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Research paper

Critical Period for Weed Control in Okra (*Abelmeschus esculentus* L. *Moench*) in Dongola, Northern State, Sudan

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ABSTRACT

An experiment was conducted at Altoraa, Dongola Locality, Northern State – Sudan, for two consecutive summer seasons (2014, 2015) to determine okra yield losses due to weed infestation and the critical period of weed/crop competition. Combined analysis showed that, crop growth components were adversely affected by weed competition. Plant height, number of branches/plant, number of leaves/plant and shoot dry weight were significantly reduced by 15, 39, 41 and 50%, respectively, compared to the weed-free plots. Results of combined analysis of the two seasons indicated that, unrestricted weed growth significantly reduced okra dry pod and seed yield by 72.81 and 40.58%, respectively, compared to the weed free plots. The study also showed that, the critical period of weed/okra competition was between 6 and 8 weeks after sowing.

Key words: Yield loss, weed-free, infestation and weed competition

الفترة الحرجة لمكافحة الحشائش في محصول البامية (*Abelmeschus esculentus* L. Moench) بمحلية دنقلا-الولاية الشمالية-السودان

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أجريت تجربة بقرية الترعة–محلية دنقلا – الولاية الشمالية – السودان، لموسمين صيفيين متعاقبين 2014 و2015 لتحديد الضرر الذى تحدثه الحشائش في محصول البامية والفترة الحرجة لمكافحة الحشائش للمحصول. أوضحت الدراسة بالتحليل المشترك للموسمين أن مكونات نمو النبات قد تأثرت سلبا بمنافسة الحشائش. الارتفاع وعدد الفروع وعدد الاوراق والوزن الجاف للنبات انخفضت معنويا بنسب 15، 39، 41 و 50% علي التوالي مقارنة بالشاهد النظيف من الحشائش. التحليل المشترك للموسمين اوضح ان وجود الحشائش ادي الي خفض معنوي للقرون الجافه والبذرة للبامية بنسب 73 و 41% علي التوالي مقارنة بالشاهد النظيف. كما اوضحت الدراسة ان الفترة الحرجة لمكافحة الحشائش للمحصول ما بين سته وثمانية اسابيع بعد الزراعة.

كلمات مفتاحية: الفقد فى الانتاجية، خالية من الحشائش، الانتشار والمنافسة بين الحشائش

Introduction

Okra (*Abelmeschus esculentus* (L) Moench, family is Malvaceae) is one of the most important and popular vegetable grown in Sudan and the world. The world production of okra as fresh fruit vegetable is estimated at 6 million tonnes per hectare (Lyagba *et al.*, 2012). It's main producing countries are India, Nigeria, Pakistan and Ghiana, where India at the top with a total production of 3,550,000 metric tons (FAO, 2004).

In Sudan, it is ranking third after onion and tomato with annual average area and yield of 58014 feddans and 291376 tons, respectively. It grows well in most parts of the country, in the tropical and subtropical areas under irrigation and rain-fed area (Ahmed, 2007 and Nagwa, 2012). It is grown mainly for its green pods which are used as vegetable, principally in soups and stews. Locally, the pods either fresh (Bamia) or dried (Weika), are cooked with meat making a favorable and popular dishes by most Sudanese (Umrogaiga and Tagalia). It is a typical food in combination with sorghum bread (Kisra). The leaves are also cooked in many areas. The seeds, roasted and ground to powder are used as a substitute of coffee.

One of the main problems that affect yield and quality of okra crop is weed interference and its competition with the crop (Imoloame, 2013). A critical period for weed competition (CPWC) is defined as the period in the crop growth cycle during which weeds must be controlled to prevent unacceptable yield losses (Vanacker *et al*., 1993).

In Sudan okra crop received little attention and the available information is inadequate especially in area of weed competition. Thus, this study was conducted to assess the magnitude of dry pod and seed yield losses in okra due to weed infestation and to determine the critical period of weed/crop competition.

