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Full Length Research Paper

Growth and yield of cassava as influenced by grain cowpea population density in Southeastern Nigeria

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The use of some leguminous crops for soil fertility improvement is being promoted for root and tuber crops production in Nigeria. Cowpea has a lot of advantages and is more compatible with cassava than other legumes. Cowpea (*Vigna unguiculata)* was intercropped with cassava (NR 8082 at 10,000 plants per hectare) at four plant densities (20,000; 40,000; 60,000 and 80,000 plants per hectare) in 2004 and 2005 planting seasons at the National Root Crops Research Institute (NRCRI) research farm in Umudike (07° 33 ' E, 05° 29 ' N), Southeastern Nigeria. The experiment was arranged in a randomized complete block design (RCBD) with three replications. The leaf area index (LAI) of cassava was highest with the highest cowpea planting density in 2005, but not in 2004 planting year. Similarly, maximum fresh root yield (t/ha) of cassava was influenced by population density in 2005, but not in 2004 planting year. Cassava root yield was highest with the cowpea planting density of 80,000 plants/ha. Cowpea variety IT93K- 452-1 at a population density of 80, 000 plants/ha is recommended for increased soil fertility for cassava production in the Southeastern Nigeria.

Key words: Cowpea, LAI, cassava, plant density, yield.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz*)* grows and produces well in the Nigerian environment, especially in the so-called cassava belts that comprises 12 states. It is an important root crop that is often found in mixture with other subsistence staples, providing food and income for over 700 million people in the tropics. Although the cultivation of cassava by resource poor farmers in Nigeria has increased tremendously in recent years due to its adaptation to shorter fallow periods, relative drought tolerance, ability to thrive well in low fertility soil and its storage potentials in the soil (Aduramigba and Tijani-Eniola, 2001), it impoverishes the soil rapidly, unless the absorbed or lost nutrients are replenished (Eke-Okoro et al., 1999). Asher et al., (1980) reported that at a tuberous root yield of 30 t/ha the amount of major nutrient removed from the soil at harvest were 164 kg/N/ha, 31kg P/ha and 200 kg K/ha. Low soil fertility occurs in many cassava growing areas because the fallow periods have become shortened as the pressure on arable land is increasing. This has made the use of inorganic fertilizer necessary.

But most farmers do not have access to inorganic fertilizer because of its high cost, inadequate supply, and soil pollution and distribution problems. The direct use of soil amendments in cassava production is low and consequently the yield potentials of various improved varieties of cassava are often not attained. Leguminous plants present a good alternative to maintenance of soil fertility. Cowpea (*Vigna unguiculata*) appears to be one of the most successful legumes in this respect due to its dual purpose as a food crop and a soil fertility improver. It is estimated that cowpea supplies about 40% of the daily protein requirements to most of the people in Nigeria (Eke-okoro et al., 1999). Cowpea can fix up to 88 kg N/ha and in an effective cowpea-rhizobium symbiosis, more than 155 kg N/ha is fixed which can supply 80-90% of plants total N requirement (Eke-okoro et al., 2001). According to Ikeorgu and Odurukwe (1990), the performance of cassava/legume association is dependent upon the population of the legume and they suggested that there is need to determine the optimum population density of various legumes in cassava production. Still, for optimum productivity, the choice of cassava variety and the quality of planting materials play a significant role in the quantity of harvestable products (e.g, leaf, shoot, root etc). Poor quality planting material is often

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Table 1. Physico-chemical properties of the soil in the experimental site at Umudike, Nigeria in 2004 and 2005.

