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Critical period for weed control in sunflower (*Helianthus annuus* L.) in Dongola Locality, Northern State, Sudan

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Abstract:
A field experiment was conducted at the Demonstration Farm of the Faculty of Agricultural Sciences- El Selaim-University of Dongola- Sherg Elneel Unit, Dongola Locality, Northern State, Sudan, during two consecutive winter seasons of 2012/2013 and 2013/1014 to determine yield loss in sunflower (*Helianthus annuus* L.) due weeds and to identify the critical period for weed control. Sunflower, cultivar hysun 33, was sown on 24 November in both winter seasons. This research comprised 12 treatments which were 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 left 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. Broad-leaved weeds were predominant in the experimental site. The results revealed that sunflower seed yield progressively increased with the decrease of weed infestation period. Further, combined analysis of both winter seasons showed that unrestricted weeds interference significantly reduced both yield and yield components and the observed yield reductions was 51.87. Growth components were significantly reduced by weed competition under full season weed infestation treatment. Therefore, the critical period for weed control (C P WC) in sunflower according to this investigation was found to be between 2 to 8 weeks after planting.

Keywords: Yield loss, weed-free, infestation and duration of interference.

Introduction

Sunflower (*Helianthus annuusL*) is a member of the family *Compositae*,. It is widely grown in the U.S.A., Australia, Turkey and Pakistan (Weiss, 1983 and Ali, 2001). The properties of the soils in the Sudan are suitable for commercial production of sunflower. In the Sudan it is grown in Damazin and Gadarif areas which are most favorable for growing sunflower under rainfed conditions and to a lesser extent under irrigated conditions (Abdel Galeel and Tageldin, 1996 and Khidir, 1997). Sunflower has gained greater importance in the Northern state of Sudan as a promising alternative crop during summer season. The crop has become important for both farmers

and consumers. It is considered one of the most important potential cash crops as oilseed crop in the Sudan and can successfully meet future oil requirements, grown as both winter and summer crop (Skoric and Marinkovic,1986 and Abdel Galeel and Tageldin, 1996). Sunflower can be used for many purposes, for its oil, bird feed and human food. Also it is used as a salad oil, for cooking and manufacture of margarine (Heiser, 1976 and Ali, 2001). The seed cake left after the oil is pressed from the seeds, is a rich source of protein and is usually used for feeding livestock. The seed hulls used as fuel and the dried stems of sunflower have also been used for fuel (to start fire) and as a source of commercial fiber. In India and Europe sunflower has medical uses (Heiser, 1976). The crop is facing high competition with weeds which constitute a serious obstacle in its production and the farmers practice is characterized by insufficient or absent weed control. Weeds 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). Controlling weeds based on critical period for weed control CPWC which 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).

In Sudan, sunflower 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 sunflower due to weed interference and determine the critical period for weed control.

Materials and Methods

The experiment was conducted during two consecutive winter seasons (2013/ 2014 and 2014/2015) at the demonstration farm of Faculty of Agricultural Sciences, El Selaim. University of Dongola, Northern State, Sudan that occupies distant northern part of the Sudan and lies between (Latitudes 16˚-22˚N and Longitudes 20˚-32˚ E). The geographyical location is well described by the enunciated bearings and the reference The State lies in the arid and semi-arid (Alaa eldeen, 2016). 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 experimental site was ploughed, disc harrowed, leveled and then divided into 48 plots. Plot size was 3×4 m. Each plot was made of five rows. Sunflower seed (hysun 33) was sown on the flat rows on 21 November in both winter seasons, three to five seeds per hole in each plot, at spacing 60 cm between rows and 30 cm between holes, later thinned to two seedlings per hole and the crop was irrigated immediately after thinning in both winter seasons. The experiment comprised 12 treatments and was arranged in a randomized complete block design (RCBD), with four replications. 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. Nitrogen fertilizer, in the form of urea, was applied at a rate of 48 kg /fed at thinning. In the weed free full season treatment, weeds were removed frequently by repeated hand weeding to keep the crop weed free 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 environnemental conditions. Sunflower

growth components which including plant height (cm), number of leaves/plant, leaf area index and stem diameter (cm) were recorded at 90 days after sowing. Leaf area index was estimating using the punch method (Waston and Waston, 1953).

Yield components characters including head diameter (cm), head weight(g), number of seeds per head and thousand seed weight (g) were determined. To determine seed yield (kg per feddan), area of 1 m^2 in each plot was harvested, air dried, and threshed, then subsequently weighed and the yield (kg per feddan) was calculated.

Statistical analysis:-

The mean collected data of the two seasons was subjected to combined analysis of variance because they were homogenous and the means were separated using Duncan's Multiple Range Test (DMRT) as described by Gomez and Gomez (1984).

