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Comparative physiological responses between cereal crops and grassy weed to safener containing herbicide formulations

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ABSTRACT

Field studies were conducted to study the comparative physiological responses between cereal crops (winter and summer) and grassy weeds to the ready made safener containing herbicide formulations. The herbicides were fenoxaprop-*p*-ethyl + safener (Puma super), clodinafop-propargyl + safener (Topic) and acetochlor with two formulations (Acetop and Harness). The data indicated that Puma super and Topic caused a significant enhancement in all the tested physiological parameters, they gave the highest induction in glutathione content extracted from the root, glutathione-S-transferases activities in both wheat and barley shoot and root system and total chlorophyll, these increases were much more in wheat than that in barley, this is due to the differences on the tolerant degree. On the other hand, they significantly decreased these parameters in all tested weeds, particularly canary grass was the most affected weed. Also, the two acetochlor formulations caused significant increase in all the tested physiological parameters in maize with no significant differences between them.

INTRODUCTION

Wheat, barley and corn are the most grown cereal crops in Egypt , weed are the major problem in these cereals production , the first 30-40 days after sowing is the critical period of crop-weed competition and can sensually limit the growth of cereal crops (Sabra and Houssien, 2003). Almost hundred percent crop losses due to weeds was recorded (Lacey, 1985).

Several methods were examined in order to minimize crop injuries caused by herbicides, thus increase their selectivity. A selective herbicide is one that control weed at rate that not injures the crop (Abu–Qare and Duncan, 2002).

Fenoxaprop-*p*-ethyl is very toxic herbicide to wheat and barley it is a selective herbicide with contact and systemic action, absorb by leaves and translocated acropetally to the roots, uses as post-emergence to control annual and perennial grass weed in broad leaves and (when applied with safeners (fenchlorazole-ethyl or mefenpyr-dimethyl), it control annual and perennial grass weed in wheat, rye and barley. The mode of action of this herbicide is inhibition of the fatty acid synthesis due to the inhibition of acetyl CoA carboxylase (ACCase) (Anonymous, 2005). Also, clodinafop–prprargyl is the post emergence systemic grass herbicide to control grass weeds, it has low toxicity to winter wheat and barley when combined with the safener, cloquintoct–methyl. In addition acetochlor is a selective herbicide used as pre- emergence or pre- plant to control annual grasses and certain annual broad leaved weeds in maize but when combined with the safener, furilazol.

Herbicide safeners are compounds of diverse chemical families. They are applied with herbicides to become non-toxic to certain crops. Using safener is a simple method of improving herbicide selectivity; this method has been applied successfully in cereal crops such as maize, rice, wheat, barley and sorghum (Abu– Qare and Duncan, 2002). They increase herbicide tolerance in cereals but not in dicotoledenous crops. The reason(s) for this difference in safening action is unknown. However, safener-induce protection in cereal is associated with increased expression of herbicide detoxifying enzymes, including glutathione-S-transferases and also increase tripeptide glutathione content. (DeRidder *et. al.*, 2002). Safeners elevate glutathione level and induce novel glutathione-S- transferases (Scott-Craig *et. al.*, 1998).

The safeners were applied either as mixed formulation with the herbicides or as seed treatment. The most herbicide classes which could be applied with safeners were including: thiocarbamate, chloroacetamide, sulfonylurea, imidazolinones, and aryloxyphenoxy propionates.

Despite extensive research effort the protective mechanism of herbicide safeners is far from being completely understood. Several hypotheses have been introduced for the mechanism(s) of the protective action of herbicide safeners. Safeners protect crop plant from herbicide damage by reducing the ability of herbicide to reach and inhibit their target site. This may be achieved through safeners induce modification of herbicide target enzyme, accelerating herbicide metabolism and detoxification in these crops by oxidation or conjugation (with glucose, glutathione) and thus herbicide became less effective or immobile; increase the response of certain enzyme (e.g. glutathione–S-transferases isozymes) and increase the level of glutathione (Davies and Caseley, 1995 and Hall and Stephenson, 1995).

Conjugation of herbicide via the thiol group of reduced glutathione (GSH) (γ- glutamyl–cysteinyl–glycine,) is well established as one of the major detoxification and selectivity factor in plants (Lamoureux *et. al.*, 1991). In addition, the tripeptide glutathione may play a key role in the defense of plant against various environmental stress e.g. cold, heat drought, high light, fungal attack and herbicide.

