J. Plant Production, Mansoura University Vol.1 (9): 1175 - 1189, 2010

EFFECT OF INTEGRATED WEED CONTROL ON SUNFLOWER (*Helianthus annuus* L.) PRODUCTIVITY AND ITS ASSOCIATED WEEDS.

Soliman, I. E.

Weed Res. Laboratory, Field Crops Res. Institute, Agric. Res. Cent., Giza, Egypt.

ABSTRACT

Two field experiments were conducted during successive summer seasons of 2007 and 2008 at Sakha Agricultural Research Station to investigate the efficacy of some weed control treatments *i.e.* butralin, Prometryne and fulazifop-p-butyle, whether alone or in combination, or plus one hand hoeing in addition to the hand hoeing twice for controlling annual weeds and their effects on some growth characters, seed yield and its components of sunflower. Results indicated that the herbicides, whether in combination, or plus one hand hoeing decreased dry weight of total weeds during the two seasons. The treatments (butralin and prometryne) plus fluazifop-p-butyl reduced the dry weight of total weeds by 83.5 and 84.1 %, respectively in the first season and 86.2 and 88.7 %, respectively in the second season while, the herbicides plus one hand hoeing reduced the dry weight of total weeds 84.1, 87.7 and 85.5 %, respectively in the first season and, 93.3, 95.8 and 94.4 % respectively in the second season as compared to the control at 65 days from sowing. Hand hoeing twice was reduced total weeds only by 81.1 and 91.7 %. Therefore, it can be used herbicides, whether combined between in, or plus one hand hoeing for the control of most annual weeds.

Results revealed that all studied herbicides plus one hand hoeing or in combination significantly increased growth characters of sunflower *i.e.* plant height, stem diameter and dry weight/plant during the growth stage and at harvest. (Butralin, prometryne and fluzazifop-p-butyle) plus one hand hoeing increased seed yield/fed by about 47.91, 48.62 and 44.84 % and, by about 45.45, 45.86 and 42.21%, during both growing seasons, respectively as compared to the control t. Data also cleared that all herbicide treatments slightly decreased chlorophyll a, b and total chlorophyll but did not adversely affect oil content of sunflower seeds.

These results indicated that under heavy invested soil with annual weeds, it is possible to apply herbicides *i.e.* butralin at 2.5 l/fed, prometryne at 1.0 l/fed, and fluazifop-p-butyl at 1.0 l/fed followed by (one hand hoeing) after 30 days from sowing or combined between in). Also, the highest net return was obtained by herbicides plus one hand hoeing and hand hoeing twice. These practices gave the height reduction in annual weeds and increased sunflower yield and its components. Thus, these herbicidal treatments can replace hand hoeing for the control of annual weeds in sunflower crop.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the most important sources of edible oil production in the world. Associated weeds with sunflower are considered as a major problem in sunflower fields, where sunflower production is seriously affected by weed competition. Reduction in sunflower yield resulting from weed competition accounted for about 66 – 68 % (Nalewaja, 1969). The maximum sunflower seed yield was obtained when weeding was carried out after 2 to 4 weeds from sowing (Johnson, 1971). Weed competition account for considerable reduction in sunflower seed yield

varying from 33 to 81 % as reported by Kholosy *et al.* ((1995) and Ibrahim (2001).

Kosovac (1981) indicated that weed control within the critical period of competition could reduced weed damages. Weeds of medium intensity negatively influence both development and yield of sunflower. If weed control was carried out late, the yield will be reduced about 10 %. Upadhyay (1984) found that one of the field of oil seed crops should be kept free from weeds for at least 40 to 45 days after sowing. This may be done either by cultural practices, herbicides application or by both methods.

Hand hoeing is still a traditional method for weed control in Egypt but scarcity in the hand-labour is becoming a problem. Mostafa and Hassanein (1983) found that one hand hoeing at 21 days from sowing sunflower significantly increase head diameter, 100 – seed weight, seed yield/plant and seed yield/fed. by 10.1, 11.5, 31.5 and 42.4 %, respectively over the un-weeded.. Shaban et al.(1985a) found that hand hoeing twice after 30 and 45 days from sowing sunflower decreased the dry weight of annual grasses by 60.0 and 57.7 % after 30 days from sowing and by 76.5 and 83.9 % after45 days from sowing, respectively in two growing seasons. Ibrahim and Abusteit (1988) found that two cultivations at 30 and 55 days from sowing decreased the fresh weight of annual grasses in sunflower by 80 and 71 % in both growing seasons, respectively.

Herbicides offer a vital solution in growing sufficient quantities of sunflower especially in the case of labour shortage. Warmington (1981) mentioned that use of pre-emergent herbicides as pendimethalin in sunflower fields should be considered when it is known, or expected, that the soil contain large numbers of weed seeds. Shaban *et al.* (1985 a) found that applying prometryne, linuron and fluometuron showed superiority in controlling broad-leaved weeds. Prometryne at the higher doses gave higher seed yield at both seasons. All tested herbicides did not adversely affect the oil content of sunflower seeds. Shaban *et al.* (1985 b) indicated that prometryne at 0.5 kg/fed combined with trifluralin at 0.48 kg/fed and/or one hoeing should be the best control of broad leaf weeds.

