

Comparative effect of certain herbicide groups on glutathione, glutathione-S-transferases and plant pigments of wheat.

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ABSTRACT

Glutathione (GSH) level, glutathione-S-transferases (GST's) activities and plant pigments contents were determined in shoot and root system of wheat (*Triticum aestivum* cv. Sakha 8) treated with eleven compounds from certain herbicide groups in field experiment to compare their effect on wheat physiology and biochemistry at different time intervals. This experiment was carried out at Agriculture Research Station, Alexandria University, Alexandria, Egypt. The herbicide groups were nitriles (bromxynil with two formulations), sulfonyl ureas (tribenuron-methyl and AC322-140), aryloxy phenoxypropionates FOP's (clodinafop-propargyl and dicolofop-methyl), phenylureas (isoproturon in three formulations) and phenylureas and other groups of herbicides (two formulations). The GSH content of wheat roots was increased with time intervals after treatments, sulfonyl urea and FOP's were superior in this respect followed by phenylurea and nitriles. The same trend in stem was observed with 3-4 times in GSH content. While GST's activities were highly increased in wheat root than in stem and the least in leaves due to herbicidal treatments. Herbicides had no effect on chlorophyll b (ch.b.) and carotenoides, while caused significant increase in ch.a.. FOP's and sulfonyl urea groups gave the highest increase in this respect.

INTRODUCTION

Wheat is the most widely grown cereal crop in Egypt, with total cultivation area of 2.3 million feddans (Anonymous 1999). Weeds are the major problem in wheat production, the percentage of wheat in the first 30-40 days after sowing is the critical period of crop-weed competition and

can sensually limit the growth of wheat plants (Nedunzhiyan *et.al.*, 1998). Almost hundred percent crop loss due to weeds was recorded (Lacey, 1985) in wheat field

Nirile herbicides such as bromoxynil and pardner are very effective against wide spectrum of broad leaf weeds (EL-Deeb *et.al.*, 1986; Shaban and EL-Deek, 1986; Gouda *et.al.*, 1994, Khan and Rashid, 1994; El-Badry, 1995 and Sabra *et.al.*, 1999). These herbicides were increased the wheat yield and yield components, but recently became non effective against some species of annual broad leaf weeds. The alternative herbicide in this respect is isoproturon which gave high weed control efficacy (percentage of control was about 97%) against both type of weeds, broad leaf and grassy weeds (Soroka *et.al.*, 1995). Many workers mentioned that, isoproturon herbicide was effective against broad leaf weeds and annual grassy weeds specially ryegrass, and this compound significantly increased the yield and yield components of wheat (EL-Deeb *et.al.*, 1986; Gogoi and Kalita, 1995; Panwar *et.al.*, 1995; Soliman, 1995 and Sabra *et.al.*, 1999). But the missuse of this herbicide may cause phytotoxicity to wheat and affect the yield and yield components (Agrowal *et.al.*, 1996).

The new group of herbicides such as sulfonyl ureas appeared recently to solve the problem of broad leaf weeds in wheat. These compounds are used by few grams per feddan and are very effective against all types of these weeds (Gulidov and Narezhnaga, 1994; Montazeri, 1995; Kosceleny and Peeper, 1996 and Kumar *et.al.*, 1996).

Graminicides are selective herbicides used against grassy weeds in many crops. Illoxan (diclofop-methyl) is very effective against grassy weeds specially ryegrass and caused an increase in wheat yield (EL-Deeb *et.al.*, 1986; Shaban and EL-Deek, 1986; Khan and Rashid, 1994; Montazeri, 1995 and Kosceleny and Peeper, 1996). Topic (clodinafop-propargyl) was recently used in wheat against grassy weeds and enhanced the yield and yield components of wheat (Lenerle and Verbeek, 1995 and Soliman *et.al.*, 2000).

