwbibio"	1.31	1.46	19.7	19.7	1.75	1.90
LSD (p=0.05	0.49	0.55	5.45	4.32	0.22	0.52
Planting pattern means						
Mixed row	1.32	1.50	23.3	21.4	1.87	2.09
Alternate row	1.34	1.50	20.5	21.7	1.77	2.28
Double row	1.32	1.35	21.6	20.2	1.79	2.03
LSD (p=0.05)	0.49	0.55	5.45	4.32	0.22	0.52
Interactions						
NR8082 x mixed row	1.31	1.51	37.3	21.5	2.19	2.04
NR8082 x alternate row	1.31	1.51	25.3	33.5	1.94	2.31
NR8082 x double row	1.32	1.21	25.5	26.1	1.87	2.48
TMS91934 x mixed row	1.34	1.55	18.7	20.7	1.69	2.23
TMS91934 x alternate row	1.34	1.48	16.9	17.3	1.61	2.45
TMS91934 x double row	1.26	1.44	21.1	1804	1.72	2.02
"Nwibibio" x mixed	1.3	1.54	19.6	18.5	1.74	2.01
"Nwibibio"x alternate row	1.33	1.52	19.4	14.4	1.77	2.08
"Nwibibio" x double row	1.30	1.41	20.1	16.0	1.74	1.61
LSD (p = 0.05)	0.10	0.89	9.43	7.45	0.39	0.90

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