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Chemical Weed control in Sunflower (*Helianthus annuus* L) in Dongola Locality, Northern State, Sudan

Mukhtar A. M. *[1]; Gamar Elniaama, A. I.[2] Salah, E. E.[3] and Babiker, M. M.[4]

1- Faculty of Agricultural studies, Shambat, Khartoum, Sudan University of Science & Technology-Sudan
2- Ministry of Agriculture and Animal Resource, Northern State, Sudan
3- Faculty of Agriculture, Shambat, Khartoum, University of Khartoum, Sudan
4- College of Agriculture, Bahri University, Sudan
*Corresponding Author: email: mukhtarazizm@gmail.com

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Abstract: A field experiment was conducted at the Demonstration Farm of the Faculty of Agricultural Sciences-University of Dongola- Sherg Elneel Unit, Dongola Locality, Northern State, Sudan, during two consecutive winter seasons of 2012/2013 and 2013/2014 to evaluate and compare the effects of Hadaf and Mister (two formulations of oxyfluorfen) and Stomp used pre-emergence on weed control, tolerant and yield of sunflower in an endeavour to determine the most suitable weed control treatment that secure high yield. The weed flora in the experimental site consisted of grassy and broad-leaves weeds. In both winter seasons broad-leaves weeds were predominant. The mean of both winter seasons indicated that, all herbicides treatments, and the weed free full season treatment significantly increased percentage graminae and percentage broad-leaves weeds control. Among the three herbicides used the best control of both grassy and broad-leaves weeds was achieved by the Stomp at high rate treatment (20.8 kg a.i/fed). The combined analysis of both winter seasons showed that, all herbicides treatments significantly reduced weed biomass (g/m^2). The lowest weed biomass (g/m^2) was achieved by the high rate of Stomp (20.8 kg a.i/fed). The combined analysis of both winter seasons indicated that, all herbicides treatments and the weed free full season treatment significantly increased growth parameters. Stomp at high rate was the best treatment among the herbicides treatments. The combined analysis of both winter seasons showed that, all herbicides treatments and the weed free full season treatment significantly increased seed yield and its components. The combined analysis of both winter seasons indicated that, unrestricted weed growth significantly reduced sunflower seed yield by 50.1%. The combined analysis of both winter seasons indicated that, among the three herbicides treatments the best seed yield (1218.4 kg/fed) was achieved by Stomp at high rate (20.8 kg a.i/fed).

Keywords: Herbicides, weed free, graminae and broad-leaved weeds.

Introduction

Sunflower (*Helianthus annuus* L) belongs to the family Asteracea (compositea). Its source of origin is south-west of the United States of America-Mexico area. It is a temperate region crop but it may grow in a wide range of environment. (Weiss, 1983 and Heiser,1976). Sunflower is the most important source of semi-dry oil in the world. It ranked number three to soybean (*Glysine max* L.) and rapeseed (*Brassica napus*) . (Khidir, 1997). Sunflower oil ideal combination-of saturated and poly-unsaturated fatty acids, which are important for the reduction of high serum cholesterol levels. Its oil also contains carbohydrates, portein and vitamin E. (Mchevith, 2005 and Skoric and marinkovic, 1986). The main producing countries in the world are :Russian Federation and Ukraine followed by Argentina, France, Spain, Australia, Romania and India (Khidir.,1997 and Anon,1994). In Sudan production of sunflower seeds was 153000 tone in season 2017/2018 and the area under sunflower crop in this season was 202000 hectare (FAO, 2018). Sunflower is the producing of the country of Sudan for annual oil seed crop, among the Arab countries. Recently sunflower has been grown commercially mainly in the mechanized rain fed schemes Damazin, Gadaref and Kosti. It has been grown in very small areas in same irrigated schemes namely, Gezira and Rahad. The average area grown with sunflower in seasons 2017/2018 was 202000 hectare with total production of 153000 tone and average yield of. 0.76 t/ha (FAO, 2018 and Khidir.,1997). The importance of sunflower is steadily increased in Sudan due to the crop may provide a source of foreign currency, will solve the problem of limited row material continuity, its cakes are aflatoxin free and can be used for poultry feed or as fodder for livestock and its field can be used as sites of bee keeping and hence honey production (Khidir.1997; Bateson and Tohami,1987; Elsadig,1987 and Cobley and Steele,1973).