Poonguzhaln *et al.* (1996) reported that pendimethalin at 0.75 kg *a.i*/ha as pre-emergence after 4 days from sowing and hand hoeing twice (20 and 40 days after sowing) reduced the dry weight of total weeds by 74.3 and 66.7 %, respectively and increased sunflower yield. Giri *et al.* (1998) found that pendimethalin at rate of 1.5 kg/ha and oxyfluorfen at rate of 0.125 kg/ha as pre-emergence increased sunflower seed yield by 35.7 and 36.2 %, respectively.

Abo Ghazala *et al.* (2001) showed that butralin + one hand hoeing were effective in controlling annual weeds and increasing seed yield of sunflower. Abd El-Hamid (2004) mentioned that butralin at rate of 1200 g, *a.i*/fed and oxadiargyl at rate 160 g, *a.i*/fed reduced fresh weight of total annual weeds by 96.3 and 90.6 % and; by 88.9 and 73.7 %, respectively in both seasons. Also, this herbicides did not affect plant height, meanwhile, it significantly affected the dry weight of sunflower plant, and sunflower seed yield. Hence, butralin and oxadiargyl achieved the highest dry weight and

increased seed yield by 595 and 536 and; by 338 and 229 kg/fed, respectively, in both seasons.

Nowadays, application of chemical weed control was the most wide spread method in sunflower fields in many countries. The aim of the present investigation was to study the effect of weed control treatments on weeds as well as on yield and its components in sunflowers.

MATERIALS AND METHODS

Two field experiments were carried out at Sakha Agricultural Research Station during 2007 and 2008 summer seasons to study the effect of some weed control treatments for controlling weeds in sunflower (*Helianthus annuus,* L.). Each experiment included ten treatments. The treatments were as follows:

1. Amex (butralin 48 % EC) [4-(1,1-dimethylethyl)-N-(methylpropyl)-2,6-dinitrobenzenamine] at the rate of 2.5 l/fed, soil surface application (directly, after sowing and before irrigation).
2. Gesagard (prometryne 50 % FW) [N,N-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine.] at the rate of 1.0 l/fed, soil surface application (directly, after sowing and before irrigation),.
3. Fusilade super (fluazifop-p-butyl 12.5 % EC) [Butyl (R)-2-[4-[[5-(trifluoron methyl)-2-pyridinyl]oxy]phenoxy]propanoate.] at the rate of 1.0 l/fed, (applied at 30 days after sowing).
4. Amex (butralin 48 % EC) at the rate of 2.5 l/fed, soil surface application (directly, after sowing and before irrigation), followed by Fusilade super at the rate of 1.0 l/fed, (applied at 30 days after sowing).
5. Amex (butralin 48 % EC) at the rate of 2.5 l/fed, soil surface application (directly, after sowing and before irrigation), followed by one hand hoeing at 30 days after sowing.
6. Gesagard (prometryne 50 % FW) at the rate of 1.0 l/fed, soil surface application (directly, after sowing and before irrigation), followed by Fusilade super at the rate of 1.0 l/fed, (applied at 30 days after sowing).
7. Gesagard (prometryne 50 % FW) at the rate of 1.0 l/fed, soil surface application (directly, after sowing and before irrigation), followed by one hand hoeing at 30 days after sowing,
8. hand hoeing at 18 days after sowing, followed by Fusilade super at the rate of 1.0 l/fed, (applied at 30 days after sowing),
9. Hand hoeing twice (carried out at 18 and 30 days after sowing).
10. Control (untreated).

Herbicides in both field experiments were sprayed by Knapsack sprayer CP3 with water volume of 200 liters per fed. In both seasons, the preceding winter crop was Egyptian clover (*Trifolium alexandrinum* L.). The plot area was 18 m^2 (5 rows, 6 m long and 60 cm apart). Seeds of sunflower (*Helianthus annuus* L.) *cv.* Sakha 53 sown in hills. Each experiment was laid in a randomized complete block design with four replications. All agronomic practices such as land preparation, fertilization and irrigation were done as recommended during the two seasons of study.

The collected data were as follows:

On weeds:

Weeds were hand pulled at random from one square meter for each plot after 45 and 65 days after sowing and classified into three categories (annual broad-leaved, annual grassy and total weeds), the fresh and dry weights of each species was estimated as (g/m2). Dry weight was determined after drying weeds in a forced draft oven at 70 ^{o}C for 48 hours. Weed control was evaluated in the form of percent reduction (% R) in the dry weight of each individual species of weeds as well as the total weeds. Percent of reduction (%R) was calculated according to Topps and Wain (1957) formula as following:

% R = (A – B / B) x 100

Where:

A = The fresh or dry weight of weeds in untreated plot.

B = The fresh or dry weight of weeds in treated plot.

