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RESPONSE OF *Cyperus rotundus* WEEDS TO GLYPHOSATE HERBICIDE WITH SOME ADJUVANTS UNDER GREENHOUSE CONDITIONS.

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ABSTRACT

Glyphosate is post-emergence herbicide commonly used in perennial weed control as foliar active compound. Thus recent approaches are aiming to minimize its usage even in amounts and numbers. The role of fourteen chemical adjuvants in enhancing or reducing the efficiency of glyphosate on nutsedge (*Cyperus rotundus*) as a dominant perennial weed was studied. The adjuvants used were: glue, ammonium sulfate, urea, diethyl ether, propanol, rape seed oil, castor oil, paraffin oil, diesel oil, mineral oil, monoethylene glycol dioleate, monoethylene glycol monoleate and glycerin. The efficacy of half rate of glyphosate with and without adjuvants compared with glyphosate recommended rate without adjuvants was evaluated on yellow nutsedge grown in pots under greenhouse conditions. The reduction percentages in weed population by the tested compounds were calculated as ratios from untreated control treatment. Using adjuvant in binary mixture with glyphosate resulted in high reduction in weed growth parameters. The maximum reduction was recorded with glycerin and followed by the surfactants monoleate, dioleate and sticking agents such as glue, urea, whereas the crop seed oil and petroleum oil came in the second category in relation to glyphosate efficiency against weeds as indicated by weed seedling parameters, i.e. fresh and dry weight, total chlorophyll and carbohydrates contents.

Keywords; Glyphosate, Weeds, Adjuvants, Surfactants, Growth, Nutsedge, Carbohydrates, Chlorophyll.

INTRODUCTON

Nutsedge is one of the most serious perennial weeds can be especially troublesome for control. It's need a combination of mechanical, agricultural and chemical elements to achieve successful control. So the quantities of effective used herbicides were increased with the time and resulted in soil contamination by these chemicals. Biological response should be considered the role of herbicide efficacy as a function of deposition:, retention , uptake, translocation and toxicity (Zabkiewicz, 2000). Optimizing the usage of herbicides is important to achieve effective weed control, without a negative influence on the environment (Enflat *et al* 1997). Adjuvants substances added to a pesticide formulation or to the spray tank to enhance the activate of the herbicide and to improve the application characteristics are classified as: 1.activator adjuvants (surfactants, wetting agents, penetrates and oils). 2.Spray modifier adjuvants (stickers film formers, spreader, spreader stickers, deposit builders, 3.Thickening agents and foams, which reduce drift and allow precise pesticide placement.4.Utility modifier (emulsifiers dispersant, stabilizing agents, coupling agents, co solvents, compatibility agents, Buffering agents and antifoam agents which are used to form stable and sprayable suspensions or solutions for many herbicide formulations(Foy and Pritchard 1996)..

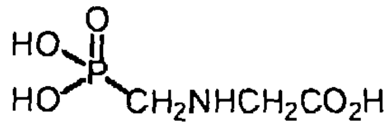
Also, adjuvants are added to a pesticide to enhance the activity of the herbicide, reduce leaching and improve the application characteristics. Drift results in a waste of product, reduces the effectiveness of pesticide application, and can damage crops that are economically or aesthetically important. Pesticide that drifts off target also can hurt wild life and contaminate water supplies (Foy and Pritchard 1996). Sundaram (1990) reported that the glyphosate-treated plants showed little increase in height, compared with the control plants, but showed significant reduction in weight and in leaf chlorophyll. No significant differences were noted in absorption and translocation patterns, growth parameters or leaf chlorophyll in plants treated with glyphosate alone or with Nalco-Trol II adjuvant, thus indicating no evidence of reduced bioavailability via entrapment of glyphosate into the polymeric chain. Barbe *et al* (1997) reported that a post-emergence spray at 0.02, 0.04 and 0.08 kg a.i. ha^{-1}, halosulfuron (with an oil-based adjuvant, Complement) gave 75-98% weed control and was superior to Actril-DS [ioxynil] at 1.3 kg a.e. ha^{-1}. Crudden *et al* (1999) observed that glyphosate formulations containing sarcosinate as the sole adjuvant were shown to exhibit excellent weed control efficacy at low surfactant concentration and to reduce the surface tension of the system to below 25 mN m^{-1}, at used concentration. Sharma and Singh (2000) studied the influence of nonionic (X-77) and organosilicon (L-77) adjuvants and of methylated seed oil (MSO) on the uptake, translocation and efficacy of glyphosate in *Bidens frondosa* and *Panicum maximum*. Significantly lower surface tension and contact angle values were obtained with aqueous solutions of L-77 alone and with glyphosate. The lower values of 14C-glyphosate in *P. maximum* also confirmed that adjuvant effects were species specific. Nelson *et al* (2002) reported that glyphosate at 0.84 kg/ha reduced yellow nutsedge dry weight 64%, whereas glufosinate at 0.4 kg/ha reduced dry weight only 22% when averaged over diammonium sulfate (DAS) and spray volume. Furthermore, yellow nutsedge dry weight was reduced 53% in the presence and 34% in the absence of DAS; however, dry weights were similar when spray volumes of glufosinate or glyphosate ranged from 140 to 1038 l/ha. The addition of nonionic surfactant, methylated seed oil, or crop oil concentrate to glyphosate plus DAS did not increase yellow nutsedge control with glyphosate in the greenhouse or field.

