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Full Length Research Paper

Evaluation of cowpea cultivars under maize and maize-cassava based intercropping systems

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A field experiment in a randomized complete block design with three replications was conducted at the research farm of the Institute of Agricultural Research and Training, Moor Plantation Ibadan, Southwest Nigeria in 2003 and 2004 cropping seasons. The aim of the experiment was to evaluate five cowpea cultivars; IT89KD-288, IT96D-610, IT99K 1060, IT95K-1072-57 and Ife Brown under sole, maize-based and maize-cassava based intercropping systems. There were significant differences (P < 0.05) among the five cowpea cultivars based on two-years average for 2003 and 2004 for number of pods per plant, pod length, number of seeds per pod, weight of 100 seeds and seed yield under sole cropping, maize-based and maize-cassava based intercropping systems. The results showed that IT96D-610 recorded high number of pods per plant, pod length, number of seeds per pod, weight of 100 seeds and seed yield in sole, cowpea-maize and cowpea-maize-cassava intercropping systems. The cowpea cultivar IT96D-610 recorded yield of 2.5 t/ha under cowpea sole cropping whereas 2.5 t/ha under maize intercropping system and 2.2 t/ha under maize-cassava intercropping system. From rhizosphere soil isolate (RSI), cowpea cultivar IT96D-610 was found most compatible with intercropping systems and the least was IT89KD-288. Therefore, cultivar IT96D-610 could be recommended for both sole and intercropping by small holder farmers.

Key words: Cowpea cultivars, sole cropping, intercropping, rank summation index.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a major food crop in sub-Saharan Africa, especially in the dry regions of West Africa (Singh and Ntare, 1985). The seed is a major source of plant proteins and vitamins for man, feed for animals, and also a cash earner for the rural farmers. The young leaves and immature pods are eaten as vegetables. Nigeria is the world's largest producer of cowpea, and substantial amounts come from Niger, Burkina-Faso and Ghana (Craufurd, 1996). In the West African region, where more than 70% of the total world production is grown, cowpea has become an integral part of the farming system (Ogbuinya, 1997) and grown in mixtures with other crops in various combinations (Olufajo and Singh, 2002). It has been suggested that cowpea could be included in the farming systems of the humid areas because of its potential to provide green manure in addition to producing primary products of grain and fodder (Quin, 1997). Cowpea is important in multiple cropping systems which involve monocropping, relay cropping, and mixed intercropping. Intercropping of cereals with legumes has been popular in tropics (Hauggard-Nielsen et al., 2001) and in rain-fed areas of the world (Banik et al., 2000) due to its various advantages (Chen et al., 2004; Ajeigbe et al., 2006).

In Africa, the bulk of cowpea production is by small-scale

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Abbreviations: IITA, International Institute of Tropical Agriculture; **RSI,** rank summation index.

farmers using the traditional system of mixed intercropping with maize, sorghum, millet, yam, cassava, pepper and other vegetable crops (CABI, 2000). Mixed cropping or intercropping is an important practice in tropical developing countries because of its several advantages (Fujita and Offosu-Budu, 1996; Isoken, 2000) and maize and cassava intercrop has been described as the most prevalent and most productive enterprise with highest net margins in Southern Guinea Savanna ecology (Fakayode et al., 2008). Farmers' preference for extra-early- and early-maturing cowpea lines in Southern Guinea Savanna is similar to other regions of Nigeria. This preference for extra early- and early-maturing crop varieties, particularly cowpea has been well documented (Singh et al., 2007; Akande, 2007; Egbe et al., 2010; Futuless and Bake, 2010).