Sunflower growth characters and yield components:

Samples of 5 sunflower plants were collected at random from each plot after 45, 65 days from sowing and at harvest to estimate sunflower growth characters *i.e.* plant height (cm), stem diameter (cm) and dry weight/plant (gm). While, yield and its components *i.e* head diameter (cm), weight of seeds/plant (g) and seed yield per feddan (kg) were determined in this study at harvest.

Oil content:

Random samples of seeds were taken randomly from each treatment to determine oil content according to method described by the (A.O.A.C. 1990), using petroleum ether (40 – 60 ^{o}C) in Soxhlet apparatus.

Chlorophyll content:

Chlorophyll content of sunflower leaves were measured according to Sweeny and Martin (1961). Chlorophyll a, b and total chlorophyll were recorded as mg chlorophyll/g sample (fresh weight).

Economic evaluation:

Net return was calculated by expressing the cost and yield of the unit area in monetary. The retail price used in computing cash returns was 5 Egyptian pounds for sunflower/kg for both seasons. The costs were negated from the overall cash returns as the resulted cash was considered to be the net return.

Statistical analysis:

The obtained data was subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and the least significant differences (LSD) at 5 % level of significance were calculated.

RESULTS AND DISCUSSION

The most dominant weeds accompanied with sunflower plants were; (*Portulaca oleracea* L.), (*Xanthium brasilicum* L.), (*Corchorus olitorius* L.), (*Solanum nigrum* L.), (*Amaranthus albus* L.), (*Chenopodium album* L.) as broad-leaved weeds and (*Echinochloa colonum*), (*Setaria viridis*), (*Dinebra retroflexa*) as grassy weeds in both growing seasons.

Effect of weed control treatments on dry weight of weeds:

Table 1 shows means of dry weight of broad-leaves, grassy and total weeds of the two weed surveys as affected by different herbicides (alone) or plus one hoeing and hand hoeing twice compared with the control in both seasons.

On broad-leaved weeds:

Results indicated that the differences between weed control treatments were significant in dry weight of broad-leaved weeds. All tested herbicides applied alone particularly fluazifop-p-butyl failed to provide the desired weed control. But, the additional one hoeing caused a great significant improvement in the efficiency of butralin, prometryn and fluazifop-p-butyl herbicides against broad-leaved weeds than that of the single application of herbicides at the two samples in both seasons.

In this respect, due to its combination with one hand hoeing, prometryne herbicide had a significant effect on the dry weight of broad-leaved weeds in both seasons. This treatment reduced the dry weight of weeds 85.6 and 87.77 % in first season and; 91.26 and 95.31 % in the second season comparing with untreated plots at 45 and 65 days after sowing, respectively. These results were in agreement with the results of Abo Ghazala *et al.* (2001) who found that butralin plus one hand hoeing was effective in controlling annual weeds. Prometryne and oxadiargyl herbicides in its combinations with one hoeing showed a significant reduction in dry weight of broad-leaved weeds ranged from season to another.

The application of hand hoeing twice gave the greatest control percent and significantly reduced the dry weight of broad-leaved weeds than control plots by 77.93 and 84.8 % in first season and; 88.40 and 91.61 % in second season, followed by the combination between herbicides (butralin and prometryn) plus fluazifop-p-butyl, treatments and single herbicides treatments. at 45 and 65 days after sowing, respectively.

On grassy weeds:

Data presented in Table 1 indicated that weed control treatments had a significant effect on dry weight of grassy weeds. These results were fairly true after 45 and 65 days from sowing, and this effect was constant from season to another. It could be noticed that dry weight of grassy weeds reached to about (294.4 g/m^2) in the control plots at 65 days after sowing in the first season. All weed control treatments significantly superior over the control plots. In this respect, the single application of fluazifop-p-butyl gave about 77.65 and 93.96 % reduction in dry weight of grassy weeds in both growing seasons, respectively compared with the control .The application of fluazifop-p-butyl plus one hand hoeing gave the best results where the reduction in fresh weight of grassy weeds reached to about 98.07 and 94.29 % at the first survey and; 96.81 and 97.48 % at the second survey in both growing seasons, respectively as compared to the control. These results were in harmony with those obtained by Abd El-Hamid and Shalaby (1999) who reported that the application of fluazifop-p-butyl at 2.8 l/ha in lentil and faba bean fields after 30 days from sowing reduced dry weight of grassy weeds up to 81%. Data also indicated that additional one hoeing sharply improved the efficiency of all the applied herbicidal treatments.

Table 1: Dry weight of annual weeds (g/m^2) at 45 and 65 days after sowing as affected by weed control treatments in 2007 and 2008 summer seasons.

