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EFFECT OF SOME HERBICIDES ON WHEAT CHARACTERS AND ASSOCIATED WEEDS WITH RESPECT TO ITS RESIDUES

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ABSTRACT

This study was carried out to evaluate the efficacy of some herbicides on wheat weeds (*Ammi majus*, *Medicago hispida* Gaerth, *Cichorium endivia* L., *Sonchus oleraceus* L., *Lolium temulentum* L., *Phalaris minor* Retz and *Avena* spp.) with respect to its effect on wheat growth and yield characters under field conditions in two growing seasons (2013-2014). Treatments comprised of post-emergence application of tribenuron-methyl, clodinafop-propargyl + pinoxaden + cloquintocet, isoproturon + diflufencan, tribenuron-methyl with clodinafop-propargyl + pinoxaden + cloquintocet and hand weeding twice. Furthermore, herbicide residues in soil as well as in leaves and grains of wheat after application were determined times different times from sowing. The results indicated that the use of the tested herbicides gave excellent control of the selected wheat weeds as well as increased wheat growth and yield characters. The tested herbicides degraded rapidly in soil and without side effect on soil characters. Residue analysis of the tested herbicides indicated the wheat grains at harvest day were free from herbicide residues and safe for human consumption.

Keywords: Weeds; wheat; herbicides; control; residue

INTRODUCTION

Human beings practically attain all their food directly or indirectly from plants. Cereal crops belonging to Gramineae (Poaceae) family produce edible grains, which provide about one-half of man's food calories and a major portion of his nutrient requirements. Wheat (*Triticum aestivum* L.) is foremost among cereals and indeed among all crops, as a direct source of food for human beings (Marwat *et al.* 2008). Wheat (*Triticum aestivum* L.) has a special importance in Egypt because the local production is not sufficient to supply the annual demands of the local requirements. Weeds are the most important problem in wheat production which cause a highly loss in the crop. The reduction of wheat yield due to weed infestation reached to 30.7%

(Nisha *et al.* 1999). Al-Marsafy *et al.* (1996) indicated that the losses in wheat yield due to grassy weed reached about 44%, meanwhile the losses in yield attributed to Phalaris mixture ranged from 40 to 50%. Shaaban *et al.* (2009) indicated that the reduction in wheat yield due to the broad-leaves weeds competition were ranged from 19.2 to 27.5 % and 33.2 to 43.7 % for grassy weeds but for total annual weeds the reduction was ranged from 46.4 to 46.8 % in two growing seasons.

Weed control is one of the essential cultural practices for raising wheat yield and improving its quality. Chemical weed control in wheat fields by post-emergence herbicides such as metosulam, tribenuron-methyl, clodinafop-propargyl and isoproturon have been used to control weeds in wheat fields in Egypt to improve wheat productivity through elimination of weed competition (El-Metwally 1999; Nagla Al-Askar 1998; Soliman *et al.* 2011). However, the recommended dose of herbicides is relatively high and hence its cost price is too expensive under the Egyptian conditions. Jain *et al.* (1998) showed that the total weed population was reduced significantly with isoproturon. The greatest grain yield of 5.75 ton/ha was achieved with isoproturon at 1.875 kg/ha and the lowest yield was produced from the untreated control (3.7ton/ha). Mekky *et al.* (2010) found that wheat was tolerant to the clodinafop-propargyl herbicide at recommended rate (333.33 g/ha) when applied at 45 days after sowing (DAS) and very effective against canary grass (Phalaris) and increased wheat production.

The high efficacy of herbicides against wheat weeds are very important parameter however its effect on wheat characters considered the key factor in weeds control process. Wolia & Kumar (2000) and Soliman *et al.* (2011) found that all herbicidal treatments (Clodinafop-propargyl, tribenuron-methyl and isoproturon) as well as hand weeding treatment increased protein, phosphorus, potassium, carbohydrate percentage and their uptake in wheat grains relative to control treatment. Yasin *et al.* (2010) found that the application of clodinafop at rate of 37 g a.i./ha produced relatively less weed biomass, more plant height, number of spikes bearing tillers, number of grains/spike, 1000-grains weight and grain yield (4.20 ton/ha). Also, Khan *et al.* (2011) indicated that clodinafop-propargyl + cloquintocetmexyl (Topik) was effective in decreasing weed biomass and enhancing grains yield and its contributing traits.