The present investigation aimed to throw light on the use of glyphosate herbicide at lower rate than the recommended one through adjuvants addition. Also the herbicidal and biological activities of glyphosate – adjuvant mixtures were studied. Surfactant adjuvant (non-ionic and cationic) and other adjuvants sticking agent, spreading agent, deactivator agent, and deposition aids were evaluated .

MATERIALS AND METHOD

1- Herbicide used:

Round up 48%WSC .It was supplied by Monsanto company
Common name: Glyphosate
Chemical name: N-(Phosphonomethyl) glycine
Molecular formula: $C_3H_8NO_5P$.



Recommended rate: 2.5 IWSC /feddan ($4200m^2$)

Adjuvants used: The trade names, chemical structures, classification and suppliers of the studied adjuvants are listed in table (1):

Table (1): List of the studied adjuvants added to glyphosate herbicide:

Names of adjuvants	Rate of application liter/fed. *	Classifications and suppliers
Glue	1.25 kg	Sticking agent local product in granular formulation
Ammonium sulfate (AMS)	1.25 kg	$(NH)_2SO_4$ (El-Nasar Company)
Urea	1.25 kg	H_2N-Co-NH_2 (El-Nasar Company)
Diethylether	1.25 liter	$C_2H_5oC_2H_5$ (El-Nasar Company)
Propanol	1.25 liter	$CH_3CH_2CH_2oH$ (El-Nasar Company)
Rape seed oil	1.25 liter	Deposition aids (Agriculture Research Center)
Castor oil	1.25 liter	Deposition aids (Local production)
Paraffin oil	1.25 liter	Deposition aids (Local production)
Mineral oil (KZ)	1.25 liter	KZ oil (Kafr El-Zayat Company)
Dioleate	0.125 liter	Non-ionic: Monoethylene glycol mono-oleate (Egyptian Company for Starch, Yeast and Detergents . Alexandria)
Monoleate	0.125 liter	Non-ionic : Monoethylene glycol Di-oleate (Egyptian company for Starch, Yeast and Detergents. Alexandria)
Emulsinaber	0.125 liter	Cationic surfactant (Egyptian Company for Starch, Yeast and Detergents. Alexandria)
Glycerin	0.125 liter	Non-ionic and Spreading agent (El-Gomhoria Medical Company)

3. Evaluation of the role of used adjuvants on glyphosate phsico chemical properties.

3.1-pH values:

The solution (glyphosate adjuvant mixtures) was shaked well to make homogeneous solution. the pH value were measured by pH meter

3.2-Conductivity(EC) and total dissolved salts (TDS).

The solutions (glyphosate adjuvant mixtures) were shaked well to make homogeneous solutions and a constant volume (80ml) was used to measure the conductivity of the solution. The reading was recorded after 1 minute or when it was stable. The EC was measured in m mhos units while TDS was determined in g/l units.

3.3-Viscosity

The cylinder was shaked well to make a homogeneous solution. A volume of 1ml was taken to measure the viscosity of the solution. The viscosity was measured by Brookfield programmable DV-11+Viscometer: 60RPM where m/ pouse is the unit of viscosity measurement.

3.4- Surface tension

Glyphosate adjuvant mixture solutions were shaked again to make a homogenous solution. A volume of about 10 ml was taken to measure the surface tension by droplet weight methods. Where dyne /cm is the unit of surface tension measurement.

4-Evaluation of the role of adjuvants on glyphosate biological activities.

The efficacy of half rate of glyphosate (1.25 liter/ feddan) was evaluated under greenhouse conditions. Different adjuvants were added to glyphosate solution and their herbicidal activities were evaluated against the yellow nutsedge weed in pots. Comparison was done with glyphosate recommended rate without adjuvant. Five tubers of nutsedge were planted in plastic pots containing a mixture of sand and clay (1:1v/v). Pots were placed in greenhouse and arranged in complete randomized-block design in six replication. Pots were gently and regularly irrigated in 3 day intervals with suitable amounts of water. Adjuvants were added to the mixtures at 1%(V/V) of the tank mixture (125 l/ feddan), while surfactants were added at the rate of 0.1% (V/V). Glyphosate mixtures were sprayed to the plants at their (5-6) leaves stage. Shoot and root fresh and dry weights and total chlorophyll were estimated after 3 weeks from herbicide application. Also, total carbohydrates content of nutsedge tubers was determined after three weeks by colorimetric method according to Herbert *et al* (1971) .

