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Research Article

EVALUATION OF INTER-ROW SPACING AND WEED MANAGEMENT ON THE GROWTH AND YIELD OF SOYBEAN (GLYCINE MAX (L.) MERRILL) IN ANYIGBA, KOGI STATE, NIGERIA

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ABSTRACT

Field experiments were conducted during the 2017 and 2018 wet seasons at the students Teaching and Research Farm of Kogi State University Anyigba (Latitude 7^0 29' N and Lougitude 7^0 11' E) to study the effect of inter-row spacing and weed management on the growth and yield of soybean(Glycine max L.) . The soybean variety used was TGX 1807-19E.The treatments were four inter-row spacing (20,30, 40 and 50cm) and eight weed management options. The weed management treatments comprised weed infested for 3,6,9, weeks and till harvest on the other. The experimental design was a randomized complete block with split plot arrangement replicated three times. In both trails, plots kept weed tree had no significant effect on plant height and 100-seed weight, Plants in plots height weed tree for only 3 weeks after sowing (WAS) were the shortest and had the least seed weight. Results of the two years analysis showed that plants in plots kept weed tree till harvest significantly produced the highest number of pods/plant and seeds/plant but comparable to the other weed management treatments except the weed tree f or only 3 WAS . Plants infested with weeds for only 3 WAS produced the highest grain yield/ha. Total grain yield was 747.9 Kg/ha in 2017 while it was 745.1 Kg /ha in 2018. Inter-row spacing did not show significant effect on a number of parameters measured. However, number of seeds/plant, number of pods/plant and grain yield (Kg/ha) were highest with the 40cm inter-row spacing in both years of study. From the foregoing in this region, the critical period of weed interference in soybean production is 3 WAS and the 40cm inter-row spacing be adopted for impressive growth and grain yield of soybean.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is a major food grain legume and oil crop. In Nigeria, its cultivation is on the increase owing to the introduction and development of new and of course improved varieties as well as its nutritional value, economic potentials and diverse use to which it is put in many communities. About 208,556 hectares of land is under soybean cultivation producing 197,333 tons of soybean seeds at an average of 315kg/ha (FAO, 2010). Soybean has the highest protein content (40%) among legumes and appreciable oil content (20%) (Wilcox, 1987). Soybean oil is rich in essential fatty acids and contains no cholesterol (Ogudipe and Weingarther, 2012). Unfortunately, its production is constrained by intense weed infestation. Akobundu (1987) revealed that uncontrolled weed growth causes yield reduction of 34-55% in maize, 28-100% in rice, 40-67% in grain legume, 52% in oil fibre crops (sunflower) and 65-91% in root and tuber crops. It is therefore imperative that every necessary measure be put in place to bring about appropriate weed management for optimum productivity of soybean.

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Inappropriate agronomic practices such as inter-row spacing and poor weed management could drastically affect growth and development of soybean and its yield potentials. The objective of this study was to investigate the appropriate inter-row spacing and the critical period of weed interference in soybean in the derived guinea savanna agro ecology.

MATERIALS AND METHODS

The experiment was conducted at the Research and Demonstration farm, Faculty of Agriculture, Kogi State University, Anyigba during the 2017 and 2018 cropping seasons. The experiment consisted of four (4) inter-row spacing (20, 30, 40 and 50cm) and eight weed management treatments. The weed management treatment comprised weed infested for 3, 6, 9 weeks and till harvest on one hand and weed free for 3, 6, 9 weeks and till harvest on the other. The experiment was replicated three times. The experiment was a split plot laid out as randomized complete block design (RCBD). The soybean variety used was TGX 1807-19E and obtained from Kogi State Ministry of Agriculture, Lokoja. After clearing, the experimental field was ploughed and harrowed. It was then marked out into plots each measuring 7m x 4m. Single superphosphate and NPK 15:15:15 fertilizers were worked into the soil at the rate of 200kg/ha and 150kg/ha respectively.