Materials and Methods

A field experiment was conducted during two consecutive summer seasons (2014 and 2015) at Alotraa, Dongola locality, Northern State-Sudan. The area is located within latitudes 16° and 22° N, and longitude 20° and 32° E. Dongola locality is a true desert, is characterized by extremely high temperatures and radiation in summer, low temperature in winter, scarce rainfall and high wind speed. The mean maximum and minimum temperatures are 36.8 and 19.5°C, respectively. The climate is hyper arid with a vapor pressure of only 10.8 mb and a relative humidity of less

than 20 % (Osman, 2004). The soil in the experimental site is a sandy clay loam, with 57.3% sand, 19.8% silt and 22.5% clay (Damirgi and Al-agidi, 1982).

Two sets of treatments were undertaken. In the first set, the plots were initially kept weedy for 0, 2, 4, 6, 8 and 10 weeks after sowing and then weed-free till harvest. In the second set, the plots were initially kept weed-free for 0, 2, 4, 6, 8 and 10 weeks after sowing by repeated hand-weeding and then left weedy till harvest.

The land was ploughed, harrowed and leveled. The sub-plots (3x3.5 m) were arranged in a randomized block design with 4 replicates. Okra (cultivar Khartuomia) was planted (3 seeds/hole) on flat at an intra row spacing of 25 cm and in rows of 70 cm a part during February. Irrigation interval was 10 days. Two weeks after sowing the seedlings were thinned to two plants per hole. One spray of Folimat was made to control aphids. Urea fertilizer was applied at a rate of 80 lb nitrogen/fed. At ten weeks after sowing 10 plants were randomly selected in each plot to determine plant height (cm), number of branches/plant, number of leaves/plant and shoot dry weight (g)/plant. At each picking, ten plants were randomly selected in each plot to determine mean number of pods/plant and mean dry pod yield (kg/fed). Two rows in each plot were kept unpicked until harvest, ten plants were randomly selected in each plot from those kept unpicked, their pods were cut and threshed in bulk to determine number of seeds/pod, 100 seed weight (g) and seed yield (kg/fed) (Baada, 1995).

Yield data were analyzed by the analysis of variance and means were separated by the Duncan's Multiple Rang Test. Combined analysis was done for the data of the two seasons.

Results and Discussion

The total number of predominant weed species/m^2 in the experimental site explained into the brackets and they were: *Chenopodium album (L.)* (69.2), *Malva parviflora (L)* (67.4), *Convolvulus arvensis* (L.) (65.6), *Amaranthus graecizans* (60.8), *Sorghum arundinaceum* (57.2), *Gynandropsis gynandra* (L.) Briq (54.8), *Sinapis arvensis* (L.) (49.4), *Tribulus terrestris* (L.) (48.0), *Datura stramonium* (L.) (46.8), *Cynodon dactylon* (L.) Pers (46.8), *Cyperus rotundus* (L.) (42.2), *Eruca sativa* (39.4), *Portulaca oleracea* (L.) (35.8), *Dactyloctenium aegyptium* (L.) Beauv. (25.2), *Sporobolus pyramidatus* (Lam.) Hitchc (20.4), *Sonchus oleraceus* (L.) (18.8) *Hyoscyamus reticulates* (15.4), *Echinochloa colona* (L.) Link (13.2), *Tephrosia apollinea* (Del.)

(13.2), *Cassia italica* (Mill.) Lam. Ex Steud (11.8), *Calotropis procera* (Ait.) Ait. f. (11.8), *Aerva javanica* (Burm. f.) (10.0), *Rhynchosia memnonia* (Del.) cooke (9.4) and *Lotus arabicus* L. (9.0).

The most three predominant weeds were *Chenopodium album (L.), Malva parviflora (L)* and *Convolvulus arvensis* (L.).

Combined analysis showed that, crop growth components were adversely affected by weed competition. Plant height, number of branches/plant, number of leaves/plant and shoot dry weight were significantly reduced by 15, 39, 41 and 50%, respectively, compared to weed-free check. Similar results were reported by Mohammed *et al.* (2013) and Adeyemi *et al.* (2014).