Although several studies on cowpea/maize intercropping undertaken elsewhere have been reported with varied intercrop advantages (Blade et al., 1992; Ezumah and Ikeorgu, 1992; Singh and Ajeigbe, 2007; Katsaruware and Manyanhaire, 2009), emphasis on the use of short duration cowpea varieties has been negligible. In Southern Guinea Savanna region of Nigeria, there is dearth of documented information on cowpea/maize intercropping involving extra-early- and early maturing varieties of cowpea. Previous research work had shown that improving the productivity of cowpea/cereal intercropping lies in the performance of the cowpea component which include among other things the choice of appropriate genotype (Egbe et al., 2010; Dahmardeh et al., 2010). There is potential for cowpea production in the wetter agro ecological zones (Quin, 1997). The introduction of cowpea into the cropping systems (intercropping systems) of the wetter agro ecological zones (such as the farming areas in Southwestern Nigeria) requires a good understanding of the likely effects of such cropping systems on growth and yield performances of different types of cowpea cultivars. To achieve this, attempt must be made on how to improve on intercrop productivity through varietal selection of cowpea for intercropping. However, most of the cowpea cultivars were developed and tested under sole crop condition and have not been evaluated for their intercrop compatibility. This study was therefore conducted to evaluate the performances of some cultivars with a view to identifying suitable cultivars for compatibility to maize-cassava based cropping systems and to ascertain yield relationship between sole and intercropped cowpea.

MATERIALS AND METHODS

The field studies were conducted at the research farm of the Institute of Agricultural Research and Training (IAR and T), Moor Plantation Ibadan (7° 22`` N, 3° 50``E) in the lowland rainforest agro ecological zone of Southwest Nigeria in 2003 and 2004. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications of 4 x 5 m plot size. Seeds of four cowpea cultivars (IT89KD-288, IT96D-610, IT99K 1060, IT95K-1072-57 from International Institute of Tropical Agriculture (IITA), Ibadan and Ife Brown from IAR and T, Ibadan, Nigeria) were used. IT89KD-288, IT96D-610 and Ife Brown cultivars were erect indeterminate early maturing while IT99K 1060 cultivar was erect indeterminate medium maturing and IT95-1072-52 cultivar was drought tolerant late maturing. Cassava cultivar, TMS 30572, a high yielding cultivar with good tuber quality and resistant to major cassava pests and diseases and the SWAN-1 SR maize variety with short duration were planted in sole and intercrops with cowpea cultivars.

The field was ploughed and harrowed and the plots were laid out according to the experimental design before planting. Three cropping systems were used, which were: sole cowpea, maize/cowpea intercrop and maize/cowpea/cassava intercrop. The cassava cuttings were planted at 1 x 1 m spacing, giving a population of 10,000 plants/ha. Maize seeds were planted at 1 x 1 m spacing at 2 seeds per hole, giving a population of 20,000 plants/ha. Cowpea seeds were planted at 1 x 0.25 m spacing at 1 seed per hole, giving a population of 40,000 plants/ha in all the systems. The planting in 2003 and 2004 was conducted during the late season in August of each year. The cowpea was sprayed with Karate 2.5 EC (Lambdacyhalothrin) at the rate of 25 g ai/ha, at two-weekly interval, starting with the onset of flowering through the pod maturity. Manual weeding was carried out with hoe at four weeks after planting. Application of fertilizer (NPK 20-10-10) was done to the maize and cassava at the rate of 400 kg/ha.

Data collected on cowpea included number of pod per plant, pod length, number of seeds per pod, weight of 100 seeds and seed yield per hectare. Grain yield and fresh tuber yield were collected on maize and cassava respectively. All data collected were subjected to analysis of variance (ANOVA). Significant means were separated using Duncan Multiple Range Test (DMRT). Compatibility of cowpea cultivars for intercropping was determined using the rank summation index (RSI) according to Dixon et al. (1994) and Mba and Dixon (1995). The RSI was estimated by ranking the performances of individual cultivar in the intercrops and later summed together to obtain the RSI and position was assigned in ascending order.

RESULTS

Performance of cowpea cultivars under sole cropping system

The performance of five cowpea cultivars under sole cropping is presented in Table 1. Cowpea cultivar IT96D-610; that was erect indeterminate and early maturing recorded 27, 18 cm, 16 and17.4 g for number of pods per plant, length of pod, number of seeds per pod and weight of 100 seeds respectively.