Results and Discussion

The weed flora in the experimental site consisted of grassy and broad-leaved weeds. The dominant weed species were *Cynodon dactylon* (L.) pers., *Cyperus rotundus* L., *Sorghum arundinaceum*. (Dew.) Stapl, *Malva palviflora* L., *Eruca sativa* Mill., *Amaranthus graecizans* L., *Tribulus terrestris* L., *Echinochloa colona* (L.) Link, *Euphorbia aegyptiaca* Boiss., *Melilotus Indica* and *Solanium dubium* Fersen. Broad-leaved weeds were predominant in the experimental site. Combined analysis of both winter seasons showed that, growth components were adversely affected by weed competition. Plant height (cm) was significantly reduced under full season weed infestation treatment. The same trend was observed for the number of leaves/plant, leaf area index and stem diameter (cm) (Table 1). Combined analysis of both winter seasons indicated that, unrestricted weed growth significantly reduced sunflower seed yield by 51.87% compared to the weed free full season treatment (Figure 1). This result could be attributed to the presence of weeds which compete with the sunflower crop for essential mineral nutrients, water and light which reduced plant growth parameters and reflected in decreased sunflower seed yield. Similar result was found by Jat and Giri, (2000);. Wanjari *et al*. (2001); Singh and Giri (2001); Daugovish *et*. al. (2003). Keeping the crop weed free for 2, 4, 6, 8, 10 after sowing and weed free full season treatment significantly increased seed yield (kg/ fed.) as compared to the weedy full season treatment . Allowing weeds to compete with the crop for 8 and 10 weeks after planting gave seed yield comparable to the weedy full season treatment. Results of this investigation revealed that sunflower seed yield increased when the duration of weed infestation period decreased. The reduction in seed yield due to weeds interference occurred mainly through reduction in yield components including head diameter (cm), head weight (g), number of seeds/head and 1000 seed weight (g) (Table 2 and Figure 1). Therefore, the critical period for weed control (C P W C) in sunflower according to this investigation was found to be between 2 to 8 weeks after planting in both winter seasons (Figure 1). This is nearly in line with the results of those obtained by Carranza and Savedra (1995) who reported that, the critical period for weed competition was determined to be between the 3 and 7 weeks after sunflower sowing. This slight difference in the critical period is expected, because its period is influenced by many factors including weed species, the environment, plant density, time of competition, soil fertility and crop cultivar. (Mahgoub, 2002; Mukhtar, 2006 and Mukhtar *et al*., 2007). From the results of these studies it can be concluded that, a long weed-free duration starting from 2 weeks after sowing until 8 weeks after planting is necessary to provide high seed yield. Although sunflower

seed yield was increased in all weed removal periods, these increases were positively related with prolonged weed free durations. The highest seed yield was provided from plots in which weeds were left for the shortest period, from emergence until the 2 weeks after sowing in both winter seasons and gave seed yield comparable to the weedy full season treatment. Therefore, the critical period for weed competition (CPWC) in sunflower seems to be between 2 to 4 weeks after sowing in both winter seasons (Figure 1).

Table 1: Influence of duration of weed interference on growth components during winter seasons (2013/2014) and (2014/2015) combined.

Treatments	plant height (cm)	Number of leaves/plant	leaf area index	stem diameter (cm)
Weed free for 2 weeks	73.87 G	24.62G	1.60 G	1.41H
Weed free for 4 weeks	78.50 F	25.88 F	1.79 F	1.88 E
Weed free for 6 weeks	88.63 E	29.49 D	2.40 D	2.22 D
Weed free for 8 weeks	135.93 C	32.08 C	2.72 C	2.65C
Weed free for 10weeks	154.04A	33.66 B	2.92 B	2.81 B
Weedy for 2 weeks	138.73 B	28.90 DE	2.60 C	2.61 C
Weedy for 4 weeks	113.88D	28.35E	2.02 E	1.72 F
Weedy for 6 weeks	77.86F	25.46 F	1.69 FG	1.65 FG
Weedy for 8 weeks	75.39G	23.93 G	1.65FG	1.59 G
Weedy for 10 weeks	68.10H	20.93 H	1.61G	1.34H
Weed free full season	155.13A	34.39 A	3.16 A	2.94 A
Weedy full season	69.06H	20.89 H	1.56 G	1.28 H
SE±	0.6228	0.2471	0.0519	0.0439
CV	1.72	2.55	6.85	6.19

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

Table 2: Influence of duration of weed interference on yield components during winter seasons (2013/2014) and (2014/2015) combined