Glutathione-S-transferases (GSTs; EC 2.5.1.18) are key enzymes catalyzing the detoxification of several herbicides in many plants. These enzymes are a diverse group of cytosolic enzymes found in all eukaryotes which catalyze the conjugation of synthetic electrophilic substrates with the tripeptide glutathione (DeRidder *et. al.*, 2002; Dengo and Hatzios, 2002; Frova, 2003; Grundy *et. al.*, 2005 and Buono *et. al.*, 2007). Besides, these families of multifunction enzymes in plant and animals are well known for their roles in detoxification of xenobiotics (Riechester *et. al.*, 1998).

Mefenpyr-diethyl (a new foliar acting safener from the chemical group of pyrazolines) is described. World-wide studies showed that the application of this safener for fenoxaprop-*p*-ethyl and iodosulfuron herbicides resulted in significant improvements of crop safety in winter wheat, winter rye, triticale, spring wheat, durum wheat and spring barley (Hacker *et. al.*, 2000). This new safener can protect wheat and barley against certain toxic herbicides, fenoxaprop-ethyl and its active isomer (Scalla and Roulet, 2002) by increasing GST activity and increase GSH and GSH peroxidase. After the application of this safener, it was absorbed and translocated to leaves and roots resulting metabolization and detoxification of the herbicide, without affecting metabolism of the herbicides in weeds. Mefenpyr-diethyl is the first foliar acting safener which can be used with herbicides with different modes of action (Hacker *et. al.*, 2000). Also, it could protect wheat and barley from iodosulfuron-methyl sodium (an inhibitor of acetolactate synthase) (Trabold *et. al.*, 2000), pebulate (Baldwin *et. al.*, 2000) and metsulfuron (King, 2007).

The aim of this study is to compare the different physiological parameters between cereal crops and grassy weeds treated with safener containing herbicide formulations.

MATERIALS AND METHODS

Field studies were conducted to compare the different physiological response between cereal crops and grassy weeds to the ready made herbicide formulations which have safener inside. The winter cereal crops were wheat (*Triticum ostevum*) and barley *(Hardeum vulgare* L), The most dominant weeds were, canary grass *(Phalaris minor)*, wild oat (*Avena fatua*) and raygrass (*Lolium temulentum* L.) which applied with (Puma super 75% EW , 0.5 L / Feddan) ((Fenoxaprop-*p*-ethyl) 2[4-(6-chloro-1,3-bezoxazolyl-oxy-phenoxy-] propanoate + safener, Fenchlorazole-ethyl or mefenpyr-dimethyl and (Topic 15%WP, 150 g/ Feddan) (Codinafop-propargyl + safener, cloquintocet-mexyl prop-2-ynyl(*R*)-2-[4-(5-chloro-3-fluoropyridin-2 yloxy)phenoxy]propionate, the two herbicides were applied as post-emergence application at 3-4 leaf stage. In addition, the summer cereal crop was maize (Zea *mays*) which applied with two formulations of Acetochlor (2-chloro-N-ethoxymethyl-6'-ethylaceto-o-toluidide + safener, furilazole (Acetop 84%EC, 1 L / Feddan which obtained from Elwatanya company) and (Harness 84%EC, 1L./Feddan which obtained from Monsanto company) as pre-emergence herbicide after planting and before irrigation. The two experiments were carried out in winter season, 2007/2008 and the summer season, 2008 at the Agriculture Research Experiment Station, Faculty of Agric., Alexandria University at Abis area. The soil type was clay loam (clay 41%, silt 22.2% and sand 36.16%). The experimental design was randomized complete blocks with four replications. The winter plants (crops and weeds) were collected 3, 7, 14 and 21 days after treatments, and the summer crop (corn) was collected 10, 17, and 24 days after treatments.

Glutathione content determination: Plant root were extracted with 70% ethanol at 0°C, glutathione content (GSH contents as µg GSH /g F.W.) were determined spectrophotometrically using DTNB (5,5- di thio bis (2-nitrobenzoic acid) as a substrate in 0.1ml ethanol at 412 nm according to Jabalankai and Hatzios (1991).

