Effects of crop spacing on weed competition and seed yield in cowpea, Vigna unguiculata [L.] Walp c.v. Ife Brown

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Abstract

When cowpea (**Vigna unguiculata** [L.] Walp c.v. "Ife Brown") was planted at spacings of 50cm x 25cm and 50cm x 50cm, 31 and 15 percent yield increases were obtained over that of the conventional (100cm x 30cm spacing respectively. Optimum yield was obtained under the 50cm x 25cm spacing with 4 weeks of weed-free maintenance, whereas 6 weeks of weed-free maintenance were required for the same under the 50cm x 50cm and 100cm x 30cm spacings. When weeds were allowed to compete with the crop for more than 4 weeks, yields decreased under the 50cm x 50cm and 100cm x 30cm spacings but yield reductions were not observed under the 50cm x 25cm spacing even with up to 6 weeks of weed competition.

Introduction

Weeds constitute a major limiting factor to cowpea (**Vigna unguiculata** (L.) Walp.) production in Nigeria. Moody (1973) reported a reduction in yield of up to 50% when weeds were left uncontrolled in cowpea plots. Reminson (1978) studied the effect of weed competition on the performance of cowpea both in the greenhouse and in the field. He obtained an overall yield decrease of 51% in the weedy plots on the field, with 'Ife brown' being the most affected out of four varieties tested. The period of weed competition that can be tolerated by a crop without yield reductions is of considerable importance in crop production. It is also possible that where early weeds have been eliminated, there could be a secondary infestation that might not necessarily reduce yields but could interfere with harvesting operations.

A lot of studies have been conducted on the critical periods of weed competition for several crops (Nieto, Brondo and Gonzalez, 1968; Kasasian and Seeyave, 1969; Moody, 1973; Doll and Piedrahita, 1976) and considerable attention paid to various chemical and mechanical weed control methods; however studies on cultural methods of control are comparatively fewer. This is also true for cowpea in Nigeria where it is now known that the critical periods for weed competition is about 4-6 weeks after planting (Fadayomi, unpublished data); and where the efficacy of chemical and mechanical methods for weed control had been adequately documented (Moody, 1973).

It has been demonstrated by a number of workers that weed control can be considerably improved and crop yields increased by reducing the row width. Burnside and Colville (1964) found that a mixed population of annual grass and broadleaf weeds yielded higher in 102cm rows than in narrower row spacings in fields of soybean [**Glycine max** L.] due to earlier shading by the crop. Peters, Gebhardt and Struzke (1965) noted that the soybean canopy covered the ground more rapidly and controlled

weeds more effectively in narrow than in wide rows. Wax and Pendleton (1968) obtained an increase of 10, 18 and 20% in soybean yield for 76, 51 and 25cm rows when compared with 102cm rows. They noted that weeds not affected by pre-planting application of herbicides had sufficient growth to cause yield reductions in wide rows but not in narrow rows. Rogers, Buchanan and Johnson (1976) found that with narrow (53cm) row spacing, cotton [**Gossypium hirsutum** L.] produced maximum yields with as little as 6 weeks weed-free maintenance, whereas it required 10 and 14 weeks of weed-free maintenance to obtain maximum yields with wider row spacings (79 and 106cm).

The objectives of the present study were to investigate the effect of row spacing on (a) the weed-free requirement of cowpeas and/or toler ance of cowpeas to weed competition and (b) the establishment and dry matter accumulation of annual weeds, within the cowpea ecosystem.

Materials and methods

These studies were conducted at the University of Ife Teaching and Research Farm on a sandy loam soil during the late sason of 1977 and the early season of 1978. The 1977 planting and one of the 1978 plantings were located on a piece of land that had been under cultivation for about 2-3 years while the other 1978 planting was located on a site that had been under continuous cultivation for over seven years. These two sites will be referred to as the 'New Arable' and the 'Old Arable' respectively. The main weed population in the experimental areas consisted of annual broadleaf and grass psecies, prominent among which were **Ageratum conyzoides L., Digitaria horizontalis L., Eleusine indica L., Acalypha ciliata L., Spigelia anthelmia L., Amaranthus** sp. and **Cyperus** sp.

The experiments on the New Arable site were established on the 12th of September 1977 and the 28th of April 1978 respectively, while the experiment on the Old Arable site was established on the 7th of April 1978. Land preparation was by conventional tillage and there was no fertilizer application. Cowpea, cv Ife Brown was planted using there spacings viz: 100cm x 30cm, 50cm x 50cm and 50cm x 25cm giving 85, 100 and 200 stands per plot for each spacing respectively. Each plot measured 5 x 4m ($20m^2$) with 1m spacing left between successive plots. There were seven weeding treatments within each spacing as follows:

Treatment: No.	Description of Treatment
1	Weedy for the first 3 weeks, weed-free until harvest.
2	Weedy for the first 4 weeks, weed-free until harvest.
3	Weedy for the first 6 weeks, weed-free until harvest.
4	Weed-free for first 3 weeks, weedy until harvest.
5	Weed-free for the first 4 weeks. weedy until harvest.
6	Weed-free for the first 6 weeks, weedy until harvest.
7	Weed-free throughout.

