African Journal of Biotechnology Vol. 8 (20), pp. 5275-5279, 19 October, 2009
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2009 Academic Journals

Full Length Research Paper

Varietal response of four cowpea cultivars (*Vigna unguiculata* L. Walp) to different densities of guinea grass (*Panicum maximum*)

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Accepted 26 March, 2009

Two field experiments were conducted in 2007 and 2008 to evaluate the performance of four cowpea varieties to different densities (0, 5, 20 and 35 m^{-2}) of guinea grass at the Experimental Garden of the Ambrose Alli University, Ekpoma. The experimental design was a 4 x 4 factorial scheme. Weed densities did not significantly (P>0.05) affect plant height at 3, 6 and 9 weeks after planting (WAP) but the varieties did. However, the interaction between weed densities and varieties was not significant throughout the study. Dry matter yield by the different cowpea varieties significantly (P<0.05) decreased with increasing weed densities. There were significant (P<0.05) differences among the varieties in terms of number of days to 50% flowering while interactions between varieties and weed densities were not significant. Number of pods was significantly (P<0.05) influenced by varying weed densities and varieties. Varying weed densities and varieties significantly influenced cowpea yields.

Key words: Cowpea varieties, densities, guinea grass.

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp*)* is an annual legume that is widely cultivated in Nigeria mainly for its edible seeds. In the south however, the cultivation of cowpea is not on a large scale due to excessive rainfall. Decades of research at the International Institute of Tropical Agriculture (IITA) have produced improved genotypes of cowpea. The latest IITA cowpea lines can be harvested within 60 days, whereas traditional varieties are not mature for harvesting until 120 days after planting. The improved lines also have resistance to some of the major pests of the crop such as leafhoppers, aphids, thrips and cowpea storage weevils (IITA, 1983).

In Ekpoma, cowpea farms are infested with many weed species among which are *Ageratum conyzoides, Euphorbia heterophylla, Aspilia africana, Plastostoma africanum* and most importantly *Panicum maximum*. *P. maximum* grows abundantly in both rice and cowpea fields in Ekpoma where the fallow period has drastically reduced due to increased population pressure. Weed control is expensive and time consuming in Edo State because most farmers know very little or nothing about herbicides.

Several weed biologists had studied the response of grain legumes to competition with weeds as well as the ability of increased crop plant densities to suppress weeds. Remison (1978) reported reduced plant height, number of nodes, green leaves, peduncles and pods as densities of *E. heterophylla* increased. Oko et al. (2004) evaluated weed suppressive efficiency and productivity of five cowpea varieties. They reported that the cowpea varieties, Sampea 6 and Sokoto White, with very vigorous spreading habits were more suppressive of weeds than L 25, IAR 48 and Ife Brown which have erect habit, whereas, L 25, IAR 48 and Ife Brown gave higher grain yields per plant under the different weed densities used in their studies.

There is no information on the losses incurred by farmers due to competition of cowpea with guinea grass (*P. maximum*). The objectives of this study were to determine the effects of different guinea grass densities on the performance and yield of four cowpea varieties, and assist farmers in identifying those varieties of cowpea that can withstand competitive stress with guinea grass.

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Table 1. Chemical composition of the soil obtained from the experimental site.

Parameter	Value
pH	6.40
Nitrogen (%)	0.14
Available phosphorus (mg/kg)	10.29
Carbon (%)	1.79
Calcium (meq/100 g of soil)	8.00
Sodium (meq/100 g of soil)	0.60
Potassium (meq/100 g of soil)	0.40
Cation exchange capacity (meq/100 g of soil)	9.16

MATERIALS AND METHODS

Two field experiments were conducted in 2007 and 2008 at the Experimental Garden of the Department of Botany, Ambrose Alli University, Ekpoma between August and November. Ekpoma is located on latitude 6° 43°N and longitude 6° 08°E in the rainforest belt of Nigeria. It experiences double rainfall peaks occurring in July and September with a short dry spell in August. 15 soil samples were randomly collected with a soil auger at a depth of 0 - 15 cm. The samples were thoroughly mixed to form a homogenous mixture and sub-samples analyzed. The results are as shown in Table 1.