Besides insects pests and diseases, weeds constitute the main obstacle in agricultural production. Weeds form gravest pests of agricultures which losses productive, where decrease production or quality of crops. Also increase cost harvest of crops (Ishag, 1988). Competition between oil crops and weeds for moisture, nutrients, light and space can often be disastrous. It was found that unrestricted growth of weeds reduced yield of sunflower by 50% or more (Americans,1994). Several investigators reported that satisfactory weed control in sunflower achieved by pre-emergence of some herbicides (Lauretti, 1987 and Woon *et al*.,1984). In Sudan Sunflower received little attention and the available information is inadequate especially in area of weed control. Thus, this study was conducted to evaluate and compare the effects of two pre-emergence herbicides namely, Hadaf and Mister (two formulations of oxyfluorfen) and Stomp on weed control, tolerant and yield of sunflower in an endeavour to determine the most suitable weed control treatment that secure high yield.

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, Dongola Locality, Northern state, Sudan that occupies distant northern part of the Sudan and lies between latitudes 16˚-22˚N and longitudes 20˚-32˚ E. 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 , harrowed, leveled and then divided into 44 plots. The plot size was 3×4 m (12 m^2). Each

plot was made of five rows. Sunflower seed (hysun 33) was sown on the flat rows on 21 November for 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 plants per hole. The herbicides treatments were; two formulations of oxyflurofen [2- chloro–1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene] (Hadaf 20% EC at 3.2, 4.8 and 6.4 kg a.i/fed and Mister 24% EC at 3.2, 4.8 and 6.4 kg a.i/fed) and Stomp 500 EC (Pendimethalin) [N- (1-ethylpropyl)-2,6-dinitro-3,4xylidine], were applied as pre- emergence, application of the herbicides was followed by irrigation. In addition, hand weeding treatment where weeds were removed frequently by repeated hand weeding to keep the crop weed free up to harvest, and weedy check treatment where weeds were left to grow unrestrictedly with the crop until harvest. The experiment was arranged in a Randomized Block Design (RBD), with four replications.. Herbicides effects on weeds were measured by counting the number of individual weeds species in meter square quadrate at 4 weeks after application. The percentages control of grassy and broad-leaves weeds, as compared to the unweeded control, for each treatment were calculated. Weed biomass weight was also determined, for both herbicides treated plots and for untreated weedy control, predominant grass and broad-leaves weeds in the experimental sites were also recorded.

Growth sunflower components which include plant height (cm), number of leaves/plant, leaf area index and stem diameter (cm) were recorded. At harvest yield (kg per feddan) and its characters including head diameter (cm), head weight(g), number of seeds per head and thousand seed weight (g). were recorded. The mean collected data of both winter seasons was subjected to combined analysis of Variance and the means were separated using Duncan's Multiple Range Test (DMRT) as described by Gomez and Gomez, (1984).

Results and Discussion

Visual observations showed that all herbicides treatments at their all rates showed no phytotoxicity symptoms on the crop. The treated plants had vigourous growth indicating that the herbicides used were selective for sunflower. The weed flora in the experimental site consisted of grassy and broad-leaves weeds. In both winter seasons broad-leaved weeds were predominant The dominant weed species were: *Tribulus terrestris* L., *Malva palviflora* L., *Eruca sativa* Mill., *Amaranthus viridis* L., *Amaranthus graecizans* L., *Euphorbia aegyptiaca* Boiss. *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Echinochloa colona* (L.) Link., *Melilotus Indica*., *Solanium dubium* Fersen and *Sorghum arundinaceum* (Dew.).