Conjugation of herbicides via the thiol function of reduced glutathione (α glutamyl-cysteinyl glycine) is well established as one of the major detoxification and selectivity factors in plants (Lamoureux *et.al.*, 1991). Though glutathione conjugation can proceed non-enzymatically at appreciable rates with some substrates, yet, these reaction are usually

accelerated through catalysis by glutathione-S-transferases enzyme (Farago and Brunold, 1994). The rate of glutathione conjugation of herbicides may be regulated in principle by both GST's level and activity as well as by glutathione availability. Also, glutathione plays a key role in the defence of plant against any toxins (Gaillard *et.al.*, 1994).

Glutathione-S-transferases (GST's EC 2.5.1.18) are a group of enzymes that catalyses the conjugation of electrophilic herbicides with the tripeptide glutathione (GSH). These enzymes have a role in determining selectivity of certain herbicides (Cole, 1994). The function of GST's in plants seems mainly to detoxify endogenous and exogenous chemicals; GSH conjugates of these toxins are usually non-phytotoxic and more water-soluble than the unreacted molecules (Martinoia *et.al.*, 1993). Detoxification of herbicides in wheat is more commonly associated with metabolism by P₄₅₀ monooxygenases than by GST's. However, several recent developments have led to reconsider this position. Wheat has been shown to have multiple and abundant GST's isozymes encoded by multiple genes, some of which are responsive to exposure to xenobiotics, the susceptibility of certain wheat cultivars to herbicides is inversely proportional to their GST's activities (Shimabukuro *et.al.*, 1970). Relatively little is known about the GST's complement in wheat, although herbicides are used as selective graminicides on this crop (Tal *et.al.*, 1992 and Richards *et.al.*, 1996).

The objective of the present research was to evaluate the effect of the recently introduced new herbicides (broad leaves herbicides and graminicides) applied by the suitable rates against weeds in wheat field in comparison with the old herbicides on plant biochemistry (glutathione (GSH) level, glutathione-S-transferases (GST's) activities and plant pigments contents).

MATERIALS AND METHODS

Field studies were conducted to compare the effect of different group of herbicides on the activity of GST's enzyme, GSH level and plant pigments (chlorophyll a, b and carotenoides) of wheat (*Triticum ostevum* CV. Sakha 8). The experiments were carried out in the winter season 2000/2001 at the Agricultural Research Experiment Station. Faculty of Agriculture, Alexandria University at Abis area. The soil type was clay loam (clay 41%,

silt 22.2 % and sand 36.16 %). Sowing date of wheat was 25th of November 2000. The experiment design was a randomized complete block design with four replicates (21m² for each replicate). The herbicidal treatments, names and rates of their application are presented in Table (1). The herbicidal treatments were post-applied (2-5 leaf stage) of wheat according to the time of application. For each herbicidal treatment using a CP3 knapsack sprayer, with the red fan type nozzle.

Table (1): Trade, common, chemical names, formulation and the rate of application of herbicidal treatments

Treatment Numbers	Trade name	Common name	Chemical name	Formulation	Rate/ Feddan
1	Brominal	Bromoxynil	3, 5-Dibromo-4-hydroxy-benzonitrile	E.C. 24%	1L.
2	Pardner	Bromoxynil	3 5-Dibromo-4-hydroxy-benzonitrile	E.C. 22.5%	1L.
3	Granstar	Tribenuron-methyl	Methyl 2-((3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-N-methylamino)carbonyl amino)sulfonyl benzoate)	D.F. 75%	8 gm
4	Gubeta	AC322,140	1-[[[cyclopropyl carbonyl) phenyl]]-3-(4,6-dimethyloxy-2-pyrimidinyl)-urea	W.P.	100 gm
5	Illoxan	Diclofop-methyl	(RS)-2-[4-(2,4-dichlorophenoxy) phenoxy] propionic acid	E.C. 36%	1L.
6	Topic	Clodinafop-propargyl	(R)-2-[4-(5-chloro-3-fluoro-2-pyridyloxy) phoxy]propionic acid	W.P.15%	140 gm
7	Proturon	Isoproturon	3-(4-isopropylphenyl) 1,1dimethyl urea	SC 50%	1.25L.
8	Swat	Isoproturon	3-(4-isopropylphenyl) 1,1dimethyl urea	SC 50%	1.25L.
9	Arelon	Isoproturon	3-(4-isopropylphenyl) 1,1dimethyl urea	FL 50%	1.25L.
10	Panler	Isoproturon+ Diflufenican	3-(4-isopropylphenyl) 1,1dimethyl urea + 2,4-difluoro-2-(4,6,6-trifluoro-m-tolyloxy) nicotinilide	SC 55%	0.6 L.
11	Arina	Isoproturon+ mazameth-Abenz	3-(4-isopropylphenyl) 1,1dimethyl urea + 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate and methyl 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate)	SC 39%	1.32 L.
12	control				

