Weeds control in artichoke crop

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ABSTRACT

Field experiments were conducted during 2007 and 2008 in two field experiments which were carried-out in the two seasons in sandy loam soil. The artichoke (*Cynara scolymus* L.) stumps were used as source for plantation. Ten herbicides were used as pre-emergence treatments which include: butralin, napropamide, propyzamide, prometryn, propachlor, acetochlor, oxadiargyl, metribuzin, diuron,(diuron + butralin). In addition mulch (PE (60 micron), beside the hand weeding and unweeded (control) was also done. The most effective weed control treatments were propyzamide, diuron, (butralin + diuron), hand weeding three times and mulch.

All of these three herbicides not only gave efficient control of all weeds in the two seasons but also gave the heighest numbers of germinated artichoke stumps, also gave the highest yield of artichoke heads not only in quantities but also in quality since significant increase of small and medium size diameter of artichoke heads which needed for exportation by hard currency was also obtained. The number of the large size diameter was also increased by these four herbicides and thus income from artichoke heads needs in the local market will also increased.

These three herbicides had considerable and useful effect on total soluble sugars content (T.S.S.), polyphenol oxidase and peroxidase activity, propyzamide gave the highest increase of total soluble sugars content in the two seasons 2007, 2008. With respect to mulch treatment which gave 100% control for all annual and perennial weeds, it caused highly significant reduction of number of germinated stumps.

Generally, prometryn and propachlor caused significant decrease of the number of germinated stumps in the two seasons and reduced yield and ascorbic acid content especially in season 2007. Mulch treatment reduced significantly ascorbic acid content in season 2007 and decrease peroxidase activity in season 2008. Oxadiargyl significantly decreased polyphenols content in season 2007 as well as inhibit significantly peroxidase activity in season 2008.

INTRODUCTION

Artichoke (*Cynara scolymus* L.) is an important vegetable crop, which belongs to the family *Asteraceae*. The immature flower bud is the edible part, which includes the fleshy receptacle and fleshy tender basis of bracts. The nutritive value of artichoke as well as its medicinal values is well known since artichoke was contributing small but useful amounts of variety of vitamins and minerals. In addition, artichokes are quite low in calories, since the edible part of one large bud contains less than 50 calories. The edible portions, young heads and stalks, are rich in the Inuline which is used as a natural relief for diabetes. Heparaxal is extracted from artichoke leaves to be used in curing liver troubles. A paste made of stems and leaves homogenized in oil has become popular in Italy (Mencarelli, 1987).

Artichoke is a native Mediterranean crop (Ryder *et al.*, 1983). The artichoke is a perennial plant and today is mainly cultivated for the production of the edible flower buds. Italy is the largest producer as well the largest consumer of artichoke. Nearly half of the world artichokes are grown in Italy (Raffaelli, *et al.*, 2004)

Egypt is considered one of the countries which produce highest artichoke productivity per unit area in the world (FAO, 2004). The cultivated area with artichoke in Egypt was

19000 feddan, with total production of 173000 tons of flower head yield, with an average of 9.1 t/fed. According to the Central Administration for Agricultural Economics, Ministry of Agriculture, for a year 2007, Artichoke is grown in El-Behira, Alexandria and Giza governorates and newly reclaimed lands.

Artichokes require about five to seven months from transplanting to first harvest, very little growth could happen in winter. A late summer/early autumn transplanting will produce buds in late spring. For all of the previously mentioned information, the production of globe artichokes (*Cynara scolymus*), in Egypt is for two purposes, for local market and as an export crop. Globe artichoke is grown in Egypt as annual and perennial crop, and as propagated vegetative.

Recently, more attention was given, to satisfy the increased demands of the local consumption, as well as exportation purposes. The weed competition, with artichoke affects both yield and globe quality characters. In spite of hand weeding can give excellent weed control, but it is usually done after weed germination, and thus the damage from these weeds has already been done. Hand weeding, besides being less effective, the shortage of agricultural hand labor in Egypt is a problem. So the efficient chemical weed control program may solve the weed problem, but other problems may arise as a result of the side effect of the used herbicides, such as the effects of herbicides on yield and its components or fruit quality characters. However, herbicides or weeds may affect yield, its components, fruit quality and time of crop maturity. These effects may depend upon the tested herbicides, its rate, its time and the method of application, as well as on the type of the present weeds and their densities.