The mean of both winter seasons indicated that, all herbicides treatments, and the weed free full season treatment significantly increased percentage graminae and percentage broad-leaves weeds control as compared to the un-weeded control treatment (Table 1). The mean of both winter seasons depicted that, the best graminae weeds control was achieved by the use of Stomp at its all rates while the best broad-leaved weeds control was achieves by Hadaf and Mister at their all rates (Table 1). The same results were found by Poienaru *et al*. (2005) and Bedmar (1997). Among the three herbicides used the best control of both grassy and broad-leaves weeds was achieved by the Stomp at high rate treatment (20.8 kg a.i/fed) (Table 1). Simillar result was found by Poienaru *et al*. (2005) and Bedmar (1997). The combined analysis of both winter seasons showed that, all herbicides treatments significantly reduced weed biomass (g/m^2) as compared to the un-weeded control

treatment. The lowest weed biomass (g/m^2) was achieved by the high rate of Stomp (20.8 kg a.i/fed) (Table 1). Similar results were found by Patalakha *et al*. (2009).

The combined analysis of both winter seasons showed that, all herbicides treatments and the weed free full season treatment significantly increased plant height (cm), number of leaves /plant and stem diameter (cm) as compared to the un-weeded control treatment. Stomp at high rate was the best treatment among the herbicides tested (Table 2). Stomp at high rate gave number of leaves /plant comparable to the hand-weeded control (Table 2). The combined analysis of both winter seasons indicated that, all herbicides treatments except Hadaf at low rate and Mister at low rate and the weed free full season treatment significantly increased leaf area index /m^2 as compared to the un-weeded control treatment. Stomp at high rate was the best treatment among the herbicides treatments (Table 2).

The combined analysis of both winter seasons showed that, all herbicides treatments and the weed free full season treatment significantly increased head diameter (cm), head weight (g), number of seeds /head, 1000 seed weight (g) and seed yield (kg /fed.) as compared to the un-weeded control treatment. Stomp at high rate was the best among the herbicides treatments (Table 3). The combined analysis of both winter seasons indicated that, unrestricted weed growth significantly reduced sunflower seed yield by 50.1%, compared to the hand-weeded control treatment (Table 3). This reduction in sunflower seed yield was due effects of weeds on various yield components (Table 3). This result is in line with that obtained by Wanjari *et al*. (2001).

The combined analysis of both winter seasons indicated that, among the three herbicides treatments the best seed yield (1218.4 kg/fed) was achieved by Stomp at high rate (20.8 kg a.i/fed). This result indicate that early removal of weeds by herbicides enabled the crop to maximize the use of available resources and thus secure good establishment and growth which increase crop seed yield. Increases in sunflower seed yield due to the use of herbicides are in line with the results of Beckie and Hall (2014); Suresh and Reddy (2010) and Jat and Giri (2000). Based on these results, it can be concluded that, the effectiveness of the herbicide Stomp at 20.8 kg a.i/fed) against weeds and its high selectivity in sunflower, make this herbicide possible candidate for control of weeds in sunflower in Northern State of Sudan.

Table 1: Effects of herbicides treatments on percentage graminae, percentage broad leaved weeds control and weed biomass (g /m$^{2)}$ during winter seasons (2013/2014) and (2014/2015), combined

Treatments	Herbicide rate kg a.i/fed	Percentage graminae weed control	Percentage broad-leaves weed control	Weed biomass
Hadaf	3.2	39.5 d	77.3 bc	12.3 b
Hadaf	4.8	44.0 cd	81.4 b	10.8 c
Hadaf	6.4	57.4 cd	90.0 ab	8.2 e
Mister	3.2	71.3 bc	76.9 bc	11.8 b
Mister	4.8	73.9 bc	81.5 b	9.6 d
Mister	6.4	81.5 b	90.6 ab	7.0 f
Stomp	14.4	90.0 ab	55.1 c	9.4 d
Stomp	17.6	97.0 a	74.4 bc	7.0 f
Stomp	20.8	97.9 a	79.2 b	5.9 g
HWC	-	100 a	100 a	0.0
UC	-	0.0 e	0.0 d	41.4 a
SE±	-	0.2	0.3	0.2
C.V%	-	0.1	1.3	4.8