TABLE 1: GRAIN YIELD (G/PLOT) AND AVERAGE YIELD G/PLANT) OF COWPEA AT 3 DIFFERENT SPACINGS AND 7 WEEDING TREATMENTS*

Weeding Treatment	CROP SPACING			Overall *mean*
	100cm x 30 cm	50cm x 50cm	50cm x 25cm	
1. Weedy for 1st 3 wks. Weed-free UH	729	837	954	840.0
2. Weedy for 1st 4 wks. Weedfree UH	906	1190	1165	1087.0
3. Weedy for 1st 6 wks. Weedfree UH	832	955	1339	1042.0
4. Weedfree for 1st 3 wks. Weedy UH	585	652	633	623.3
5. Weedfree for 1st 4 wks. Weedy UH	807	1052	1190	1016.3
6. Weedfree for 1st 6 wks. Weedy UH	1028	1214	1200	1147.3
7. Weedfree throughout	970	868	1172	1003.3
Overall Mean	836.7	966.9	1093.3	
Average yield	9.84	9.67	5.46	

**Average yield for all three trials*
LSD.05 for Weeding = 184.5
LSD.05 for Spacing = 137.0
Weeding x Spacing interaction not significant

TABLE 2 WEED ESTABLISHMENT AT 3 WEEKS AND WEED FRESH WEIGHT AT 4 WEEKS IN TREATMENT 2 IN THE 1978 TRIALS

CROP SPACING	Number of weed seedlings/M^2		Weed fresh weight (Kg/plot)		Relative weed growth	
	New Arable	Old Arable	New Arable	Old Arable	New Arable (X10 5)	Old Arable (X10 5)
100cm x 30cm	179	205	0.23	0.06	6.5	1.5
50cm x 50cm	326	214	0.26	0.08	4.0	1.9
50cm x 25cm	226	134	0.29	0.05	6.5	1.9
LSD.05	128	NS	NS	NS	----	---

TABLE 3: WEED ESTABLISHMENT AT 3 WEEKS AND WEED FRESH WEIGHT AT 6WEEKS IN TREATMENT 3 IN BOTH THE 1977 AND 1978 TRIALS

CROP SPACING	Number of weed seedlings/M			Weed fresh weight (Kg/plot)			Relative weed growth		
	New Arable		Old Arable	New Arable		Old Arable	New Arable (X10 3)		Old Arable (X10 2)
	1977	1978	1978	1977	1978	1978	1977	1978	1978
100cm x 30cm	1773	229	134	62.7	4.6	27.6	1.8	1.0	1.1
50cm x 50cm	1154	215	180	48.2	5.18	28.5	2.1	1.9	0.8
50cm x 25cm	2205	121	148	47.6	1.8	33.6	1.1	0.8	1.2
LSD.05	945	NS	NS	NS	NS	NS			

Discussion

As expected, the effects of varying periods of weed competition in cowpea on its yield were the same for the three spacings, with the highest yields being recorded when there were four weeks of weed competition after planting before weeding except under the 50cm x 25cm spacing where yield continued to increase up to six weeks of weed competition. Weed competition beyond the fourth week after planting led to decreased yields in the other two spacings. With respect to the weed-free maintenance treatment also, yield was significantly higher at the 50cm x 25cm than at the other two spacings. It was observed during the course of the study that by the fourth week, the entire ground surface was almost completely covered by the crop under the 50cm x 25cm spacing whereas up till the eighth week, the ground had not been completely covered under the 100cm x 30cm spacing. Such ground coverage as was obtained under the 50cm x 25cm spacing might have been responsible for suppressing the vegetative growth of the weeds. Similar results were obtained in cotton by Rogers **et al.** (1976).

There was a significant increase in yield with increasing tenure of weed competition up to four weeks under the 50cm x 50cm spacing and six weeks under the 50cm x 25cm spacing. The reverse of this situation, as obtained by Nieto **et al.** (1968) was expected. It is possible that yields obtained at three weeks of weed competition were negatively affected by flower drop, which might be caused by moisture stress that could result from leaving the soil bare after the initial period of weed competition; as well as stem and root wounding that is likely to occur during the subsequent weedings until harvest.

Contrary to expectation, the number of weed seedlings per unit area was greater under the 50cm x 25cm spacing than in any of the other spacings in some cases. This is most likely due to the fact that the weed population is dependent on the natural abundance of their seeds in the plots. Apart from their effects on yield, weeds could also constitute harvesting problems. Under the 50cm x 25cm spacing, the crop was

better able to compete with the weeds through a suppression of their vegetative growth than under the conventional spacing on the New Arable site. Similar results were obtained in soybeans (Burnside and Colville 1964; Peters **et al.** 1965).

The comparatively lower average seed yield per plant obtained under the 50cm x 25cm spacing was probably due to intraspecific competition between the crop. However, this was compensated for by the higher plant population such that ultimately, the highest yields were obtained with that spacing. This increased yield along with the suppressive effect on weeds, thus reducing the amount of weed management required, will probably compensate for the additional input in terms of seeds required for the 50cm x 25cm planting.

This series of experiments indicates that there was an advantage in adopting the narrow (50cm x 25cm) spacing, however further studies on desirable optimum spacing are still necessary.

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