Table (1): Influence of duration of weed interference on growth components during summer seasons 2014 and 2015 combined

Treatments	plant height (cm)	Number of branches/ plant	Number of leaves/ plant	Shoot dry weight (g)
Weed free for 2 weeks	**86.6 abcd**	**2.1 de**	**24.6 c**	**32.1 bcde**
Weed free for 4 weeks	**88.6 abc**	**2.3 cde**	**28.4 c**	**32.6 bcde**
Weed free for 6 weeks	**84.6 abcd**	**1.9 e**	**30.1 bc**	**32.1 bcde**
Weed free for 8 weeks	**92.6 ab**	**2.8 bcd**	**36.0 ab**	**33.9 bcd**
Weed free for10 weeks	**91.8 abc**	**3.3 ab**	**42.9 a**	**46.0 a**
Weedy for 2 weeks	**93.9 a**	**2.9 b**	**37.0 ab**	**38.5 abc**
Weedy for 4 weeks	**97.5 a**	**2.8 bc**	**36.3 ab**	**40.1 ab**
Weedy for 6 weeks	**79.1 cde**	**2.9 b**	**36.4 ab**	**37.4 abc**
Weedy for 8 weeks	**75.4 de**	**3.0 ab**	**37.0 ab**	**27.5 cde**
Weedy for 10 weeks	**67.9 e**	**3.6 a**	**38.0 a**	**23.8 de**
Weed free full season	**94.4 a**	**3.3 ab**	**41.4 a**	**43.4 ab**
Weedy full season	**80.0 bcde**	**2.0 de**	**24.5 c**	**21.5 e**
SE±	**13.3%**	**23.2%**	**18.3%**	**30.9%**
CV%	**5.7**	**0.3**	**3.1**	**5.3**

Treatment means with the same letters are not significantly different at p (0.05) according to Duncan's Multiple Range Test.

Combined analysis of the two seasons indicated that, unrestricted weed growth, significantly, reduced okra dry pod and seed yields by 72.81 and 40.58%, respectively, compared to the weed free check (Table 2 and figure 1). This could be attributed to the presence of weeds which compete with the crop for essential mineral nutrients, water and light which resulted in reduction of plant growth parameters and henceforth decreased okra dry pod and seed yields.

Similar results for reduction in dry pod yield was found by Mani (1977), while reduction in seed yield is similar to the findings of Mohammed *et al.* (2013); Rasheed and Oluseun (2009); Bhalla and Parmar (1982) and singh *et al.* (1981).

A critical period for weed control (CPWC) is defined as the period in the crop growth cycle during which weeds must be controlled to prevent unacceptable yield losses (Oroka and Omovbude 2016).

Results showed that, okra dry pods and seed yield increased when the duration of weed infested period decreased. Similar results were found by Covindra *et al.* (1982), Iremiren (1988) and Oroka and Omovbude (2016). These results indicated that, the critical period of weed/okra competition was between 6 and 8 weeks after sowing (Figure 1). Further, these results were also in line with that obtained by Adeyemi *et al.* (2014) who reported that, the critical period of weed interference in okra was between 3 and 16 WAS; Imoloame (2013) who showed that, the critical period of weed/ okra competition was between 2 weeks after planting until harvest; Rasheed and Oluseun (2009) who said that, the critical weed-free period was between 2- 8 WAS in okra; Kumar and Charanjit (1986) who reported that, critical level in okra was 40 days after sowing and Sigh *et al.* (1981) who mentioned that, the critical period of weed competition in okra was between 2 to 6 WAS. However, the results obtained in this study did not agree with those found by Temnotfo and Henry (2017) who reported that, the critical period of weed interference in okra was 36 days after sowing; Imoloame (2013) who depicted that, the critical period of weed competition in okra was between 2 and 4 weeks after sowing and Mohammed *et al.* (2013) who reported that, the critical period for weed competition in okra was between 20 to 30 days after planting. The differences in the critical period of weed/okra competition is mainly due to many factors such as differences in weed species, weed infestation, environment, plant density, time of competition, soil fertility and crop cultivar.