The fate and behavior of herbicides in the soil and wheat crop after application considered a source of major concern. The fate of herbicides influenced by many factors, including soil properties, management, application methods, herbicide properties, landscapes, cultivated crops and climatic conditions. Therefore determination of herbicide residues in wheat and soil after application are in demand to reflect its effect on soil characters and the safety of wheat products for human consumption. Many researchers determined the residues and investigate the fate of herbicides in wheat grains and straw during harvest (Ramesh & Beena 2008; Singh *et al.* 2008; Mitwally 2012; Fakkar *et al.* 2013)

The aims of this study were to evaluate the efficacy of some herbicides (tribenuron-methyl, clodinafop-propargyl +pinoxaden+ cloquintocet and isoproturon+ diflufencan) against some wheat weeds (annual grassy, broad leaves weeds), to evaluate the effect of these herbicides on some wheat growth and yield characters (N, P and K uptake, plant height, spike length, weight of grains/spike, number of grains/spike, straw and grains yield) and to determine its residues in soil and wheat leaves and grains in two growing seasons under field conditions.

MATERIALS AND METHODS

1.Weeds control efficacy

Two field experiments were carried out at the Experimental Agricultural Research Station of Sakha during two successive winter seasons (2012/2013 and 2013/2014) to study the effect of some herbicides on wheat crop, associated weeds and determination of its residues in wheat and soil. The mechanical and chemical analysis of cultivated soil was shown in Table (1).

Table 1. Physical and chemical analysis of soil.

Season	Organic matter %	Soil pH	Sand %	Silt %	Clay %	Textural class	N ppm	P ppm	K, ppm
2012/13	1.35	8.29	18.72	33.73	48.4	Clay	22.00	20.00	280.92
2013/14	1.45	8.09	17.66	33.14	51.2	Clay	19.53	18.45	277.10

Wheat grains (*Triticum aestivum* L.) cv. Cids 12 was used in this study. The experiments were laid out in a complete randomized block design with a plot size of 3.0 x 3.5 m and replicated four replications. The grains were broadcasted on the soil at rate of 142.8 kg/ha in the 15^{th} and 20^{th} of November in the first and the second seasons, respectively. Sex treatments were applied in this study as follow:

Traxos 5.06% EC (clodinafop-propargyl 2.25% + pinoxaden 2.25% + cloquintocet 0.56%) at rate of 1.190 L/ha which applied after 35 days from sowing, granstar75% DF (tribenuron-methyl) at rate of 19.2 g/ha which applied at 21 days after sowing, a mixed treatments (granstar75% DF (tribenuron-methyl) at the rate of 19.2 g/ha applied at 21 days after sowing plus traxos at the rate of 19.2 L/ha applied after 35 days from sowing), panther 55% SC (50% isoproturon + 5% diflufencan) at the rate of 1.43 L/ha applied at 28 days after sowing and hand weeding twice (carried out at 30 and 50 days after sowing) beside control (untreated). Herbicides were sprayed by knapsack sprayer CP_3 with water volume of 476 liters/ha. All agronomic practices in wheat such as land preparation, fertilization and irrigation were done as recommended during the two seasons of study.

Weeds were hand pulled randomly from one square meter from each plot after 70 and 90 days from sowing and classified into three categories (broad-leaved, grassy and total weeds). The fresh weight of each species was estimated as g/m^2. Weed control efficacy was evaluated in the form of percent reduction (%R) in the fresh weight of each individual species of weeds as well as the total weeds. Percent of reduction (%R) was calculated according to Topps& Wain (1957) formula as following:

$$\% R = (A-B)/A \times 100$$

Where: A= the fresh weight of weeds in untreated plot and B = the fresh weight of weeds in treated plot.

At harvest, samples of 10 wheat plants were randomly collected from each plot to measure the following characters: plant height (cm), spike length (cm), weight of grains/spike and number of grains/spike. The straw yield (ton/ha) and grain (ton/ha) were determined at harvest from yield of the whole plot.

2. Chemical composition of wheat grains

Determination of total nitrogen, phosphorus and potassium in wheat grains was carried out on the ground dry materials. The samples were digested in a mixture of sulfuric and salicylic acids as well as hydrogen peroxide according to the method described by Linder (1944). Total nitrogen content was estimated by Kjeldahl method (Rangnna 1979). Phosphorus and potassium percentages in grains were determined according to the method described by Cottenie *et al.* (1982).

3. Determination of herbicide residues in soil, leaves and grains

3.1. Sampling

The tribenuron-methyl, isoproturon+diflufencan and clodinafop-propargyl +pinoxaden+cloquintocet were sprayed after 21, 28 and 35 days of sowing, respectively. Wheat leaves and soil samples were taken at zero time (24 hours after application), 10, 30, 60, 90, 120 and 159 days after application, respectively. These samples were transferred and subjected to residues analysis.

