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EFFECTS OF CASSAVA GENOTYPE AND VEGETABLE COWPEA POPULATIONS ON THE COMPONENT CROP YIELDS AND SYSTEM PRODUCTIVITY IN CASSAVA/VEGETABLE COWPEA INTERCROPPING SYSTEMS

BY

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ABSTRACT

The effects of varying vegetable cowpea populations and cassava cultivars on the component crop yields and total productivity of cassava/vegetable cowpea intercropping systems was studied in order to determine the compatibility of cassava and vegetable cowpea in space dimension. A factorial combination of three cassava cultivars and three vegetable cowpea populations as well as the sole crops were laid out in a randomized complete block design with three replications.

Cassava cultivar significantly affected cassava root yield with NR8082 (a profuse-branching cultivar) giving the highest root yield irrespective of vegetable cowpea population. The green pod yield of vegetable cowpea was not significantly influenced by the cassava genotype, but it decreased as the vegetable cowpea population was increased. Generally, the land equivalent ratio (LER) exceeded 1.0 for the intercropping systems and was neither significantly affected by cassava cultivar nor by vegetable cowpea population. Intercropping systems involving NR8082 produced higher protein and energy yields than those of the other two cassava cultivars tested. Protein and energy yields increased with increasing vegetable cowpea populations. Intercropped cassava and vegetable cowpea gave higher protein and energy yields than the sole crops.

INTRODUCTION:

Intercropping describes a cropping system in which two or more crops are grown on the same piece of land such that the periods of overlap is long enough to include their vegetative stages (Gomez and Gomez, 1983). Yield advantages which have been reported from intercropping studies (Okoli *et al.*, 1996, Muoneke and Asiegbu, 1997) have been attributed to better use of environmental resources such as light, nutrients and water (Trenbath, 1976) and better control of weeds (Anuebunwa, 2000). These advantages occur when the component crops differ markedly in their growth habits (Willey, 1979). Cassava has a slow initial growth and attains complete ground coverage about three months after planting (IITA, 1990). During this period, light and other growth resources are poorly utilized by cassava. Intercropping a short stature and short cycle crop such as a legume has been shown to improve the cropping system productivity (Leihner, 1978). Cassava/legume intercropping produces both energy and protein simultaneously. Much of the work on cassava/cowpea intercropping have made of use of grain cowpeas, which are better adapted to semi-arid, and driers climatic conditions than humid conditions, where high humidity causes disease and drying problems. Vegetable cowpeas show remarkable adaptation to humid environments (Ezueh and Nwoffiah, 1984). There is yet little or no work on cassava/

vegetable cowpea intercropping system in the humid southeastern Nigeria.

In traditional intercropping systems many farmers tend to reduce plant populations below the monocrop level on the justification that soil moistures and nutrients may not support higher populations of each crops. In Nigeria, vegetable cowpeas are usually grown in mixtures with yam, cassava and cocoyams, with vegetable cowpea mostly planted along the boundaries at no definite but low plant populations. This practice results in low productivity of the system. Results have shown that when resources are not limiting, the closer a component crop population gets to its monocrop populations, the greater the yield owing to an optimal utilization of growth resources (CIAT, 1975). There has not been any planned research on the optimum population for vegetable cowpea in a cassava-based system. This work was carried out to determine the effect of varying vegetable cowpea populations on the yields and productivity of cassava/vegetable cowpea intercropping systems, with a view to increasing the system's productivity and protein intake of the rural farmers.

Materials and Methods

The experiment was conducted at the National Root Crops Research Institute (NRCRI), Umudike in the 1997/1998 and 1998/1999 cropping seasons. Umudike is situated at latitude 05^0 29 N and longitude 07^0 33 E and at an elevation of 122 m above sea level. The annual rainfall on a 63-year average basis is 2162.7 mm, while the relative humidity, minimum and maximum temperatures ranged from 54-87%, 20-23°C and 28-33°C, respectively. The soil is acidic with well drained red to yellow sandy clay top soil. The 1997/1998 experiment was conducted in a plot of land that lay fallow for two years after cassava/maize intercropping in the 1993/1994 cropping season, while the 1998/1999 experiment was carried out in a plot of land that has been fallowed for two years following a sole cassava multiplication programme in the 1994/1995 cropping season. Land preparation consisted of clearing, disc ploughing, harrowing and ridging. The treatments consisted of a 3 x 3 factorial combinations of three cassava cultivars, (NR8082 having profuse branching, TMS 91934 with medium branching habit and a non-branching local cultivar, "Nwibibio) and three populations (40,000, 60,000 and 80,000 plants/ha.) of indeterminate and prostrate vegetable cowpea. Sole crops of each of the cassava cultivars and sole vegetable cowpea at each of the populations were added for the computation of the productivity parameters of intercropping systems. The treatments were laid out in a randomized complete block design and replicated three times.