Table 1 Main effect of period of weed free on growth and yield of soybean

Period (WAS)	100-seed weight (g) 2017	100-seed weight (g) 2018	Grain yield (kg/ha) 2017	Grain yield (kg/ha)2018	Number of pods/plant2017	Number of pods/plant2018	Number of seeds/plant 017	Number of seeds/plant 2018	Plant height (cm) 2017	Plant height (cm) 2018
3	9.11	9.08	172.2	168.2	30.8	29.25	21.75	21.58	29.17	27.79
6	10.09	9.78	536.3	515.8	55.2	52.25	40.92	38.25	32.07	31.95
9	9.92	10.08	776.1	783.8	68.1	65.58	44.25	41.08	31.74	30.94
WFTH	9.91	10.38	787.2	778.8	72.4	69.67	46.17	46.08	32.03	31.39
FLSD $_{(0.05)}$	NS	NS	15.10	19.56	2.9	2.8	1.99	2.61	NS	NS

WAS = weeks after sowing; WFTH = Weed free till harvest

Table 2 Main effect of period of weed infestation on the growth and yield of soybean

Period (WAS)	100-seed weight (g) 2017	100-seed weight (g) 2018	Grain yield (kg/ha) 2017	Grain yield (kg/ha) 2018	Number of pods/plant 2017	Number of pods/plant 2018	Number of seeds/plant 2017	Number of seeds/plant 2018	Plant height (cm)2017	Plant height (cm)2018
3	9.88	9.89	747.9	745.1	72.17	67.67	40.67	41.50	31.73	31.43
6	8.36	8.71	193.7	184.3	29.25	30.08	20.25	20.58	21.07	20.70
9	8.14	8.11	162.9	140.2	10.00	9.75	10.42	9.25	20.82	20.56
WFTH	7.83	7.91	107.6	100.9	9.17	8.58	8.42	8.67	14.33	15.80
F-LSD$_{(0.05)}$	NS	NS	7.71	15.76	1.53	2.57	1.57	1.62	NS	NS

WAS = weeks after sowing; WFTH = Weed infested till harvest

Table 3 Main effect of spacing under weed free management on the growth and yield of soybean

Spacing (cm)	100-seed weight (g) 017	100-seed weight (g) 018	Grain yield (kg/ha) 2017	Grain yield (kg/ha) 2018	Number of pods/plant 2017	Number of pods/plant 2018	Number of seeds/plant 2017	Number of seeds/ Plant 2018	Plant height (cm) 2017	Plant height (cm) 2018
20	9.64	9.78	531.7	512.8	44.5	41.67	25.33	23.58	31.23	30.44
30	9.80	9.74	553.9	547.2	54.3	52.17	34.58	33.75	31.23	30.97
40	9.78	9.86	595.6	597.7	67.7	66.25	47.58	47.0	31.31	30.09
50	9.81	9.94	590.8	589.0	60.1	56.67	45.58	42.67	31.24	30.57
FLSD $_{(0.05)}$	NS	NS	15.1	15.56	2.83	2.79	1.98	2.61	NS	NS

Table 4 Main effect of spacing under weed infestation on the growth and yield of soybean

Spacing (cm)	100-seed weight (g) 2017	100-seed weight (g) 2018	Grain yield (kg/ha) 2017	Grain yield (kg/ha) 2018	Number of pods/plant 2017	Number of pods/plant 2018	Number of seeds/plant 2017	Number of seeds/plant 2018	Plant height (cm) 2017	Plant height (cm) 2018
20	8.65	8.52	271.6	269.3	23.42	22.58	11.75	12.67	21.50	22.13
30	8.62	8.64	286.7	272.9	26.92	26.0	18.67	17.67	21.81	21.98
40	8.68	8.68	331.2	319.5	36.08	35.75	25.42	25.92	22.55	22.32
50	8.76	8.78	332.7	308.7	34.17	31.75	23.92	23.75	22.11	22.07
FLSD $_{(0.05)}$	NS	NS	7.71	15.76	1.53	2.56	1.57	1.67	NS	NS

Table 5 Interaction effects of period of weed free by spacing on 100-seed weight in 2017.

Spacing (cm)	Period (weeks)	100-seed weight (g)
20	3	9.03
	6	10.23
	9	9.77
	WFTH	9.53
30	3	9.13
	6	9.90
	9	9.93
	WFTH	10.23
40	3	9.10
	6	10.10
	9	10.03
	WFTH	9.87
50	3	9.17
	6	10.13
	9	9.93
	WTTH	10.00
FLSD (0.05)		NS

WFTH = Weed free till harvest

Table 6 Interaction effects of period of weed free by spacing on 100-seed weight in 2018.

