International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 3, No. 9, p. 19-25, 2013

INNSPUB

RESEARCH PAPER OPEN ACCESS

Growth and yield of okra as influenced by weeding regimes in Samaru- Zaria, Nigeria

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Article published on September 22, 2013

Key words: Growth, yield, weeding frequency, okra.

Abstract

The research was conducted at the Teaching and Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria located on latitude11°11'N, longitude7°38'E and 686m above sea level in the Northern Guinea Savanna Ecological Zone of Nigeria during 2010 and 2011 cropping seasons. The trial was established to study Growth and yield of okra as influenced by weeding regimes in Samaru, Zaria. The experiment was made of four treatments, replicated three times and laid out in a Randomized Complete Block Design (RCBD). From the results of this trial, 4 Weeding regimes significantly produced the highest mean values of growth and yield parameters such as plant height, number of leaves/plant, number of branches/plant, leaf area/plant, number of pods/plant, pod yield per plot and pod yield/ha throughout the period of this study, while the Control treatment significantly gave the lowest mean values of both growth and yield parameters at the same period of measurement. This results showed that the more the weeding regimes, the more the increase in growth and yield parameters. However, the less the weeding regimes, the lower the increase in growth and yield parameters of okra during 2010 and 2011 cropping seasons.

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Introduction

Okra (*Abelmoschus esculentus* L. Moench.) belongs to the family *Malvaceae* (Iremiren, 1988). It originated from Ethiopia in Africa, but now is widely grown all over the world (Khalid *et al.*, 2005). It is one of the most prominent and lucrative vegetables used in fresh and canned forms (PROTA, 2010). In USA, a significant quantity of okra is used because of its thickening characteristics in the preparation of soups and stews (Kader *et al.*, 1985). Although an important vegetable crop, yields are usually lower in developing countries compared to developed countries. Besides other factors such as temperature, relative humidity, rainfall, solar radiation, pests/diseases etc. for lower yields, lack of proper weed control is also responsible in reducing yields and quality of okra and other field crops (Khalid *et al.*, 2005). Weeds are plants growing where they are not wanted in a disturbed habitat by man (Akobundu, 1997). Therefore in the absence of man in the ecosystem, there is no weed (Akobundu, 1997). Nwafor *et al.* (2010) defined weeds as plants that are growing where they are not wanted and doing more harm than good. Akobundu (1997) also defined weeds as plants that are undesirable and are often considered out of place. According to Gworgwor (2000) when maize seeds germinate in an okra bed, it becomes a weed though maize is a crop and if appropriate actions are not taken, any weed can be a problem because it will compete for space, light, water and nutrients with crops. Thus, its presence will adversely affect growth as well as yields of the crops by denying them of these resources (Gworgwor, 2000). The objectives of this trial therefore, were to determine the effect of weeding regimes on growth and yield of okra variety (Clemson spineless) and to recommend to our farmers, the appropriate weeding regime that will increase the yield of okra variety(Clemson spineless) in Samaru, Zaria.

Materials and methods

Site location, land preparation, experimental design and crop establishment

Two field experiments were conducted during the rainy seasons of 2010 and 2011 at the Teaching and Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria located on latitude11°11'N, longitude7°38'E and 686m above sea level in the Northern Guinea Savanna Ecological Zone of Nigeria(UBRDA,2010). The land was ploughed, harrowed and pulverized with a hand hoe to make the soil level smooth and suitable for seed germination and establishment. The experimental design used was Completely Randomized Block Design (CRBD) with one okra variety of Clemson spineless as main plot treatments and four weeding regimes as small plot treatments replicated three times to give a total of twelve small plots. The treatments were as follows: No Weeding regime = 0, One Weeding regime = 1, Two Weeding regimes = 2 and Three Weeding regimes = 3 . Main plot size was (17 x3m) = 51m^2 and small plot size was (5 x3m) = 15m.^{2} Spacing between replications = 2.5m, spacing between main plots = 2.5m and Spacing between small plots =1m.