Glutathione–S-tansferases activities determination: According to Jabalankai and Hatzios (1991) and modified by Houssien (1999), plant shoot and root were extracted by 0.1M phosphate buffer (PH 6.8), the specific activity (GST's specific activities as (µmol CDNB/ min/ ml/g F .W) of the enzyme were determined by CDNB (1-chloro-2.4-dinitrobenzene) as a substrate and reduced glutathione was measured at 340 nm. The rate of non-enzyme conjugation was determined.

Chlorophyll determination: Chlorophyll a, b and total chlorophyll as mg/g F.W. were determined in plant leaves according to Grodzinsky and Grodzinsky (1973), and modified by Sabra (1993).

Statistical analysis: All data were subjected to analysis of variance (ANOVA) followed by Student-Newman-Keuls test (Cohort software Inc., 1985) to determine the significant differences among means values at the probability level of 0.05.

RESULTS AND DISCUSSION

Effect of the tested herbicides on glutathione content extracted from roots of different plants and weeds: Data in Table, 1-a. and b. showed the effect of the tested herbicides which contain safener on their formulations on glutathione content extracted from roots of winter crops (wheat and barley) as well as of three weeds; wild oat, canary grass and ray grass at different time intervals. In addition, the effects on summer crop, corn at different time intervals was also estimated. The two herbicides, which gave the highest increase in glutathione content (GSH) at all time intervals, were clodinafop-propargyl + safener (Topic) which caused highly significant increase in GSH content in wheat more than fenoxaprop-p-ethyl + safener (Puma super), it gave 80.49 µg GSH /g F.W on wheat, while Puma super gave 70.140 µg GSH /g F.W. In case of barley, Topic gave 56.140 µg GSH /g F.W, wheras Puma super gave 67.263 µg GSH /g F.W.

The two tested herbicides not only caused significant decrease in glutathione content in the all tested weeds but also, they caused the death of canary grass at 21 days after treatments, for example Puma super gave 13.825 and 10.632 µg GSH /g F.W. for wild oat and ray grass, compared with untreated weeds which gave 53.333 and 54.807 µg GSH /g F.W., respectively. Within plants, ray grass and canary grass were the most affected weeds followed by wild oat and finally ray grass. It could be concluded that the safener significantly increase the GSH content in crops and significantly decrease it in weeds and caused the death, also safener increased GSH content in wheat more than barley. In addition, GSH content was higher in grass species that are moderately tolerant such as wheat and moderately susceptible such as barley to fenoxaprop-ethyl than species that are very susceptible to the herbicide such as *Avena fatua* and *Echiochloa cruss-galli* (Hall and Stephenson, 1995). The herbicide safener, fenchlorazole-ethyl enhanced the metabolism of fenoxaprop-ethyl in barley and wheat without affecting the pattern of metabolism (Romano *et. al.*, 1993a and Yaacoby *et. al.*, 1991), this was not happen in oat. Also, GSH, cystien and glucose conjugation are among the selectivity mechanisms of fenoxaprop-ethyl in grass species (Romano *et. al.*, 1993b). Moreover, Topic applied safely in wheat and barley to control grass weeds such as *Avena* sp. and *Lolium* sp. Treated barley with the safener cloquintoct–methyl (the safener in Topic) doubles the vacuolar transport activities for both glutathione and glucoside conjugates (Gaillared *et. al.*, 1994 and Zand *et. al*, 2007).

Table 1-a: The effect of the tested herbicides on glutathione content from shoots of winter crops and weeds at different time intervals.

Treatments		Glutathione content (µg GSH /g F.W.) Days after treatments			
	Plant	3DAT	7DAT	14DAT	21DAT
Control	Wheat	73.193	70.035	78.737	67.474
	Barley	67.754	66.877	72.842	60.947
	Wild Oat	58.421	55.474	56.421	53.333
	Canary grass	62.632	58.947	60.070	59.684
	Ryegrass	48.526	54.737	59.158	54.807
Puma super	Wheat	89.509	76.737	83.158	70.140
	Barley	73.754	73.123	70.596	67.263
	Wild Oat	18.561	16.842	15.298	13.825
	Canary grass	22.000	33.404	18.702	0.000
	Ryegrass	18.982	16.632	10.175	10.632
Topic	Wheat	90.070	76.842	86.246	80.491
	Barley	69.754	67.404	68.421	56.140
	Wild Oat	44.702	60.211	57.895	38.386
	Canary grass	45.825	38.456	14.596	0.000
	Ryegrass	43.649	30.807	17.761	20.632