3.2. Extraction

Tribenuron-methyl, isoproturon, diflufencan, clodinafop-propargyl, pinoxaden and cloquintocet were extracted from wheat (leaves and grains) and soil (50 g of each sample) according to the method described by Mou *et al.*(2011) and Sánchez-Brunete *et al.* (1998), respectively**.** All samples were cleaned up using sap-pale cartridge (C_{18}).

3.3. Analysis

Herbicide residues were determined using Beckman HPLC instrument fitted with variable wave length detector (119), C_{18} stainless steel column (10 x 250 mm), dual pump for delivering solvent (110) and mobile phase of water/methanol (30/70) was for tribenuron-methyl and isoproturon while water/acetonitrile (30/70) was for diflufencan, clodinafop-propargyl, pinoxaden and cloquintocet with a flow rate of 1 ml/min. The detection limits were 0.03, 0.06, 0.07, 0.05, 0.052 and 0.06 ppm for tribenuron-methyl, isoproturon, diflufencan, clodinafop-propargyl, pinoxaden and cloquintocet, respectively. The recovery of tribenuron-methyl, isoproturon, diflufencan, clodinafop-propargyl, pinoxaden and cloquintocet ranged from 94.62 to 97.88%.

Calculation of residual half-life values (RL_{50}) was carried out mathematically according to the method described by Moye *et al.* (1987) using the following equations;

RL_{50} ($t_{1/2}$) = ln2 / K\` = 0.6932 / K\` (1)

K\ = 1 / t_x * ln a / b_x (2)

Where:-

K\` = rate of decomposition. t_x = time in days.

a = initial residue. b_x = residue at x time.

3.4. Statistical analysis

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

RESULTS

1. Efficacy of weed control treatments

The most dominant weeds accompanied with wheat plants were: Common bishops weed (*Ammi majus*), bur clover (*Medicago hispida* Gaerth), Chicory (*Cichorium endivia* L.), annual sowthistle (*Sonchus oleraceus* L.), rye grass (*Lolium temulentum* L.), little seed canary grass (*Phalaris minor* Retz) and wild oat (*Avena* spp.) as grassy weeds in both growing seasons.

The fresh weight of broad-leaved, grassy and total annual weeds of the two seasons surveys as affected by different tested herbicides compared with the control treatment in both growing seasons are shown in Table (2). At the first survey, all tested treatments significantly reduced the fresh weight of the selected annual weeds compared with control treatment. Clodinafop-propargyl + pinoxaden+cloquintocet (Traxos) herbicide decreased the fresh weight of grassy weeds. Tribenuron-methyl (granstar) decreased the fresh weight of broad-leaved weeds, while isoproturon+diflufenican (panther) showed the highest reduction in fresh weight of total annual weeds followed by tribenuron-methyl and clodinafop-propargyl+pinoxaden+cloquintocet, respectively. Hand weeding treatment as well as foliar application of isoproturon+ diflufencan and tribenuron-methyl mixed with clodinafop-propargyl +pinoxaden+cloquintocet gave higher efficiency in controlling annual weeds with reduction percentages in fresh weight of 90.16, 93.57 and 99.54%, respectively. While, clodinafop-propargyl + pinoxaden+cloquintocet and tribenuron-methyl herbicides alone gave the less effective control of total annual weeds with reduction percentages in fresh weight of 45.86 and 68.05%, respectively compared with the control treatment in the first and the second seasons.

At the second survey, the same trend was observed. Hand weeding, isoproturon+diflufencan and tribenuron-methyl mixed with clodinafop-propargyl + pinoxaden + cloquintocet as post-emergence reduced the fresh weight of total weeds with reduction percentages of 94.0, 91.46 and 98.6% in the first season and 92.44, 92.46 and 98.48% in the second season, respectively compared with control treatment.

Table 2 . Effect of weed control treatments on fresh weight of weeds (g/m^2) after 70 and 90 days of wheat sowing in 2012/2013 and 2013/14 seasons.

Treatments	Rate F. /ha	70 days after sowing			90 days after sowing		
		Broad leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2)	Broad leaved weeds (g/m^2)	Grassy weeds (g/m^2)	Total weeds (g/m^2)
2012/2013							
Traxos	1.19 L	1052.3	3.4	1057.7	2104.4	6.9	2111.3
Granstar	19.2 g	9.7	614.6	624.3	18.5	938.5	957.0
Granstar/Traxos	19.2/1.19	9.2	5.6	14.8	12.6	14.6	27.2
Panther	1.428 L	79.3	46.3	125.6	158.4	86.6	245.0
Hand weeding	Twice	92.6	99.7	192.3	134.9	190.7	325.6
Control		1086.4	867.4	1953.8	2172.4	2926.7	5099.1
LSD at 5%		36.6	41.7	49.1	46.2	52.1	62.4
2013/2014							
Traxos	1.19 L	1150.9	7.8	1158.7	2168.9	23.7	2192.6
Granstar	19.2 g	22.4	742.1	765.1	53.7	1462.8	1016.5
Granstar/Traxos	19.2/1.19	16.8	25.5	42.3	32.6	43.7	76.3
Panther	1.428 L	103.5	156.8	260.3	192.4	137.8	366.2
Hand weeding	Twice	195.3	292.6	487.9	174.8	392.2	367.0
Control		1836.3	1212.3	3048.6	2642.5	2213.3	4855.8
LSD at 5%		46.3	45.1	51.0	44.3	56.4	59.6