Cassava cuttings 20 cm long with at least 4 nodes were planted on the crest of the ridge at 100 x 100 cm giving a plant population of 10,000 plants/ha. Two seeds of vegetable cowpea per hole were sown mid-way from the crest on the left side of the ridge at a spacing of 100 cm x 50 cm, 100 cm x 33 cm or 100 cm x 25 cm to give 40,000, 60,000 and 80,000 plants/ha, respectively. Weeding was carried out twice by hoeing at 4 and 12 weeks after planting (WAP). Tall weeds were slashed at 8 weeks before the cassava root harvest. Cowpea insect pests were controlled by spraying the vegetable cowpea with Cymbush (Cypermetrin a non-branching or -Cyano-3-phynoxybenzyl-3-(2,2-dichlorovinyl)-2,2-dimethylcycloprpane carboxylate) at 800g a.i. ha^{-1} (Singh and Allen 1979) at 2 WAP when the attack was first noticed and subsequently at 4 and 6 WAP. Immature green pods of vegetable cowpea were harvested at weekly intervals, starting from 8 WAP, while cassava roots (tubers) were harvested at 56 WAP. Land equivalent ratio (LER) (Mead and Wiley, 1980) was calculated as:

$$LER = \frac{\text{intercrop yield of cassava}}{\text{sole crop yield of cassava}} + \frac{\text{intercrop yield of vegetable cowpea}}{\text{sole crop yield of vegetable cowpea}}$$

Protein and energy yields were also calculated using data from Oyenuga (1968). All data were subjected to standard statistical analysis of variance as outlined by Gomez and Gomez (1984). Means were compared using standard error (S.E.) of a difference between two means at 0.05 level of probability.

Results

Cassava Yield:

Root yields of TMS 91934 and "Nwibibio" cultivars were similar and significantly less than that of NR8082 in both 1997 and 1998 experiments (Table 1). Cassava root yield increased as the populations of vegetable cowpea was increased irrespective of cassava cultivar, but this trend was only significant with NR8082 in 1997 and with NR 8082 and Nwibibio in 1998

Vegetable Cowpea Pod Yield:

The green pod yield was not significantly affected by the cassava cultivar, but pod yield generally decreased, as the population of vegetable cowpea increased in both 1997 and 1998 (Table 2). The cassava cultivar x vegetable cowpea population interaction effect on green pod yield was not significant.

Table 1. Effect of Cassava genotype and vegetable cowpea population on component cassava root yield.

	Vegetable cowpea populations (plants/ha)				
Cassava variety	40,000	60,000	80,000	Mean	LSD (p=0.05)
1997/1998					
NR 8082	22.2	25.6	35.9	27.9	
TMS91934	17.4	18.0	22.8	18.4	3.1
Nwibibio	18.1	16.1	20.4	17.2	
Mean	18.2	19.7	26.4	-	
LSD (p=0.05)	3.1				
1998/1999					
NR 8082	26.6	28.6	38.9	31.4	
TMS91934	21.1	21.7	25.8	23.1	4.7
Nwibibio	14.7	18.6.	26.6	20.0	
Mean	20.6	23.0	30.4	-	
LSD (p=0.05)	4.7				

Table 2. Effect of Cassava genotype and vegetable cowpea population onvegetable cowpea yield.

Cassava variety	Vegetable cowpea populations(plants/ha) 40,000	60,000	80,000	Mean	LSD (p=0.05)
1997/1998					
NR 8082	1.1	1.1	1.2	1.1	0.2
TMS91934	1.2	1.2	1.0	1.0	
Nwibibio	1.3	1.2	0.9	1.1	
Mean	1.2	1.2	1.0		
LSD (p=0.05)	0.2				
1998/1999					
NR 8082	1.5	2.0	1.7	1.7	.03
TMS91934	1.0	1.7	1.6	1.7	
Nwibibio	2.2	1.9	1.2	1.8	
Mean	1.9	1.9	1.5		
LSD (p=0.05)	0.3				

Land Equivalent ratio (LER):

In 1997, the LER was not significantly influenced by cassava cultivar, while in 1998, intercropping with NR8082 and Nwibibio produced similar LERs which were each greater than that of TMS 91934 (Table 3). Although LER appeared to increase with an increase in vegetable cowpea populations, the differences were not significant at 5% significant level. The cassava cultivar x vegetable cowpea population interaction was not significant. Intercropping cassava and vegetable cowpea was 1.10 times more productive as compared to sole cropping of both crops in both 1997 and 1998.

Protein Yield:

Using NR8082 cassava cultivar in the cassava /vegetable cowpea intercropping system produced a significantly higher total protein yield than with TMS 91934 or Nwibibio in both 1997 and 1998 (Table 3). Protein yields were also significantly affected by vegetable cowpea population, being highest with highest population (80,000 cowpea plants/ha).The cassava x vegetable cowpea interaction was not significant. The intercrop protein yields were greater than the sole cassava and sole cowpea protein yields by 39% and 66.7%, respectively, in 1997 and by 48.8% and 61.4%, respectively, in 1998.