The land was cleared manually, burnt and the remaining plant materials packed and burnt. The entire area was ploughed and harrowed with a hoe before demarcating into plots measuring 4 × 3 m each. Strips of 1 m width were left between rows and columns to ease cultural operations. The experimental design was a 4 x 4 factorial scheme consisting of 4 varieties of cowpea and 4 different weed densities. All treatments were replicated four times. Weed densities constituted the columns while varieties were the rows. Four cowpea varieties namely: IT87D – 941-1, IT93K – 452-1, IT845 – 2246 – 4 and IT90K – 227-2, all early maturing, were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan. Apart from IT93K – 452 – 1 which was bunchy, other varieties studied were of spreading habit.

Three seeds were sown per hole at a depth of 2.5 cm and at a spacing of 60 × 30 cm and later thinned to 2 seeds per stand at 3 weeks after planting (WAP). On the same day of sowing cowpea, guinea grass seeds previously collected and stored for the purpose were broadcast on the soil surface and gently worked into the soil with a hoe. Guinea grass weeds were thinned to the desired densities of 0, 5, 20 and 35 m^{-2} between 3 and 4 WAP. Other weeds emerging in the experimental plots were hand-pulled. The weed-free plots served as the controls.

Some vegetative and reproductive characters were evaluated. The characters were plant height at 3, 6 and 9 WAP and dry weight determined with plants sampled from the inner rows of each plot; the samples were oven dried at 70°C for 72 h and weighed with a Metler Electronic balance. Other parameters studied include, mean number of days to 50% flowering, pod length, number of seeds per plant, yield per plant and yield per hectare. The data obtained from the two-year-trial were initially analysed separately but the results showed no significant differences and were therefore pooled together for the analysis of variance evaluation.

RESULTS

Vegetative traits

At 3 WAP, the four varieties of cowpea significantly varied in plant height ($P<0.05$), but the different planting densities did not affect plant height (Table 2). At 6 WAP, IT87D-941-1 was tallest (37.1 cm) followed by IT93K-452-1 (30.4 cm). The shortest plants were recorded for IT90K-277-2 (23.4 cm). At 9 WAP, the same pattern of growth was observed; weed densities were of no effect while varieties significantly ($P<0.05$) influenced plant height.

The varieties significantly ($P<0.05$) varied in dry matter production; IT87D-941-1 had the highest dry matter yield of 4.5 g per plant while IT93K-452-1 was the least with 1.93 g per plant at 3 WAP. Weed densities did not significantly ($P>0.05$) affect dry matter yield. Cowpea plants subjected to a density of 35 weeds m^{-2} had the lowest dry matter yield (2.51 g per plant); this was 25% lower than the highest in cowpea plants exposed to competition with 20 weeds m^{-2} (Table 3).

At 6 WAP, cowpea in weed-free plots produced 47.3% more dry matter than those that competed with 20 weeds per m^{-2}; while cowpea plants subjected to 35 weeds m^{-2} produced 20% less dry matter than those in weed-free plots. The varieties differed significantly in dry matter yield as evident in Table 3. In essence, the effect of weed densities on dry matter yield started manifesting its effect at 6 WAP. At 9 WAP, both weed densities and varieties significantly ($P<0.05$) affected dry matter yield of cowpea. Weed free plots gave a mean dry matter yield of 108.46 g perplant; this was 20.4% higher than the yield on cowpea plots subjected to competition with 35 weeds m^{-2} (Table 3). Mean dry matter production per plant by IT87D-941-1 was 114.36 g; this was 33.9% higher than the least produced by IT90K-277-2. The interaction between densities and varieties was not significant throughout the growth period of the different varieties.

Reproductive traits

The four varieties of cowpea significantly varied in their number of days to 50% flowering. Flowering was first recorded in IT93K-452-1 at 34 days after planting (DAP); this was 15 days earlier compared to IT90K-277-2 that recorded 49 DAP. Flowering in IT87D-941-1 and IT90K-277-2 occurred at 48 and 49 DAP respectively (Table 4). Different weed densities were of no effect in determining days to 50% flowering (Table 4).