L.S.D (0.05) within plant = 2.5 L.S.D (0.05) within herbicides = 1.98
L.S.D.(0.05) interaction =8.89 L.S.D (0.05 within time = 2.29
Puma super = Fenoxaprop-ethyl + safener Topic= Clodinaphop-propargyl + safener

Table 1-b, showed the effect of acetochlor with two formulations on corn, within herbicide, the two herbicides significantly increased the GSH content but without significant deferent compared with untreated plants. At the end

of the experiment, Acetop gave 77.684 µg GSH /g F.W whereas the other formulation from Monsanto company (Harnes) gave 71.123 µg GSH /g F.W compared with untreated plant which was 53.439 µg GSH /g F.W.

Table 1-b: The effect of the tested herbicides on glutathione content in corn at different time intervals

Treatments	Glutathione content (µg GSH /g F.W.)		
	7 DAT	17 DAT	24 DAT
Control	57.298	58.632	53.439
Acetop	86.982	86.667	77.684
Harnes	86.386	82.561	71.123

L.S.D (0.05) for total within time = 5.5 L.S.D (0.05) for total within herbicides = 5.4
L.S.D.(0.05) interaction =9.53
Acetop = Acetochlor from Elwatania.Company Harnes = Acetochlor from Monsanto Company

Effect of the tested herbicides on glutathione-S-transferases activities in shoots of different plants and weeds: From the data recorded in Table 2.a, it could be concluded that canary grass and ray grass were the most affected weeds followed by wild oat. Within herbicides, the two tested herbicides were highly effective compared with untreated plants. Puma super gave the highest increase in the GST's activities in wheat and barley followed by Topic. Since, Puma super gave 764.44 and 719.11 µmol CDNB/min/ml/g F.W in wheat and barley respectively, after 21 days, whereas Topic gave 716.44 and 705.78 µmol CDNB/min/ml/g F.W., compared with untreated plants which gave 700.44 and 622.22 µmol CDNB/min/ml/g F.W in wheat and barley, respectively, 21 days after treatment. The two tested herbicides were significantly decreased the GST's activities on both wild oat and ray grass without any significant differences. Puma super gave only 142.22 µmol CDNB/min/ml/g F.W in two weeds while Topic gave 142.22 and 145.33 µmol CDNB/min/ml/g F.W. compared with untreated plants which gave 378.67 and 453.33 µmol CDNB/min/ml/g F.W for wild oat and ray grass, respectively. Both compounds caused death to canary grass after 21 days. In general, while Puma super and Topic caused significant increase of GST's activities in wheat and barely, they caused significant decrease of the activities of these enzymes in all weeds after 3, 7, 14 and 21 days, except in canary grass which killed after 21 days.

Harness gave the highest increased in GST's activities, it gave 884.44 µmol CDNB/min/ml/g F.W without significant different with the other formula (Acetop) which gave 872.89 µmol CDNB/min/ml/g F.W which have no significant difference with untreated plants (871.11 µmol CDNB/min/ml/g F.W).

Table 2-a: The effect of the tested herbicides on glutathione-S-transferases activities from shoots of winter crops and weeds at different time intervals.

Treatments		GST (µmol CDNB/min/ml/g F.W)			
		Days	after	treatments	
	Plant	3DAT	7DAT	14DAT	21DAT
Control	Wheat	395.56	606.22	675.56	700.44
	Barley	336.00	604.44	595.56	622.22
	Wild Oat	257.78	453.33	376.00	378.67
	Canary grass	237.33	426.67	471.11	462.22
	Ryegrass	215.11	339.56	435.56	453.33
Puma super	Wheat	652.44	708.44	746.67	764.44
	Barley	428.44	683.56	702.22	719.11
	Wild Oat	304.89	222.22	160.00	142.22
	Canary grass	240.00	180.44	106.67	0.00
	Ryegrass	275.56	160.00	160.00	142.22
Topic	Wheat	644.44	695.11	724.44	716.44
	Barley	408.89	688.00	684.44	705.78
	Wild Oat	204.44	240.00	177.33	142.22
	Canary grass	204.44	240.00	163.56	0.00
	Ryegrass	195.56	133.33	128.00	145.33

L.S.D (0.05) within plant = 17.53 L.S.D (0.05 within time = 13.5
L.S.D (0.05) within herbicides = 15.67 L.S.D.(0.05) interaction =60.71
Puma super = Fenoxaprop-ethyl + safener Topic= Clodinaphop-propargyl + safener

Table 2-b: The effect of the tested herbicides on glutathione-S-transferases activities from shoots of corn at different time intervals.