Energy Yields:

Energy yields of the various intercropping systems were also significantly influenced by cassava cultivar with the NR8082/vegetable cowpea system giving the highest energy values in both years of study (Table 3). Planting vegetable cowpea at 80,000 plants/ha gave significantly higher energy yields than planting at 40,000 and 60,000 plants/ha. The interaction effect was not significant. Intercrop energy yields were greater thansole cassava and sole vegetable cowpea energy yields by 18.5% and 95%, respectively in 1997 and by 20.9% and 93.5%, respectively in 1998.

Table 3: Assessment of intercropping system using land equivalent ratio (LER), protein and energy values.

Treatments	LER 1997	LER 1998	Protein (t/ha) 1997	Protein (t/ha) 1998	Energy (x 10^4 kcal/ha) 1997	Energy (x 10^4 kcal/ha) 199
Intercrop NR8082	2.15	2.29	0.95	1.28	11.27	12.9
Intercrop TMS 91934	2.05	1.64	0.78	1.08	7.63	9,7
Intercrop Nwibibio	2.10	2.24	0.73	0.96	7.67	8.3
LSD (p=0.05)	**0.34**	0.89	**0.12**	**1.68**	**0.12**	4.6
Intercrop cowpea at 40,000/ha	1.90	1.76	0.76	1.02	7.20	8.7
Intercrop cowpea at 60,000/ha	2.07	2.17	0.82	1.08	8.22	9.7
Intercrop cowpea at 80,000/ha	2.33	2.33	0.97	1.20	10.62	12.4
LSD (p=0.05)	**0.33**	**0.89**	**0.12**	**1.68**	**0.12**	4.6
Sole NR 8082	-		0.59	0.81	8.52	11.6
Sole TMS 91934	-		0.48	0.51	6.96	7.3
Sole Nwibibio	-		0.43	0.38	6.18	5.4
Sole cowpea at 40,000/ha			0.30	0.50	0.47	0.7
Sole cowpea at 60,000/ha	-		0.29	0.40	0.45	0.6
Sole cowpea at 80,000/ha	-		0.23	0.38	0.37	0.6

Discussion

The cassava root yields in both monoculture and intercropping systems were significantly different in the order of NR8082 > "Nwibibio" > TMS91934. This reflected the order of their canopy densities and leaf area indices (LAI) (Udealor, 2002). It appeared then that the cassava root yield was related to its canopy density which was reported to be a genetic trait but highly influenced by environmental conditions (Leihner, 1978). Cassava varieties with high LAI gave high root yields (IITA, 1990), especially at LAI within the optimum level of 3.0-3.5 (Cock *et al.*, 1978).

It was also found that cassava root yield in intercropping system was higher than that in monoculture and that cassava root yields increased with increasing vegetable cowpea populations Udealor and Asiegbu (2004) showed that when cassava was intercropped with vegetable cowpea, the soil organic matter, soil N and K and the cation exchange capacity were higher than under sole crop conditions and that these nutrients increased with an increase in vegetable cowpea populations. The vegetable cowpea, therefore, acting as green live manure mulch, increased the nutrient capacity of the soil, which lead to an increase in root yield in intercropping as compared to sole crops, and the higher the vegetable cowpea populations the higher these nutrients, and in-turn the higher the root yield of cassava.

The differences in vegetable cowpea pod yield were due to differences in vegetable cowpea population and not to differences in cassava cultivar as can be expected. Because vegetable cowpea completed its growth cycle before cassava attained complete ground cover, intercrop competition for growth resources was less than intracrop competition, indicating a high degree of complementarity. It has been stated that the major way complementarity can occur is when the growth patterns of the component crops differ in time, so that the crops make their major demands on resources at different times (Willey, 1979). This was confirmed by the land equivalent ratio (LER), which exceeded 1.0 in all intercropping situations, with a grand mean of 2.09. According to Mead and Willey (1980), this implies that a farmer growing either sole cassava or vegetable cowpea would require 109% more land in order to achieve the yield produced by growing intercropped cassava /vegetable cowpea. Because of the complementary nature of cassava and vegetable cowpea, both crops contributed to the high LER. On a two-year average, intercrop yield of cowpea was 100% of sole cowpea, while the intercrop cassava yield was 120.8% of sole cassava yield. Therefore, the mean LER of 2.09 is quite attractive, since it was achieved at no expense to cassava, which is the main crop. Although the protein concentration in cowpea (24.67%) is higher than that in cassava 2.71% (Oyenuga 1968), the higher cassava root yield than vegetable cowpea green pod yield resulted in higher total protein yield. On the other hand, because the energy equivalent of cassava root (390.95) is comparable with that of cowpea, (389.94) (Oyenuga, 1968), the total energy produced followed similar trend as that of cassava root yield. It seems, therefore, that the total energy production in the cassava/vegetable cowpea intercropping system was driven by the much higher yields of cassava. These perhaps explain why treatments with higher cassava root yield gave higher protein, energy and yields. On this basis therefore, intercropping NR8082 cassava cultivar with vegetable cowpea at 80,000 plants/ha is recommended for further evaluation at an on-farm adaptive research stage.

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