*F = formulation

2. Impact on wheat growth parameters

Data presented in Table (3) showed that the all tested treatments increased significantly all wheat growth parameters relative control treatment. For plant height, tribenuron-methyl mixed with clodinafop-propargyl+pinoxaden+cloquintocet gave the highest values and significantly increased plant height of wheat followed by hand weeding and isoproturon + diflufencan at harvest time in both growing seasons.

Concerning spike length, data in Table (3) show that the highest spike length was obtained in wheat plants treated with tribenuron-methyl mixed with clodinafop-propargyl+pinoxaden+cloquintocet followed by hand weeding and isoproturon + diflufencan, respectively. However, the rest herbicidal treatment gave significantly shorter spike length than the control treatment.

Data recorded in Table (3) revealed significant difference between treatments in number and weight of grains/spike at harvest in both growing seasons. The highest values of grains number and weight per spike were obtained from tribenuron-methyl mixed with clodinafop–propargyl + pinoxaden + cloquintocet followed by hand weeding and isoproturon + diflufencan treatments, respectively. While clodinafop-propargyl + pinoxaden + cloquintocet and tribenuron-methyl separately were significantly less than the rest other treatment.

Table 3. Effect of the tested treatments on wheat growth components at harvest in 2012/2013 and 2013/2014 seasons.

Treatments	Rate F./ha	Plant height (cm)	Spike length (cm)	Wt. of grains/spike (g)	No. of grains/ spike
		2012/13			
Traxos	1.19 L	90.30	8.90	2.10	41.70
Granstar	19.2g	95.80	9.10	2.80	44.60
Granstar/Traxos	19.2/1.19	119.50	14.20	3.74	58.20
Panther	1.428 L	110.40	11.60	2.90	49.40
Hand weeding	Twice	112.60	12.20	3.0	50.80
Control (untreated)		81.40	7.30	0.70	29.18
LSD at 5%		4.68	2.37	1.25	5.74
		2013/14			
Traxos	1.19 L	97.7	8.4	2.1	42.8
Granstar	19.2g	103.5	9.6	2.3	45.4
Granstar/Traxos	19.2/1.19	118.2	13.8	3.8	59.6
Panther	1.428 L	111.4	12.1	2.7	48.1
Hand weeding	Twice	113.7	11.7	2.9	52.4
Control (untreated)	-	82.8	7.1	0.7	21.7
LSD at 5%		4.59	5.01	1.36	5.27

*F = formulation

3. Effect of the tested treatments on wheat yield

Data in Table (4) show that the all treatments significantly produced higher straw yield (ton/ha) than control treatment. The highest straw yield/ha was obtained from tribenuron-methyl mixed with clodinafop-propargyl + pinoxaden + cloquintocet followed by hand weeding, isoproturon + diflufencan, clodinafop-propargyl + pinoxaden + cloquintocet and tribenuron-methyl, respectively compared to the control treatment.

Data presented in Table (4) showed that the wheat grain yield (ton/ha.) was affected by different weed control treatments during the two growing seasons. All treatments significantly exceeded the control treatment in grain yield(ton/ha). It is evident that the best treatments were tribenuron-methyl mixed with clodinafop-propargyl+pinoxaden+cloquintocet, followed by hand weeding and isoproturon + diflufencan, clodinafop-propargyl + pinoxaden +

cloquintocet and tribenuron-methyl. These treatments significantly increased grains yield about 50.58, 46.75, 46.56, 29.21 and 36.79% in the first season relative to control treatment, respectively. Furthermore, the same trend was presented in second season.

Table 4. Effect of weed control treatments on wheat yield components at harvest in 2012/2013 and 2013/2014 seasons.

