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Morpho-physiological and yield response of okra to fertilizer application and weed control

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Introduction

Okra (*Abelmoschus esculentus* (L) Moench) is one of the most important fruit vegetables widely grown all over tropical, subtropical and warm temperate regions of the world. In Nigeria, it is produced predominantly by peasant farmers, usually in home gardens or in mixture with other cereal crops for its young leaves and green pods. The pods contain a mucilaginous substance that is used to thicken soups and stews. The mucilaginous substance is also used as plasma replacement or blood volume expander (Onunkun, 2012). Okra is also boiled or fried and eaten as vegetable. It can also be cut into pieces, dried and/or powdered and stored for use in soups during the dry season when fresh okra fruits are scarce. The young leaves are also boiled and used in soups. The leaves are further used for medicinal purposes. Okra seeds contains about 20% protein similar to amino acid composition of soybean protein and 20% oil (similar in fatty acid composition to cotton seed oil) (Siemonsma and Hamon, 2004). The fruits are exported by some African and Caribbean countries to Europe and America where there is a ready demand from the resident ethnic groups from tropical and sub-tropical countries including Indians, West Africans, Pakistanis and Surinamese.

In Nigeria, the limiting factors to okra production and other vegetables among others include weed management, tillage practices, soil fertility, low yielding varieties and sub-optimal planting density (Adeyemi *et al.*, 2008). Substantial evidence have shown that when weeds interfere with vegetables like okra, it affects their vegetative and reproductive growth and that this is influenced by the period of growth of the crop and the weeds. The time of weed removal is therefore as important as the removal itself. Crops will however respond to weed interference in different ways under varying soil fertility levels. The objective of this research work was to determine the response of okra to fertilizer application and various weed management practices.

Materials and Methods

Two experiments were carried out at Ido in Ido Local government, Ibadan (7^{o} 28' N and 3^{o} 45' E), Nigeria between March/June and August/November 2014 to evaluate the effects of fertilizer application and weed control treatments on the performance of okra. The experiments were laid out in a 2 x 5 split-plot arrangement in a randomized complete block design and replicated four times. The main plots consisted of 2 levels of fertilizer: (NPK 20 10 10) applied at 0 and 300 kg N/ha at 3 weeks after sowing (WAS), while the sub plots had 5 different weed control methods: pre-emergence herbicide super union (SU) (Promectryn 13% + Acetochlor 38%) of 1.2 kg a.i. /ha (P 1.2) with supplementary hoe weeding at 6 WAS, weed free initially for 6 WAS, weed infested for 6 WAS, weed free throughout and weed infested throughout. In all, there were ten treatments combinations. Okra variety NHAe47-4 obtained from National Institute of Horticulture Research and Training (NIHORT), Ibadan, Nigeria was used for the study. The plant spacing was 60 cm x

40 cm, one plant/stand. The plot size was 3.6 x 3.2 m^2 when the field was 33.8 x 18 m^2. Weeding was done manually using hoes according to the various weeding treatments.

Data taken include: plant height, stem diameter, number of branches, number of leaves, leaf area, crop vigour score, leaf chlorophyll readings (SPAD), weed cover scores, weed biomass and okra fruit yield. Data were analysed using ANOVA and means were separated using Duncan's multiple range test.

Results and Discussion

Fertilizer and the weed control treatments significantly influenced the stem diameter, number of leaves, number branches of okra plants as well as the chlorophyll content in the experiments (Table 1). The herbicide treated plots and the plots that were kept weed free for 6 WAS and weed free throughout had plants with significantly thicker stem than those that were kept weed infested for 6 WAS. Okra crop vigour was significantly influenced by weed control treatments. The plots that were kept weed infested throughout and those kept weed infested for 6 WAS had plants that were significantly weaker than plants from other plots. Only plots that were kept weed infested throughout had plants with chlorophyll content that was significantly lower than those from all other plots.

There was no significant difference in the weeds biomass collected from the plots that received fertilizer and those that did not. There were however significant differences in those that were collected from the plots that received different weed control treatments (Table 2). The weed biomass collected from the plots that were kept weed infested throughout the crop's life and plots kept weed infested for 6 WAS were significantly higher than those from the other plots. There were significant differences in the yield components of okra. Keeping the plots weed infested throughout the crop's life resulted in pods with significantly lower pod diameter than other weed control treatments except weed infested for 6 WAS.