Treatments were compared with the untreated controls, then co-toxicity factor was calculated according to Sun and Johnson (1960) equation:

$$\% \text{ Difference} = \frac{\text{Control - treatment}}{\text{Control}} \times 100$$

RESULTS AND DISCUSSION

1- Physical and chemical properties of glyphosate, adjuvants and their binary mixtures.

Data in table (2) indicate different role of glyphosate concentration on the studied physico –chemical properties in laboratory. Half of field rate (1.25lit/fed) showed less value of EC, pH and TDS, while the contrary was recorded with viscosity and surface tension. The obtained values were 2.53&1.24 m mols /m (EC), 5.82 and 5.62 (pH), 1.27 and 0.6 g/l (TDS), 10.10 and 12.40 cm/pouse (viscosity) and 59.6 and 63.50 dyn/cm (surface tension) in case of the full and half rates of glyphosate herbicide, respectively.

As for the properties of glyphosate, adjuvants and their binary mixture, data in the same table indicate the important role of chemical structure and nature of studied mixtures in determining physico-chemical properties of adjuvants. The highest value of electric conductivity (EC) was recorded with glyphosate-ammonium sulfate (AMS) mixture (13.85mmols/m), while the EC values of the others mixtures ranged 1.21 to 2.15 m mols /m compared to (2.53-1.24) m mols/m at full and half rates of glyphosate, respectively.

It is clearly evident to notice that glyphosate and all tested adjuvants are characterized with acidic properties. The highest pH was recorded with glue mixture (6.43), while the others mixtures, showed pH's ranged 5.07 -5.62 compared to 5.82-5.62 with glyphosate alone. As for total dissolved salts TDS data indicate that the highest values were recorded with glyphosate mixtures with AMS, glue and urea showing 7.90, 5.00 and 2.33 g/l, respectively). The other mixtures showed TDS 's of 0.40-0.93 g/l compared to 0.68-1.27 g/l of glyphosate when used alone.

Data in the same table indicate high viscosity of glyphosate herbicide when used at half rate of 1.25 lit/fed than that of the full rate, showing 12.4 and10.10 cm/ pouse, respectively. The highest viscosity values were recorded with the mixtures of urea (17.80cm/ pouse), glycerin (14.70) and rape seed oil (14.30).. The lowest value were found with emulsinaber (2.8), monoleate (7.90) and dioleate (8.20), The other adjuvant mixtures showed viscosity range of 10.30- 13.60 cm/pouse.

Table (2): Physical and chemical properties of glyphosate and tested adjuvants mixtures

Tested mixture	Rate of application liter/fed.*	EC (mmols/ m)	pH	TDS (g/l)	Viscosity (cm/pouse)	Surface tension dyn/cm
1 fold gly.	2.5 l*	2.53	5.82	1.27	0.10	59.60
0.5 fold gy.	1.25 l	1.24	5.62	0.68	12.40	63.50
Gly. Plus glue	1.25 l + 1.25 kg	2.15	6.43	5.00	13.60	59.90
Gly. Plus AMS	1.25 l + 1.25 kg	13.85	5.62	7.90	13.10	59.30
Gly. Plus urea	1.25 l + 1.25 kg	2.00	5.23	2.33	17.80	58.90
Gly. Plus diethyl ether	1.25 l + 1.25 l	1.21	5.11	0.83	10.30	58.00
Gly. Plus propanol	1.25 l + 1.25 l	1.53	5.10	0.93	11.70	58.40
Gly. Plus rape seed oil	1.25 l + 1.25 l	1.27	5.07	0.67	14.30	57.70
Gly. Plus castor oil	1.25 l + 1.25 l	1.21	5.12	0.70	11.20	57.50
Gly. Plus paraffin oil	1.25 l + 1.25 l	1.28	5.20	0.70	10.50	57.50
Gly. Plus diesel oil	1.25 l + 1.25 l	1.23	5.20	0.69	12.60	58.40
Gly. Plus mineral oil	1.25 l + 1.25 l	1.24	5.09	0.69	11.80	51.97
Gly. Plus dioleate	1.25 l + 0.125 l	1.22	5.55	0.40	7.90	42.52
Gly. Plus monooleate	1.25 l + 0.125 l	1.23	5.23	0.74	8.20	40.82
Gly. Plus emulsinaber	1.25 l + 0.125 l	1.52	5.50	0.73	2.80	47.73
Gly. Plus glycerin	1.25 l + 0.125 l	1.33	5.20	0.82	14.70	50.20

gly. glyphosate — fFed*: Feddan (4200 cm^2)
l*: liter, kg kilogram — AMS: Ammonium Sulfate

As for surface tension, data in table (2) indicate the high value of this property with glyphosate at the two tested dilutions (59.60&63.50 dyn/cm at full and half rates, respectively). With the exception of mixtures with dioleate, monoleate, emulsinaber, glycerin and mineral oil which showed low values (42.52, 40.82, 47.73, 50.20 and 51.47 dyn/cm), the other adjuvants showed almost approximate values of surface tension as glyphosate (57.50-59.90 dyn/cm).