The aim of the present work is to compare between mechanical, mulch and chemical control of the weeds and find out the effective tool against weeds growing in artichoke fields under the Egyptian conditions, as well as investigate the most effective herbicides or their combinations, and the side effects of the tested herbicides on:

a) Artichoke yield and its components.
b) Globe weight, diameter and number.
c) Globe quality characters.

The studying of such parameters may lead to find out the best treatment in artichoke fields with the least harmful side effects under Egyptian conditions, especially in reclaimed land areas.

MATERIALS AND METHODS

The work was divided into two main parts:-

Part I. The field trails.
Part II. The Laboratory experiments.

The herbicides used in this work belonged to-eight different types of chemical groups. They were as follows:-

Table (1): The treatments and the rates of the tested herbicides per feddan and the method of applications were as follows.

Treatments	Trade name and formulation	Rate/Feddan	Method of application
Butralin	Amex 50 % WP	2.5L.	Pre-Planting
Napropamide	Devrinol 50 % WP	1.0 Kg.	Pre-Planting
Propyzamide	Kerb 50 % WP	1.0 Kg.	Pre-Planting
Prometryn	Gesagard 500 SC	1.75L.	Pre-Planting
Propachlor	Ramrod 65 % WP	1.0 Kg.	Pre-Planting
Acetochlor	Harness 84% EC	1.0L.	Pre-Planting
Oxadiargyl	Topstar 80% WG	0.25 Kg.	Pre-Planting
Metribuzin	Sencor 70 % WP	0.3 Kg	Pre-Planting
Diuron	Karmex 50% WP	0.75 Kg	Pre-Planting
Diuron + Butralin	Karmex + Amex	0.5 Kg + 1.0L.	Pre-Planting
Mulch	-	-	PE (60 micron)
Hand weeding	-	-	-
Un weeded check	-	-	-

All the herbicidal treatments were done on the basis of the commercial formulations of the herbicides, and the method of application and rate per feddan in table (1)

Part 1: Field Trials

The randomized complete block design was used in these experiments. Four replicates were made for each treatment. Each experimental plot consisted of four ridges. In case of early post- planting treatments, the herbicides were sprayed on the growing weeds after 21 days of artichoke planting, using funnel direct spray. The all plots were planted by artichoke stumps immediately after spraying. Evaluation of the herbicides efficacy was carried-out by collecting all the grown in weeds in the middle ridge of each plot in an area of 1 m^2 then they were sorted, classified, counted and weighed as fresh weight (after 45 day from planting). On the other hand, determine the side effects of the tested herbicides on the total yield of artichoke. All heads of each plot were harvested, and then weighed. Also both of the mean weight of a head and the number of heads were also recorded.

Head samples of each treatment were taken to the laboratory in order to estimate the globe quality characters (laboratory experiments)

Part II. Laboratory Experiments

Two field experiments were conducted in the 15th of August, 2007 and the 1st of August 2008, in two different locations, 55 and 60 Kilometers of Alexandria - Cairo Desert Road in the two seasons, to study the effect of certain herbicides on the crop yields, and certain components, as well as the activities of certain enzymes in the artichoke heads. The soil type of the two location is sandy loam soil.

The field and laboratory measurements included the followings:-

1-Total heads yield

2-Dry matter content (D.M.C)

3-Determination of ascorbic acid of globe artichoke (vitamin C) content.

The method was carried out according to **David (1970)**, modified by **Sabra (1988)**.

4-Determination of polyphenols of globe artichoke.

a)- Extraction of polyphenols

The method of extraction was carried out according to **Hsu, *et al* (2003).**

b)-Determination of polyphenols of globe artichoke.

The method was carried out according to **McGrath.*et al.*, (1982)**, modified by **Sabra, (1993)**

5- Determination activity of oxidative enzymes

a) Poly phenol oxidase activity

The method of determination was carried out according to **Broesch (1954.**

b) Peroxidase activity

The method of determination was carried out according to **Fehrmaun and Dimond (1967).**

RESULTS AND DISCUSSION

I. Field experiments

Two field experiments were carried out in two succeeding seasons during 2007 and 2008. These experiments included weed control with different methods, in artichoke (*Cynara scolymus* L.) in two different locations (55 and 60 kilometer of Alexandria – Cairo Desert Road in season 2007 and 2008 respectively).