Soil characteristic	Soil depth: 0 – 15 cm ; 2004	2005
Sand (%)	74.1	73.8
Silt (%)	7.1	5.8
Clay (%)	18.8	20.4
pH (H_2O)	5.2	4.9
Texture class	Sandy-loam	Sandy-loam
Organic matter (%)	2.40	2.55
Organic carbon (%)	0.81	1.24
Total Nitrogen (%)	0.14	0.16
Available P (ppm)	30.0	28.3
Excess K (meg/100 g)	0.16	0.14
Excess Ca (meg/100 g)	1.20	1.20
Excess Mg (meg/100 g)	0.80	0.40
EA	1.60	2.56
CEC	3.76	4.30

associated with marginal growth and productivity of cassava (Okeke, 1998). Eke-okoro et al. (2001) report that in cassava production, root yields are dependent on the weight of stake used for planting and that in any production systems, the size and quality of stem are of fundamental importance for high yields. Differences in weight of stem cuttings result in differences in food reserve (Okeke, 1998), and it is on this that the initial growth of the plant depends. The objective of this study was to determine the optimum plant density for cowpea while intercropped with cassava.

MATERIALS AND METHODS

Cowpea variety IT93K- 452-1, an erect variety that matures within 3 months after planting, and cassava variety NR 8082, a branching type that matures within 12 months after planting, were used in this study. Cowpea seeds were supplied by the International Institute of Tropical Agriculture (IITA) at Ibadan, Nigeria, while the cassava stems were supplied by the National Root Crops Research Institute (NRCRI) at Umudike Nigeria. The experiment was carried out in two years (2004 and 2005) at the research farms of NRCRI in Umudike (07°33' E; 05°29' N). The soil was a sandy loam with acidic reaction which characteristics were as follows: Soil pH 5.20 and 4.90 (1:2.5 soil: water), organic carbon 0.81 and 1.24%, total N 0.14 and 0.16%, available P 30.0 and 28.3 cmol/K, exchangeable K 0.16 and 0.14 cmol/kg for 2004 and 2005 experiments, respectively (Table 1). Annual rainfall ranges between 1800 and 2200 mm, whereas annual average air temperature varied from the minimum of 22°C to maximum of 32°C; relative humidity ranged from 51 to 87% and sunshine hours from 2.69 to 7.86 h per day.

Cassava and cowpea were both planted on 24 July, 2004 and 28 July, 2005 for the 2004 and 2005 trials, respectively. Cassava cuttings of about 25 cm long with at least five nodes were planted on the crest of the ridge at 1 x 1 m giving a plant density of 10,000 plants/ha. One row of cowpea was planted in between the rows of cassava with intra row spacings of 0.50, 0.25, 0.16 and 0.12m and one plant per stand to obtain plant densities of 20,000, 40,000, 60,000 and 80,000 plants/ha. The plot size was 6 x 6 m (36 m^2) each containing six ridges. A randomized complete block design with three replicates was used. Data on establishment percentage, plant height, number of branches, canopy diameter, leaf area index (LAI), number of marketable storage roots/plant and yield (t/ha) were taken at harvest. Data on the yield components of cassava were taken from 16 m^2 (4 x 4 m of inter and intra- row) from the inner rows. The data were analysed with Gentstat Discovery (versions 4.23) according to the procedure of a randomized complete block design (RCBD), whereby treatment means were compared using standard error as outlined by Steele and Torrie, 1980).

RESULTS AND DISCUSSION

Establishment of cassava was significantly ($P<0.05$) higher in sole cropped cassava than in any of the cassava-cowpea intercropped plots in both 2004 and 2005 planting season (Table 2). The two higher cowpea densities (60,000 and 80,000 plants/ha) had higher establishment than the lower densities in both years. The lower establishment of cassava when intercropped with cowpea could be due to the modification of the soil micro-environment at full coverage of cowpea at 8 weeks after planting as reported by Ikeorgu and Odurukwe (1990) in cassava/egusi melon intercropping system. Osiru and Ezumah (1994) have reported high variability in cassava with respect to sprouting ability and leafiness which they reported as a major factor in compatibility of cassava with short duration crops. There was no significant effect of cowpea planting density on cassava plant height, number of branches, canopy diameter and leaf area index in both the 2004 and 2005 seasons. However, cowpea density significantly ($P<0.05$) increased LAI in 2005 (Table 2). One expects plant height to increase with cowpea population density as a result of crowding and competition for light. However, this result did not conform to this expectation, possibly because cowpea population at which interspecific competition for light becomes limiting might not have been reached. Besides, the

Table 2. The effect of four cowpea plant densities on top growth of cassava at umudike, Nigeria in 2004 and 2005.