These results indicate that the main role of adjuvants affecting the value of physical properties of spray mixture solution than the herbicide solutions when used alone showing decrease pattern except AMS mixture. These result are in harmony with Norsworthy *et al* (2001) who concluded that the addition of nonionic surfactant (NIS) to a low rate of Roundup Ultra(R) reduced absorption of 14C-glyphosate by barnyardgrass and hemp sesbania, but had no effect on the herbicidal activity.

2-Effect of tested adjuvants on glyphosate activity against *Cyperus rotundas* weed.

Data concerning the effects of glyphosate, adjuvants and their binary mixtures on the growth parameters of purple nutsedge weed (fresh and dry weight), chlorophyll and carbohydrate contents are tabulated in Tabls (3-5). Examination of the obtained results indicate the important role of glyphosate concentration, adjuvant type and herbicide adjuvant mixture in determining the growth and biochemical aspects of the treated weed. To facilitate the presentation of data, each growth aspect will be discussed separately in the followings:

2.1. Effect on shoot and root fresh weight of the purple nutsedge weed.

Data in table (3) indicate the herbicidal activity of glyphosate on the purple nutsedge weed as shown from the values of fresh weights of weed shoot and root. Glyphosate concentration played considerable role in this respect. The reductions in fresh weights three weeks after treatment than the untreated reached 35.19 and 54.00% (shoot) and 46.13 and 50.17% (root) at half and full rate, respectively. The addition of all the applied adjuvants resulted in general reduction of shoot fresh weight of purple nutsedge weed three weeks after treatment than the untreated check. The highest reductions in shoot fresh weight were recorded with glycerin, emulsinabe and glue mixture with ½ rate of glyphosate, showing 62.20, 59.25 and 57.76% reduction, respectively. A moderate reductions were recorded with urea, diethyl ether and monoleate (49.69, 48.07 and 46.79%, respectively). The lowest reduction occurred with diesel oil (13.39). The same trend of results was obtained with root fresh weight, where glyphosate when used alone and in mixture with the tested adjuvants caused various rates of reduction according to the type and concentration used. The reduction percent in root fresh weight of purple nutsedge three weeks after treatment by glyphosate alone reached 46.13 and 50.17% of full and half rates, respectively. The addition of adjuvants resulted in decrease root fresh weight of weed lower than obtained with glyphosate when used alone. However mixtures with dioleate and paraffin reduction values were statistically equal to that obtained with glyphosate at full rate and reduced purple nutsedge root fresh weight by 45.73 and 44.45%, respectively than the untreated treatment .The lowest reductions were recorded with diesel oil and emulsinaber – glyphsate mixtures, showing 12.09 and 13.19% reductions, respectively. Considering the weights of weeds treated with ½ rate of glyphosate as a base line for comparison (100.0), the relative responses of herbicide adjuvant mixtures were varied according to weed part.

Table (3): Effect of glyphosate and its adjuvants mixtures on shoot and root fresh weight of purple nutsedge weed.