Treatments	2012/2013		2013/2014	
	Straw yield (ton/ha)	Grain yield (ton/ha)	Straw yield (ton/ha)	Grain yield (ton/ha)
Traxos	1.35	4.71	1.29	4.73
Granstar	1.42	5.27	1.38	5.22
Granstar/Traxos	1.78	6.74	1.74	6.61
Panther	1.56	6.23	1.53	6.17
Hand weeding	1.61	6.26	1.58	6.34
Control (untreated)	0.69	3.33	0.67	3.48
LSD at 5%	0.35	0.96	0.29	0.73

4. Effect on nutrient uptake by wheat

Data in Table (5) show that the uptake of N, P and K (kg/ha.) in wheat grains was higher with all weed treatments than control treatment. The highest percentage of elements in wheat grains due to it high uptake by wheat plant was obtained in wheat treated by tribenuron-methyl mixed with clodinafop-propargyl + pinoxaden + cloquintocet followed by isoproturon + diflufencan and hand weeding treatments, respectively.

Table 5. Effect of weed control treatments on N, P, and K uptake (kg/ha) of wheat grains in 2012/13 and 2013/14 seasons.

Treatments	Rate F./ha	N%	P%	K%	Absolute amount (kg/ha)		
					N	P	K
2012/2013							
Traxos	1.19 L	1.77	0.253	0.518	24.18b	11.80b	82.66b
Granstar	19.2g	1.80	0.248	0.529	28.70b	13.42b	97.41c
Granstar/Traxos	19.2/1.19	2.12	0.358	0.622	39.70d	22.85d	135.33e
Panther	1.428 L	2.06	0.299	0.585	34.37c	17.56c	121.05d
Hand weeding	Twice	2.01	0.279	0.569	33.56c	16.45c	118.55d
Control		1.33	0.142	0.233	6.93a	4.21a	39.56a
2013/2014							
Traxos	1.19 L	1.81	0.262	0.526	24.89b	12.40b	85.68b
Granstar	19.2g	1.84	0.253	0.534	28.82c	13.66b	99.32c
Granstar/Traxos	19.2/1.19	2.17	0.371	0.641	40.10e	13.69b	135.73d
Panther	1.428 L	2.05	0.296	0.581	33.77d	17.21c	119.14c
Hand weeding	Twice	2.03	0.272	0.564	33.75d	16.28c	121.45c
Control		1.46	0.163	0.237	7.40a	5.09a	45.55a

*F = formulation

5. Determination of herbicide residues

Data in Table (6) showed that the behavior of tribenuron-methyl in soil as well as in leaves and grains of wheat plants. The concentration of tribenuron-methyl in soil after application (zero time) became 12.48 and 14.32 ppm in the first and second seasons, respectively. The time for 50% loss of initial tribenuron-methyl in soil were 50.79 and 48.33 days in the two growing seasons, respectively. Finally, after 159 days of application the loss percentages of tribenuron-methyl in soil reached 98.56 and 98.67% loss in the two growing seasons, respectively.

For tribenuron-methyl residue in leaves, 8.17 and 9.58 ppm were found in wheat leaves in first and second seasons, respectively at zero time (21 days after sowing). However after 30 days of application, the tribenuron-methyl residue in leaves became 4.26 and 4.62 ppm with loss percentages of 47.86 and 51.77% of its initial concentration in the first and second seasons, respectively. On the other hand after 90 days the loss of tribenuron-methyl residue in wheat leaves became 96.45 and 92.28% in the two growing seasons, respectively.

Tribenuron-methyl residue in wheat grains were 0.06 and 0.06 ppm after 120 days of application in the two growing seasons, respectively with a loss percentages of 99.27 and 99.37% of its initial concentration in the grains in the two seasons. After 159 days of application, tribenuron-methyl residue was undetected in grains in the two growing seasons.

Table 6. Residues of tribenuron-methyl in soil, leaves and grains of wheat in 2012/2013 and 2013/2014 seasons.

Samples time (days)	2012/2013					
	Soil ppm	Loss %	Leaves ppm	Loss %	Grains ppm	Loss %
Zero	12.48a	-	8.17a	-	-	-
10	11.72b	6.09	6.12b	25.09	-	-
30	9.28 c	25.64	4.26 c	47.86	-	-
60	4.34 d	65.52	2.17 d	72.58	-	-
90	2.28 e	81.73	0.29e	96.45	0.19 a	97.67
120	1.28 f	89.74	-	-	0.06b	99.27
159	0.18g	98.56	-	-	UND	100.0
RL_{50} (days)	50.79		36.98		62.89	
	2013/2014					
Zero	14.32a	-	9.58s	-	-	-
10	13.47b	0.94	7.02 b	26.72	-	-
30	10.22c	28.63	4.62 c	51.77	-	-
60	5.42d	62.15	2.70d	71.82	-	-
90	2.67e	81.35	0.74 e	92.28	0.21a	97.81
120	1.46f	98.80	-	-	0.06 b	99.37
159	0.19g	98.67	-	-	UND	100.0
RL_{50}(days)	48.33		37.23		65.57	