Means in the same column with the same letters are not significantly different at P (0.05) according to Duncan's Multiple Range Test.
HWC = Hand-weeded control
UC = Un-weeded control

a.i = Active ingredient. Kg = Kilogram.

Table 2: Effects of herbicides treatments on sunflower growth components during winter seasons (2013/2014) and (2014/2015), combined

Treatments	Herbicide rate kg a.i/fed	Plant height (cm)	Number of leaves/plant	Leaf area index /m^2	Stem diameter (cm)
Hadaf	3.2	77.6 h	25.7 e	1.6 h	1.4 f
Hadaf	4.8	81.0 g	28.6 d	1.8 g	1.4 f
Hadaf	6.4	88.0 f	31.6 c	2.3 d	1.8 d
Mister	3.2	78.3 h	27.8 d	1.6 h	1.4 f
Mister	4.8	81.3g	28.4 d	2.3 e	1.6 e
Mister	6.4	100.6 d	31.5 c	2.3d	1.8 d
Stomp	14.4	90.6 e	28.8 d	2.0 f	1.7 e
Stomp	17.6	111.4 c	33.4 b	2.8 c	2.3 c
Stomp	20.8	131.9 b	35.0 a	3.0 b	2.5 b
HWC	-	143.4 a	35.8 a	3.4 a	2.6 a
UC	-	73.0 i	23.8 f	1.6 h	1.3 g
SE±	-	0.5	0.4	.03	0.1
C.V%	-	1.5	3.3	4.0	1.8

Means in the same column with the same letters are not significantly different at P (0.05) according to Duncan's Multiple Range Test.
HWC = Hand-weeded control
UC = Un-weeded control
a.i = Active ingredient. Kg = Kilogram.

Table 3: Effects of herbicides treatments on sunflower seed yield (kg/fed) and its components during winter seasons (2013/2014) and (2014/2015), combined

Treatments	Herbicide rate kg a.i/fed	Head diameter (cm)	Head weight (g)	No. of seeds/head	1000 seed weight	Seed yield (kg/fed)
Hadaf	3.2	12.7 g	74.4 f	729.8 h	53.0 h	933.4 g
Hadaf	4.8	13.1 f	75.8 f	828.4 e	63.8 g	985.6 e
Hadaf	6.4	14.5 c d	88.2 d	860.8 d	92.3 d	1078.8 c
Mister	3.2	13.6 e	75.1 f	742.4 g	54.8 h	960.3 f
Mister	4.8	14.2 d	82.4 e	852.0 d	72.5 f	991.3 e
Mister	6.4	14.6 c d	88.3 d	895.6 c	102.5 c	1088.3 c
Stomp	14.4	14.3 d	81.3 e	780.4 f	71.6 f	1028.4 d
Stomp	17.6	14.8 c	91.1 c	960.6 b	89.4 e	1083.0 c
Stomp	20.8	16.0 b	93.2 b	966.4 b	123.3 b	1218.4 b
HWC	-	16.7 a	97.0 a	1063.7 a	131.2 a	1279.8 a
UC	-	11.4 h	66.9 g	689.0 i	50.8 i	639.2 h
SE±	-	0.1	0.6	4.3	0.7	8.6
C.V%	-	2.7	2.1	1.4	2.3	2.4

Means in the same column with the same letters are not significantly different at P (0.05) according to Duncan's Multiple Range Test.
HWC = Hand-weeded control
UC = Un-weeded control
a.i = Active ingredient. Kg = Kilogram.

