

Full Length Research Paper

Effect of scab disease on the yield of intercrop systems of cowpea maize and sorghum

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Three field sites were selected during the raining season (July to October) of 2004, 2005 and 2006 at the Institute for Agricultural Research, Ahmadu Bello University, in Samaru, Zaria, Nigeria to determine the effect of scab on the yield of cowpea variety (Ife brown) intercrop with cereals. This variety (Ife Brown) selected was highly susceptible to scab. Any reduction in yield is attributed to the disease since it affects all the above ground parts of the plant. Pod abortion was observed and pods were deformed and transformed into mummies. The yields obtained from the different cropping patterns were calculated using land equivalent ratio (LER) to compare the yield from the different cropping patterns with the yield of sole cowpea. Sole cropped cowpea had a higher yield than the other cropping patterns. Improved practices yielded more for both cowpea and cereals than farmers' practices. Strip cropping proved better for improved practices and inter-row for farmers' practices. Cowpea grain yield from farmers' practices were lower in quantity and of poor quality (being wrinkled) than yield from the other cropping patterns.

Key words: Scab, cowpea, intercrop, maize, sorghum.

INTRODUCTION

Cowpea, which is valued for its high nutritive quality, has a protein content of about 25% (Davis et al., 1991; Obuinya, 1997; Singh et al., 1995). The seeds can be boiled as fresh vegetable, canned or frozen, mashed and fried as cowpea cakes or tied on leaves and boiled.

Current estimate indicates that West Africa accounts

for about 9.3 million hectares with annual production of 5 million tones. The major cowpea producing countries in the region are Nigeria with about 4.4 million hectares and 3 million tones production, followed by Niger with about 4.1 million hectares and produces 0.69 million tones (FAO, 2006). However, cowpea is also an important crop

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in Sudan, Somalia, Burkina Faso, Cameroon, Egypt, Benin Republic, Ghana, Kenya, Malawi, Mali, Senegal, South Africa and Togo (Singh et al., 1997).

Reduction in the yield of cowpea can be attributed to many factors amongst which are diseases, parasitic weeds, insect pests, drought and low soil fertility (Olufajo and Singh, 2002; Niringiye et al., 2005). Scab is one of the most destructive diseases of cowpea in the Guinea savanna belt of West and Central Africa including Burkina Faso, Nigeria and Cameroon (Emechebe and Shoyinka, 1985; Mungo et al., 1995). In eastern and southern Africa, the disease is recognized from Ethiopia, Kenya, Uganda, Tanzania, Zambia (Iceduna, 1993; Edema et al., 1997; Edema and Adipala, 1996; Tumwegamire et al., 1998) and Rwanda (Price and Cishahayo, 1985). Despite its wide geographical distribution, it appears that the disease is ecologically restricted to semi-arid environments. In Nigeria, scab is seldom encountered outside a narrow latitudinal belt of about $10^{\circ}30' - 12^{\circ}30'N$ which corresponds approximately to the extent of the Guinea savanna. Cowpea scab is absent in the sub-humid forest, the northern Sudan savanna and the Sahel Zones of Nigeria. The disease affects all the different plant parts of the cowpea. Yield losses of 60-100% due to severe infections has been reported from Nigeria (Emechebe, 1980; Emechebe and Shoyinka, 1985; Mungo et al., 1995).

MATERIALS AND METHODS

Site selection

Three field sites were selected during the raining season (July to October) of 2004, 2005 and 2006 at the Institute for Agricultural Research, Ahmadu Bello University, in Samaru, Zaria, Nigeria. One variety of cowpea (Ife brown- highly susceptible to scab) and two varieties of cereals (maize, TZEEW-extra early and sorghum, ICSV111-extra early) were used for this study. The field layout was factorial concept in randomized complete block design (RBCD) with four replicates. Five cropping patterns (mixed cropping at different ratios for both farmers' and improved practices versus monocropping) and the cultivars grown were noted.

Each treatment plot consisted of eight, 75 cm ridges, 6 m long. The plots were separated by border rows consisting of one ridge along the length and 2 m along the width. Cowpea and maize were sown at two seeds per stand and sorghum at eight seeds per stand and were later thinned to two plants per stand two weeks after germination to give approximately the same population of plants/ha in the various plots. Plant spacing for inter-row mixed cropping of maize and sorghum was 0.5 m and cowpea was 25 cm. Plant spacing for intra-row mixed cropping of maize and sorghum was 1 m and cowpea was 25 cm in-between the maize and sorghum, respectively. Plant stand establishment was taken at 14 DAS and fertilizer was applied 14 DAS for both cowpea and cereals. A second dose of fertilizer was applied on the cereals two weeks after the first application. All plots were weeded thrice and cowpea plants were protected from insect damage by spraying biweekly with insecticide (Uppercott- Cypermethrin + Dimethoate at 1 L/ha) until 75% podding.