All the cultural practices were applied as usually in wheat plantation. The wheat plants were collected from experimental plot at different time intervals; 2, 7, 14, 21 and 35 days from herbicides application and transferred to the laboratory to determine the GST's activities, GSH level and pigments contents (chlorophyll a, b and total; and carotenoids).

Procedure:

At the proper time intervals, the wheat root, leaves and stem were cut into small pieces and prepared for determination of the different parameters.

1- GST's activities determination: According to Jabalankai and Hatzios (1991), the enzyme were extracted from root, leaves and stem by 0.1 M phosphate buffer (pH 6.8), and the specific activity of GST's were determined by CDNB (1-chloro-2,4-Dinitrobenzene) as a substrate and reduced glutathione by spectrophotometry at 340 nm. The rate of non-enzyme conjugation was determined.

2- GSH level: Wheat root and stem were extracted by 70% ethanol at 0°C and the GSH content was determined spectrophotometry using DTNB (5,5-Dithio bis (2-nitrobenzoic acid)) as a substrate in 0.1 ml ethanol at 412 nm according to Jabalankai and Hatzios (1991).

3- Plant pigment: Chlorophyll a. and b. were determined according to Grodzinsky and Grodzinsky (1973) and modified by Sabra (1988) from wheat leaves which were extracted by 80% acetone, chlorophyll a was determined at 662 nm and chlorophyll b was determined at 640 nm. Carotenoides were extracted and determined according to Canal Villanueva *et.al.* (1985) and modified by Sabra (1993). All data were statistically analyzed using L.S.D_(0.05) to compare the means.

RESULTS AND DISCUSSION

1- Effect of the tested herbicides on glutathion level

1-a The effect on roots:

The glutathion content of wheat roots in average was significantly enhanced by all herbicide groups, except nitriles groups and AC322-140 for sulfonylurea, (Table 2). At different time intervals, this level increased with the time up to 35 days except at 21 days. At 2 days after treatments, there was no significant differences between all treatments except isoproturon

(No. 8) and isoproturon+diflufenican (No. 10) which gave high increase in GSH content by 214.11% and 196.46% respectively. Diclofop-methyl (No. 5), gave the highest increase in the GSH content at 14 and 21 days after treatments by 184.61% and 168.59% respectively. Also, clodinafop-propargyl (treatment No. 6) and isoproturon+diflufenican (No. 10) gave significant increase in GSH content at 14 days after treatments. At the end of the experiment, there was no significant difference between nitriles and AC322-140 and the untreated plants. On the other hand, all herbicidal treatments gave an increase in GSH content, tribenuron-methyl (No. 3) gave the highest increase in this respect (240.26%) at 35 days of treatments followed by clodinafop-propargyl (No. 6), diclofop-methyl (No. 5) and isoproturon (No. 8) which gave 202.106, 186.71 and 186.60% resp. In general, there were no significant differences between nitriles, sulfonyl urea herbicide groups and untreated plants, also, between isoproturon as urea herbicide alone or mixed with others, also, between sulfonyl urea (tribenuron-methyl) and aryloxyphenoxypropionate "FOPs" (clodinafop-propargyl). Diclofop-methyl (No. 5), gave the highest increase in GSH content as general mean (170.09%).