Table(2): Weeds, common in the fields experiments, and their percentages of infestation, in 2007 and 2008 seasons

Weed type	% infestation	
	2007 season	2008 season
1- Common purslane	66.1	57.2
2- Cocklebur	19.8	0
3- Jimson weed	5.6	0
4- Common lambsquarters	0	4.7
5- Livid amaranth	0	4.8
6- Jungle rice	0	18.6
7- Bristly foxtail	0	11.7
8- Purple nutsedge	2.6	0
9- Field bindweed	3.3	0
10-Bermudagrass	2.6	2.5

*N. B.: 1- *Portulaca oleracea* L, 2- *Xanthium pungens* Wallr, 3- *Datura stramonium* L., 4- *Chenopodium album* L., 5- *Amaranthus ascendens lois,* 6- *Echinochloa colonum* L. Link, 7- *Setaria verticillata L. Beauv,* 8- *Cyperus rotundus* L, 9- *Convolvulus arvensis* L., 10- *Cynodon dactylon* L

First season, (2007):

I-A. – Effects on certain annual broad leaf weeds.

The data shown in table (3) indicate that:

1- The most predominant weed in the two seasons was the common purslane (*Portulaca oleracea* L), and all the weed control treatments caused significant reduction in the

fresh weight of this predominant weed. Oxadiargyl, prometryn and mulch gave 100% control of common purslane. The efficacy of prometryn against common purslane was also concluded by **Basnitzky, and Lifshitz 1970.** Other treatments were also very effective to control purslane and gave more than 91% control, this group of treatments include propyzamide, diuron, (butraline + diuron), acetochlor and hand weeding three times which gave 98, 97, 96, 93, and 91% respectively. Butralin gave also very good control of this weed since it gave 82% control.

2- The second predominant weed was cocklebur (*Xanthium pungens* Wallr). The data obtained from table (3) indicated that all of the tested herbicides failed to give reasonable control of cocklebur except propyzamide which gave 100% control of this troublesome weed. On the other hand the other weed control treatments including mulch and hand weeding three times were very effective against cocklebur and gave 100 % control. Prometryne was moderately toxic to cocklebur since it gave 77% control.

3- The least prevalent weed was Jimson weed (*Datura stramonium* L.), since its percentage of infestation was only 5.6%. The data obtained from table (3) indicated that all weed control treatments were very effective against Jimson weed and gave 100% control except butralin and (butralin + diuron) which gave only 64 and 75% respectively.

4- It is very important to notice that the high percentage of control of certain treatments which reached 100% does not mean the high efficacy of these treatments, the real explanation of this case may be due to the low infestation of this weed (Jimson weed).

5- In general propyzamide, prometryn, oxadiargyl, (butralin + diuron) as well as mulch and hand weeding could be recommended as very efficient weed control tools in artichoke fields since they gave: 99,95,89,87,100 and 93% control of total weeds respectively. Similar results concerning the high efficacy of propyzamide, prometryn, oxadiargyl, butralin, diuron in artichoke fields against several weeds was concluded by several workers e. g for propyzamide (**Jami *et al* 1981, Bohec and Hemery, 1974**, for prometryn (**Basnitzky, and Lifshitz 1970, Curvale *et al.*, 1971, Vercesi, 1976,**), for diuron (**Curvale *et al*,1971, Jami *et al.*, 1981**).

Second season, (2008).

I.B. Effects on the annual weeds.

The efficacies of all weed control treatments against certain annual weeds (both broad and narrow leaf weeds) were estimated and recorded in table (4) from which the following remarks could be deduced.

1- All herbicides as well as mulching and hand weeding three times caused significant reduction in the fresh weights of all germinated weeds. Propachlor and mulch were the most effective in this respect

2- With respect to the most prevalent weed in table (2), common purslane (57.2%) was sensitive to almost all treatments which gave more than 85% control except butralin and acetochlor which gave 78 and 58% respectively. Propachlor was the most effects against common purslane. which gave 96% control was the most effected against common purslane . Diuron, prometryn, propyzamide were the next efficient herbicides against common purslane which gave, 94,93 and 91 % control respectively.

3- Concerning common lambsquarters the data in table (4) showed amazing results which was 100% control with all treatments except butralin which gave only 71%. The same trend was observed in case of livid amaranth since all weed control treatments gave 100% control. In general 100% control of any weed mean the absence of this weed.