Cowpea-maize intercropping system

Intercropping cowpea with maize significantly ($P < 0.05$) affected the performance of cowpea cultivars based on the two years average (Table 2). The cowpea cultivar IT96D-610 recorded 26 pods per plant, 18.1 cm pod length and 14.7 seeds per pod and 17.4 g per 100 seeds.

Table 1. Performance of cowpea cultivars under sole cropping system on yield parameters based on 2-years average for 2004 and 2004.

Treatments	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Weight of 100 seeds (g)
IT89KD-288	24.1[b]	18.0[a]	14.8[b]	14.3[d]
IT96D-610	26.9[a]	18.2[a]	16.0[a]	17.4[a]
IT99K-1060	25.1[a]	16.7[b]	14.2[b]	15.8[b]
IT95-1072-57	22.4[c]	15.5[c]	14.7[b]	15.9[b]
IFE BROWN	22.5[c]	15.9[c]	14.8[b]	15.2[c]

Means with different letter(s) are statistically different by DMRT.

Table 2. Performance of cowpea cultivars under maize-based intercropping system on yield parameters based on 2-years average for 2004 and 2004.

Treatments	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Weight of 100 seeds (g)
IT89KD-288/maize intercrop	25.0[a]	17.4[b]	13.7[bc]	14.9[d]
IT96D-610/maize intercrop	26.0[a]	18.1[a]	14.7[a]	17.4[a]
IT99K-1060/maize intercrop	25.0[a]	16.4[c]	14.1[ab]	16.2[b]
IT95-1072-57/maize intercrop	22.1[b]	15.3[d]	13.4[c]	16.3[b]
IFE BROWN/maize intercrop	22.5[b]	16.2[c]	14.1[ab]	15.4[c]

Means with different letter(s) are statistically different by DMRT.

Table 3. Performance of cowpea cultivars under cassava-maize based intercropping system on yield parameters based on 2-years average for 2004 and 2004.

Treatments	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Weight of 100 seeds (g)
IT89KD-288/cassava/maize intercrop	24.3[b]	16.0[b]	12.2[d]	14.9[d]
IT96D-610/cassava/maize intercrop	25.8[a]	19.4[a]	15.4[a]	17.8[a]
IT99K-1060/cassava/maize intercrop	25.9[a]	16.1[b]	14.0[b]	I5.8[c]
IT95-1072-57/cassava/maize intercrop	21.0[d]	15.0[b]	12.9[cd]	17.5[b]
IFE BROWN/cassava/maize intercrop	22.1[c]	18.3[b]	13.4[bc]	14.9[d]

Means with different letter(s) are statistically different by DMRT.

The yield attributes of this cultivar were superior to that of other cultivars.

Cowpea-maize-cassava intercropping system

Intercropping cowpea with maize and cassava significantly ($P < 0.05$) affected the performance of cowpea cultivars based on two years average (Table 3). The cowpea cultivar IT96D-610 recorded about 3 pods per plant, 19.4 cm pod length, 15.4 seeds per pod and 17.8 g per 100 seeds. The yield attributes of this cultivars was superior to that of other cultivars as against the low performance of IT95-1072-57 under maize intercrop.

Yield performance under different cropping systems

The rank summation index was computed for two-year average for performances of individual crops under different cropping systems (Table 4). Under sole cowpea, IT96D-610 recorded seed yield of 2.5 t/ha in the two years. The rank summation index computed for two-year average for cowpea under sole cropping ranked cowpea cultivar IT 96D-610 the best for all the parameters. Under maize-based intercropping system, cowpea cultivar IT96D-610 recorded seed yield of 2.5 t/ha while 1.4 t/ha was recorded for IT95-1072-57. The rank summation index computed for cowpea under maize-based intercropping system indicated that cowpea cultivar

Table 4. Maize, cassava and cowpea yields under different cropping systems and RSI of performances of individual crops under different cropping systems based on 2-years average for 2003 and 2004.