Conclusions

1. The critical period for weed control in okra is between 6 and 8 WAS.
2. Weed control in okra should be carried out using post-emergence herbicides before 6 WAS.
3. Removing weeds in okra by hand or mechanical should be carried out before 6 WAS.
4. Removing weeds in okra during the critical period will negatively affect crop yield.

Table (2): Influence of duration of weed interference on yield and its components during summer seasons 2014 and 2015 combined

Treatments	Number of pods/plant	Number of seeds/pod	100 seed weight (g)	Seed yield (kg/fed.)
Weed free for 2 weeks	15.59bcd	56.53b	5.750a	726.6cd
Weed free for 4 weeks	17.81abc	66.25a	6.000a	955.5bc
Weed free for 6 weeks	17.17abc	65.80a	5.500a	963.9bc
Weed free for 8 weeks	16.99abc	62.78ab	5.500a	1012.1b
Weed free for 10 weeks	19.76a	61.53ab	5.875a	1201.13ab
Weedy for 2 weeks	17.79bc	66.28a	5.50a	1291.4a
Weedy for 4 weeks	19.09a	64.22ab	6.000a	1138.1ab
Weedy for 6 weeks	16.99abc	63.83ab	6.000a	1020.5 b
Weedy for 8 weeks	16.02bc	62.85ab	5.500a	751.8cd
Weedy for 10 weeks	13.07d	59.83ab	5.750a	665.6d
Weed free full season	18.39ab	66.40a	5.75a	1138.1ab
Weedy season	15.52cd	61.13ab	5.750a	676.3d
SE±	14.20%	11.90%	14.80%	23.24%
CV%	**1.2117**	**3.7509**	**0.4171**	**111.7663**

Treatment means in the same column with the same letters are not significantly different at p (0.05) according to Duncan's Multiple Range Test.

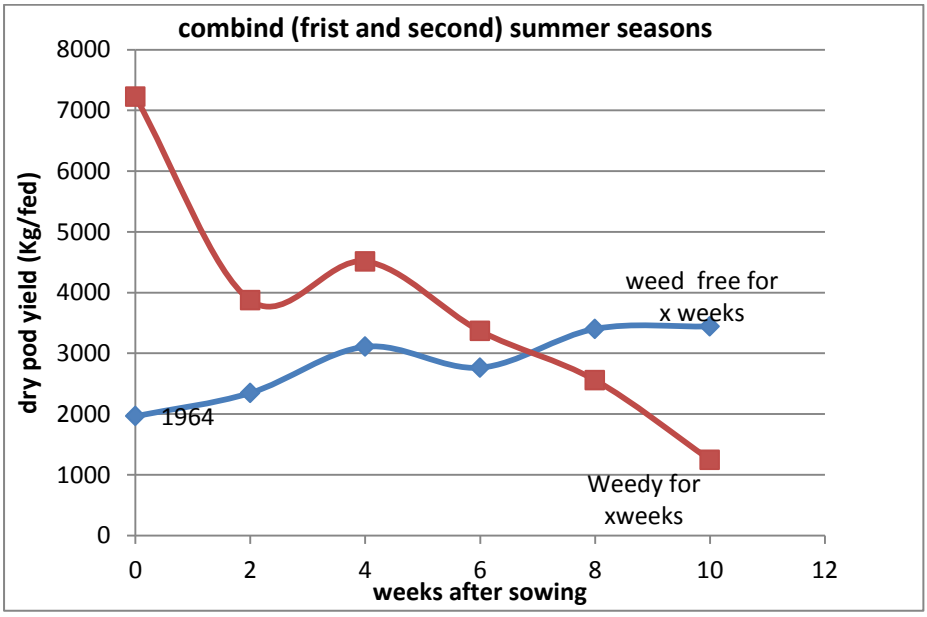

Fig. 1: Effect of weed competition on dry pod yield (kg/fed) during summer seasons 2014 and 2015, combined

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