Table (3) : Efficacy of certain preplanting herbicide and other weed control treatments on certain annual broad leaf weeds expressed as fresh weight(F.Wt.), of the present weeds in gm/m^2 as well as the calculated peecentages of control(%control) of these weeds in artichoke plots(season 2007)

Treatment	broad leaf weeds						Total	
	common purslane		*Jimson weed*		*cocklebur*			
	F.Wt.	% Control	F.Wt.	%Control	F.Wt.	%Control	F.Wt.	%Control
Butralin	549,5	82	93	64	663	28	1305	69
Napropamide	1913	38	0	100	370	60	2285	46
Propyzamide	50	98	0	100	0	100	50	99
Prometryn	5	100	0	100	210,5	77	216	95
Propachlor	1525	50	0	100	320	65	1845	57
Oxadiargyl	0	100	0	100	480	48	480	89
Metribuzin	1605	48	0	100	440	52	2045	52
Acetochlor	215	93	0	100	1070	-16	1285	70
Diuron	100	97	0	100	675	27	775	82
Butralin+Diuron	125	96	66	75	365	60	556	87
Mulch	0	100	0	100	0	100	0	100
Hand weeding(3 times)	290	91	0	100	0	100	290	93
Control	3075	0	260	0	920	0	4255	0
L.S.D (0.05)							725	

Generally this could happen in case of the low infestation percent as in case of common lambsquarters and livid amaranth where % of infestation was 4.7 and 4.8 % respectively.

4- With respect to the effect of all treatments on annual narrow leaf weeds the data shown in table (4) indicated that there were two weeds but its percentages of infestations were low they including jungle rice (18.6%) and bristly foxtail 11.7%. All herbicidal treatments, also mulch and hand weeding three times were very effective against bristly foxtail since they gave 100 % control. Similar results were observed in case of jungle rice since all treatments gave more than 95% control except in case of hand weeding 3 times, (butralin+diuron) and metribuzin which gave 92,78 and 63% respectively.

5- In general it could be concluded that annual weeds either broad or narrow leaf weeds could be controlled by at least 8 treatments which gave more than 90% control to all annuals, these include in the following descending order: mulch, propachlor, diuron, prometryne, hand weeding 3 times, propyzamide, oxadiargyl and Napropamide which gave 100, 97, 96. 96, 95, 93, 92 and 91% respectively.

Table(4) : Efficacy of certain preplanting herbicides and other weed control treatments on certain annual weeds expressed as fresh weight (F.Wt.), of the present weeds in gm / m^2 as well as the calculated percentages of control(%cont.) of these weeds in artichoke plots (season 2008)

Treatment	annual broad leaf weeds								annual narrow leaf weeds						Total annuals	
	Common purslane		Common lambsquarters		Livid amaranth		Total		*Jungle rice*		*Bristly foxtail*		Total			
	F.Wt.	% cont.	F.Wt.	% cont	F.Wt	% cont	F.Wt	% cont.	F.Wt.	% cont.	F.Wt.	% cont.	F.Wt.	% cont.	F.Wt.	% cont.
Butralin	286	78	30	71	0	100	310	79	0	100	0	100	0	100	310	86
Napropamide	191.25	85	0	100	0	100	191	87	7.5	98	0	100	8	99	199	91
Propyzamide	110	91	0	100	0	100	110	93	22.5	95	13	95	35	95	145	93
Prometryn	94	93	0	100	0	100	94	94	0	100	0	100	0	100	94	96
Propachlor	54	96	0	100	0	100	54	96	13.75	97	0	100	14	98	68	97
Oxadiargyl	155	88	0	100	0	100	155	90	20	95	0	100	20	97	175	92
Metribuzin	179	86	0	100	0	100	179	88	152.5	63	0	100	153	77	332	85
Acetochlor	536.3	58	0	100	0	100	536	64	0	100	0	100	0	100	536	75
Diuron	82.5	94	0	100	0	100	83	94	7.5	98	0	100	8	99	90	96
Butralin + Diuron	162.5	87	0	100	0	100	163	89	90	78	0	100	90	87	253	88
Mulch	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100
Hand weeding	86.3	93	0	100	0	100	86	94	32.5	92	0	100	33	95	119	95
Control	1277.5	0	105	0	106.25	0	1489	0	412.5	0	260	0	673	0	2162	0
L.S.D 0.05							206						124			

I.C. Effects on the artichoke productivity in (2007 and 2008) seasons.