Treatments	(Rate/fed) (kg or l)	2007					
		45 days after sowing			65 days after sowing		
		Broad-leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total annual weeds (g/m^2)	Broad-leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total annual weeds (g/m^2)
Butralin	2.5	122.5	92.7	215.2	190.6	167.1	357.7
Prometryne	1.0	111.6	80.0	191.6	157.1	147.2	304.3
Fluazifop-p-butyle	1.0	217.3	28.2	245.5	269.5	65.8	335.3
Butralin+fluazifop-p-butyl	2.5+1.0	74.2	18.3	92.5	85.0	25.3	110.3
Prometryne+fluazifop-p-butyl	1.0+1.0	65.7	15.4	81.1	81.5	24.8	106.3
Butralin+Hand hoeing	2.5+H.H	47.7	23.5	71.2	55.6	50.8	106.4
Prometryne+ Hand hoeing	1.0+H.H	39.2	19.6	58.8	45.8	36.4	82.2
Fluazifop-p-butyle+ H. hoeing	1.0+H.H	61.8	4.4	66.2	79.9	16.8	96.7
Hand hoeing	Twice	60.1	33.5	93.6	56.9	69.8	126.7
Untreated control	--	272.3	228.0	500.3	374.4	294.4	668.8
LSD (5%)		31.5	66.5	67.3	44.7	82.4	73.6
		2008					
Butralin	2.5	161.2	19.621	184.2	209.2	33.4	242.6
Prometryne	1.0	11214.7	19.6	138.7	161.9	26.3	228.2
Fluazifop-p-butyle	1.0	9.1	14.3	229.0	261.9	14.6	276.5
Butralin+fluazifop-p-butyl	2.5+1.0	66.3	6.7	72.0	71.5	8.4	79.9
Prometryne+fluazifop-p-butyl	1.0+1.0	46.6	6.4	53.0	57.8	7.6	65.4
Butralin+Hand hoeing	2.5+H.H	23.7	9.3	32.0	16.3	12.7	39.0
Prometryne+ Hand hoeing	1.0+H.H	21.4	6.9	28.3	15.9	8.8	24.7
Fluazifop-p-butyle+ H. hoeing	1.0+H.H	45.9	5.1	51.0	26.4	6.1	32.5
Hand hoeing	Twice	28.4	16.8	45.2	28.4	19.9	48.3
Untreated control	-	244.8	159.8	404.6	338.7	241.9	580.6
LSD (5%)		29.4	19.4	46.3	35.2	23.2	51.6

On total weeds:

Data revealed that fresh weight of total weeds/m^2 was significantly affected by weed control treatments. However, it could be noticed that plots that treated with single herbicides resulted in insufficient weed control in both seasons. All studied herbicides in its combinations between in, or with hoeing were highly effective for reducing the fresh weight of total weeds than that of single herbicidal treatments. These findings were true after 45 and 65 days from sowing, and this effect was constant from season to another. This means that applying one supplementary hoeing was necessary to eliminate the weed plants that survived or escaped from the herbicides, particularly, (*Xanthium brasilicum* L.). Similar results were obtained by Abo Ghazala *et al* (2001) they reported that the best weed control treatment improving yield are: Applying herbicides (pre-emergence) plus one hand hoeing, particularly under heavy weed infestation, while the post-emergence application of fluazifop-p-butyl alone or followed by one hoeing were the best treatments against grassy weeds.

Hand hoeing twice reduced the fresh weight of total weeds which recorded the control percentages (81.06 and 91.68 %) at second survey in both growing seasons, respectively. The superiority of two hoeing application

against weeds than herbicides alone could be attributed to the continuous destroying effect of the sequential application of hoeing during vegetativ growth. Similar results were obtained by Ibrahim and Abusteit (1988).

Effect of weed control treatments on some growth characters of sunflower:

Data presented in Table 2 show the effect of weed control treatments on plant height (cm), stem diameter (cm) and dry weight of plant (g) at 45 and 65 days after sowing and at harvest during the two growing seasons.

Plant height:

Data indicated that weed control treatments had a significant effect on plant height at both the tested samples during the two growing seasons. Hand hoeing twice application gave the high values and significantly increased the plant height of sunflower than the control at the first survey by 18.89 and 18.75 % and; at the second survey by 20.33 and 23.72 % in both seasons, respectively.

Butralin, prometryne and fluazifop-p-butyl (plus one hoeing) were significantly superior over hand hoeing twice. Also, (butralin and prometryne) plus fluazifop-p-butyl superior in the height of sunflower plants and recorded the tallest plants 197.9, 206.9 and 195.3 cm, respectively as compared to hand hoeing twice treatment (181.6 cm) at harvest in first season, this effect was constant at the second season. This reduction in plant height under the control plots might be attributed to the negative effects of weeds on crop growth which may be occurred as a result of the competition between sunflower and weed plants.

Stem diameter:

Data revealed that stem diameter was significantly affected by weed control treatments at both the tested samples during the two growing seasons. Plots that were hoed two times produced the thickest stems as compared to herbicide treatments alone or combind between in (butralin and prometryne) plus fluazifop-p-butyl and control. It could be noticed that the results of this character had the same trend of that of plant height under this study.

This reduction in the control reflect the negative impacts of weeds on crop growth which may be occurred as a result of the competition between sunflower and weed plants for the environmental resources (light, water and nutrients) which, are necessary for plant growth.

Chemicals weed control plus one hand hoeing was superior in increasing stem diameter of sunflower than chemical treatments alone or combined between in, during both seasons. These results were in complete agreement with those obtained by Abo Ghazala *et al.* (2001).