Table (2): Effect of herbicidal treatments on glutathione content of wheat root at different time intervals (μg GSH/g F.W.) under field conditions.

No. of treatment	Time intervals (in days)					Mean
	2	7	14	21	35	
1	3.811	11.158	15.221	9.916	15.874	11.195a
2	4.105	12.968	22.842	10.526	13.474	12.783a
3	9.200	10.158	21.284	18.947	43.347	20.673cd
4	9.179	8.126	15.284	12.274	14.316	11.835a
5	11.200	15.074	33.305	20.253	33.684	22.703d
6	9.853	18.316	29.389	9.832	36.463	20.77cd
7	11.705	14.400	21.053	8.421	29.474	17.047b
8	15.326	15.095	18.611	8.211	33.663	18.18bc
9	11.179	16.126	18.632	8.968	27.011	16.383b
10	14.063	14.821	25.495	7.853	27.853	18.016bc
11	13.200	16.358	19.456	8.653	26.800	16.89b
12	7.158	11.453	18.042	12.042	18.042	13.347a
Mean	9.9a	13.7b	21.5c	11.32a	26.6d	

L.S.D_(0.05)herbicides=2.58

L.S.D_(0.05)time=1.65

L.S.D_(0.05)interaction=5.77

1-b: The effect on stem:

GSH content increased with the increase of the time, but on the other hand, all herbicides caused significant decrease in GSH level in the stem until the end of the experiment. In general, there was no significant differences in decreasing the GSH level of wheat stem between nitriles, sulfonyl urea, phenylurea alone or with other groups (isoproturone+disflufenican), also, between FOPs, phenylurea alone or with other groups. AC322 , 140 was the herbicide which caused the least content of GSH on both root and stem (Table 3).

Table (3): Effect of herbicidal treatments on glutathione content of wheat stem at different time intervals (μg GSH/g F.W.) under field conditions.

No. of treatments	Time intervals (in days)					Mean
	2	7	14	21	35	
1	13.811	35.579	50.989	48.084	100.421	49.77b
2	11.579	35.537	48.442	47.958	109.516	50.60b
3	11.411	28.463	58.379	45.937	109.053	50.64b
4	10.547	14.458	37.347	27.221	56.211	29.21a
5	43.747	52.000	53.305	46.379	112.358	61.55c
6	47.747	51.895	55.537	49.768	114.274	63.84c
7	29.705	55.684	56.842	38.737	122.021	60.59c
8	31.516	53.053	56.821	42.505	129.053	62.58c
9	27.368	36.632	43.516	21.979	101.242	45.84b
10	29.389	40.842	44.105	20.674	101.474	47.29b
11	35.937	43.368	56.074	53.116	129.004	64.09c
12	47.242	91.242	233.12	223.64	223.895	165.827d
Mean	28.33a	44.92b	66.45d	55.375c	118.21e	

L.S.D_(0.05) herbicides=5.08

L.S.D_(0.05)time=3.28

L.S.D_(0.05)interaction=11.36

2-Effect of the tested herbicides on GST's activities:

2-a – The effect on stem:

The GST's activities of wheat stem were enhanced significantly after 7 and 14 days from herbicides applications when compared with untreated plants (Table 4). At the first 2 days after treatments, there was no significant

difference between all herbicides and untreated plants but at 7 and 14 days after treatments, diclofop-methyl (No. 5), clodinafop-propargyl (No. 6), phenylurea alone or with other groups caused significant increase in GST's activities. Isoproturone (No. 7) gave the highest increase of the activities by 456.56% followed by isoproturone+diflufenican (No. 10) which caused 347.64 % at 7 days after treatments. In general, at the end of the experiment, there was no significant differences between nitriles (No. 1, 2), sulfonyl urea (No. 4) and untreated plants. Also, diclofop-methyl (No. 5), clodinafop-propargyl (No. 6) and phenylurea alone or with other groups caused significant increase in GST's activities with no significant differences between themselves. Isoproturon alone (No. 7) gave the highest increase in the enzymes GST's activities, as general mean (170.602 %).