Treatments	GST (µmol CDNB/min/ml/g F.W)		
	7 DAT	17 DAT	24 DAT
Control	711.11	791.11	871.11
Acetop	880.00	835.56	872.89
Harnes	915.56	918.22	884.44

L.S.D (0.05) for total within time = 83.469 L.S.D (0.05) for total within herbicides = 83.469
L.S.D.(0.05) interaction =141.28
Acetop = Acetochlor from Elwatania.Company Harnes = Acetochlor from Monsanto Company

Effect of the tested herbicides on glutathione-S-transferases activities in roots of different plants and weeds: Table 3-a showed the effect of the tested herbicides, which have safener on their formulations, on GST's activities extracted from wheat and barley roots, and they follow the same direction like shoot. Within plants, canary grass and wild oat were the highly affected plants followed by ray grass. The canary grass had been dead at the end of the experiment, and the activity of the enzyme at the same time was not detected in ray grass. Puma super and Topic significantly increased the GST's activities extracted from root in both wheat and barley. However, Puma super caused significant increase in the enzyme activities extracted from wheat more than that from barley and more than Topic. It gave 720.00 and 672.89 μmol CDNB/min/ml/g F.W in wheat and barley but topic gave 690.67 and 631.11 μmol CDNB/min/ml/g F.W in wheat and barley compared with untreated plants which gave 604.44 and 568.89 μmol CDNB/min/ml/g F.W in wheat and barley. Both compounds gave significant decrease in all weeds, it gave 137.78 μmol CDNB/min/ml/g F.W in wheat and barley for Puma super and 132.44 μmol CDNB/min/ml/g F.W in wheat and barley for Topic on ray grass. The safener mefenpyr-dimethyl (the safener in puma super reduce the crop damage in wheat and barley without influencing herbicide efficacy (Trabled *et. al.*, 2000), and it enhance the activities of GST's (Hacher *et. al.*, 2000 and Scalla and Roulet, 2002)

Table 3-b, indicated that, there was no significant difference between the two acetochlor formulations and untreated plants on the enzymes activities extracted corn root, Harnes gave 1040 μmol CDNB/min/ml/g F.W and the other formulation (Acetop) gave 1048.89 μmol CDNB/min/ml/g F.W compared with untreated plants (990.22 μmol CDNB/min/ml/g F.W.). In cereals, maize, wheat, rice barley and sorghum herbicide tolerance can enhanced using herbicide safeners (Davies and Caseley, 1999 and DeRidder *et. al.*, 2002).

Effect of the tested herbicides on chlorophyll content of different plants and weeds: Data shown in Tables 4-a and b showed the effect of the tested herbicides which contain safener on plant pigments (chlorophyll a and b and total chlorophyll) of winter crops (wheat and barley) and weeds (wild oat, canary grass and ray grass). The effect of these herbicides on corn was also estimated.

Table 3-a: The effect of treated herbicides on glutathione-S-transferases activities from roots of winter crops and weeds at different time intervals.

Treatments	GST (µmol CDNB/min/ml/g F.W)				
		Days	after	treatments	
	Plant	3DAT	7DAT	14DAT	21DAT
Control	Wheat	351.11	613.33	586.67	604.44
	Barley	299.56	504.89	475.56	568.89
	Wild Oat	272.00	279.11	240.89	174.22
	Canary grass	208.89	183.11	140.44	131.64
	Ryegrass	192.53	184.00	176.00	149.33
Puma super	Wheat	419.56	772.44	752.89	720.00
	Barley	377.78	666.67	698.67	672.89
	Wild Oat	313.78	133.33	160.00	ND
	Canary grass	168.89	97.78	43.56	0.00
	Ryegrass	115.56	213.33	168.89	137.78
Topic	Wheat	417.78	733.33	742.22	690.67
	Barley	368.89	666.67	669.33	631.11
	Wild Oat	136.89	87.11	50.57	ND
	Canary grass	186.67	62.22	44.44	0.00
	Ryegrass	128.00	142.22	141.33	132.44

L.S.D (0.05) within plant = 17.43 L.S.D (0.05 within time = 15.59
L.S.D (0.05) within herbicides = 13.5 L.S.D.(0.05) interaction =60.4
Puma super = Fenoxaprop-ethyl + safener Topic= Clodinaphop-propargyl + safener

Table 3-b: The effect of the tested herbicides on glutathione-S-transferases activities from roots of corn at different time intervals.