The effect of the supplementary hoeing after herbicides not only was necessary to eliminate the weed flora and particularly of those weed most difficult to control such as (*Xanthium brasilicum* L.) and consequently to avoid its negative impact on crop plants, but also to improve the soil conditions to make it more suitable to crop growth.

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Dry weight of plant:

Dry weight of sunflower plants at the two tested periods and at harvest in both seasons was significantly influenced by weed control treatments. All studied weed control treatments were superior over the control at the three surveys in both growing seasons. All tested herbicides in its combination with one hoeing or combined in between, significantly increased dry weight of sunflower plants if compared with the control plots. The highest values were obtained by applying prometryne plus one hoeing followed by butralin, fulazifop-p-butyl and hand hoeing twice under any tested period and this superiority was constant from season to season.

Effect of weed control treatments on sunflower seed yield and its components:

Data presented in Table 3 show the effect of weed control treatments on head diameter (cm), seed yield/plant (gm), seed yield (kg/fed) and oil yield (kg/fed) at harvest in both growing seasons.

Head diameter:

Data indicated that the effect of weed control treatments was significant on head diameter of sunflower in both growing seasons.

All tested herbicides in its combination with one hoeing or combined in between, significantly increased head diameter if compared with the control plots, which recorded the lowest values for head diameter (12.8 and 13.8 cm) in two the seasons, respectively. Prometryne plus one hoeing recorded the highest head diameter, where recorded (22.8 and 22.3 cm) in the first and second seasons, respectively, followed by butralin and fluazifop-p-butyl. Hand hoeing twice gave the least values as compared with the tested herbicides plus one hand hoeing.

Seed yield per plant:

The results revealed that the differences between weed control treatments, were significant in both seasons.

Dense weeds growth with sunflower plants during the two seasons in control plots resulted in the lowest seed yield/plant (32.63 and 29.38 g) however, elimination of weed by applying prometryne plus one hoeing followed by butralin and fluazifop-p-butyl gave the highest seed yield/plant and increased seed yield/plant up to 77.23, 74.45 and 68.63 g (57.75, 56.17 and 52.46 %) in the first season, respectively. This effect was constant at the second season.

Integrated weed control treatments exerted an intensive increase in seed yield/sunflower plants where the additional one hoeing had significantly increased seed yield/plant of all the tested herbicides than un-hoed herbicides ones, and this effect was constant from season to season.

Seed yield (kg/fed):

Data signify revealed that weed control treatments had a significant effect on final seed yield/fed in both growing seasons. Dense weeds growing with sunflower plants all over the growing seasons in control plots resulted in the lowest yield (620.3 and 660.2 kg/fed) and seed yield losses, reached to 48.62 and 45.86 % in the two growing seasons, respectively as compared to seed yield harvested from plots treated by prometryne plus one hand hoeing. This drop in seed yield/fed under the control plots might be attributed to the

reduction in the values of growth characters, which occurred as a result of the competition between sunflower and weed plants for the essential environmental resources *i.e.,* light, water and nutrients. Similar results were obtained by Abo Ghazala *et al.* (2001) and Abd El-Hamid (2004).

Data showed that all tested herbicides were superior significantly over the treatments in seed yield/fed in both seasons. Chemical weed control plus one hand hoeing or combined in between, was superior in increasing seed yield/fed of sunflower than chemical treatments alone in both seasons. Similar results were obtained by Abo Ghazala *et al.* (2001).

Table 3: Effect of weed control treatments on yield components of sunflower in 2007 and 2008 summer seasons.

Treatments	(Rate/fed) (kg or l)	2007				
		Head diameter (cm)	Seed yield/ plant (g)	Seed yield (kg/fed)	Oil % of seeds	Oil yield (kg/fed
Butralin	2.5	18.3	61.90	936.3	39.27	367.69
Prometryne	1.0	18.60	63.82	952.4	39.66	377.72
Fluazifop-p-butyle	1.0	17.8	58.10	924.8	38.73	358.18
Butralin+fluazifop-p-butyl	2.5+1.0	19.1	66.71	1007.5	39.66	399.57
Prometryne+fluazifop-p-butyl	1.0+1.0	19.7	67.38	1020.4	39.82	406.32
Butralin+Hand hoeing	2.5+H.H	21.4	74.45	1190.8	41.64	495.85
Prometryne+ Hand hoeing	1.0+H.H	22.8	77.23	1207.2	42.23	509.80
Fluazifop-p-butyle+ H.hoeing	1.0+H.H	20.8	68.63	1124.6	41.15	462.77
Hand hoeing	Twice	20.8	70.04	1178.8	41.45	488.61
Untreated control	--	12.8	32.63	620.3	32.94	204.33
LSD (5 %)		2.2	5.3	48.3		31.9
		2008				
Butralin	2.5	19.1	63.23	956.8	39.39	376.88
Prometryne	1.0	19.6	64.62	979.8	39.70	388.98
Fluazifop-p-butyle	1.0	18.9	55.45	938.4	37.64	353.21
Butralin+fluazifop-p-butyl	2.5+1.0	19.9	66.78	1021.6	40.09	419.78
Prometryne+fluazifop-p-butyl	1.0+1.0	20.8	67.00	1048.2	40.18	421.17
Butralin+Hand hoeing	2.5+H.H	21.6	70.41	1210.3	41.63	503.85
Prometryne+ Hand hoeing	1.0+H.H	22.3	72.36	1219.4	42.23	514.95
Fluazifop-p-butyle+ H.hoeing	1.0+H.H	21.0	67.22	1142.5	40.35	461.55
Hand hoeing	Twice	21.2	67.85	1154.2	40.84	471.38
Untreated control	--	13.4	29.38	660.2	35.89	236.95
LSD (5 %)		1.4	3.6	57.3		35.6