Data collection and analyses

Disease incidence and severity for scab and *Septoria* leaf spot

were recorded at weekly intervals starting from the first appearance of the symptoms. Data for the different plant parts infected by scab and *Septoria* leaf spot were recorded from four middle ridges for each plot.

Produce from the different cropping systems were harvested, sun-dried, threshed and winnowed, and the weights were recorded. The yields of each of the crops in the different cropping patterns were calculated using land equivalent ratio (LER) to compare yield from sole cowpea with that from the different cropping pattern. The data obtained was subjected to analysis of variance (ANOVA) and mean separation was by Student Newman Keuls Test (SNK).

RESULTS

Cowpea variety Ife brown is highly susceptible to scab and a reduction in yield of this variety with respect to the different cropping pattern is attributed to the disease since it affects all the above ground parts of the variety. The yields obtained from the different cropping patterns were calculated using land equivalent ratio (LER) to compare the yield from the different cropping patterns with the yield of sole cowpea. In 2004 and 2005, the effect of cropping patterns on the yield of cowpea variety Ife brown for both cowpea: maize and cowpea: sorghum were statistically similar. As compared to sole cropped cowpea that had a higher pod and grain yield, improved practices (double-row and strip cropping) followed with a higher pod and grain yield than farmers' practices (inter-row and intra-row). Strip cropping proves better for improved practices and inter-row for farmers' practices. Intra-row for farmers' practices had the lowest pod and grain yield as compared to the other cropping patterns. Yield from farmers' practices were lower in quantity and of poor quality. In 2006, a significant ($P \leq 0.05$) difference was observed on pod yield on the different cropping patterns for cowpea: maize with intra-row having a lower pod yield as compared to the other cropping patterns. Pod and grain yields from the other cropping patterns for cowpea: maize and cowpea: sorghum were statistically similar and the trend was the same as in 2004 and 2005 (Table 1).

The effect of cropping patterns on cowpea variety Ife brown in all the years combined showed significant ($P \leq 0.05$) differences for cowpea: maize and cowpea: sorghum with intra-row having the lowest pod and grain yields as compared to the other cropping patterns. The results gotten from the combined years followed the same trend with what was obtained in 2004, 2005 and 2006. The general range of increase in pod and grain yields for all the cropping patterns in all the years combined was in the order of sole > strip > double-row > inter-row > intra-row (Table 1). Reduction in yield in the different cropping patterns was due to scab infection, which resulted in pod abortion with some of the pods being deformed and transformed into mummies.

The effects of cropping pattern on grain yield of maize were not significantly different from each other in 2004, 2005 and 2006 but improved practices had a higher maize yield than farmers' practices. A significant ($P \leq 0.05$)

Table 1. Effect of cropping pattern on the yield of cowpea variety Ife brown in 2004, 2005, 2006 and combined.

Cropping patterns	Cowpea Pod yield (kg/ha) in:				Grains yield (kg/ha) in:			
	2004	2005	2006	Combined	2004	2005	2006	Combined
Cowpea: Maize								
Inter-row	1400.0 ^{cb}	722.2 ^a	1324.2 ^a	1148.8 ^b	979.2 ^b	527.8 ^a	1027.9 ^a	844.9 ^{ab}
Intra-row	1219.5 ^{cb}	666.7 ^a	541.7 ^b	809.3 ^c	862.5 ^b	507.0 ^a	421.3 ^b	596.9 ^c
Double-row	1418.1 ^{cb}	750.0 ^a	1231.6 ^a	1133.2 ^b	1080.6 ^b	562.5 ^a	935.6 ^{ab}	844.4 ^{ab}
Strip	1611.1 ^{cb}	854.2 ^a	1389.0 ^a	1284.8 ^{ab}	1187.5 ^b	590.3 ^a	1129.7 ^a	969.2 ^{ab}
Cowpea: Sorghum								
Inter-row	1500.0 ^{cb}	701.4 ^a	1222.3 ^a	1141.3 ^b	1137.5 ^b	541.7 ^a	963.0 ^{ab}	880.7 ^{ab}
Intra-row	1166.7 ^c	687.5 ^a	805.6 ^{ab}	886.6 ^c	805.6 ^b	513.9 ^a	629.7 ^{ab}	649.7 ^c
Double-row	1486.1 ^{cb}	729.2 ^a	1361.2 ^a	1192.1 ^b	1020.9 ^b	520.9 ^a	1074.2 ^a	812.5 ^b
Strip	1655.6 ^b	638.9 ^a	1370.5 ^a	1305.0 ^{ab}	1166.7 ^b	687.5 ^a	1045.7 ^a	966.6 ^{ab}
Sole cowpea	2095.9 ^a	1007.0 ^a	1157.5 ^a	1420.1 ^a	1479.2 ^a	743.1 ^a	898.2 ^{ab}	1040.2 ^a

Figures with the same letters within a column for the same cropping patterns are not significantly different at $P \leq 0.05$ (SNK Test).