Sowing seeds of okra variety of Clemson spineless was done as soon as rains established during the 2010 and 2011 cropping seasons. Planting was done on the 20th June, 2010 and 24th June, 2011 cropping seasons respectively, using a hand hoe for dibbling seeds at the rate of three seeds/hole and later thinned to two plants/stand at an inter- row and intra - row spacing of 75cm x 50cm during the first weeding, three weeks after sowing giving an estimated plant population of 66,666.67plants/ha (Smith and Ojo, 2006). Subsequent weeding followed at two weeks interval up to the final weeding. The final fruit yield of each small plot was obtained by harvesting five plants. The harvested fruits were allowed to dry after slicing into small pieces to constant moisture content and each treatment was taken to the laboratory for detailed measurements.

Data collected

The following growth parameters such as Plant height, number of leaves/plant, number of branches/plant and leaf area (cm^2) were recorded from five randomly selected plants and averaged in each sub plot. While yield parameters such as number of pods/plants, pod yield per plot and pod yield/ha were also recorded from five randomly selected plants and averaged in each small plot for each cropping season. All the data collected was analysed statistically. Means were compared using the least significance difference at 5% level of probability.

Results and discussion

Plant height (cm)

Significant difference at P < (0.05) were observed among treatments. Treatment 0 significantly produced the lowest mean values among other treatments, while treatment 4 significantly gave the highest mean values among the treatments (Table 1). This observation may be that treatment 0 which was not weeded could not control weeds very effectively from competing with plants for light, space, water and nutrients denying them of these resources which resulted into lower production of photosynthesis and lower performances of plants under this treatment thus, producing lower mean values of plant height. On the other hand, treatment 3 which was weeded three times, was able to control weeds effectively from competing with plants for light, space, water and soil nutrients which resulted into higher production of photosynthesis and hence higher performances of plants in this treatment thus, producing higher mean values of plant height as observed by (Iremiren,1988; Gbadomosi *et al.*, 2003; Kolo and Daniya, 2006) that the presence of weeds in okra fields cause competition between the crop for light, space, water and nutrients. Their presence adversely affects growth components between 50 -70% and the general performance of the crop.

Number of leaves/plant

Significant differences at P ≤ (0.05) were observed among treatments in 2010 and 2011 cropping seasons. Treatment 0 significantly produced the lowest mean values throughout the period of measurement, while treatment 3 significantly produced the highest mean values among the treatments (Table 1). This observation may mean that treatment 0 which consisted 0 weeding frequency, could not control weeds very well resulting into lower performances of plants in those plots as the weeds had a greater advantage of utilizing the resources of water, space, light and soil nutrients more than the crop thus, making the crop to produce lower mean values of number of leaves/plant. Treatment 4 which consisted four weeding regimes, was able to control weeds very well from competing with the crop for soil resources thus, making the crop to produce higher mean values of number of leaves/plant. This observation is in line with works of (Okezie, 2000; Tunku, 2006 and Gogoi *et al.*, 1997). They observed that the more the weeding regimes, the more the performances of a crop as the rate of weeding will determine the overall performances of the crop in terms of growth and yield parameters.

Number of branches/plant

There was a significant difference observed at P ≤ (0.05) among treatment means. Treatment 0 significantly produced the lowest mean values among other treatments, while treatment 3 significantly produced the highest mean values among all other treatments (Table 1). This observation could be that treatment 0 which was not weeded at all, could not control weeds very well and so, competition for resources between weeds and the crop went in favour of weeds and at the detriment of the crop which resulted into lower performances of the crop in the field in terms of photosynthetic production and assimilation thus, resulting into lower production of mean values on number of branches/plant. However, treatment 4 which was weeded four times, prevented competition between weeds and the crop which gave the crop the advantage to utilize enough soil resources, hence resulting into higher photosynthetic ability of the crop which led to the production of higher mean values on number of branches/plant throughout the period of assessment as reported by (Adeyemi and Olaniyi, 2008; Markus *et al.*, 1994). That the lower performances of okra weed infested fields cause the denial of the crop for soil water, space, light and nutrients. Proper weed control using 2-3 manual weeding could improve the performance of the crop up to 15%.

Table 1. Growth and Yield of Okra as Influenced by weeding regimes at Samaru, Zaria in 2010 and 2011 Cropping Seasons.