Table (4): Effect of herbicidal treatments on GST's activities (μ mol CDNB/ μ g protein/min) of wheat stem at different time intervals under field conditions.

No. of treatments	Time intervals (in days)					Mean
	2	7	14	21	35	
1	9.148	11.423	16.087	13.609	19.797	14.012a
2	10.853	16.468	17.246	9.634	18.224	14.48a
3	12.443	19.655	16.060	7.633	16.697	14.497a
4	9.120	11.039	19.233	13.929	18.676	14.39a
5	13.956	23.922	25.140	11.973	15.498	18.098ab
6	14.474	34.957	32.056	11.973	14.432	21.678bc
7	20.090	51.473	34.839	12.590	6.397	25.07c
8	22.617	34.611	34.695	16.092	8.090	23.22bc
9	17.386	27.244	35.974	13.208	7.974	22.772bc
10	19.442	39.193	37.048	7.446	4.638	21.553bc
11	16.995	28.023	33.866	12.674	9.313	22.075bc
12	18.107	11.274	16.558	13.521	14.017	14.695a
Mean	15.29a	25.77b	26.608b	13.82a	12.81a	
L.S.D _(0.05) herbicides=4.04 L.S.D _(0.05) time=2.61 L.S.D _(0.05) interaction=9.047						

2-b – The effect on roots:

Data from Table 5, revealed that, two days after treatments, phenylurea alone or with other group of herbicides caused significant increase in GST's activities, treatment (No. 8) gave the highest increase in the activity by 262.81%. Twenty one days after treatment, there was no significant differences between all herbicides and that was kept until the end of the experiment. In general, there was no significant differences between nitriles, AC322, 140, FOP's and phenylurea alone or with other groups of herbicides in increasing the activity of GST's. Again isoproturon alone (No. 8) gave the highest increase of activity, it gave 124.603% as a main mean. The GST's activities of wheat roots were highly increased after 2 days and was still increased up to 35 days from herbicides application except at 21 days.

Table (5): Effect of herbicidal treatments on GST's activities (μ mol CDNB/ μ g protein/min) of wheat root at different time intervals under field conditions.

No. of treatments	Time intervals (in days)					Mean
	2	7	14	21	35	
1	90.074	71.703	66.304	87.504	78.527	78.822ab
2	79.102	84.489	76.648	95.682	71.682	81.58ab
3	76.142	41.501	89.616	36.403	67.851	62.211a
4	75.088	62.107	112.448	71.911	101.436	84.598ab
5	84.313	55.514	95.514	37.252	71.497	68.818ab
6	82.451	55.920	86.126	41.920	79.864	69.256ab
7	85.666	117.678	53.616	66.855	75.972	80.057ab
8	136.408	106.508	60.065	68.974	59.486	86.288b
9	107.372	86.613	62.751	56.386	74.316	73.554ab
10	85.364	102.139	54.211	52.805	77.216	74.347ab
11	116.149	77.485	51.999	59.925	62.957	73.424ab
12	51.904	64.432	96.546	61.647	79.354	69.25ab
Mean	89.169c	77.174b	75.449b	59.683a	75.08b	
L.S.D _(0.05) herbicides=13.75 L.S.D _(0.05) time=8.88 L.S.D _(0.05) interaction=30.748						

2-c – The effect on leaves:

The effect of herbicides on GST's activities of wheat leaves was illustrated in Table 6, it was noticed that, GST's activities depend upon the time

intervals, the maximum activation in these enzymes were achieved after 2 days and declined up to 14 days after treatments and increased again up to 21 days and was still at the same level with low decrease up to 35 days from herbicide application. In general, no significant different was noticed due to herbicides groups under different time intervals on GST's activities in samples isolated from leaves and this result varied with the effect of the same herbicides on GST's activities isolated from stem and roots. The mechanism by which herbicides could trigger an induction response leading to enhanced GSH level and GST as the metabolic detoxication is not fully understood (Dean *et.al.*, 1990). But, Reade *et al.*, (1997) reported that GST activity in resistant plants was approximately twice that of the susceptible plants. Also, these herbicides enhanced the level of GSH level and GST activity firstly in the plant tissues and after that higher level, detoxification the herbicide was also enhanced (Hatton *et al.*, 1998).