Spacing (cm)	Period (weeks)	100-seed weight (g)
20	3	9.07
	6	9.70
	9	9.93
	WFTH	10.40
30	3	9.00
	6	9.63
	9	10.10
	WFTH	10.23
40	3	9.10
	6	9.80
	9	10.07
	WFTH	10.47
50	3	9.17
	6	9.97
	9	10.23
	WTTH	10.40
FLSD (0.05)		NS

WFTH = Weed free till harvest

seeds/plant in 2017

Spacing (cm)	Period (weeks)	100-seed weight (g)
20	3	15.67
	6	25.0
	9	29.67
	WFTH	31.0
30	3	19.67
	6	37.33
	9	40.67
	WFTH	40.67
40	3	22.0
	6	52.67
	9	56.33
	WFTH	59.33
50	3	29.67
	6	48.67
	9	50.33
	WFTH	53.67
FLSD (0.05)		1.99

WFTH = Weed free till harvest

Table 8 Interaction effects of period of weed free by spacing on number of seeds/plant in 2018.

Spacing (cm)	Period (weeks)	100-seed weight (g)
20	3	15.33
	6	22.33
	9	27.67
	WFTH	29.00
30	3	20.00
	6	36.67
	9	37.33
	WFTH	41.00
40	3	25.67
	6	48.67
	9	52.67
	WFTH	61.00
50	3	25.33
	6	45.33
	9	46.67
	WFTH	53.33
FLSD (0.05)		2.61

WFTH = Weed free till harvest

Table 9 Interaction effects of period of weed free by spacing on grain yield in 2017.

Spacing (cm)	Period (weeks)	Grain yield (kg/ha)
20	3	171.3
	6	491.0
	9	733.0
	WFTH	731.3
30	3	170.3
	6	505.7
	9	764.0
	WFTH	775.7
40	3	174.7
	6	577.0
	9	802.0
	WFTH	828.7
50	3	172.7
	6	571.7
	9	805.3
	WTTH	813.3
FLSD (0.05)		15.10

WFTH = Weed free till harvest

Table 10 Interaction effects of period of weed free by spacing on grain yield in 2018.

Spacing (cm)	Period (weeks)	Grain yield (kg/ha)
20	3	164.7
	6	430.3
	9	726.3
	WFTH	729.7
30	3	168.3
	6	494.0
	9	782.0
	WFTH	744.3
40	3	168.7
	6	573.3
	9	822.3
	WFTH	826.3
50	3	171.0
	6	565.7
	9	804.7
	WFTH	814.7
FLSD (0.05)		19.56

WFTH = Weed free till harvest

In planting, grooves were made to a depth of 4cm and the seeds evenly spread along and then covered with a thin layer of soil. The seedlings were later thinned down to 5cm between plant stands along the row. Data collected on parameters such as plant height, number of pods/plant, number of seeds/plant, 100 seed weight and grain yield/ha were subjected to analysis of variance (ANOVA) and the means separated using the Fishers least significant difference (F-LSD) at 5% level of probability.

RESULTS

As shown in Table 1, the period of weed free did not have significant effect on plant height at harvest and 100 seed weight in both years of study. However, plants kept weed free for 3 weeks after sowing (WAS) were the shortest and produced the least seed weight in comparison with the rest of the weed interference treatments. Plant heights at 3 weeks of weed free treatment were 29.17 and 27.79cm in 2017 and 2018 respectively. Similarly, 100-seed weights obtained from plants subjected to the same weed interference treatments (3 weeks of weed free treatment) were 9.11 and 9.08g in 2017 and 2018 respectively. In both years of study, the plots kept weed free till harvest had significantly the highest number of pods/plant and seeds/plant and were comparable to the rest of weed interference treatments except the weed free 3 WAS. The plots kept weed free till harvest consistently and significantly produced the highest grain yield thought comparable to that produced from plots kept weed free for 9 WAS. Plants kept weed infested for 3 WAS had optimum yield and growth parameters in comparison to other weed interference treatments in both years of study (Table 2). Plants infested with weeds 3 WAS produced the highest grain yield in both years; 747.9kg/ha (2017) and 745.1kg/ha (2018).

