Critical Period of Weed Interference in Sesame (*Sesamum indicum* L.) in Dongola Locality, Northern State, Sudan

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Abstract: A field experiment was conducted at Altraa village, Sherg Elneel Unit, Dongola Locality, Northern State, Sudan, during two consecutive summer seasons of 2010 and 2011 to determine yield loss in sesame (*Sesamum indicum* L.) inflicted by weeds and to identify the critical period for weed interference. Sesame, cultivar Promo, was sown on 23 June in both seasons. A set of weeding regimes comprised of 12 treatments was arranged in randomized complete block design, with four replicates. The crop was kept weed-free for the first 2, 4, 6, 8 or 10 weeks after crop sowing and then remained weedy till harvest or kept weedy for the same periods and then remained weed-free till harvest. Weed free and weedy treatments till harvest were included as controls for comparison. Combined analysis of both seasons indicated that unrestricted weed growth significantly reduced sesame seed yield by 53.2% compared to weed free full season treatment. Seed yield decreased as the weed infestation period increased. Number of leaves/plant was significantly reduced by 58.93% under full season weed infestation. The same trend was observed for the first capsule height from the soil surface, plant height, and number of branches/plant. The critical period of weed competition was found to be between 2-6 weeks after crop planting.

Key words: The critical period, Weed competition.

Introduction

Sesame (*sesamum indicum* L) belongs to the Family Pedaliaceae. It is one of the most important vegetable oils and cash crops in the Sudan. It ranks third in area after sorghum and millet. It draws its importance from the fact that it is a food crop, raw material for industry, feed for livestock, as well as a leading export crop. Sesame is grown mainly in the rainfed sector under traditional and mechanized farming systems. However, the cultivated area and yield fluctuated from season to another due to variation in the production factors. Sudan is the second in volume of sesame exports as it cultivats 80% and 40% of the sesame area in the Arab world and African continent, respectively (Mohamed *et al*., 2008 and Abdel Rahman *et al.*, 2009). Weeds constitute a serious obstacle in sesame production. They interfere with the utilization of land and water resources and thus adversely affect human welfare (Mukhtar and Elamin, 2011). Weeds are the major constraint to crop production in all cultivated areas in Sudan. Unrestricted weed growth promotes soil degradation in cultivated lands and reduces yield of the main crops by 50-100 % (Hamada, 2000). 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. Controlling weeds based on CPWC is the most appropriate way to optimize weed control.

With the aid of CPWC it is possible to make decisions on the need for and timing of weed control and to control weeds only when required (Abdelmarouf, 2004 and Mukhtar and Hamada, 2011). The two approaches commonly used to determine the CPWC are i) the crop is kept free from weeds until a certain time, after which weeds are allowed to grow and ii) weeds are allowed to grow from the beginning to a certain time, after which they are removed until the end of the growing season (Mukhtar, 2006). If approach i) is followed, there is a minimum time limit called minimum time point weed free (MTPWF), until which the crop must be kept weed-free from the beginning of growth to avoid crop losses from weeds emerging thereafter. If approach ii) is followed, there is a maximum time limit, called maximum time point under weed infestation (MTPWI), after which the crop must be kept free from weeds emerging with crop to prevent competition causing yield loss. The time interval between (MTPWF) and (MTPWI) is defined as the CPWC (Mahgoub, 2002).

In Sudan, sesame received little attention and the available information is inadequate especially in the area of weed competition. The

present study was, therefore, conducted to assess the magnitude of yield losses in sesame due to weed infestation and determine the critical period for weed competition.

Materials and Methods

A field experiment was conducted for two consecutive summer seasons of 2010 and 2011 at Altraa village, Sherg Elneel Unit, Dongola Locality, Northern State, Sudan. The area is located within latitudes 16° and 22° N, and longitude 20° and 32° E. It is true desert with 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 vapour pressure of 10.8 mb and a relative humidity less than 20% (Mukhtar, 2012).

The soil of the area is sandy clay loam, with 57.34% sand, 19.83% silt and 22.50% clay (Damirgi and Al-agidi, 1982). The land was ploughed, disc harrowed, leveled and divided into plots. A set of weeding regimes comprised of 12 treatments was arranged in randomized complete block design, with four replicates. The crop was kept weed-free for the first 2, 4, 6, 8 or 10 weeks after crop sowing and afterward remained weedy till harvest or kept weedy for the same periods and then remained weed- free till harvest. Weed free and weedy treatments till harvest were included as controls for comparison. Plot size was 5×4.2 m. Each plot was consisted of seven ridges, each five meters long. Sesame, cultivar Promo, was sown on 23 June in both seasons.Three seeds per hole were planted in ridges 60 cm apart and 20 cm between holes, on the ridges. The seedlings were later thinned to one plant per hole. Urea at 48 kg /fed was applied at thinning. In the weed free full season treatment, weeds were removed frequently by repeated hand weeding to keep the crop free from weeds till harvest. However, in the weedy full season treatment weeds were left to grow, unrestrictedly, with the crop until harvest. Irrigation water was applied at 7-10 days interval depending on temperature and other environmental conditions. The insecticide, Morisban, was applied to control the heavy infestation of termites in both seasons.