Treatment	Rate of application liter/Fed	*Shoot fresh weight (g) /5 plants	Relative response (+, -) % based on control, full rate, half rates.			*Root fresh weight (g) /5 plants	Relative response (+, -) % based on control, full rate, half rates.		
			Control	Full rate	half rate		Control	Full rate	Half rate
Control		5.45				8.15			
1 fold gly.	2.5 l*	2.51	54.00	0.00	29.02	4.39	46.13	0.00	-8.10
0.5 fold gly.	1.25 l	3.53	35.19	-40.89	0.00	4.06	50.17	7.49	0.00
Gly. plus glue	1.25 l + 1.25 kg	2.30	57.76	8.18	34.82	5.11	37.30	-16.40	-25.83
Gly. plus AMS	1.25 l + 1.25 kg	3.85	29.30	-53.69	-9.09	6.51	20.11	-48.31	-60.33
Gly. plus urea	1.25 l + 1.25 kg	2.74	49.69	-9.37	22.37	5.92	27.42	-34.74	-45.65
Gly. plus diethyl ether	1.25 l + 1.25 l	2.83	48.07	-12.88	19.88	6.20	23.98	-41.14	-52.57
Gly. plus propanol	1.25 l + 1.25 l	3.81	30.06	-52.05	-7.93	6.58	19.25	-49.91	-62.05
Gly. plus rape seed oil	1.25 l + 1.25 l	3.16	41.98	-26.13	10.48	6.60	19.01	-50.36	-62.55
Gly. Plus castor oil	1.25 l + 1.25 l	3.30	39.50	-31.51	6.65	6.52	19.99	-48.54	-60.58
Gly. plus paraffin oil	1.25 l + 1.25 l	3.30	39.50	-31.51	6.65	4.53	44.45	-3.12	-11.48
Gly. plus diesel oil	1.25 l + 1.25 l	4.72	13.39	-88.27	-33.64	7.17	12.04	-63.30	-76.53
Gly. plus mineral oil	1.25 l + 1.25 l	3.70	32.04	-47.75	-4.87	6.20	23.90	-41.28	-52.72
Gly. plus dioleate	1.25 l + 0.125 l	3.61	33.74	-44.04	-2.24	4.42	45.73	-0.75	-8.91
Gly. plus monoleate	1.25 l + 0.125 l	2.90	46.79	-15.68	17.89	5.84	28.39	-32.94	-43.71
Gly. plus emulsinaber	1.25 l + 0.125 l	2.22	59.25	11.41	37.12	7.08	13.19	-61.16	-74.22
Gly. plus glycerin	1.25 l + 0.125 l	2.06	62.20	17.83	41.68	5.05	38.09	-14.94	-24.26
LS D (0.05)		0.190				0.160			

*Each figure in the table represent the average of 3 replicates, 5 plants each (one pots).

Except AMS, propanol, diesel oil, mineral oil and dioleate mixtures, the others resulted in potentiation as more reductions occurred in fresh weights of shoot than glyphosate alone at ½ rate three weeks after treatment, i.e. glycerin (41.68), emulsinaber (37.12), glue (34.82), urea (22.37), diethyl ether (19.88), monoleate (17.89), rape seed oil (10.48), castor oil (6.65) and paraffin oil (6.52)%.

The decrease in fresh weights of weed shoot and or root may be attributed to the effect of herbicide in biosynthesis that related with substance's production and storing in weed organ. Such findings are in agreement with that obtained by Masiunas and Weller (1982) who studied the inhibition dose (ID) response curves for potato cv. Superior to glyphosate at 3 stages, viz. initiation of shoot primordia from tuber discs (I), shoot formation (II) and rooting of excised shoots (III). They found that ID50 (shoot formation) responses for I and II were 50 µM glyphosate. ID50 (% survival) for III was 10 µM glyphosate. Complete inhibition occurred at glyphosate rates above 100 µM for I and III while for II, shoot elongation was inhibited above 250 µM. Canal *et al* (1987) reported that the effects of glyphosate on endogenous IAA levels, IAA oxidase activity, and possible interactions with alterations in phenolic metabolism were examined in *Cyperus esculentus*. A significant increase in IAA content was recorded after glyphosate treatment. No IAA oxidase activity was detected in control and treated tissues.

3-Effect on shoot and root dry weights of the purple nutsedge weed:

Data in table (4) indicate that glyphosate when used alone caused different reductions in shoot dry weights than the untreated check, but in various values according to the used concentration. The recommended rate (2.50 lit/fed) showed 50.18% reduction compared with 12.10% with the half rate 3 weeks after treatment. A fluctuated reduction in shoot dry weights were noticed with the all used mixture of glyphosate ½ rate with the added adjuvants. The higher reductions were recorded with mixtures of ½ rate of glyphosate with monoleate (59.01%), dioleate (55.87%) , castor oil (51.86%), glycerin (40.32%), emulsinaber (39.82%), paraffin oil 38.65 %, mineral oil (30.79%), glue (30.79 %), urea (27.42%), diethyl ether (19.39%), propanol (10.73), diesel oil (9.36%) and rap seed oil (6.25%) as compared with control. Based on the dry weight of shoot of nutsedge treated with glyphosate ½ rate for comparison (100%), the relative values of some of the mixtures of ½ rate with adjuvants were lowered than the herbicide alone. The highest relative reduction in weight reached 53.37% (monoleate), 49.79%. (dioleate) and 45.23% (castor oil). Moderate reductions in shoot dry weights were occurred with glycerin (32.10%), emulsinaber (31.53%), paraffin oil (30.20%), glue (21.26%) and mineral oil (21.26%). The others glyphosate adjuvant mixtures showed low relative reduction in weights of the nutsedge weed ranged 17.42-8.29%. The mixtures of glyphosate with AMS, propanol, rape seed oil and diesel oil showed increase in shoot dry weight than that recorded with glyphosate alone at ½ rate.