Table (6): Effect of herbicidal treatments on GST's activities (μ mol CDNB/ μ g protein/min) of wheat leaves at different time intervals under field conditions.

No. treatments	Time intervals (in days)					Mean
	2	7	14	21	35	
1	15.918	14.536	9.408	13.007	13.665	13.306a
2	16.849	14.736	12.166	9.981	12.440	13.234a
3	25.102	16.892	8.131	7.716	9.596	13.487a
4	19.239	15.387	11.888	14.343	8.691	13.937a
5	25.401	23.780	7.376	12.211	8.145	15.383a
6	24.497	21.564	6.847	11.727	9.556	14.839a
7	24.148	25.787	7.941	12.151	11.409	16.287a
8	19.815	11.297	8.265	18.377	11.454	13.841a
9	20.710	10.231	6.160	13.346	11.412	12.395a
10	21.826	25.083	6.729	8.787	10.791	14.643a
11	24.872	15.451	7.168	13.193	11.025	14.342a
12	32.27	26.273	15.333	11.519	9.969	19.07a
Mean	22.55c	18.41bc	8.95a	15.59b	10.67a	
L.S.D _(0.05) herbicides=6.8 L.S.D _(0.05) time=4.41 L.S.D _(0.05) interaction=14.28						

Table (7): The effect of herbicidal treatments on plant pigments of wheat leaves (chlorophyll a, b and total carotenoids as mg/g.F.W).

No.	2 Days			7 Days			14 Days			21 Days			35 Days		
	Ch.a	ch.b	Carote noides	Ch.a	ch.b	Carote noides	Ch.a	ch.b	Carote noides	Ch.a	ch.b	Carote noides	Ch.a	ch.b	Carote noides
1	0.433	0.173	6.910	0.563	0.342	10.573	0.898	0.277	13.515	1.233	0.419	19.952	0.727	0.338	12.729
2	0.492	0.215	7.743	0.671	0.329	10.101	1.033	0.338	15.968	0.690	0.358	12.936	0.883	0.323	14.024
3	0.401	0.180	7.005	0.864	0.341	13.151	1.263	0.954	13.952	1.122	0.406	17.987	0.892	0.331	14.334
4	0.353	0.176	5.072	0.760	0.294	11.613	0.850	0.293	13.048	1.212	0.422	19.172	1.124	0.412	18.172
5	0.453	0.215	6.825	0.783	0.315	11.408	0.967	0.176	14.220	0.964	0.766	19.183	1.503	0.672	18.615
6	0.452	0.195	6.844	0.875	0.316	13.642	1.018	0.260	15.045	0.631	0.345	12.326	1.531	0.879	20.793
7	0.409	0.176	6.220	0.642	0.253	10.289	0.638	0.217	12.836	0.820	0.307	13.496	1.361	0.528	17.746
8	0.470	0.223	6.610	0.527	0.247	10.260	0.793	0.262	12.207	0.870	0.533	14.812	1.038	0.391	16.406
9	0.298	0.263	5.907	0.780	0.284	11.255	0.809	0.108	14.546	0.670	0.289	12.167	1.146	0.366	17.443
10	0.321	0.190	5.271	0.774	0.384	14.069	0.673	0.228	13.363	0.780	0.302	13.212	1.173	0.497	17.575
11	0.306	0.238	6.875	0.786	0.260	10.968	0.915	0.363	13.159	0.754	0.272	10.828	0.758	0.291	16.578
12	0.318	0.168	4.907	0.614	0.249	9.448	0.711	0.255	10.729	0.768	0.176	11.581	0.750	0.293	12.634
L.S.D.(0.05) for herbicide(Ch.a)=0.141															
L.S.D.(0.05) for herbicide(Ch.b)=0.167															
L.S.D.(0.05) for herbicide(carotene)=2.76															
L.S.D.(0.05) for time(Ch.a)=0.171															
L.S.D.(0.05) for time(Ch.b)=0.107															
L.S.D.(0.05) for time(carotene)=1.78															
L.S.D.(0.05) for interaction(Ch.a)=0.315															
L.S.D.(0.05) for herbicide(Ch.b)=0.373															
L.S.D.(0.05) for herbicide(carotene)=6.169															