In this respect, due to its combination with one hand hoeing, the highest seed yield/fed (1207.2 and 1219.4 kg/fed) was achieved from prometryne in both seasons, followed by butralin and fluazifop-p-butyl plus hand hoeing (1190.8 and 1124.6 kg/fed), respectively in first season and (1210.32 and 1142.5 kg/fed) in second season. This may be due to that applying one supplementary hoeing was necessary to eliminate the weed plants, which survived or escaped from the herbicides and assure on the important by using the suitable herbicides due to the expected problem of weed flora.

Oil % and oil yield (kg/fed):

Data denoted that weed control treatments had a significant effect on oil yield in both seasons. The influence of such treatments on oil yield had the same trend of that of seed yield/fed. The control plots recorded the lowest oil

yield (204.33 and 236.95 kg/fed). Oil yield losses from weed competition reached to 305.47 and 278.0 kg oil/fed (59.92 and 53.99 %) as compared to oil estimated from applying prometryne plus one hand hoeing (509.80 and 514.95 kg/fed) in both seasons, respectively. However, elimination of weeds increased oil yield to different extent according to the effectiveness of the used weed control program.

Generally, data indicated that the highest increase in oil yield was achieved from the herbicides plus hand hoeing in the two seasons, followed by hand hoeing twice, combination between herbicides; and every herbicide alone as compared to control. The slight differences in oil % and the significant differences in oil yield/fed among different weed control treatments in both seasons must be attributed to the different treatments. The highest oil % and yield were produced by herbicides plus one hand hoeing followed by hand hoeing twice, combination between herbicide treatments and every single herbicide. Meanwhile, the lowest oil yield were obtained from the control. Such superiority of these treatments in increasing oil yield was mainly due to higher seed yield, whereas, the lowest oil yield was due to reduction in seed yield reflecting the dominant weed growth. Similar results were obtained by Shaban *et al.* (1985 b) and; Ghalwash and Soliman (2008) they reported that tested herbicides did not adversely affect the oil content of sunflower and flax.

Effect of tested herbicides on chlorophyll content:

Data presented in Table 4 showed that chlorophyll content of the leaves of sunflower plants were estimated after 21 and 35 days from herbicides application. The results of this study were shown as mg chlorophyll per g fresh leaves of the sunflower plants.

The results revealed clearly that untreated healthy plants gave the highest chlorophyll content *i.e.* a, b and total chlorophyll. At 21 days after application of tested herbicides, chlorophyll a was decreased by about (11.32, 17.45 and 22.17 %) for sunflower plants treated by butralin, prometryne and fluazifop-p-butyl. and (9.17, 14.68 and 19.72 %) at 35 days after herbicides applications, respectively. While, chlorophyll b was decreased by (16.55, 22.76 and 32.41 %) at 21 days, and; (11.69, 17.53 and 25.97 %) at 35 days after herbicides applications, respectively.

Also, the results tabulated revealed that chlorophyll b was more sensitive to the herbicides than chlorophyll a in the leaves of sunflower plants. Also, the all tested herbicides showed least effective on chlorophyll content comparing with the untreated healthy plants, hence it was less risky to chlorophyll content of sunflower plants. These results agreed with that Ghalwash and Soliman (2008), and; Soliman and Abd El-Hamid (2009) they reported that the herbicides butralin and fluazifop-p-butyl slightly decreased chlorophyll a, b and total chlorophyll.

Table 4: Effect of some herbicides on chlorophyll contents (mg/g*) in sunflower plant leaves after 21 and 35 days from application in 2007 and 2008 summer seasons.

Treatments	(R./fed) (kg or l)	21 days					
		Chlorophyll a		Chlorophyll b		Total Chlorophyll	
		mg/g*	I %**	mg/g	I %	mg/g	I %
Butralin	2.0	1.88	11.32	1.21	16.55	3.09	13.45
Prometryn	1.0	1.75	17.45	1.12	22.76	2.87	19.61
Fluazifop-p-butyle	1.0	1.65	22.17	0.98	32.41	2.63	26.33
Control (untreated)	-	2.12	-	1.45	-	3.57	-
35 days							
Butralin	2.0	1.98	9.17	1.36	11.69	3.34	10.22
Prometryn	1.0	1.86	14.68	1.27	17.53	3.13	15.86
Fluazifop-p-butyle	1.0	1.75	19.72	1.14	25.97	2.89	22.31
Control (untreated)	-	2.18	-	1.54	-	3.72	-

*** = Weight chlorophyll determined by mg per g of leaves of sunflower plants.**
**** = Percent inhibition of the chlorophyll weight was calculated in relation to control**

Economic evaluation:

Economic evaluation data in Table 5 indicated that the weed control treatments could be arranged in descending order according to their effect on the net return of sunflower yield (L.E./fed) in the following order :- (prometryne, butralin and fluazifop-p-butyl) plus one hand hoeing followed by hand hoeing twice, (prometryne and butralin) plus fluazifop-p-butyl and the single application of the herbicides (prometryne, butralin and fluazifop-p-butyl) increased the net return in both seasons as compared to control treatment.