Treatments	GST (µmol CDNB/min/ml/g F.W)		
	7 DAT	17 DAT	24 DAT
Control	606.22	1097.78	990.22
Acetop	709.33	1111.11	1040.00
Harnes	727.11	1120.00	1048.89

L.S.D (0.05) for total within time = 106.96 L.S.D (0.05) for total within herbicides = 106.9
L.S.D.(0.05) interaction =185.38
Acetop = Acetochlor from Elwatania.Company Harnes = Acetochlor from Monsanto Company

The data showed that Topic caused significant increase of total chlorophyll content in wheat and barley but not in the case of Puma super. Within plants, the canary grass was the most affected weed followed by wild oat and ray grass. There was no significant deference between the two tested herbicides on their effects on crops and weeds.

Table 4-a: The effect of the tested herbicides on chlorophyll a, b, and total of winter crops and weeds at different time intervals.

Treatment	Plant.	3day			7day			14day			21day		
		Chlorophyll content (mg/g F.W)											
		Ch a	Ch b	total	Ch a	Ch b	total	Ch a	Ch b	total	Ch a	Ch b	Total
Control	Wheat	2.05	1.73	3.78	2.06	1.32	3.37	2.27	1.46	3.73	2.33	1.57	3.90
	Barley	1.95	1.71	3.67	1.97	1.47	3.44	2.07	1.41	3.49	1.95	1.46	3.41
	Wild Oat	2.03	1.56	3.58	1.87	1.51	3.37	1.52	2.31	3.82	1.64	1.45	3.08
	Canary grass	1.60	0.84	2.44	1.05	1.14	2.19	1.51	1.33	2.84	1.45	1.03	2.48
	Ryegrass	2.16	1.49	3.66	2.06	2.06	4.12	1.36	2.18	3.54	0.98	2.17	3.15
Puma super	Wheat	2.14	1.81	3.95	2.34	1.33	3.67	2.40	1.38	3.78	2.60	1.55	4.14
	Barley	2.24	1.66	3.90	2.40	1.34	3.74	2.39	1.25	3.64	2.40	1.60	4.00
	Wild Oat	1.89	1.53	3.42	1.50	1.40	2.90	1.35	0.73	2.08	1.15	0.14	1.29
	Canary grass	1.69	1.02	2.72	1.17	0.83	2.01	0.82	0.11	0.94	0.20	0.24	0.43
	Ryegrass	2.20	1.49	3.68	2.36	1.02	3.38	1.90	1.94	3.84	1.40	1.33	2.73
Topic	Wheat	2.24	1.87	4.11	2.33	1.96	4.29	2.33	1.83	4.16	2.55	2.06	4.61
	Barley	2.29	1.56	3.86	2.45	1.61	4.06	2.35	1.66	4.00	2.37	1.87	4.24
	Wild Oat	1.99	1.19	3.18	1.64	0.85	2.49	1.12	1.19	2.31	0.96	0.56	1.52
	Canary grass	1.50	0.86	2.35	1.26	0.60	1.85	1.21	0.74	1.95	0.36	0.03	0.39
	Ryegrass	1.97	1.75	3.72	1.20	2.06	3.26	1.19	0.67	1.85	0.64	0.35	0.99

L.S.D (0.05) for total within plant = 0.172 L.S.D (0.05) for total within time = 0.154

L.S.D (0.05) for total within herbicides = 0.134 L.S.D.(0.05) interaction = 0.598