Table 2. Effect of cropping pattern on the yield of cereals (maize and sorghum) in 2004, 2005, 2006 and combined.

Cropping patterns	Maize yield (kg/ha) in			
	2004	2005	2006	Combined
Inter-row	1426.4 ^a	2015.3 ^a	1370.5 ^a	1716.6 ^a
Intra-row	1211.9 ^a	1708.5 ^a	638.9 ^a	1186.4 ^b
Double-row	1916.7 ^a	2388.9 ^a	1037.1 ^a	1790.2 ^a
Strip	1944.5 ^a	2505.6 ^a	1222.3 ^a	1881.5 ^a
Sorghum yield (kg/ha)				
Inter-row	2048.7 ^a	2451.4 ^a	194.5 ^a	1564.8 ^a
Intra-row	774.4 ^b	1441.1 ^a	97.23 ^b	770.9 ^b
Double-row	1965.3 ^a	2257.0 ^a	129.6 ^{ab}	1450.6 ^a
Strip	2104.2 ^a	2555.6 ^a	213.0 ^a	1624.2 ^a

Figures with the same letters within a column for the same cropping patterns are not significantly different at $P \leq 0.05$ (SNK Test).

different was observed for sorghum yield in 2004 and 2006 with intra-row having a lower yield as compared to the other cropping patterns. Sorghum yield from the other cropping patterns were statistically similar but higher for double-row and strip cropping than for inter-row. In 2005, sorghum grain yield was not significantly different from each other. Generally, the grain yields obtained for maize and sorghum followed the same trend with strip cropping having a higher yield for improved practices and intra-row having the lowest yield for farmers' practices (Table 2).

Generally, cropping pattern showed a significant ($P \leq 0.05$) different for both maize and sorghum yields in all the years (combined) with intra-row having the lowest yield as compared to yield obtained from the other

cropping patterns which were statistically similar. Maize and sorghum yields obtained from intra-row were lower in quantity but of good quality. The results obtained in the combined years followed the same trend with the results obtained in the individual years with strip cropping been better for improved practices and inter-row for farmers' practices. The general range of increase for maize was in the order of strip > double-row > inter-row > intra-row and for sorghum, the order was strip > inter-row > double-row > intra-row (Table 2).

DISCUSSION

Cropping patterns significantly affected the yield of Ife brown for both cowpea: maize and cowpea: sorghum with sole cowpea having a higher yield than the other cropping patterns. This report confirms those of Carsky and Vanlauwe (2002) that a greater cowpea yield was obtained from sole cropping than when cowpea was intercropped with maize. Study by Niringiye et al. (2005) and Atuahene-Amankwa et al. (2004) also confirms that sole-cropped bean yielded more than bean: maize intercrop. Similar results by Myaka et al. (2002) agreed that sole cowpea had a higher yield than cowpea intercropped with cotton. Considering the different cropping patterns, strip cropping had a higher yield for improved practices and inter-row for farmers' practices for both cowpea: maize and cowpea: sorghum. Intra-row had the lowest yield as compared to the other cropping patterns. A reduction in yield may be due to a favourable moisture regime that favoured disease development in cowpea variety Ife brown. Similar reports by Niringiye et al. (2005) suggested that a reduction in yield of bean intercrop with maize might be due to favourable moisture

present among maize plant population density that could lead to adverse effects. Ife brown showed marked differences in its reaction to scab. In this study, Ife brown was highly susceptible to scab. A reduction in yield of this variety may be attributed more to scab infection because the disease affects all the above plant parts of the crop. Similar reports by Alabi (1994) showed that Ife brown was highly susceptible to brown blotch. Grain yields obtained from intra-row intercrop were lower in quantity and of poor quality as compared to grain yield from inter-row, improved practices and sole cowpea. Some pods were deformed and transformed into mummies and also pod abortion was observed.

Cropping patterns also showed significant differences on the yield of maize and sorghum with improved practices having a higher grain yield than farmers' practices. Strip cropping had higher grain yield and intra-row had the lowest grain yield for all the cropping patterns. Reduction in yield may be due to drought stress and competition among the plant population density. This confirms similar reports by Niringiye et al. (2005) that plant population density and drought stress significantly affects the yield of maize intercrop. Grain yield from intra-row intercrop were of good quality than those from the other cropping patterns. This may be attributed to intra-row spacing of maize and sorghum seeds that were sown at 1 m apart as compared to the other cropping patterns where seeds were sown at 0.5 m apart

Conflict of Interests

The authors have not declared any conflict of interests.

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