Each plot was planted with 20 stumps, the effect of all weed control treatments on the germination of artichoke stumps, was estimated as percentages of germination. The data obtained was recorded in table (5), (6) from which the following remarks could be deduced:

1- Fortunately the percentages of germination was not related to the control treatments, but a real calculation was carried out compared with the real number of stumps planted in each (20 stumps planted) in each experimental plot. In fact the stumps of artichoke were not perfect since the percentages of stumps germination were 53.75 and 47.5 % in the untreated plots in season 2007 and 2008 respectively.

2- comparing the germination of artichoke stumps in untreated plots (control) with the weed control treatments through hand weeding three times since percentages of germination were 72.5 and 63.75 % in seasons 2007 and 2008 respectively this could be explained due to lower competitions of weeds and thus reduce its toxic exudates which may render stumps germination, in addition hand weeding bring more soil around the artichoke stumps and permit amount of air to penetrate the soil to enhance its germination.

Table(5) : Effect of certain pre-planting and early post Herbicides and other weed control treatments on the germinated stumps, yield (ton/ fed.), dry mater content (D.M.C), total soluble sugar (T.S.S), Vit. C, polyphenols, PPO and peroxidase (PDO) in season (2007)

Treatment	phytotox	Head Quality characters						
	% Germination	Yiled ton/f.	D.M/C	T.S.S %	Vit. C (ug/gm)	Polyphenol (ug/gm)	P.P.O (% A)	Peroxidase (% A)
Butralin	76.00	4.70	-23.89	13.75	55	394.00	14	65
Napropamide	86.25	6.80	10.15	16.80	47	547.00	-9	82
Propyzamide	96.25	8.35	-16.30	19.00	49	531.00	1	-20
Prometryn	27.50	3.65	46.13	17.55	39	428.00	-3	77
Propachlor	22.50	2.97	-3.44	16.45	43	608.00	-17	140
Oxadiargyl	63.75	4.45	51.81	16.13	48	281.00	6	44
Metribuzin	60.00	6.06	-13.26	17.63	31	526.00	-20	-7
Acetochlor	66.25	5.81	50.43	16.28	67	183.00	-17	-13
Diuron	73.75	9.32	-12.01	15.40	38	371.00	-1	19
Butralin+Diuron	53.75	6.24	0.52	19.15	39	417.00	21	150
Mulch	33.75	6.00	37.01	15.08	33	473.00	-4	1
Hand weeding	72.50	5.50	-17.50	13.00	58	402.00	-5	0
Control	53.75	4.35	0.00	12.05	53	524.00	0	0

3- In general all percentages of germination in season 2008 were lower than the corresponding treatments in season 2007 except in case of (butralin + diuron) which was 53.75 % compared with 62.5 % in season 2008, this may due to unfavorable conditions or due to artichoke stumps in season 2008 were less efficient than these in season 2007. The safety of diuron to artichoke was

4- concluded by other workers who mentioned that diuron was not toxic to artichoke (Curvale *et al*, 1971 and Jami, *et al.*, 1981)

5- One of the amazing results was observed in case of propyzamide since percentages of germination were 96.25 and 95 % in season 2007 and 2008 respectively. The only reasonable explanation of this phenomenon might be due to that the chemical activation of propyzamide to artichoke stumps in the two seasons was perfect since the germination were almost 100%. This result was in agreement with the findings of Curvale *et al*, 1971 and Vincezetti, *et al.*, 1976 who concluded that propyzamide was non toxic to artichoke stumps by any means. The same trend was observed but to lower extent in case of napropamide since it gave 86.25 and 78.75 % in season 2007 and 2008 respectively. Butralin and diuron gave 75 and 73.75 % respectively in season 2007 and 55 and 63.75 % respectively in season 2008.