Puma super = Fenoxaprop-ethyl + safener , Topic= Clodinaphop-propargyl + safener

For example, both herbicides gave the highest increase in the total chlorophyll in wheat and barley at all time intervals, this increase was due to the increase in chlorophyll a and b compared with untreated plants. They increase total chlorophyll in wheat and barley at the end of the experiment since, Puma super gave 4.14 and 4.00 mg/g F.W., respectively). On the other hand, Topic gave 4.61 and 4.24 mg/g F.W. for wheat and barley, respectively, compared with untreated wheat and barley (3.9 and 3.41 mg/g F.W., respectively). Both herbicides significantly decreased the total chlorophyll in all tested weeds, for example, in wild oat, canary grass and ray grass. Puma super gave 1.29, 0.43 and 2.73 mg/g F.W., 1.52, 0.39 and 0.99 mg/g F.W., for Topic and 3.08, 2.48 and 3.15 mg/g F.W., compared with untreated weeds for wild oat, canary grass and ray grass, respectively. In general, it could be concluded that the presence of the safener significantly increased the amount of chlorophyll in crops and significantly decreased it in weeds.

Table 4-b showed that, Harnes gave the highest increased in total chlorophyll, chlorophyll a and b extracted from corn leaves followed by the Acetop. At the end of the experiment, the amounts of total chlorophyll were 7.54 and 6.72 mg/g F.W. for harness and Acetop, respectively, compared with untreated corn (5.57 mg/g F.W).

Table 4-b: The effect of the tested herbicides on chlorophyll a, b, and total of corn at different time intervals.

Treatments	Chlorophyll content (mg/g F.W)								
	10day			17day			24day		
	Ch a	Ch b	total	Ch a	Ch b	total	Ch a	Ch b	total
Control	1.5	1.37	2.87	2.49	1.25	3.74	2.87	2.74	5.57
Acetop	1.63	1.47	3.10	4.15	3.54	7.68	1.89	4.82	6.72
Harnes	2.13	1.93	4.06	4.17	4.08	8.25	2.86	4.68	7.54

L.S.D (0.05) for total within time =0.192 L.S.D (0.05) for total within herbicides =0.193
L.S.D.(0.05) interaction =0.33
Acetop = Acetochlor from Elwatania.Company Harnes = Acetochlor from Monsanto Company

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الاختلافات الفسيولوجيه بين المحاصيل و الحشائش النجيليه لمبيدات الحشائش المضاف اليها ترياق داخل التجهيزات التجاريه

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تم عمل تجربه حقليه لمقارنه الاختلافات الفسيولوجيه بين المحاصيل و الحشائش النجيليه المعامله بمبيدات الحشائش المضاف اليها ترياق داخل التجهيزه التجاريه.

المحاصيل الشتويه كانت القمح و الشعير و التى تم معاملتها بعد الانبثاق فى عمر 3-4 ورقات بمبيدى الفينوكسابرب – ايثيل المضاف اليه ترياق و المسمى تجاريا (بوما سوبر) و كذلك مبيد الكلادينافوب – بروبارجايل و المضاف اليه ترياق و المسمى تجاريا (توبك) و ذلك لمكافحه الحشائش النجيليه الاتيه : الزمير البرى و الصامه و الفلارس. أيضا تم اختبار مبيد الاسيتوكلور على نبات الذره الصيفى و الموجود تجاريا بتجهيزتين مضاف اليهما الترياق (اسيتوب و هارنس) و الذى طبق بعد الزراعه و قبل الرى. بالتركيزات الموصى بها . و كانت الصفات المقدره: المحتوى الجذرى من الجلوتاثيون و نشاط انزيم الجلوتاثيون - س- ترانسفيراز و المستخلص من المجموع الجذرى و المجموع الخضرى و كذلك المحتوى من الكلوروفيل أ و ب و الكلوروفيل الكلى . و قد أظهرت النتائج أن مبيدات الحشائش المطبقه على القمح و الشعير أحدثت زياده معنويه فى كل الصفات المقدره مقارنه بالنباتات الغير معامله و لكنها على النقيض من ذلك أحدثت خفض معنوى فى هذه الصفات المقدره فى الحشائش أدى ببعض الحشائش الى الموت. وكذلك وجدنا أن هذه المبيدات والمضاف اليها ترياق أحدثت زياده فى هذه الصفات فى القمح أكثر من الشعير و ذلك راجع الى الاختلاف فى درجه التحمل و الحساسيه بين الاجناس المختلفه.

بالاضافه الى ذلك فإن استجابه نبات الذره للتجهيزتين التجاريتين من الاسيتوكلور و المضاف اليهما ترياق كانت متساويه فقد أحدثت التحهيزتين زياده معنويه فى كل الصفات بدون فروق معنويه.