Pod production per plant was highest in IT87D-941-1 and lowest in IT90K-277-2; these were 144.3 and 49.88, respectively. Varying weed densities significantly influenced number of pods produced per plant (Table 4). Weed-free plots produced an average of 150.3 pods per plant and the lowest of 52.38 was recorded in cowpea exposed to 35 weeds m^{-2}. In addition, weed-free plots produced the longest pods. Cowpea pods harvested from weed-free plots were 21, 24 and 42% longer than pods picked from cowpea that competed with 5, 20 and 35 weeds m^{-2}, respectively.

Table 2. Effects of different weed densities on the height (cm) of four cowpea varieties at 3, 6 and 9 weeks after planting (WAP).

Cowpea variety	3 WAP Weed densities (m^{-2})				Varietal means	6 WAP Weed densities (m^{-2})				Varietal means	9 WAP Weed densities (m^{-2})				Varietal means
	O	5	20	35	-	O	5	20	35	-	O	5	20	35	-
IT87D-941-1	10.4	9.08	10.03	19.60	12.28	30.91	29.95	31.41	56.2	37.12	65.40	73.92	90.43	119.82	83.39
IT93K-452-1	11.08	12.22	8.48	9.12	10.23	33.61	43.58	21.20	23.22	30.4	112.06	98.76	75.66	95.26	95.44
IT84S-2246-4	7.28	6.37	9.41	7.42	7.62	16.22	14.62	22.15	22.58	18.89	42.96	29.66	70.37	67.66	52.66
IT90K-277-2	8.29	9.19	7.39	8.80	8.42	30.67	28.29	15.07	19.41	23.36	70.89	86.29	46.39	47.89	62.86
Density means	9.27	9.22	8.83	11.24	-	27.85	29.11	22.46	30.36	-	72.83	72.16	70.71	82.66	-
L.S.D (P ≤ 0.05)															
Variety	2.6						8.8					18.85			
Weed density	NS						NS					NS			
Interaction	NS						NS					NS			

Table 3. Effects of different weed densities on the dry weight (g) per plant of four cowpea varieties at 3, 6 and 9 WAP.

Cowpea varieties	3 WAP Weed densities (m^{-2})				Varietal means	6 WAP Weed densities (m^{-2})				Varietal means	9 WAP Weed densities				Varietal means
	0	5	20	35	-	0	5	20	35	-	0	5	20	35	-
IT87D-941-1	4.4	4.2	4.8	4.6	4.5	40.6	44.6	51.6	73.5	52.58	127.64	141.88	74.41	113.5	111.26
IT93K-452-1	1.9	2.2	2.4	1.2	1.9	64.7	66.05	21.2	22.1	43.51	174.83	112.6	56.44	60.8	101.17
IT84S-2246-4	2.0	1.6	5.2	2.3	2.78	59.2	17.8	23l1	33l8	33.48	50.24	51.32	119.8	124.3	86.42
IT90K-277-2	3.0	2.65	1.0	1.9	2.14	46.25	54.6	12.3	39.0	38.03	81.12	93.11	51.18	51.18	45.6
Density means	2.83	2.66	3.35	2.51	-	52.68	45.76	27.1	42.1	-	108.46	95.69	85.94	86.32	-
L.S.D (P = 0.05)															
Variety	0.25						4.62					13.07			
Weed density	NS						9.37					9.16			
Interaction	NS						NS					NS			

Cowpea yields were significantly ($P<0.05$) influenced by varieties and to a less extent by weed densities. Crops in weed-free plots gave higher yields than those exposed to competition with weeds (Table 5). An average yield of 871.1 kg ha^{-1} was obtained in weed-free plot. As weed densities increased, mean yields declined, though, not significantly ($P>0.05$) different from others. Two varieties; IT84S-2246-4 and IT87D-941-1 gave highest mean yields, in the weed-free plots as well as under competition for grain yields (Table 5).

DISCUSSION

Plant growth throughout the period of study was least affected by different weed densities. The cowpea varieties studied were fast-growing species with wide leaves that shaded less vigorous

Table 4. Effects of different weed densities on number of pods per plant and days to 50% flowering of four cowpea varieties.