Table (4) Effect of glyphosate and its adjuvants mixtures on dry weight of shoot root of purple nutsedge weed

Treatment	Rate of application liter/Fed	*Shoot dry weight (g)/5 plants	Relative response (+, -) % based on control, full rate, half rates.			*Root dry weight (g)/ 5 plants	Relative response (+, -) % based on control, full rate, half rates.		
			Control	Full rate	Half rate		Control	Full rate	Half rate
Control		2.99				3.12	.		
1 fold gly.	2.5 l*	1.49	50.18	0.00	43.32	2.20	29.74	0.00	12.20
0.5 fold gly.	1.25 l	2.63	12.10	-76.44	0.00	2.50	19.97	-13.90	0.00
Gly. plus glue	1.25 l + 1.25 kg	2.07	30.79	-38.93	21.26	2.22	28.97	-1.09	11.24
Gly. plus AMS	1.25 l + 1.25 kg	2.75	8.06	-84.56	-4.60	2.60	16.87	-18.31	-3.88
Gly. plus urea	1.25 l + 1.25 kg	2.17	27.42	-45.70	17.42	2.44	21.83	-11.25	2.32
Gly. plus diethyl ether	1.25 l + 1.25 l	2.41	19.39	-61.81	8.29	2.97	4.80	-35.49	-18.96
Gly. plus propanol	1.25 l + 1.25 l	2.67	10.73	-79.19	-1.56	2.04	34.76	7.15	18.48
Gly. plus rape seed oil	1.25 l + 1.25 l	2.80	6.25	-88.19	-6.66	2.85	8.80	-29.79	-13.96
Gly. Plus castor oil	1.25 l + 1.25 l	1.44	51.86	3.36	45.23	2.78	11.11	-26.51	-11.08
Gly. plus paraffin oil	1.25 l + 1.25 l	1.84	38.65	-23.15	30.20	2.23	28.65	-1.55	10.84
Gly. plus diesel oil	1.25 l + 1.25 l	2.71	9.36	-81.95	-3.12	2.98	4.61	-35.76	-19.20
Gly. plus mineral oil	1.25 l + 1.25 l	2.07	30.79	-38.93	21.26	2.10	32.91	4.51	16.16
Gly. plus dioleate	1.25 l + 0.125 l	1.32	55.87	11.41	49.79	2.06	34.12	6.24	17.68
Gly. plus monoleate	1.25 l + 0.125 l	1.23	59.01	17.72	53.37	2.02	35.24	7.84	19.08
Gly. plus emulsinaber	1.25 l + 0.125 l	1.80	39.82	-20.81	31.53	2.78	10.98	-26.70	-11.24
Gly. plus glycerin	1.25 l + 0.125 l	1.79	40.32	-19.80	32.10	2.00	35.88	8.75	19.88
LS D (0.05)		0.140				0.240			

*Each figure in the table represent the average of 3 replicates, 5 plants each (one pots).

As for root dry weight of the nutsedge weed, data in the same table indicate that the glyphosate at the two used rates and its mixtures of ½ rate with the tested adjuvants caused different reduction percentage than that of the untreated values 3 weeks after treatment. Reduction % in nutsedge root dry weight reached 29.74 and 19.97% than the check with full and half rates of glyphosate, respectively. Comparing with untreated treatment, the tested adjuvants decreased purple nutsedge root dry weight indesending order as fellow: with glycerin (35.88%), monoleate (35.24), propanol (34.76), dioleate (34.12%), mineral oil (32.91), glue (28.97%), paraffin oil (28.65), urea (21.83%), AMS (16.87), castor oil (11.11%), emulsinaber (10.98%) rape seed oil (8.80%), diethyl ether (4.80%) and diesel oil (4.61%).

Taking the root dry weight of nutsedge weed treated with 1/2rate of glyphosate as a base line (100), for calculation the differences, data in the same table showed that six binary mixtures of herbicide plus adjuvants increased dry weights. Increase percentage were varied according to the tested mixture, i.e. AMS (-3.8%), diethyl ether (-18.96%), rape seed oil (-13.98%), castor oil (- 11.8%), diesel oil, (-19.20%) and emulsinaber (-11.24%). The other mixtures showed less root dry weights of the treated weed than that recorded with glyphosate alone at ½ of the recommended rate. These results indicate that the decrease in dry weights of shoot and root may be attributed to glyphosate disrupting effect on biosynthesis and production of growth substances.

4-Effect on leaves chlorophyll and tuber carbohydrate contents of nutsedge plant.