3-Effect of the tested herbicides on plant pigments:

At the first two time, all herbicides did not have any effect on cha, chb. and total carotenoids. At 14 days after treatments, there was no significant deference between all herbicides except, nitriles (No. 2), tribenuron-methyl (No. 3) and clodinafop-propargyl (No. 6) which caused an increase in the content of cha. by 145.29, 177.64 and 143.18%; respectively with no any effect on chb. and total carotenoids. At the end of the experiment, AC322-140 (No. 3), diclofop-methyl (No. 5) and clodinafop-propargyl (No. 6), isoproturon alone or with other group of herbicides caused significant increase in cha., also with no significant difference on chb. and total carotenoids. In general, these herbicides had no effect on chb. and total carotenoids and they caused significant increase in cha. Tribenuron-methy (No. 3), diclofop-methyl (No. 5) and clodinafop-propargyl (No. 6) gave the highest increase in cha., as shown in Table 7.

In conclusion, the GSH content of wheat roots was increased with time intervals after treatments, sulfonyl urea and FOP's were superior in this respect followed by phenylurea and nitriles. The same trend in stem was observed with 3-4 times in GSH content. While GST's activities were highly increased in wheat root than stem and the least in leaves due to herbicidal treatments. Herbicides had no effect on chlorophyll b (ch.b.) and carotenoids, while caused significant increase in ch.a.. FOP's and sulfonyl urea groups gave the highest increase in this respect.

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التأثير المقارن لبعض مجاميع مبيدات الحشائش على محتوى الجلوتاثيون و نشاط إنزيم الجلوتاثيون أس-ترانسفيراز والصيغات النباتية في القمح

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تم تقدير محتوى الجاوتاثيون-نشاط إنزيم الجلوتاثيون أس-ترانسفيراز والصيغات النباتية في نباتات القمح بعد المعاملة بـ ١١ مبيد حشائش من مجاميع مختلفة تحت الظروف الحقلية وقد تمت التجربة في مزرعة كلية الزراعة جامعة الاسكندرية. و كانت مجاميع مبيدات الحشائش المستخدمة هي النتريلات (البروموكسينل بتجهيزتان) - السلفونيل يوريا (تراينيبورون-ميثيل، AC322-140) - أريل أوكسى فينوكسى بروبيونيك أسيد FOPs (كلودينا فوب-بروباجيل ودايكوفوب-ميثيل) ومجموعة الفينيل يوريا (الايذوبروتيريون بثلاثة تجهيزات) بالإضافة إلى خلانت للفينيل يوريا مع مجاميع أخرى. وقد أظهرت النتائج أن محتوى الجذور والميقان من الجلوتاثيون يزداد مع طول الوقت بعد المعاملة بالمبيد. وقد أعطت المبيدات التابعة لمجموعة السلفونيل يوريا و FOPs أعلى زيادة يليها الفينيل يوريا والنيتريل. أما نشاط الإنزيم فكان في الجذر أعلى منه في الساق يليه الأوراق. أما عن الصيغات النباتية فلم يكن للمبيدات المستخدمة أى تأثير على محتوى النبات من كلوروفيل-ب أو الكاروتينات بينما أحدثت زيادة في كلوروفيل أ والتي أعطت زيادة هي مجاميع FOPs والسلفونيل يوريا.