Table(6) : Effect of certain pre-planting and early post Herbicides and other weed control treatments on the germinated stumps, yiled, dry mater content (D.M.C), total soluble sugar (T.S.S), Vit. C, polyphenols, PPO and peroxidase (PDO) in season (2008)

	phytotox.	Head Quality characters						
Teratment	Germenation	Yiled ton/f.	D.M/C	T.S.S %	Vit. C. (ug/gm)	Polypheno l (ug / gm)	P.P.O (% A)	Peroxidase (% A)
Butralin	85.00	3.51	22.85	11.13	68	607.00	32	65
Napropamide	71.25	5.70	8.82	14.13	68	557.00	11	146
Propyzamide	95.00	8.27	-6.43	17.25	72	555.00	18	20
Prometryn	29.00	5.73	2.44	13.00	60	568.00	22	5
Propachlor	27.50	3.60	6.40	12.00	74	588.00	9	27
Oxadiargyl	45.00	3.25	2.03	12.50	71	513.00	-3	-25
Metribuzin	30.00	3.08	14.18	12.75	67	449.00	2	49
Acetochlor	45.00	4.11	0.14	12.25	66	487.00	-20	85
Diuron	63.75	8.16	7.39	16.13	66	562.00	-12	69
Butralin+Diuron	62.50	7.23	12.03	10.63	67	556.00	2	33
Mulch	30.00	5.42	3.47	10.50	69	521.00	-17	6
Hand weeding	63.75	4.70	18.05	11.25	75	526.00	-5	133
Control	47.50	3.87	0.00	11.88	68	561.00	0	0

6- On the other hand a great reduction of the germination of artichoke stumps was observed in case of propachlor and prometryn as well as mulch treatment since percentages of germination of propachlor, prometryn and mulch treatment were 22.5, 27.5 and 33.75 % respectively in first season 2007. The same deleterious effect of the three treatments was repeated once more in season 2008. Since they gave 27.5, 29 and 30 % for propachlor, prometryn and mulch treatment respectively so these three treatments must be never recommend in artichoke field.

I.D. Effects on the total yield

Table (5), (6) recorded the amount of artichoke collected from each plot in the two seasons from which the following remarks could be concluded:

In 2007 Season:

Only three herbicides namely diuron, propyzamide and napropamide caused highly significant increase in artichoke yield since they gave 9.32, 8.39 and 6.8 ton / feddan respectively. The corresponding percentages of increase of artichoke yield compared with the untreated plots were 114.5, 92.28 and 56.47 % for diuron, propyzamide and napropamide respectively. Non of all treatments caused significant reduction in artichoke yield. This was in agreement of the work of **Fatma *et al.*, 1997** who mentioned that sencor (metribuzin) increased plant height, number of leaves, leaf area and plant dry weight and total yield of flower heads of artichoke plants.

In 2008 Season

Five herbicides caused significant increase in artichoke yield, They arranged in the following. propyzamide (113.97 %) > diuron (111.07 %) > (butralin+diuron) (87.16 %) > prometryn (48.18 %) > Napropamide (47.5 %) the same herbicides gave the following %

germination: 95, 63.75, 62.5, 29, and 71.25 respectively. It could be concluded that mulch could cause decrease in stump germination in the two seasons, but because there was no weeds in this treatment so due to eliminate weed competition thus the increase of artichoke yield was 38.03 and 40.13 % increase in seasons 2007 and 2008 respectively. The mean yield in the two seasons was very high in case of diuron, (112.89 % increase) followed by propyzamide (102.49%) and (butralin+diuron) (64.05 %). The mean yield of the two years was greatly reduced in case of propachlor and oxadiargyl which gave 19.91 % and 6.31 % reduction in artichoke yield respectively.

2. Laboratory experiments

2.A. Effects on the dry matter content

The data recorded in table (5), (6) pointed to the following points:

1- Since the estimation of dry matter content was carried out in artichoke globe, this estimation was due to the direct effect of the weed control treatments on the metabolism of all dry matter in these parts. In season 2007 three herbicides only caused significant increase of dry matter of artichoke globe since they caused the increase of dry matter with 51.81, 50.43 and 45.13 % for oxadiargyl, acetochlor and prometryn respectively. On the other hand 6 weed control treatments reduced dry matter content in artichoke globe but these decreases were not significant.

2- In season 2008, other three weed control treatments caused significant increase of dry matter of artichoke globe which include butralin, hand weeding and metribuzin, which gave 28.56, 27.44 and 26.54 % increase of dry matter respectively. The increase of plant dry matter due to application of metribuzin was also found by (Fatma *et al.*, 1997). On the other hand propyzamide was the only one who reduced dry matter by 6.43 % but this reduction was not significant.