Data in table (5) clearly indicate that glyphosate when used alone at the full and half rates, as well as its mixtures with the tested adjuvants caused significant decrease in chlorophyll content of nutsedge leaves 3 weeks after treatment. This may be explained by the deleterious role of this herbicide and its mixtures with tested adjuvants on photosynthesis process. The untreated leaves were found contained 34.37 chlorophyll SPAD units in average, while glyphosate treated leaves were contained 3.70 and 5.8 units in case of full and half rates, respectively. The same trend of reductions occurred with herbicide-adjuvant mixture as chlorophyll content ranged from 1.87 to 5.80 units. The highest reduction in chlorophyll content recorded with glyphosate glycerin mixture (95%), followed by the mixtures with dioleate (91.70%), AMS (91.44%), propanol (91.17%) and glue (90.37%).

Based on the chlorophyll content, data in the same table showed that all tested mixtures except herbicide emulsinaber caused different levels of reductions in chlorophyll content than that recorded with glyphosate alone at ½ rate. Reduction percent ranged from 8.62to 67.76% in diesel oil and glycerin mixtures, respectively.

The main effect of glyphosate on photosynthesis reactions were related with chlorophyll content. Such findings are in agreement with that obtained by Percival *et al* (1990) who suggested that modification of chlorophyll fluorescence induction kinetics was used to evaluate aspects of uptake of photosynthetically-active herbicides (diuron, phenmedipham and bentazone), a non-photosynthetically-active herbicide (glyphosate) and a plant growth regulator (PGR) (chlormequat) in wheat leaves.

Table (5): *Effect* of glyphosate and its adjuvants mixtures on leaves total chlorophyll and tuber total carbohydrate % of purple nutsedge weed.

Treatment	Rate of application *liter/Fed*	Total chlorophyll SPAD unit	Relative response (+, -) % based on *control, full rate,* half rates.			Total carbohydrate %/ g dry weight	Relative response (+, -) % based on control, *full rate, half rates.*		
			Control	Full rate	Half rate		Control	Full rate	*alf rate*
Control		37.37				12.80	0.00		
1 fold gly.	2.5 l*	3.70	90.10	0.00	36.21	4.63	63.83	0.00	-25.14
0.5 fold gly.	1.25 l	5.80	84.48	-56.76	0.00	3.70	71.09	20.09	0.00
Gly. plus glue	1.25 l + 1.25 kg	3.60	90.37	2.70	37.93	4.23	66.95	8.64	-14.32
Gly. plus AMS	1.25 l + 1.25 kg	3.20	91.44	13.51	44.83	4.45	65.23	3.89	-20.27
Gly. plus urea	1.25 l + 1.25 kg	3.10	91.70	16.22	46.55	4.20	67.19	9.29	-13.51
Gly. plus diethyl ether	1.25 l + 1.25 l	4.10	89.03	-10.81	29.31	4.63	63.83	0.00	-25.14
Gly. plus propanol	1.25 l + 1.25 l	3.30	91.17	10.81	43.10	4.23	66.95	8.64	-14.32
Gly. plus rape seed oil	1.25 l + 1.25 l	4.20	88.76	-13.51	27.59	3.67	71.33	20.73	0.81
Gly. Plus castor oil	1.25 l + 1.25 l	3.80	89.83	-2.70	34.48	3.10	75.78	33.05	16.22
Gly. plus paraffin oil	1.25 l + 1.25 l	4.70	87.42	-27.03	18.97	5.22	59.22	-12.74	-41.08
Gly. plus diesel oil	1.25 l + 1.25 l	5.30	85.82	-43.24	8.62	5.10	60.16	-10.15	-37.84
Gly. plus mineral oil	1.25 l + 1.25 l	4.20	88.76	-13.51	27.59	7.30	42.97	-57.67	-97.30
Gly. plus dioleate	1.25 l + 0.125 l	3.10	91.70	16.22	46.55	3.47	72.89	25.05	6.22
Gly. plus monoleate	1.25 l + 0.125 l	3.80	89.83	-2.70	34.48	3.03	76.33	34.56	18.11
Gly. plus emulsinaber	1.25 l + 0.125 l	5.80	84.48	-56.76	0.00	3.58	72.03	22.68	3.24
Gly. plus glycerin	1.25 l + 0.125 l	1.87	95.00	49.46	67.76	3.53	72.42	23.76	4.59
LS D (0.05)		0.290				0.700			

Fluorescence changes exhibited a direct correlation with foliar uptake of [14C]diuron, which inhibited photosynthetic electron transport by binding to the reaction centre-containing D1 polypeptide of PSII complexes. Kim *et al* (1995) conducted trials in a growth chamber to assess the effect of glyphosate on the accumulation of shikimic acid and degradation of chlorophyll in tomato cv. Moneymaker. Glyphosate at 200 nmol was applied as 20 µl drops to the 1st, 2nd and 3rd oldest leaves, or sprayed to the whole of 6-week-old plants. Shikimic acid analyses were conducted using HPLC. Results showed that shikimic acid accumulated within the leaves 24 h after glyphosate application. This was accompanied by chlorophyll loss in the apical leaves. Chlorosis was acropetal in the apical region of young leaves.