Treatments	head diameter (cm)	head weight (g)	number of seeds/head	1000 seed weight (g)
Weed free for 2 weeks	12.54 F	65.76 I	704.18 G	52.71 H
Weed free for 4 weeks	13.93 E	75.92 F	727.02 F	73.61 E
Weed free for 6 weeks	14.91 D	91.76 D	835.12 E	82.63 D
Weed free for 8 weeks	15.56 C	94.96 C	944.06 C	110.90 C
Weed free for 10 weeks	16.36 B	96.39 B	993.98 B	123.47 B
Weedy for 2 weeks	14.97D	94.35 C	879.35 D	82.03 D
Weedy for 4 weeks	13.98 E	80.33 E	729.93 F	66.64 D
Weedy for 6 weeks	12.77 F	75.33 F	703.30 G	60.92 F
Weedy for 8 weeks	12.69 F	72.49G	697.79 G	60.27 G
Weedy for 10 weeks	12.13 G	69.78H	691.49 G	53.06G
Weed free full season	17.42 A	99.03A	1067.35 A	130.4A
Weedy full season	12.02 G	64.14 J	686.43 G	52.21 H
SE±	0.1045	0.4387	7.31	0.654
CV	2.09	1.52	2.57	2.34

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

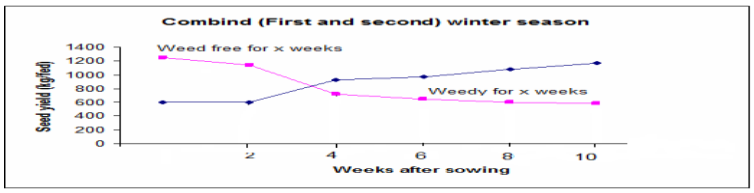

Figure1: Effect of weed competition on seed yield (kg/ fed) during both winter seasons

Conclusions

i) Sunflower seed yield decreased as the duration of the weed competition period increased.

ii) The reduction in seed yield due to weeds interference was mainly through reduction in sunflower yield components

iii) Unrestricted weed growth significantly reduced sunflower seeds yield by 51.87%.

iv) The critical period for weed competition in sunflower was between 2 and 8 weeks after planting.

Recommendations

i) Weed control in sunflower should be carried out by pre-emergence herbicides or by post-emergence herbicides at 2 weeks after sowing.

ii) Removing weeds in sunflower should be carried out from 2 – 8 weeks after sowing.

iii) allowing weeds to compete with the crop should continue for not more than 2 weeks after sowing,

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الفترة الحرجة لمنافسة الحشائش في زهرة الشمس بمحلية دنقلا - الولاية الشمالية - السودان (*Helianthus annuus* L.)

– كلية الدراسات الزراعية – شمبات – جامعة السودان للعلوم و التكنولوجيا – السودان

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المستخلص

أجريت التجربة الحقلية بمزرعة كلية العلوم الزراعية التجريبية بالسليم، جامعة دنقلا، وحدة شرق النيل، محلية دنقلا ، الولاية الشمالية، السودان، خلال موسمين شتويين متعاقبين للعامين في إنتاجية زهرة الشمس لتقويم 012! /2013 و 013! /2014 لتقويم الفقد الناجم من الحشائش وتحديد الفترة الحرجة لـ كافـ ة الحشائش . تمت زراعة صنف هاي صن 33 فى الرابع والعشرين من نوفمبر فى الموسمين الشتويين. شمل هذا البحث 12 معاملة صممت باستخدام التصميم العشوائي بأربع مكررات. تمت إزالة الحشائش من المحصول لفترة !، ا، ، 8 أو 10 أسابيع بعد زراعة المحصول وبعد ذلك ترك المحصول موبوءاً بالحشائش حتى الحصاد أو ترك موبوءاً لنفس الفترات وبعد ذلك ترك خالياً من الحشائش حتى الحصاد. المعاملات الخالية من الحشائش والموبوءة بها حتى الحصاد تم تضمينها كشواهد للمقارنة. الحشائش عريضة الأوراق كانت سائدة في موقع التجربة. ظهر التحليل المشترك للموسمين الشتويين أن إنتاجية بذور زهرة الشمس زادت تدريجياً بتقليل فترة تدخل الحشائش . أشار التحليل المشترك للموسمين الشتويين إلي أن تدخل الحشائش غير المحدود قلل معنوياً إنتاجية ومكونات الإنتاجية زهرة الشمس و ان النقصان الملاحظ 51.87% للإنتاجية مقارنة بالمعاملة الخالية من الحشائش طول الموسم. مؤشرات النمو قلل معنوياً بمنافسة الحشائش طول الموسم. وجد أن الفترة الحرجة لـ كافـ ة الحشائش في زهرة الشمس وفقاً لهذا البحث تراوحت بين الأسبوع الثاني والثامن بعد الزراعة.