3- In general the mean of the two seasons for all treatments were similar to the control and there were no significant difference between all weed control treatments.

2.B. Effects on total soluble sugars content

Table (5), (6) showed the data recorded concerning the estimation of total soluble sugars content in artichoke globe after exposure to certain weed control treatments. From which the following could be observed:

1- All of the tested herbicides caused significant increase of total soluble sugars except butralin and diuron which gave almost the same content of the control in season 2007.

2- (butralin + diuron) and propyzamide caused the highest increase of total soluble sugars in artichoke globe since they gave 58.92 and 57.68 % increase respectively, followed by metribuzin (46.27 %) and prometryn (45.64 %). The following herbicides gave the third level of increase of T.S.S. these herbicides include napropamide, propachlor, acetochlor and oxadiargyl which gave 39.42, 36.51, 35.06 and 33.82 % respectively.

3- In the second season 2008 propyzamide and diuron were the only two herbicides which caused significant increase of T.S.S. in artichoke globe since they gave 45.26 and 27.37 % increase respectively. Mulch treatment and hand weeding caused non significant reduction of (T.S.S.) in season 2007. The same was noticed in case of (butralin + diuron) and butralin, in season 2008. Unfortunately the last result was not repeated in the first season (2007).

4- In general the mean of the two years proved that propyzamide caused the highest increase in T.S.S. with 51.52% increase following by napropamide which gave only 29.26 %.

2.C. Effects on ascorbic acid content

1- Ascorbic acid is one of the targets which could be affected from weed control treatments. Generally table (5), (6) indicated that in season 2007, 5 herbicides as well as mulch treatment caused significant reduction of ascorbic acid content. These herbicides could be arranged in the following descending order prometryne (39) = (butralin + diuron) (39), diuron (38) and metribuzin (31) ug /gm, in other words metribuzin caused the highest reduction of ascorbic acid content since it caused 41.67% decrease following by mulch treatment which gave 37.04% reduction of ascorbic acid content. In general none of all treatments gave significant increase of ascorbic acid content in season 2007.

2- In the second season all weed control treatments did not significantly affect ascorbic acid content neither by increasing nor decreasing ascorbic acid content. The same was true in case of the mean amount of ascorbic acid in both years (2007 and 2008).

2.D. Effects on polyphenols content

The data recorded in table (5), (6) indicated the following:

1- The statistical analysis of the biosynthesis of polyphenols was greatly affected due to the presence of certain herbicides which caused significant decrease of polyphenols content in the first season (2007) since they arranged in descending order, acetochlor > oxadiargyl > diuron, butralin, (butralin + diuron) > and prometryn which gave 65.08> 46.37> 29.2> 24.81> 20.42> and 18.32% decrease of polyphenols content respectively.

2- Hand weeding 3 times caused 23.28% reduction of polyphenols content, while mulch treatment caused slight reduction of polyphenols content but not significant since it gave 9.73% reduction.

3- In the second season (2008), only metribuzin caused significant slight decrease in polyphenols content with 19.96% reduction of its content.

4- In general it coulc be concluded the biosynthesis of important components in the plant like polyphenols did not that affected by most of the tested herbicides. These compounds is very important since the artichoke properties of the considerable quantity of polyphenols in the fresh extract of artichoke plants was concluded by Alamanni and Cassu, 2003. In addition Mabeau, *et al* 2007 found that the antioxidant activity of single polyphenols or complex extracts from artichoke edible parts. This study showed that extracts with high antioxidant activity can be obtained from artichoke and artichoke industrial by products. These extracts might be of interest within the developing market of nutritional ingredients.

2.E. Effects on polyphenol oxidase activity

1- The data recorded in table (5), (6) and the statistical analysis of these data proved that all weed control treatments had no significant effect on polyphenol oxidase activity in the two seasons (2007 and 2008).

2- In general in the first season 2007, (butralin + diuron) and butralin gave the highest non significant increase of polyphenols oxidase activity since they gave 21 and 14 % increase respectively while metribuzin, acetochlore and propachlor gave the highest

non significant reduction of polyphenol oxidase since they gave 20, 17 and 17 % reduction respectively.