Conclusions

i) Among the three herbicides treatments the best significant reduction weed biomass (g/m^2) and the best seed yield (kg/fed) in sunflower was achieved by Stomp at high rate (20.8 kg a.i/fed).

ii) The positive effect of herbicides on weed control lead to a significant increase in sunflower seed yield.

iii) A significant weed control was achieved in terms of total weed biomass reduction with all herbicides treatments as compared to the weedy full season treatment.

Recommendations

i) Weed control in sunflower should be carried out by Stomp at (20.8 kg a.i/fed) as pre-emergence treatment.

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المكافحة الكيميائية للحشائش في زهرة الشمس (*Helianthus annuus* L)
بمحلية دنقلا-الولاية الشمالية-السودان

مختار عبد العزيز محمد[1]، قمر النعمة آدم ابراهيم [2] ، صلاح التوم الأمين[3] وبابكر محمد محجوب[4]

1- كلية الدراسات الزراعية – شمبات – جامعة السودان للعلوم والتكنولوجيا – السودان.
2- وزارة الزراعة والثروة الحيوانية، الولاية الشمالية، السودان.
3- كلية الزراعة – شمبات – جامعة الخرطوم – السودان.
4- كلية الزراعة – جامعة بحري – السودان.

Mukhtarazizm@gmail.com

المستخلص

أجريت هذه التجربة بالمزرعة التجريبية بكلية العلوم الزراعية-السليم-جامعة دنقلا- وحدة شرق النيل، محلية دنقلا، الولاية الشمالية، السودان، خلال موسمين شتويين متعاقبين للعامين 2013/2012 و2014/2013 لتقييم ومقارنة تأثير هدف ومستر (مستحضرا أوكسي فلورفين) وأستومب المستعملة قبل الانبثاق علي مكافحة الحشائش، تحمل وإنتاجية زهرة الشمس في محاولة لتحديد أنسب معاملة لمكافحة الحشائش لتحقيق أعلي إنتاجية. الحشائش الموجودة شملت حشائش نجيلية وعريضة الأوراق. الحشائش السائدة كانت عريضة الأوراق في الموسميين الشتويين. أظهر متوسط الموسميين الشتويين أن الأستومب بجميع جرعاته أنجز أحسن مكافحة للحشائش النجيلية بينما الهدف والمستر بجميع جرعاتهما أنجزا أحسن مكافحة للحشائش عريضة الأوراق. بمقارنة مبيدي الحشائش مع بعضهما البعض أنجز الأستومب بجرعته الأعلي 20.8 كجم م. ف. للفدان أحسن مكافحة للحشائش النجيلية وعريضة الأوراق. أوضح التحليل المشترك للموسمين الشتويين أن جميع معاملات مبيدي الحشائش قللت معنوياً الوزن الجاف للحشائش بالجم في المتر المربع. أستومب بجرعته الأعلي 20.8 كجم م. ف. للفدان حقق أقل وزن جاف للحشائش بالجم في المتر المربع. أشار التحليل المشترك للموسمين الشتويين إلي أن جميع معاملات مبيدي الحشائش والمعاملة الخالية من الحشائش طول الموسم أدت إلي زيادة معنوية في مؤشرات النمو، أستومب بجرعته الأعلي كان أحسن معاملة وسط معاملات مبيدي الحشائش. أوضح التحليل المشترك للموسمين الشتويين أن جميع معاملات مبيدي الحشائش والمعاملة الخالية من الحشائش طول الموسم أدت إلي زيادة معنوية في إنتاجية البذور ومكوناتها. أشار التحليل المشترك للموسمين الشتويين إلي أن النمو غير المحدود للحشائش قلل إنتاجية بذور زهرة الشمس ب 50.1%. أشار التحليل المشترك للموسمين الشتويين إلي أن الأستومب بجرعته الأعلي 20.8 كجم م. ف. للفدان حقق أحسن إنتاجية بذور (1218.4 كجم للفدان) وسط معاملات مبيدي الحشائش.