At 10 weeks from sowing, 5 plants were randomly selected from the two inner ridges in each plot. First capsule height from the soil surface, plant height, number of branches/plant and number of leaves/plant were determined. At harvest capsules from ten randomly selected plants in each treatment were cut, air dried and used for determination of yield characters inc-luding, number of capsules/plant, number of seeds/capsule and 1000 seeds weight. Plants from the inner 2 ridges (4×1.2 m.) was harvested in each plot, air dried, threshed, weighted and the total seed yield calculated.

The procedure described by Gomez and Gomez (1984) was used to estimate the combined analysis of variance (ANOVA), carried out on data obtained using the stati-stical analysis system (SAS) computer package for SAS Institute Inc., 1990, to detect signi-ficant effects among the treatments and populations. Mean squares for treatments or populations were calculated. Simple statistics including mean, standard deviation, standard error and coefficient of variation (C. V. %) were also calculated.

Results and Discussion

The weed flora in the experimental site consisted of grassy and broad-leaved weeds. The dom-inant weed species were *Cynodon dactylon* (L.) pers., *Sorghum arundinaceum*. (Dew.) Stapl, *Convolvulus arvensis* L., *Malva palvi-flora* L., *Cyperus rotundus* L., *Datura stram-onium* L., *Eruca sativa* Mill., *Sonchus oleraceus* L., *Amaranthus graecizans* L., *Tribulus terrestris* L., *Cassia italica* (Mill.) Lam. Ex Steud., *Desmostachya bipinnata*, *Tephrosia apollinea* (Del.) DC, *Echinochloa colona* (L.) Link, *Aerva javanica* (Burm. f.), *Euphorbia aegyptiaca* Boiss., *Calotropis procera* (Ait.) Ait. f., *Ipomoea cordofana* Choisy, *Lotus arabicus* L., *Rhynchosia memn-onia* (Del.) cooke, *Dactyloctenium aegyptium* (L.) Beauv, *Sporobolus pyramidatus* (Lam.) Hitchc., *Portulaca oleracea* L., *Corchorus olitorius* L., *Citrullus lanatus* and *Hyoscyamus reticulates*. Sesame is a plant which is extre-mely sensitive to weeds competition because it emerges more slowly than weeds. Weed competition for water, nutrients and light is one of the major factors limiting the yield of

sesame as its seedling grows slowly during the first four weeks making it a poor competitor at earlier stages of crop growth (Bennett and Conde, 2003). Combined analy-sis of both summer seasons indicated that unrestricted weed growth significantly reduced sesame seed yield by 53.2% compared to weed free full season treatment (Table 1). This is in line with the finding of Grichar et al. (2011) who reported that, unrestricted weed growth could lead to high losses ranging from 65% to 95% in sesame crop yield. Also, similar results were reported by Zubair *et al.,* (2011) who showed that, insufficient weed control during early growth period of sesame causes yield reduction between 35% to 70%. These results could be attributed to the presence of weeds which compete with the crop for essential mineral nutrients, water and light which reduce plant growth and decrease sesame yield.

Results of this investigation revealed that sesame seed yield increased when the duration of weed infestation period decreased. This supports the work of Grichar *et al.,* (2011) who reported that, sesame seed yield reduction by weeds was directly related to the duration of weed interference. The reduction in sesame seed yield due to weeds interference occurred mainly through reduction in yield components including number of capsules/plant, number of seeds/capsule and 1000 seed weight (Table 1).

The CPWC in sesame was between 2 and 6 weeks after crop planting (Table 1). This is in agreement with results obtained by Singh *et al*., (1993) and Mizan (2011) who reported that the CPWC in sesame was between 15 and 45 days after sowing. Moreover, the result was in line with that of Mizan *et al*. (2009) and Zubair *et al*., (2011) who showed that the CPWC in sesame was between 10 and 45 days after emergence.

However, the result obtained from this work is at variance with that of obtained by Grichar *et al*. (2001) who showed that, the CPWC in ses-ame is more than 50 days after seedling emergence. This is expected, because the CPWC is influenced by several factors incl-uding weed species, density or ground covered by weeds, the environment, plant density, time of weed competition, soil fertility and crop cultivar (Mahgoub, 2002 and Mukhtar *et al*., 2007). Growth parameters were adversely affected by weed competition. Number of leaves/plant was significantly reduced under full season weed infestation. The same trend was observed for the first capsule height from the soil surface, plant height, and number of branches/plant (Table 2).

It is evident that a weed-free period starting from 2nd to 6th week after sowing is necessary to provide high seed yield. To attain a weed-free environment in sesame, pre or post-emergence herbicides, mechanical and hand weeding during this period should be timed and adjusted to the critical period of weed competition only. In this, way use of persistent soil acting herbicides could be avoided and weed control treatments minimized.

Conclusions

Sesame seed yield decreased as the duration of the weed, period increased.