Treatments	Plant height (cm)	Number of leaves per plant	Number of branches per plant	Leaf area (cm²)	Number of pods per plant	Pod yield(kg) plot	Pod yield (kg) ha⁻¹
	2010 2011	2010 2011	2010 2011	2010 2011	2010 2011	2010 2011	2010 2011
0	48.20d	08.28d	03.22b	48.98a	05.70c	1.95b	2435.20c
1	47.28c	10.24c	03.64b	47.90a	04.98c	1.82b	2533.40c
2	53.14c	11.34c	04.10a	47.86a	06.11b	1.98b	2545.80b
3	54.58b	11.15c	05.17ab	48.87a	06.12b	2.08b	2548.58b
	57.26b	14.16b	06.90a	50.24a	07.46a	2.14ab	2698.80b
	58.14a	15.25b	06.77ab	49.96a	07.64a	2.37ab	2638.46b
	60.15a	17.10a	07.60a	51.25a	08.45a	2.38a	3243.0a
	59.48a	18.28a	07.85a	50.15a	09.18a	3.18a	3249.15a

Means with the same letter (s) within a column are not significantly different at P < (0.05) Duncan's' Multiple Range Test (DMRT).

Table 2. Density per (m²) of Different Weed Species in Okra as Influenced by weeding regimes at Samaru, Zaria in 2010 and 2011.

Treatments	*Eleusine indica*		*Echinochloa colona*		*Cyperus rotundus*		*Ageratum conyzoides*	*Cynodon dactylon*	
	2010	2011	2010	2011	2010	2011	2010 2011	2010	2011
0	70.40a	74.35a	68.32a	74.18a	27.52a	26.84a	16.23a	14.28a	14.30a
1	27.78b	38.76b	34.26b	12.36d	18.12b	17.87b	13.80a	11.85b	10.12b
2	29.76b	30.44d	31.80b	18.73c	14.40c	14.57c	11.14b	07.78c	07.24c
3	31.52b	32.48c	24.27c	57.28b	13.80c	13.85d	08.22c	10.43b	09.17bc
							10.16b		
							10.43b		
							09.67b		
							07.86c		

Means with the same letter (s) within a column are not significantly different at P < (0.05) Duncan's' Multiple Range Test (DMRT).

Table 3. Weed Dry matter in (gm/m²) of Weed Species in Okra as Influenced by weeding regimes at Samaru, Zaria in 2010 and 2011.

Treatments	*Eleusine indica*	*Echinochloa colona*	*Cyperus rotundus*	*Ageratum conyzoides*	*Cynodon dactylon*
	2010 2011	2010 2011	2010 2011	2010 2011	2010 2011
0	33.16a	34.36a	16.31a	15.22a	15.32a
1	32.70a	32.22a	18.94a	14.38a	14.24a
2	18.16b	14.78b	14.28b	07.18b	14.12b
3	16.68b	13.29b	13.66b	06.46c	14.18a
	17.82b	15.22b	13.41b	08.14b	08.28c
	17.24b	14.13b	10.76c	08.52b	10.26b
	16.92b	18.40b	15.22ab	07.28b	08.32bc
	16.25b	13.34b	13.20b	06.48c	08.64c

0 = Control 1 = One Weeding Frequency 2 = Two Weeding Frequency 3 = Three Weeding Frequency

Means with the same letter (s) within a column are not significantly different at P < (0.05) Duncan's' Multiple Range Test (DMRT).

Leaf area (cm^2)

Significant difference was observed among treatment means at P $\leq$ 0.05 (Table1). Treatment 0 significantly recorded lower mean values throughout the period of assessment, while treatment 3 significantly recorded higher mean values throughout the period of measurement. This observation may mean that treatment 0 which was not weeded could not control weeds very effective as treatment 3. The results indicated that competition between weeds and okra went in favour of weeds at the detriment of the crop. On the other side, treatment 3 which was weeded three times was able to control weeds very effective making plants under this treatment to perform very well in producing higher mean values of both growth and yield parameters throughout the period of measurement. This observation is in line with the work of (Roberts, 1976).

Number of pods/plant

A significant difference was observed at P $\leq$ (0.05) among treatment means in 2010 and 2011 cropping seasons. Treatment 0 significantly gave the lowest mean values, while treatment 3 significantly produced the highest mean values throughout the period of measurement (Table 1). This observation could mean that 0 weeding regime was not very effective in controlling weeds in all plots under this treatment; thereby resulting into lower performances of the crop under these plots thus, giving out lower mean values of pod number per plant. When treatment 3 was weeded three times it succeeded in eliminating weeds from all plots under this treatment and a reduction in competition between plants and weeds. Hence, making plants under treatment 4 to photosynthesize more, grow well and give out higher mean values of number of pods/plant as observed by (Hudu, 1999; Aladesanwa and Adejobi, 2007 and Roberts, 1976) that the more the weeding frequency, the higher the yield of any crop. Also, the lower the weeding frequency the lower the yield of any crop as a result of competition between the crop and weeds on nutrients for survival.