Treatments	Maize grain yield (t/ha)	Cassava fresh tuber yield (t/ha)	Cowpea seed yield (t/ha)	Rank summation index (RSI)
Sole cowpea				
Sole IT89KD-288	-	-	1.5[d]	4th
Sole IT96D-610	-	-	2.5[a]	1st
Sole IT99K-1060	-	-	1.8[c]	3rd
Sole IT95-1072-57	-	-	2.0[b]	2nd
Sole IFE BROWN	-	-	1.8[c]	5th
Cowpea/maize intercrop				
IT89KD-288/maize intercrop	3.3[a]	-	1.7[b]	5th
IT96D-610/maize intercrop	3.4[a]	-	2.5[a]	1st
IT99K-1060/maize intercrop	3.0[a]	-	1.7[b]	2nd
IT95-1072-57/maize intercrop	3.4[a]	-	1.4[c]	3rd
IFE BROWN/maize intercrop	3.3[a]	-	1.7[b]	3rd
Cowpea/maize/cassava intercrop				
IT89KD-288/cassava/maize intercrop	1.6[a]	17.8[a]	1.0[c]	5th
IT96D-610/cassava/maize intercrop	1.8[a]	18.3[a]	2.2[a]	1st
IT99K-1060/cassava/maize intercrop	1.8[a]	18.5[a]	1.4[b]	2nd
IT95-1072-57/cassava/maize intercrop	1.8[a]	18.4[a]	1.5[b]	3rd
IFE BROWN/cassava/maize intercrop	1.8[a]	18.4[a]	1.4[b]	3rd
Cropping systems				
Sole cropping	3.4[a]	22.2[a]	2.1[a]	1st
Cowpea/maize intercrop	3.2[a]	-	2.0[a]	1st
Cowpea/maize/cassava intercrop	1.7[b]	18.3[b]	1.6[b]	3rd

Means with different letter(s) are statistically different by DMRT.

IT96D-610 was the best for all the parameters. There were no significant differences among the cultivars for maize grain yield.

Under maize-cassava based intercropping system, cowpea cultivar IT96D-610 recorded seed yield of 2.4 t/ha while IT89KD-288 had 1.3 t/ha for seed yield. There were significant differences in the yields of maize, cassava and cowpea. Maize grain yield under sole cropping recorded the highest value of 3.4 t/ha, this was neither significantly different from the value recorded under cowpea/maize intercrop (3.3 t/ha) nor from the value recorded under cowpea/maize/cassava intercrop (1.7 t/ha). Cassava fresh tuber yield under the sole cropping recorded 22.2 t/ha as compared to 18.3 t/ha recorded under cowpea/maize/cassava intercrop. Under sole cropping, cowpea seed yield recorded 2.1 t/ha which slight decreased to 2.0 t/ha under cowpea/maize intercrop while 1.6 t/ha was recorded under cowpea/maize/cassava intercrop.

DISCUSSION

Considering the two-year results, most of the cowpea cultivars evaluated showed degree of yield decrease under cassava-maize intercropping system compared to sole cowpea and maize-based intercropping system. Most of the cowpea cultivars evaluated were quite compatible or amenable to maize-based intercrop; the moderate light interception within the maize-based intercrop could be contributory. Out of the five cowpea cultivars evaluated under different cropping systems, IT96D-610 ranked best based on rank summation index. This early maturing indeterminate cultivar; was the most adaptable and compatible cowpea for either maize/cowpea or maize/cassava/cowpea intercrops. This cultivar is suitable for both sole cropping and intercropping. Conclusion can be drawn about the necessity of conducting specific breeding programmes for intercropping. It is generally accepted, as reported by Rezende and Ramalho (1994) that this procedure is not necessary for maize and cassava components, which are not affected by presence of cowpea. The results obtained from this study indicate that the seed yield of cowpea in sole cropping is the main factor in determining its behavior in intercropping. This idea is supported by Francis et al. (1978), who recommended that selection in the first breeding generations should be done in monocropping only. The evaluation for intercropping would then occur later in the selection process, when the

progeny number is smaller. Therefore, cultivar IT96D-610 could be recommended for both sole and intercropping by small holder farmers.

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