The reduction in sesame seed yield due to weeds interference was mainly through reduction in number of capsules/plant and number of seeds/capsule.

Combined analysis of both seasons indicated that unrestricted weed growth accounted for 53.2% loss in sesame seed yield.

The CPWC in sesame was between 2 and 6 weeks after crop planting.

Table 1: Effect of weed interference on seed yield and yield components during both seasons, combined

Treatments	Number of capsules/plant	Number of seeds/capsule	1000 seed weight (g)	Seed yield (kg/fed.)
Weed-free for 2 weeks 2	113.04a	51.90a	3.00a	261.60b
Weed-free for 4 weeks	133.05a	51.36a	3.50a	381.44a
Weed-free for 6 weeks	121.63a	49.00ab	3.30a	388.70a
Weed-free for 8 weeks	122.99a	47.84ab	3.50a	379.30a
Weed-free for 10 weeks	122.85a	51.58a	3.25a	362.30a
Weedy for 2 weeks	126.42a	47.01ab	3.00a	390.80a
Weedy for 4 weeks	123.43a	46.00b	2.50a	234.20b
Weedy for 6 weeks	105.03ab	47.30ab	3.50a	214.40b
Weedy for 8 weeks	106.45ab	49.30ab	3.25a	212.70b
Weedy for 10 weeks	93.40b	43.42b	3.50a	219.40b
Weed free full season	144.77a	54.94a	3.50a	411.33a
Weedy full season	55.90c	33.20c	3025a	192.50b
C.V%	20.16	07.53	24.05	27.85
S.E.±	9.02	0.29	0.41	24.93

-Means with the same letters in a column are not significantly different at 0.05 level of probability according to DMRT.

Table 2: Effect of weed interference on plant growth parameters during both seasons, combined

Treatments	First capsule height from soil surface (cm)	Plant height (cm)	Number of leaves/ plant	Number of branches/plant
Weed-free for 2 weeks 2	122.70a	164.70a	277.90a	9.80b
Weed-free for 4 weeks	120.80a	160.55a	258.80a	8.80b
Weed-free for 6 weeks	126.50a	167.50a	282.20a	9.90b
Weed-free for 8 weeks	122.80a	157.60a	284.70a	12.30a
Weed-free for 10 weeks	122.20a	161.10a	266.50a	11.90a
Weedy for 2 weeks	113.85a	157.10a	385.90a	15.20a
Weedy for 4 weeks	119.40a	157.90a	291.10a	12.30a
Weedy for 6 weeks	106.05a	137.90b	309.20a	8.20b
Weedy for 8 weeks	107.25a	137.15b	305.40a	8.40b
Weedy for 10 weeks	105.70a	129.60b	256.80a	10.30b
Weed free full season	129.70a	163.10a	367.20a	15.40a
Weedy full season	107.70a	148.70b	150.80b	7.50b
C.V%	8.47	9.53	29.80	42.33
S.E.±	6.06	6.51	35.97	2.24

-Means with the same letters in a column are not significantly different at 0.05 level of probability according to DMRT.

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تأثير الحشائش على نمو وإنتاجية 25 (Sesamum indicum L.)
بمحلية دنقلا–الولاية الشمالية–السودان

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المستخلص

أجريت هذه التجربة بقرية الترعة، وحدة شرق النيل، محلية دنقلا، الولاية الشمالية، السودان، خلال موسمين صيفيين متعاقبين للعامين 2010 و2011) لتقويم الفقد فى إنتاجية السمسم (*Sesamums indicum* L.) الناجم من الحشائش وتحديد الفترة الحرجة لمنافسة الحشائش. تمت زراعة السمسم فى 6/23 فى الموسمين الصيفيين. شملت التجربة 12 معاملة صممت بإستخدام التصميم العشوائى الكامل بأربع مكررات. تمت إزالة الحشائش من المحصول لفترة 2، 4، 6، 8 أو 10 أسابيع بعد الزراعة وبعد ذلك ترك المحصول موبوءاً بالحشائش حتى الحصاد أو ترك موبوءاً لنفس الفترات وبعد ذلك ترك خالياً من الحشائش حتى نهاية الموسم. المعاملات الخالية من الحشائش والموبوءة بها حتى الحصاد تم تضمينها كشواهد للمقارنة. أشار التحليل المشترك للموسمين إلى أن منافسة الحشائش حدت معنوياً من إنتاجية السمسم بنسبة 53.2% مقارنة بالمعاملة الخالية من الحشائش طول الموسم. هذا وقد إنخفضت إنتاجية بذور السمسم بزيادة فترة منافسة الحشائش. منافسة الحشائش طول الموسم أدت إلى نقص معنوى فى عدد أوراق النبات بنسبة 58.93%. وقد لوحظ نفس التأثير مع إرتفاع أول كبسولة من سطح التربة، إرتفاع النبات و عدد الفروع فى النبات. الفترة الحرجة لمنافسة الحشائش تراوحت بين الأسبوع الثانى والسادس بعد زراعة المحصول.