Pod yield/plot (kg)

Significant difference was observed among treatment means at P $\leq$ (0.05). Treatment 0 significantly produced the lowest mean values among other treatments, while treatment 3 significantly produced the highest mean values among other treatment means (Table 1). The lower mean values of treatment 0 could be due to higher competition between the crop and weeds which resulted in lower photosynthetic ability and performances of the crop in all plots under this treatment. The higher mean values of treatment 3 could be that, there was less competition between weeds and the crop which resulted into higher performances of the crop in all plots under this treatment. Hence, higher mean values of pod yield per plant were produced. This observation is in line with works of (Tijani-Eniola *et al.,* 2006; Schippers, 2000; Rodenburg and Johnson, 2009) who earlier reported that the lower the infestation of weeds in a crop, the higher the performances of the crop in terms of growth as well as yield. However, the higher the infestation of the crop by weeds, the lower the performances of the crop in terms of growth and yield parameters.

Pod yield/ha (tons)

Significant difference was observed among treatment means at P $\leq$ (0.05). Treatment 0 significantly produced the lowest mean values among other treatments, while treatment 3 significantly produced the highest mean values among other treatment means (Table 1). The lower mean values of treatment 0 could be due to higher competition between the crop and weeds which resulted in lower photosynthetic ability and performances of the crop in all plots under this treatment. The higher mean values of treatment 3 could be that, there was less competition between weeds and the crop which resulted into higher performances of the crop in all plots under this treatment. Hence, higher mean values of pod yield per plant were produced. This observation is in line with works of (Tijani-Eniola *et al.,* 2006; Schippers, 2000; Rodenburg and Johnson, 2009) who earlier reported that the lower the infestation of weeds in a crop, the higher the performances of the crop in terms of growth as well as yield. However, the higher the infestation of the crop by weeds the lower the performances of the crop in terms of growth and yield parameters.

Weed density/m²

Table 2 shows a significant difference at $P \leq 0.05$ on weed density due to weed control methods among the treatments. The control treatment significantly gave higher mean values than the rest of the treatments. On the other hand, treatment 3 significantly gave lower mean values of weed density than the rest treatments. This means that a combination of weed control methods involving the chemical control + hand weeding significantly controlled weed population in all plots under this treatment. This observation is in agreement with works of Mathew and Screenivasan (1998) who earlier reported that the presence of weeds reduced yield by 82 % and significant yield increase in pod was noted by controlling weeds up to45 days of sowing. Also, Dadari (2003) and Silva *et al.* (2003) earlier reported that the use of herbicides in cowpea to control weeds appears to be useful and considered to be more effective against weeds.

Weed dry matter (gm/m²)

Table 3 shows a significant difference on weed dry matter among treatment means at $P \leq (0.05)$. The control treatment significantly gave higher weed dry matter than the rest treatments, while treatment 3 significantly gave lower mean values on weed dry matter at $P \leq (0.05)$ in all the two cropping seasons. This observation may mean that there was less competition between the crop and weeds since 3 weeding regimes were employed under this treatment, it succeeded in eliminating most of the weeds there by resulting into a lower competition between the crop and weeds for nutrients, space, light, water and carbon dioxide. However, in the control treatment which had an opportunity for the crop and weeds to compete for nutrients, space, light, water and carbon dioxide gave the weeds the advantage to supersede the crop and utilized resources at its detriment giving the weeds the dominant advantage over cowpea. This resulted in a higher population of weeds in all plots under this treatment over other treatments and hence, higher biomass production in this treatment than the rest. This observation is in agreement with the report of Dadari (2003) that competition between weeds and crop starts right from germination of the crop up to harvest affecting both growth and yield parameters adversely.

Conclusion

From the results obtained on the effect of weeding regimes on growth and yield of okra, it can be concluded that treatment 4 seemed to be the optimum treatment for okra production due to the superior performances of this treatment as it affected all growth and yield parameters measured.

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