* UND = undetected

Zero: after 48 hours after application

UND: Undetectable

RL_{50}: residue half lives

Table (7) showed the residual trend of clodinafop-propargyl + pinoxaden + cloquintocet in soil , leaves and grains of wheat under field conditions. At zero time (35 days after sowing), the concentration of clodinafop-propargyl + pinoxaden + cloquintocet in the soil were 16.32 and 15.67 ppm in the first and second seasons, respectively. However after 60 days 55.76 and 54.95% loss of its initial concentration in the soil was found in the two seasons, respectively. The time for 50% loss of initial clodinafop-propargyl + pinoxaden + cloquintocet concentration in soil was shorter in the first (55.73 days) than the second season (57.21 days). At the end of experiment about 97.73 and 97.32% loss of initial clodinafop-propargyl + pinoxaden + cloquintocet concentration in the soil were found in both growing seasons, respectively.

Table 7. Residues of taroxs (clodinafop- propargyl + pinoxaden + cloquintocet) in soil, leaves and grains of wheat in 2012/13 and 2013/14 seasons.

Samples time (days)	2012/13					
	Soil ppm	Loss %	Leaves ppm	Loss %	Grains ppm	Loss %
Zero	16.32a	-	9.43a	-	-	-
10	13.17 b	19.30	9.31a	33.09	-	-
30	11.54 c	29.29	4.87b	48.36	-	-
60	7.22d	55.76	2.21c	76.56	-	-
90	4.19e	74.33	0.62d	93.43	0.22a	96.29
120	2.13f	86.95	-	-	0.07b	99.26
159	0.37g	97.73	-	-	UND	100.0
RL_{50} (days)	55.73		31.44		40.65	
	2013/14					
Zero	15.67a	-	8.32a	-	-	-
10	12.33b	21.31	6.11b	26.56	-	-
30	10.46c	33.25	4.27c	48.68	-	-
60	7.06d	54.95	2.08d	75.00	-	-
90	4.01e	74.41	0.67e	91.95	0.26a	96.88
120	2.10f	86.60	-	-	0.09b	98.92
159	0.42g	97.32	-	-	UND	100.0
RL_{50}(days)	57.21		41.52		59.13	

* UND = undetected

*The concentration of taroxs formulation determined in this table is a summation of the concentration the three active ingredients (clodinafop-propargyl + pinoxaden + cloquintocet) in this formulation.

The concentration of clodinafop-propargyl +pinoxaden+ cloquintocet at zero time in leaves was 9.43 and 8.32 ppm in the two growing seasons, respectively. While after 30 days of application the loss its initial concentration was 48.36 and 48.68% in both growing seasons. Then clodinafop-propargyl +pinoxaden+cloquintocet residue decreased to 2.21 and 2.08 ppm with loss percentages of 76.56 and 75.0% in the two growing seasons, respectively after 60 days of application. The half-lives of clodinafop-propargyl+ pinoxaden+

cloquintocet in leaves were 31.44 and 41.52 days for the first and second seasons, respectively under field conditions.

The detected concentration of clodinafop-propargyl +pinoxaden+cloquintocet residue in wheat grains was 0.07 and 0.09 ppm that reached to the grains in the first and second seasons, respectively after 120 days of application with loss percentages of 99.26 and 98.92% in both tested seasons. At the end of experiment (159 days), no clodinafop-propargyl +pinoxaden+cloquintocet residue detected in the grains in the two growing seasons.

Table (8) showed the residue of panther (isoproturon + diflufencan) in soil , leaves and grains of wheat plants under field conditions. The concentration of isoproturon + diflufencan in soil after application (zero time) was 17.62 and 15.12 ppm in the two growing seasons, respectively. The times for 50% loss of initial isoproturon + diflufencan concentration in soil were 56.78 and 53.67 days in the two growing seasons, respectively. After 159 days of application the initial isoproturon + diflufencan concentration reached to about 0.18 and 0.19 ppm with a loss percentages of 97.32 and 98.74% in the two growing seasons, respectively.

The concentration of isoproturon + diflufencan at zero time (28 days after growing) in leaves were about 10.57 and 8.87 ppm in the first and second seasons, respectively. While, after 30 days of application isoproturon + diflufencan residue in leaves became 4.96 and 4.23 ppm with loss percentages of 53.07 and 52.31% of its initial concentration in the first and second seasons, respectively. After 90 days the loss became 93.47 and 91.88% in the two growing seasons, respectively.