Keeping the plots weed free for 6 WAS resulted in significantly higher number of pods than keeping the plots weed infested for 6 WAS, while the herbicide treatment also resulted in production of comparable number of pods to keeping the plots weed free for 6 WAS and beyond. Similarly, fresh weights of pods obtained from plots that were kept weed infested throughout were significantly lower than those obtained from all other treatments in both experiments. Weed infestation for 6 WAS resulted in significantly lower fresh pod weight than all other treatments except the weed infested throughout.

Fertilizer treatments significantly influenced the fresh pod weight and higher values were recorded for all other yield parameters in both experiments. Khan *et al*. (2003) reported no significant differences in yields of okra obtained from nitrogen application rates of 45, 90, and 135 kg /ha of soil residual plus applied N/ha top-dressed with 22, 44 and 66 kg. They further observed that the highest rate of N application tended to delay fruit production. Sajid *et al*. (2012), however observed a significant response of various levels of nitrogen and phosphorus in number of pods/plant and seed yield (kg/ha). Other results obtained from fertility trials on okra by most researchers also showed that the crop has significant positive yield response to fertilizers.

Table 1: Effects of fertilizer and weed control on morpho-physiological parameters of okra

	Number of leaves/plant	Leaf area(cm^2)	Number of Branches	Stem diameter	Crop vigour	Chlorophyll content
Fertilizer NPK						
300 kg /ha	17.3a	607	2.7a	18.8a	6.43	36.97a
0 kg /ha	14.2b	519	2.2b	15.3b	4.88	34.71b
Weed control						
P 1.2 SHW	16.0b	533b	2.8b	19.7a	6.00b	36.7a
WF 6WAS	19.2ab	837a	2.7b	19.3a	7.38ab	37.8a
WI 6WAS	18.2ab	573ab	3.5a	17.3b	3.00c	33.8b
WF throughout	20.1a	659ab	3.0ab	19.8a	7.50a	37.9a
WI throughout	5.0b	213c	0.3c	9.15c	4.38c	33.1b

Means with the same letter(s) under the same treatment in a column are not significantly different according to DMRT ($P \leq 0.05$); P 1.2 = Pre-emergence herbicide at 1.2 kg a.i./ha; SHW = Supplementary Hoe-weeding; WF = Weed Free; WI = Weed Infested; WAS = Weeks after Sowing

Table 2: Effects of fertilizer and weed control treatments on weed dry weight, yield and yield components of okra

	Cumulative weed dry weight (t/ha)	Pod length	Pod diameter	Number of pods (x1000/ha)	Pod fresh weight (t/ha)
Fertilizer NPK					
300 kg /ha	5.2	48.9	20.2	965	15.90a
0 kg /ha	5.0	50.3	20.6	778	12.97b
Weed control					
P 1.2 SHW	2.8b	50.6ab	21.1a	1195a	19.20a
WF 6WAS	3.1b	51.8a	21.3a	1139a	19.22a
WI 6WAS	7.1a	50.3ab	20.6ab	861bc	14.15b
WF throughout	3.8b	53.9a	21.3a	1097ab	18.38a
WI throughout	8.6a	41.7b	17.7b	292d	4.49c

Means with the same letter(s) under the same treatment in a column are not significantly different according to DMRT ($P \leq 0.05$); P 1.2 = Pre-emergence herbicide at 1.2 kg a.i./ha; SHW = Supplementary Hoe-weeding; WF = Weed Free; WI = Weed Infested; WAS = Weeks after Sowing

Earlier report by Ibe *et al*. (2008) have indicated improved okra yields on plots given adequate weed control. The fresh pod yield values in this report are high compared to those reported by

Adejonwo *et al*. (1989) (8 t/ha). This might be due to varietal difference as well as fairly high nutrient in the soil.

Conclusions and Outlook

Pre-emergence herbicide application of super union at the rate of 1.2 kg active ingredient per hectare with a single supplementary hoe-weeding at 6 weeks after sowing gave crop performance that was comparable to the control of weed free check as well as keeping the plots free for 6 weeks after sowing. This treatment gave maximum pod fresh yield in the first trial and gave satisfactory yield (67%) of the maximum yield in the second trial. It can be recommended that pre-emergence application of the herbicide acetochlor plus prometryne (super union) can be used with supplementary hoe-weeding to reduce the drudgery of weed removal. Fertilizer application enhanced the production but may not be necessary on soils with similar nutrient status for okra production.

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