Crop contribution	Stem Estab. %		Plt ht at harvest		Canopy cover		No. of branches		LAI	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
NR.8082	98.1	93.3	159.3	162.4	194.0	216.1	4.00	4.00	0.73	0.79
NR8082 + 20,000 cowpea	89.8	77.5	171.4	169.6	207.3	213.0	4.00	4.00	0.56	0.93
NR8082 + 40,000 cowpea	83.3	74.4	149.2	166.7	169.1	214.4	4.00	4.00	0.72	0.72
NR8082 + 60,000 cowpea	92.6	84.0	159.9	172.7	207.7	213.6	4.00	4.00	0.77	0.85
NR8082 + 80,000 cowpea	90.7	89.8	178.0	155.7	229.1	206.2	4.00	4.00	0.66	0.97
Se	2.2	3.7	10.5	12.3	11.6	7.6	0.1	0.1	0.16	0.05

Se = standard errors.

Table 3. The effect of various cowpea plant densities of yield components of cassava at Umudike, Nigeria in 2004 and 2005.

Crop combinations	Total no. of roots/ha			Wt. of saleable root (kg)			Yield (tons/ha)		
	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
NR8082	92	150	121	41.7	19.6	30.7	46.9	32	39.45
NR8082 + 20,000	94	154	124	40.1	28	34.1	45.9	36.84	41.37
NR8082 + 40,000	66	190	128	32.8	27.8	30.3	36.43	37.39	36.91
NR8082 + 60,000	77	168	122.5	35.9	26.6	31.3	39.37	36.3	37.84
NR8082 + 80,000	96	167	131.5	39.8	30.2	35	43.83	40.67	42.25
S.e.	15.33	21.06		8.5	2.9		7.89	1.58	

growth habits of the two crop species differed; while cowpea was low growing, cassava has erect growth. This result also showed cassava plant height, number of branches and LAI increased with age. Similar results have been reported by (Olasantan, 1993) in cowpea/cassava intercropping and Aduramigba and Tijani-Eniola (2001) in groundnut/cassava intercropping systems.

Cowpea population density on total number of tubers as well as yield of tubers per hectare in 2004 and 2005 planting seasons were not significant (P>0.05) (Table 3). In 2005 planting season, tuber yield was higher in higher cowpea density probably as a result of use of additional nitrogen contributed by cowpea. Also, cassava tuber yield increased with increase in cowpea planting density in 2005 as a result of incremental contribution of nitrogen by high population of cowpea. The highest tuber yield was obtained at 80,000 in 2005 (Table 3). Increases in cassava root yield with increased cowpea population density had been reported (Eke-Okoro et al., 1999; Jagtap et al., 1998). The wide maturity gap between cowpea (about 90 days) and cassava (about 360 days) and the slow initial growth of cassava enhances the compatibility of cassava and cowpea as intercrops (Ikeorgu and Odurukwe, 1990; Udealor and Asiegbu, (2005). Available nitrogen in our trials was moderately low (0.14 and 0.16% in 2004 and 2005, respectively). Thus, cassava may have benefited from the nitrogen fixed by the cowpea as well as from the organic matter added by cowpea residues after its harvest. However, results of cowpea/cassava trials in South America (CIAT, 1993) contradicted the above results as cowpea depressed cassava yields by up to 30% depending on the growth habits and vegetative development of the crops.

In conclusion, cowpea density significantly affected cassava storage root in 2005 but not in 2004. However, for higher cassava storage root yields, grain cowpea intercropped with cassava genotypes with profuse branching canopy preferably NR 8082 at 80,000 plants/ha is recommended to Nigeria farmers.

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