After 120 days of application only 0.09 and 0.11 ppm of isoproturon + diflufencan were detected in the grains in the first and second seasons, respectively with loss percentages of 99.15 and 98.76%, respectively of its initial concentration. After 159 days, the isoproturon + diflufencan residue was undetectable in grains in the two growing seasons.

Table 8. Residues of panther (isoproturon + diflufencan) in soil, leaves and grains of wheat in 2012/2013 and 2013/2014 seasons.

Samples time (days)	2012/2013					
	Soil ppm	Loss %	Leaves ppm	Loss %	Grains ppm	Loss %
Zero	17.62a	-	10.57a	-	-	-
10	15.73b	10.73	7.32b	30.75	-	-
30	12.32c	30.08	4.96c	53.07	-	-
60	8.44d	52.10	2.07d	80.42	-	-
90	4.15e	76.45	0.69e	93.47	0.34a	96.78
120	2.23f	89.48	-	-	0.09b	99.15
159	0.18g	97.32	-	-	UND	100.0
RL_{50} (days)	56.78		28.02		33.82	
	2013/2014					
Zero	15.12a	-	8.87a	-	-	-
10	13.32b	11.90	6.12b	31.00	-	-
30	9.02c	40.34	4.23c	52.31	-	-
60	6.37d	57.87	2.10d	76.32	-	-
90	3.97e	73.74	0.72e	91.88	0.44a	95.04
120	2.11f	86.04	-	-	0.11b	98.76
159	0.19g	98.74	-	-	UND	100.0
RL_{50}(days)	53.67		25.91		30.32	

* UND = undetected

*The concentration of panther formulation determined in this table is a summation of the concentration the two active ingredients (isoproturon + diflufencan) in this formulation

DISCUSSION

All the tested treatments significantly reduced the fresh weight of wheat weeds compared with control treatment. The superiority of these treatments in controlling weeds could be attributed to the continuous destroying effect of the sequential application of herbicides during vegetative growth. Similar results were obtained by Nagla Al-Askar(1998) and Mekky *et al.* (2010).

The applied treatments increased significantly all wheat growth parameters relative to untreated control. This could be attributed to the high efficiency of weeds control treatments which subsequently resulted in reduction of weeds competition and increase wheat growth parameters (Table 2). On the other side, the lowest wheat growth parameters obtained from untreated control could be attributed to the negative effect of weeds on crop growth which may be occurred as a result of the competition between wheat and weed plants. Similar results were reported by El-Metwally *et al.* (1999) and Nagla Ai-Askar (1998).

Significant difference between treatments in number and weight of grains/spike as well as straw yield (ton/ha) at harvest time in both growing seasons was recorded. This is might be due to the increase of plant height at the harvest as a result of better weeds control treatments relative to untreated control. Similar results were obtained by El-Metwally *et al.* (1999) who reported that the post-emergence application of isoproturon as and hand weeding treatments increased the straw yield in wheat compared with the control treatment.

All treatments significantly exceeded the control treatment in wheat grain yield/ha. This increase might be due to not only the high weeds control efficiency of the previous treatments (Table 2), but also to their significant effects in raising grains yield per unit area and its related components such as spike length, number of grains/spike and weight of grains/spike which leading to the high grain yield/ha. The drop in grains yield/ha obtained from untreated control might be attributed to the reduction in the values of wheat growth characters, which occurred as a result of the competition between wheat and weed plants for the essential environmental resources i.e., light, water and nutrients. These results are in a harmony with those obtained by Mekky *et al.* (2010) and Soliman *et al.* (2011), they reported that hand weeding treatment and foliar application of isoporutron or clodinafop-propargyl + ploquintocet-mexyl gave the highest grains yield of wheat compared to the control treatment.

The uptake of N, P and K (kg/ha) in wheat grains yield was higher and significant with all treatments as compared with control. This superiority are attributed to the minimizing of weeds competition with wheat by herbicides application which in turn increased the availability of these elements to wheat plants for uptake as compared with control treatment that let the weeds to share wheat in nutrients uptake. Similar results were obtained by Soliman *et al.* (2011) who found that isoproturon, clodinafap-propargyl and hand weeding twice reduced uptake of N, P and K by weeds to about 54-60%.

The results showed significant loss of herbicide residues in soil which may be due to degradation. These results were in agreement with Mitwally (2012) who found that the residues of cldinafop-propargyl and isoproturon were not detected in the soil after 150 days from application at the recommended rates. Herbicides degradation may be due to greater microbial and enzymatic soil activities (Berger *et al.* 1998). Berger *et al.* (1998) reported that the natural production of citric acid by the fungus decreased the pH in soil which followed by chemical hydrolysis of herbicides.