As for total carbohydrate content in nutsedge tubers in relation to glyphosate treatment, data in table (5) indicate the detection of the highest level of total carbohydrate content in normal untreated control 3 weeks after treatment (12.80%). Glyphosate when used alone caused great reduction percentage in carbohydrate content, i.e. 63.83 and 71.09% with full and ½ rates of glyphosate, respectively. The same trend of results was obtained with glyphosate adjuvant mixtures. The reduction percentage than the untreated check were ranged from42.97 to 76.33%. Among the tested 14 adjuvants, 8 mixtures with glyphosate (glue, AMS, urea, diethyl ether, propanol, paraffin oil, diesel oil and mineral oil) showed slight increase in carbohydrate content than that obtained with glyphosate half rate.

Reviewing the aforementioned results, it could be concluded that each of the tested chemicals, i.e. glyphosate herbicide, adjuvants and their binary mixtures having its own physical and chemical properties such as EC, pH, TDS, viscosity and surface tension. Adjuvants when mixed with glyphosate caused different change in herbicide properties, but in various levels according to the type of each adjuvant.

Such finding are in agreement with that obtained by Ream *et al* (1988) who reported that the herbicide glyphosate was found to inhibit the enzyme competitively with respect to PEP (Ki = 0.16 µM). Lydon and Duke(1988) showed that the concentration of protocatechuic acid in leaf tissue varied among species and was dependent upon the glyphosate dose, duration of exposure, and tissue assayed. Wang and Wang (2001) found that glyphosate at 33.5 mM caused inhibition of bud elongation, increased total free amino acid concentration, and caused rapid accumulation of shikimic acid in sprouted tubers of nutsedge.

These data provide fairly reliable estimates of compatability that can be further tested and validated with in field studies. Our results supported by Sundaram (1990) who reported that the effect of a polymeric adjuvant Nalco-Trol II on bioavailability of glyphosate (Roundup) was studied using *Populus tremuloides* seedlings. Toxic effects of glyphosate were assessed for a period up to 28 days after treatment. The glyphosate-treated plants showed little increase in height, compared with the control plants, but showed significant reduction in weight and in leaf chlorophyll. No significant differences were noted in absorption and translocation patterns, growth parameters or leaf chlorophyll in plants treated with glyphosate alone or with Nalco-Trol II, thus indicating no evidence of reduced bioavailability via entrapment of glyphosate into the polymeric chain. The synergistic effects of different adjuvants on the herbicidal activity and performance of glyphosate herbicide were reported by many researchers. i.e. Lark and Streibig (1995); Ruiter (1996); Jordan (1996); Sundaram *et al* (1996); Suwanketnikom (1997); Cabanne *et al* (1998); Leaper and Holloway (2000); Swann *et al* (2000); Zabkiewicz (2000); Singh and Sharma(2001); Nelson *et al* (2002) and Ferrell *et al* (2003).

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استجابة حشائش السعد لمبيد الحشائش الجليفوسات مع بعض المواد الإضافية تحت ظروف الصوبة .

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أجريت الدراسة بهدف ترشيد استخدام مبيد الجليفوسات المستخدم بعد الانبثاق على حشائش السعد المعمرة و ذلك برفع الكفاءة البيولوجية للمبيد عن طريق الخلط مع بعض المواد الإضافية : مواد ذات نشاط سطحي (المونواوليت والداى اوليت والجليسرين والاملسنابر) ومواد لاصقة معدلة للزوجة (الغراء) ومواد مزيلة للنشاط السطحي (اليوريا) وبعض الزيوت النباتية مثل(زيت الخروع و الراب) و بعض الزيوت البترولية مثل (زيت البرافين والديزل والزيت المعدني) ، مواد أخرى مثل (سلفات الامونيوم و البروبانول والداي ايثيل ايثر). بخلط المبيد بنصف التركيز الموصى به ومقارنته بالمبيد بالتركيز الحقلي و نصف التركيز الحقلي بالإضافة للكنترول وذلك على الخصائص النباتية للسعد (الوزن الخضري والجاف والمحتوى الكلوروفيلى و الكربوهيدراتى) و كانت أعلى المعاملات هى الجليسرين تلاها المونواوليت والداى اوليت ثم الغراء و اليوريا وجاء فى المرتبة الثالثة الزيت المعدنى والبرافين والخروع وأخيرا سلفات الامونيوم و البروبانول والداى ايثيل أيثر وزيت الراب و زيت الديزل على التوالى . كما تم دراسة تأثير هذه المخاليط على الخصائص الكيماوية و الطبيعية لسائل الرش (التوتر السطحى و اللزوجة و رقم الحموضة و التوصيل الكهربى و الاملاح الذائبة الكلية).