Table 5: Cost of weed control treatments, total head yield (kg /fed). and net return of sunflower yield (L. E./fed) as affected by weed control treatments during 2007 and 2008 seasons.

Treatments		2007			2008		
		Weed control treatm-ents cost (LE./f)	Head yield (kg/f)	Net return (LE/f)	Weed control treatm-ents cost (LE./f)	Head yield (kg/f)	Net return (LE/f)
Butralin	2.5	275	936.3	4405.5	315	956.8	4469.0
Prometryne	1.0	125	952.4	4637.0	140	979.8	4759.0
Fluazifop-p-butyle	1.0	145	924.8	4479.0	160	938.4	4532.0
Butralin+fluazifop-p-butyl	2.5+1.0	420	1007.5	4617.5	475	1021.6	4633.0
Prometryne+fluazifop-p-butyl	1.0+1.0	270	1020.4	4832.0	300	1048.2	4641.0
Butralin+Hand hoeing	2.5+H.H	575	1190.8	5379.0	615	1252.3	5641.5
Prometryne+ Hand hoeing	1.0+H.H	425	1207.2	5611.0	440	1219.4	5657.0
Fluazifop-p-butyle+ H. hoeing	1.0+H.H	445	1124.6	5178.0	460	1142.5	5252.5
Hand hoeing	Twice	600	1178.7	5293.5	600	1154.7	5173.5
Untreated control	--	0.0	620.3	3101.5	0.0	660.2	3301.0
LSD (5%)			48.3			57.3	

Thus the net return (L.E./fed) in the case of (prometryne, butralin and fluazifop-p-butyl) plus one hand hoeing was 5111.0, 4879.0 and 4678.0 in the first season and 5157.0, 5141.5 and 4752.6 in the second season, followed by hand hoeing twice (4793.6 and 4673.6) in both seasons, respectively. The obtained results are in agreement with those reported by Dillared *et al.* (2004) and Dixit et al. (2005) who reported that the use of pendimethalin and hand hoeing twice gave the highest net return, these results may be due to the effect of these treatments on increasing growth characters and seed yield (kg/fed).

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تأثير المكافحة المتكاملة للحشائش علي انتاجية دوار الشمس والحشائش المصاحبة له.

إبراهيم السيد سليمان
معمل بحوث الحشائش – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر.

أجريت تجربتان حقليتان في مزرعة محطة البحوث الزراعية بسخا – كفر الشيخ خلال موسمى الزراعة الصيفى ٢٠٠٧ و ٢٠٠٨ م لدراسة تأثير بعض مبيدات الحشائش (بيوترالين – بروميترين و فلوزيفوب – ب – بيوتايل) سواء بصورة مفردة أو مشتركة مع بعضها أو متبوعة بعزقة يدوية واحدة – بالإضافة إلى معاملة العزيق مرتين على مكافحة الحشائش الحولية وبعض صفات النمو والمحصول ومكوناته فى دوار الشمس.

أشارت النتائج أن مبيدات الحشائش (بيوترالين – بروميترين وفلوزيفوب- ب-بيوتايل) متبوعة بعزقة واحدة أعطت مكافحة جيدة للحشائش الحولية الكلية (عريضة وضيقة الأوراق) فى كلا موسمى الدراسة حيث أحدثت هذه المعاملات نقص كبير فى الوزن الجاف للحشائش الحولية الكلية بنسبة ٨٤,١ ، ٨٧,٧ و ٨٥,٥ % فى الموسم الأول ونسبة ٩٣,٣ ، ٩٥,٨ و ٩٤,٤ % فى الموسم الثانى على التوالى مقارنة بالكنترول . أما معاملة العزيق مرتين أحدثت نقص فى كثافة الحشائش الحولية الكلية بنسبة ٨١,١ و٩١,٧ % على التوالى فى كلا موسمى الدراسة وذلك بعد ٦٥ يوم من الزراعة مقارنة بالكنترول.

أعطت النتائج أن استخدام جميع مبيدات الحشائش المختبرة متبوعة بعزقة واحدة زيادة معنوية فى صفات النمو لدوار الشمس مثل (طول النبات ، قطر الساق والوزن الجاف للنبات) أثناء نمو النبات وعند الحصاد.