The results showed that herbicide residues were not detected in wheat grains at harvest day and these results were in agreement with the findings of Reuchand *et al.* (1991) who reported that the residue of diflufenican and its metabolites were not detected in the flour of wheat after harvest. Also, Marshal *et al.* (1996) reported that the wheat was identified by its rapid uptake and subsequent degradation of ^{14}C-tralkoxydim (within 6 h) in the treated leaves. Therefore these herbicides are useful to control weeds with no residue in wheat grains which reflect its safety on human health.

CONCLUSIONS

Weed control methods played a vital role for the growth and yield of wheat. From the previous results, it could be deduced that tribenuron-methyl, clodinafop-propargyl + pinoxaden + cloquintocet and isoproturon + diflufencan herbicides were effective against weeds in wheat fields and increased wheat growth and yield characters. They degraded rapidly during planting of wheat in soil, leaves and grains without any effect on the wheat or the soil characters. Residues analysis reflects the safety of wheat grains for human consumption.

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تأثير بعض معاملات مكافحة الحشائش على محصول القمح والحشائش المصاحبة له وتقدير متبقياتها فى نباتات القمح والتربة

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الملخص العربى

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا ـ كفرالشيخ خلال موسمى الزراعة ٢٠١٣/٢٠١٢ و ٢٠١٤/٢٠١٣ لدراسة تأثير مبيدات الحشائش (جرانستار ١٩.٢ جم/هكتار، تراكسوس١.١٩٠ لتر/ هكتار وبانتر ١.٤٣ لتر/ هكتار) بالإضافة إلى معاملة النقاوة اليدوية مرتين على محصول القمح والحشائش المصاحبة له وتقدير متبقيات تلك المبيدات فى التربة وأوراق وحبوب القمح. وقد أظهرت النتائج ان إستخدام مبيد الحشائش جرانستار بمعدل ٨ جم/فدان أعطى مكافحة جيدة للحشائش عريضة الأوراق ومبيد تراكسوس بمعدل ١.١٩٠ لتر/ هكتار أعطى كفاءة عالية ضد الحشائش ضيقة الاوراق ومعاملة (جرانستار/تراكسوس) ومبيد بانتر بمعدل ١.٤٣ لتر/ هكتار ومعاملة النقاوة اليدوية مرتين أعطت مكافحة جيدة ضد الحشائش الحولية (عريضة وضيقة الأوراق) فى كلا موسمى الزراعة. أظهرت معاملة النقاوة اليدوية ومبيد الحشائش بانتر و(جرانستار /تراكسوس) تفوقا كبيرا فى تحسين نمو القمح وزيادة جودة محصول الحبوب ومكوناته. كذلك أظهرت زيادة ملحوظة فى نسبة النتروجين والفوسفور والبوتاسيوم فى حبوب القمح مقارنة بمعاملة الكنترول. أظهرت طرق تحليل متبقيات المبيدات فى التربة وأوراق وحبوب القمح حدوث فقد ٥٠% من تركيز مبيد جرانستار فى التربة بعد ٥٠.٧٩ و ٤٨.٣٣ يوم للموسم الاول الثانى على التوالى من تطبيق المبيد وحدوث تدهور لنفس المبيد فى الأوراق حتى وصل إلى ٠.٢٩ و ٠.٧٤ جزء فى المليون للموسم الاول الثانى على التوالى ولم يتم التعرف على أى متبقيات للمبيد فى نهاية التجربة (١٥٩ يوم) فى كلا موسمى الزراعة. حدوث تدهور لمبيد تراكسوس فى التربة حيث وصلت نسبة الفقد الى٩٧.٧٣ و٩٧.٣٢% فى نهاية التجربة (١٥٩ يوم). وكان تركيز المبيد الذى وصل للحبوب بعد ٩٠ يوم ٠.٢٢ و ٠.٢٦ جزء فى المليون فى الموسمين على التوالى ولم يتم التعرف على أى متبقيات للمبيد فى الحبوب فى نهاية التجربة. حدث تدهور لمبيد بانتر حيث تم فقد ٥٠% من تركيز المبيد فى التربة بعد ٥٦.٧٨ و ٥٣.٦٧ يوم فى الموسمين على التوالى من تطبيق المبيد ووصلت نسبة الفقد للمبيد فى نهاية التجربة الى٩٧.٣٢ و٩٨.٧٤% فى الموسمين على التوالى وكان تركيز المبيد الذى وصل الحبوب ٠.٣٤ و ٠.٤٤ جزء فى المليون فى الموسمين على التوالى ولم يتم التعرف على أى متبقيات للمبيد فى نهاية التجربة بعد ١٥٩ يوم فى كلا موسمى الزراعة.