Grain yield was only 193.7 and 184.3kg/ha in 2017 and 2018 respectively with plants infested with weeds 6 WAS. It was much less with plants infested 9 WAS with the least resulting from plants infested till harvest. Inter-row spacing had no significant effect on most of the parameters measured. However, number of seeds/plant, number of pods/plant and grain yield (kg/ha) were highest with the 40cm inter-row spacing in both years of study on the weed-free plots. Equally, 40cm inter-row spacing infested with weeds out yielded the rest of the inter-row spacing with regards to number of pods/plant, number of seeds/plant and the total grain yield in the two years of study (Table 4).In the two years of study, the interaction between spacing and periods of weed-free on 100-seed weights was not significant. In 2017, the interaction of 20cm inter-row spacing x weed-free for 6 WAS and that of 30cm inter-row spacing x weed free till harvest produced the heaviest seeds (10.23g) (Table 5). There was no consistency in the interaction of spacing x period of weed-free on 100 – seed weight in 2017 as the interaction of 40cm inter-row spacing x weed free till harvest produced the heaviest seed weight (10.47g) (Table 6.).

As indicated in Table 7, the interaction between inter-row spacing and weed-free interference treatments showed significant effect on the number of seeds/plant during the two years of study. In 2017, the 40cm inter-row spacing and the plots kept weed-free till harvest produced the highest number of seeds/plant though, not statistically significant compared to the number of seeds produced per plant at 9 weeks of weed-free treatment at the same inter-row spacing. The result did not differ much in 2018 as the interaction between 40cm inter-row spacing and the plots kept weed-free till harvest produced significantly the highest number of seeds/plant although this was similar to the seeds/plant produced by the interaction of 40cm inter-row spacing x crop kept weed free for 9 WAS (Table 8). The interaction between inter-row spacing and weed-free interference treatments was significant on grain yield in both years of study. In 2017, grain yield was significantly highest at the interaction between 40cm inter-row spacing and crop kept weed-free till harvest although this was comparable with the interactions of 40cm x crop kept weed-free for 9 WAS and 50cm x crop kept weed-free till harvest (Table 9). The interaction of 40cm x crop kept weed-free till harvest consistently produced the highest grain yield but was comparable with the interactions of 20cm, 30cm and 50cm x 9 WAS and weed-free till harvest in each case (Table 10).

DISCUSSION

The period of weed free had no significant effect on plant height and 100-seed weight in this study. This could be attributed to response of plants of the same genetic constitution as one soybean variety (Tax 1807-19E) was studied. In the two years of study, it was found out that inter-row spacing did not significantly affect total grain yield and other agronomic parameters examined. This was in agreement with the findings of Olufajo and Pal (1991). They reported that for a three-year study, row spacing did not significantly affect grain yield in addition to other agronomic characteristics studied. But some researchers such as Lechman and Lambert (1960) and Herbert and Litchfield (1980) have associated seed yield advantage from narrow rows with the production of greater number of pods/plant. However, the result of these authors were similar to findings in this study as the number of pods/plant number of seeds/plant and the grain yield (kg/ha) were highest with the 40cm inter-row spacing in both years. Grain yields were greatly reduced from 787.2 to 1722 and 778.8 to 168.2 kg/ha in 2017 and 2018 respectively when weeding was terminated at 3 WAS as against the yields obtained from plots subjected to weed – free till harvest in both years. It is important to note that grain yields from weed – free plots for 9 WAS and weed-free till harvest were similar.

Moreover, grain yields from weed – free plots for 9 weeks was even higher than that obtained from plots kept weed-free till harvest in the same year. In the same vein, grain yields from plots kept weed infested for only 3 WAS in both years were the highest. Yields were much less in plots kept weed infested for 6 WAS with the least from plots weed infested till harvest. This could be due to severe weed competition later in the life cycle of the crop. This is in agreement with the findings of Pal and Singh (1990) who observed that when soybean was weed infested for 4 weeks or longer, there was severe yield reduction on account of intense weed competition. In both years of the study, grain yields were highest at 40cm inter-row spacing thereby negating the findings of Safo-Kantanka and Lawson (1980) who observed a decrease in grain yield with increase in inter-row spacing.

CONCLUSION

From this study, it is advocated that keeping soybean farm weed free for 9 WAS should be emphasized as this resulted to impressive grain yield, which is actually the hallmark of soybean production. In the alternative, soybean farms could be kept weedy for only 3 or 4 weeks and thereafter allowed to remain weed-free for the rest of the crop life cycle for efficient grain yield production capacity. Similarly, 40cm inter-row spacing should be adhered to for optimum soybean production in Anyigba, Kogi State.

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