أظهرت النتائج أن مبيدات (بيوترالين – بروميترين وفلوزيفوب – ب – بيوتايل) متبوعة بعزقة واحدة زيادة فى محصول البذرة/فدان بحوالى٤٧,٩ ،٤٨,٦ و ٤٤,٨ % فى الموسم الأول وبحوالى ٤٥,٥ ، ٤٥,٩ و ٤٢,٢ % فى الموسم الثانى – كما أحدثت زيادة فى محصول الزيت/فدان قدرها ٥٨,٧٩ ، ٥٩,٩٢ و٥٥,٨٥ % فى الموسم الأول وزيادة قدرها ٥٢,٩٧ ، ٥٣,٩٩ و ٤٨,٦٦ % فى الموسم الثانى على التوالى مقارنة بمعاملة الكنترول. بالاضافة للحصول على اعلى صافى ربح.

كما أظهرت النتائج أن مبيدات الحشائش المختبرة أدت إلى نقص ضعيف فى محتوى كلوروفيل أ ، ب والكلوروفيل الكلى بينما لم يكن لها أى تأثيرات ضارة على محتوى الزيت فى بذور دوار الشمس.

ولهذا توصى الدراسة بإمكانية استخدام أحد مبيدات الحشائش الآتية (بيوترالين بمعدل ٢,٥ لتر/ف ، برومترين بمعدل ١ لتر/ف ، فلوزيفوب – ب – بيوتايل بمعدل ١ لتر/ف) متبوعة بعزقة واحدة ٣٠ بعد يوم من الزراعة كبديل لمعاملة العزيق مرتين فى مكافحة الحشائش الحولية وذلك للحصول علي مكافحة جيدة للحشائش وزيادة معنوية فى إنتاجية محصول دوار الشمس ومكوناته.

قام بتحكيم البحث

أ.د /سعد أحمد المرسى	**كلية الزراعة – جامعة المنصورة**
أ.د / أمين عبد الباقى زين	**كلية الزراعة – جامعة كفر الشيخ**

Table 2: Effect of weed control treatments on some growth characters of sunflower in 2007 and 2008 summer seasons.

Treatments	(R./fed) (kg or l)	2007								
		45 days after sowing			65 days after sowing			At harvest		
		Plant height	Stem diameter	Dry weight /plant	Plant height	Stem diameter	Dry weight /plant	Plant height	Stem diameter	Dry weight /plant
Butralin	2.5	136.4	1.55	75.8	151.4	1.96	94.5	183.6	2.97	141.4
Prometryne	1.0	137.6	1.55	78.6	151.7	1.98	98.6	186.5	3.05	141.7
Fluazifop-p-butyle	1.0	134.2	1.51	70.9	149.5	1.92	91.7	181.6	2.93	139.5
Butralin+fluazifop-p-butyl	2.5+1.0	138.2	1.65	80.3	152.6	2.10	105.4	188.4	3.12	142.6
Prometryne+fluazifop-p-butyl	1.0+1.0	1140.4	1.69	81.3	152.6	2.31	105.4	194.4	3.41	148.6
Butralin+Hand hoeing	2.5+H.H	142.3	1.93	87.4	162.3	2.81	115.2	197.9	3.84	152.3
Prometryne+ Hand hoeing	1.0+H.H	146.5	2.10	95.2	170.2	3.12	124.3	206.9	4.26	160.2
Fluazifop-p-butyle+ H.hoeing	1.0+H.H	139.9	1.81	84.3	159.2	2.78	109.6	195.3	3.62	149.2
Hand hoeing	Twice	141.9	1.90	85.7	159.9	2.79	114.5	181.6	3.64	149.7
Untreated control	--	115.1	1.23	57.4	127.4	1.29	76.3	142.7	1.54	107.4
LSD (5 %)		3.2	0.32	4.2	7.1	0.68	8.2	8.0	0.82	10.3
		2008								
Butralin	2.5	138.5	1.36	75.6	153.5	1.92	109.6	181.5	2.53	161.5
Prometryne	1.0	140.2	1.40	77.1	156.2	1.95	101.7	185.9	2.72	165.9
Fluazifop-p-butyle	1.0	135.8	1.34	71.3	146.6	1.86	96.8	172.6	2.23	152.6
Butralin+fluazifop-p-butyl	2.5+1.0	142.4	1.43	78.7	159.7	2.04	103.5	188.4	2.82	168.4
Prometryne+fluazifop-p-butyl	1.0+1.0	143.8	1.74	81.2	160.2	2.14	108.4	192.6	2.91	172.6
Butralin+Hand hoeing	2.5+H.H	149.5	1.82	85.2	168.3	2.65	119.5	192.5	3.61	176.5
Prometryne+ Hand hoeing	1.0+H.H	152.3	1.90	89.7	174.3	2.91	123.2	203.3	3.71	183.3
Fluazifop-p-butyle+ H.hoeing	1.0+H.H	145.6	1.72	81.2	161.4	2.19	111.6	193.3	3.00	173.3
Hand hoeing	Twice	145.6	1.69	83.8	164.4	2.46	113.1	198.9	3.04	178.9
Untreated control	--	118.3	1.12	41.5	125.4	1.22	66.4	142.2	1.43	102.7
LSD (5 %)		4.3	0.26	6.7	9.5	0.60	9.4	11.2	0.62	14.8