Cowpea varieties	Number of pods/plant Weed densities				Varietal means	Days to 50% flowering Weed densities				Varietal means
	O	5	20	35	-	O	5	20	35	-
IT87D-941-1	198.8	146.3	178.5	53	144.13	53.5	45.75	45.5	46.25	48.19
IT93K-452-1	123.5	56.0	107.25	62.5	87.33	31.3	34.3	30.8	40.5	34.19
IT84S-2246-4	203.3	53.2	72.3	72.3	100.24	44	46.8	46.5	43.5	45.20
IT90K-277-2	75.8	60.8	41.3	21.8	49.88	49.5	48	53.3	45.8	49.13
Density means	150.3	70	86.63	52.38	-	44.58	43.71	44.03	44.01	-
L.S.D (P ≤ 0.05)										
Variety	35.93						NS			
Weed Density	33.68						3.79			
Interaction	NS						NS			

Table 5. Effects of different weed densities on pod length (cm) and yield (Kg ha^{-1}) of four cowpea varieties.

Cowpea varieties	Pod length (cm) Weed densities				Varietal means	Yield (Kg ha^{-1}) Weed densities				Varietal means
	O	5	20	35	-	O	5	20	35	-
IT87D-941-1	14.11	14.4	14.02	14.24	14.19	816	519	687	375	599.25
IT93K-452-1	27.28	11.53	13.95	10.92	15.93	486.9	284.1	518.1	534	455.78
IT84S-2246-4	14.2	13.84	13.12	11.43	13.15	1465.8	455.1	123	499.8	633.93
IT90K-277-2	13.39	14.33	10.93	12.13	12.69	715.5	437.1	284.1	441.9	469.65
Weed density means	17.14	13.52	13.00	12.18	-	871.1	423.8	403	462.68	-
L.S.D (P = 0.05)										
Variety	3.39						105			
Weed Density	NS						179			
Interaction	NS						NS			

vigorous guinea grass underneath; cow-pea seeds were first to germinate and establish. The growth patterns observed in this study were similar to reports by Bozsa and Oliver (1993) when common cocklebur competed with soybean. The different weed densities did not affect dry matter yield at 3 WAP because the weeds were yet to establish while the dry matter yield of the varieties significantly varied among themselves (P<0.05). This was expected as the cowpeas were of different genetic make-up and varied in growth habits. As from 6 WAP, the effects of weeds became evident as they increased their area of influence (Lawrence, 1988). As cowpea plants aged, some of their older leaves withered thereby allowing more light to reach the weeds below. In a study by Baysinger and Sims (1991), increased interference duration of giant ragweed with soybean for 6 weeks reduced soybean dry weight by 46%, while a season-long interference resulted in 85% reduction in dry weight of soybean compared to weed-free plots. In the present study, the differences in dry matter yields were small because the varieties cultivated were mainly spreading types that effectively suppressed weeds. The harvesting of cowpea pods had already commenced before the establishment of guinea grass. The competition for nutrients, space and light was therefore minimal as the guinea grass had not produced many tillers at that time.

This study has shown that flowering is a varietal characteristic and not dependent on different weed densities to which the different varieties were exposed to (Table 4). This result is contrary to an earlier report by Remison (1978) where *Euphorbia heterophylla* competetion with cowpea increased number of days to flowering by 6 days. The conclusion from this study is that where a weed is more aggressive and vigorous than the cultivated crop, it would significantly influence days to flowering; in a situation where the crop suppresses the growth of weeds, weed densities would be of little or no effect.

Pod production occurred over a long period of time during which weed competition with the crops had started manifesting; increased competitive stress depressed number of pods produced (Table 4). In the same vein, pod length was significantly (P<0.05) affected by weed densities (Table 5).

Grain yield was most affected by different weed densities. At the early stages of growth of cowpea plants, guinea grass was suppressed by cowpea foliage thereby reducing their area of influence. As older cowpea leaves dropped due to senescence, more light penetrated the cowpea canopy; the growth of guinea grass became more vigorous and competed for nutrients, space, light and water. The rank order of the varieties for grain yield based on weed densities was IT84S – 2246 -4 > IT87D – 941-1 > IT90K – 227-2 > IT93K – 452-1. The variety – IT84S – 2246-4 was least affected by varying weed densities because of its pronounced spreading habit; this ensured that most weeds were kept in check by shading.

Finally, the conclusion from this study is that spreading varieties should be planted as they are capable of effectively controlling aggressive weed.

ACKNOWLEDGEMENTS

The authors are grateful to the technical staff of the Department of Botany, Ambrose Alli University for preparing the land and marking out the plots.

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