3- In general in second season 2008 the highest increase but not significant was noticed in case of butralin and prometryn since they gave 32 and 22 % increase respectively while on the other hand acetochlor and mulch treatment gave the highest decrease of polyphenols oxidase activity but not significant since they gave 20 and 17 % reduction respectively.

4- Fortunately most herbicides did not enhance polyphenol oxidase activity since deleterious effect to artichoke heads could happen under these circumstances as mentioned by Dogan, *et al* 2005, who isolate and purified polyphenol oxidase (PPO) from artichoke. They also found that artichoke (PPO) was inhibited with certain compounds like ascorbic acid, glutathione and benzoic acid...etc. this enzyme could be responsible about the browning phenomena of artichoke heads if stored at low temperature (40°C). (Lattanzio *et al.*, 1994).

2.F. Effects of on peroxidase activity

1- In season 2007 while six of the tested herbicides did not cause significant increase of peroxidase activity, neither mulch treatment nor hand weeding three times had any effect on peroxidase activity.

2- The highest increase of peroxidase activity was noticed in the first season (2007) in case of (butralin + diuron) and propachlor since they gave 150 and 140 % increase of the enzyme activity followed by napropamide and prometryn which gave 82 and 77 % increase of the enzyme activity. The third category of activation were butralin and oxadiargyl which gave 65 and 44 % respectively. On the other hand certain propyzamide, acetochlor and metribuzin caused non significant decrease of peroxidase activity since they caused 20, 13 and 7% reduction of peroxidase activity.

3- In season 2008 only oxadiargyl decreased peroxidase activity but not with significant reduction. On the other hand two herbicides, napropamide and acetochlor caused significant increase of enzyme activity by 146 and 85 % respectively. In addition, hand weeding 3 times caused significant increase of peroxidase activity.

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الملخص العربى

مكافحة الحشائش في محصول الخرشوف

اجريت تجربتان حقليتان فى 2007 ، 2008 فى تربة طفلية رملية . واستخدمت العقل الساقية للزراعة. استخدمت 10 مبيدات كمعاملة قبل الانبثاق وهم: بيوترالين ، نابروباميد ، بروبيزاميد ، برومترين ، بروباكلور ، أسيتوكلور ، أوكسادايرجيل ، متروبيزين ، دايرون ، بيوترالين + دايرون. بالاضافة الى التغطية بشرائح البولى ايثلين السوداء والعزيق اليدوى وبدون معاملة (الكونترول) وكانت أفضل المعاملات فى مكافحة للحشائش هى بروبازميد ، دايرون ، بيوترالين + دايرون ، والعزيق اليدوى ثلاث مرات ، التغطية بشرائح البولى ايثلين السوداء. والمبيدات الثلاث ليست فقط مؤثرة على مكافحة الحشائش فى الموسمين ولكن أيضا اعطت أعلى انبات للعقل الساقية للخرشوف ، وأعلى انتاج لرؤس الخرشوف ليس فقط كميا ولكن أيضا على صفات الجودة وكان هناك زيادة معنوية لحجم الرؤس الصغيرة والمتوسطة للخرشوف وهو الحجم المطلوب للتصدير. والجم الكبير كان به زيادة معنوية أيضا للاربع مبيدات والمطلوبة للسوق المحلى. وهذه المعاملات أحدثت زيادة معنوية فى محتوى السكريات الذائبة الزائبة ونشاط انزيم البولى فينول أوكسيديز والبروأكسيديز. مبيد بروبيزاميد أعطى أعلى زيادة فى محتوى السكريات الزائبة الكلية فى الموسمين 2007 ، 2008.والتغطية بشرائح البولى ايثلين السوداء اعطت 100% مكافحة للحشائش الحولية والمعمرة ولكن سببت نقص شديد فى نسبة الانبات. بصفة عامة وجد أن مبيدى برومترين وبروباكلور قد خفضا نسبة الانبات بدرجة معنوية فى الموسمين وخفضوا الانتاج والمحتوى من فيتامين ج على الأقل فى موسم 2007. التغطية بشرائح البولى ايثلين السوداء قللت معنويا من محتوى فيتامين ج فى موسم 2007 , كمل قلل نشاط انزيم البيروكسيديز فى موسم 2008. أوكساديرجيل قلل محتوى الفينولات الكلية فى موسم 2007 كما ثبط معنويا نشاط انزيم البروكسيديز فى موسم 2008.