

ENHANCING HERBICIDAL ACTIVITY OF GLYPHOSATE BY ADJUVANTS IN MANDARIN ORCHARDS

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ABSTRACT: Field experiments were conducted during 2006 and 2007 seasons at Bielbis Farm, Sharkia Governorate to evaluate the effectiveness of certain adjuvants namely Silwet L-77, Tween 80 and Hamadoul A /1000 on the efficacy of glyphosate commercial product (Herbazed 48% WSC) for control of three broad-leaved weeds, (redroot -Pigweed *Amaranthus retroflexus*, common purslane *Portulaca oleracea* and knotweed *Polygonum salicifolium*) and to three grassy weeds, barnyard- weed *Echinochloa crus-gallia*, jungle rice *Echinochloa colonum*, and forssk *Dinebra retroflexa*).

Results indicated that glyphosate at recommended rate (1.2 kg a.i./fed.) decreased the fresh weight of broad - leaved, and grassy weeds as compared to unweeded (control) by more than 91.89 and 91.44% respectively in both seasons at 3 weeks after application. After 3 weeks post-treatment, the addition of Silwet L-77 either at 0.01 or 0.05% increased the efficacy of glyphosate at half of recommended rate (0.6 kg a.i./fed.) on broad-leaved weeds in both seasons. The addition of Tween 80 and Hamadoul A/1000 either at 0.01 or 0.05% to glyphosate at half recommended rate decreased fresh weight of broad-leaved and grassy weeds in both seasons at 3 weeks after application. The using of adjuvants, Silwet L-77, Tween 80 and Hamadoul A /1000 alone were ineffective on weeds at all treatments, Hand hoeing method significantly depressed weeds growth comparing to the unweeded one (control) in both seasons.

Key words: Glyphosate, nonionic surfactant, broad-leaved weeds, grass weeds, control.

INTRODUCTION

The temperature and abundant moisture of citrus groves is favorable for year-round germination and growth of weeds. On the other hand, frequent fertilization further aggravate the weed problems in citrus groves. Glyphosate, a non selective postemergence herbicide, is used extensively for control and chemical mowing of weeds in citrus groves. Enhancing activity of formulated glyphosate with an additional spray adjuvant depends mainly on the type of adjuvant, weed species, and environmental factors (Reddy and Singh, 1992). Various adjuvants have been evaluated for their ability to enhance glyphosate activity on several weeds (Jansen, 1973; Wyrill and Burns, 1977, Sweietlik, 1989); nonionic surfactants, the organosilicone, Silgard 309 (Reddy and Singh, 1992) and both petroleum and seed oils (Gauvrit and Cabanne, 1993). The surfactant Silwet L-77 cause reductions in the surface tension of spraying mix of approximately, 23.3 and 22.1 mN/m, ensuring excellent wettability of glyphosate on aquatic weeds with the highest upper and lower leaf surface

wetting area (Da Costa *et al.*, 2005). Organosilicone adjuvants, reduced surface tension and contact angle of diuron spray solutions to a greater extent than did nonsilicone adjuvants, its adjuvants significantly increased the control and reduced the fresh weigh of barnyard grass, *Echinochloa crus-galli* (Tan and Sharma, 2002). Surfactants and rapeseed oil ethoxylate are used to improve the biological efficacy of glyphosate on different weed species (Scherhag *et al.*, 2005). In the presence of an organosilicone surfactant, the stomatal uptake of glyphosate varied with both surfactant concentration and plant species (Liu, 2004). Triton X-100, non-ionic surfactant was the most effective in enhancing herbicidal activity of biodiesel to sicklepod and velvetleaf, which was sufficiently sever enough to result in plant death (Vaughn and Holser, 2007). Water alone on velvetleaf makes a contact angle bigger than 90°, aqueous Triton X-100 solution gives a larger spreading area, however, Silwet L-77 provides a significant increase in the spreading area and decrease in contact angle making it can effective wetting agent (Lee *et al.*, 2008). Therefore, the aim of the present work is to

study the effect of glyphosate alone or in combination with some adjuvants on weeds control efficiency in citrus groves.

MATERIALS AND METHODS

Field studies were conducted during 2006 and 2007 seasons in citrus grove at the Bielbis Farm, Sharkia Governorate, Egypt. The efficacy of glyphosate, either at 1.2 Kg a.i./fed. (recommended rate) and 0.6 Kg a.i./fed. (half recommended rate) was evaluated. Adjuvants, namely: Silwet L-77, Tween 80 and Hamadoul A/1000 were applied alone or in combination with glyphosate at half recommended rate.

Tested Chemicals

1. Glyphosate: N-(Phosphonomethyl) glycine, Known commercially as Herbazed 48 % WSC: sprayed on broad - leaved and grassy weeds after 60 days for emergence at the rate of 1.2 kg a.i./fed.
2. Silwet L-77: (Polyalkaleneoxide Modified Heptamethyl Trisiloxane, Produced by Loveland Industries, Greeley, Colo., USA), is used at the rate of 0.01% and 0.05%.
3. Tween 80: (El-Nasr Pharmaceutical Chemicals Co., Egypt), is used at the rate 0.01 and 0.05%.
4. Hamadoul A/1000: (Nonionic liquid of fatty acid ester condensed with Polyglycol of molecular weight 1000), Egyptian Company for Starch and Yeast Products of Alexandria, Egypt), is used at the rate 0.01 and 0.05%.

Methods Used

The experimental area was designed as complete randomized block four plots as replicates were used for each treatment and each replicate was 42m². The plots, were established between mandarin rows. The herbicidal treatments were applied when weed plants were at 7-12 leaves stage for annual weeds using a knapsack sprayer. Glyphosate, and their binary mixtures with adjuvants effects were evaluated after three weeks from the application. Weeds fresh weight counts per 1.0 m² were taken randomly by placing two 0.5m² quadrats in the two middle rows of each plots. One hand hoeing and unweeded checks were also included in the two seasons. The hand hoeing treatment was evaluated according to (El-Wekil *et al.*, 1991). Weeds were identified and classified into two

groups i.e. broad-leaved and grassy weeds, fresh weight of each group (g/m^2) were calculated. The family, scientific and English names of annual weeds infesting citrus groves are given in Table 1. Statistical analysis of all the previously designed experiments has been carried out according to procedures "ANOVA" reported by Sndecor and Cochran (1980). Treatment means were compared by the least significant difference test "L.S.D" at 5 % level of probability. The reduction percentages of the weeds under these treatments were in comparison with the unweeded

(control) treatments (El-Metwally, 2002, and El-Deen, 2005).

RESULTS AND DISCUSSION

Field Evaluation of Weed Control Treatments on Different Weeds in Mandarin Orchards

Broad-leaved weeds

Date showed the efficiency of glyphosate, and three adjuvants, Silwet L-77, Tween 80 and Hamadoul A/1000 singly or in binary mixtures with glyphosate at half recommended rate against three broad-leaved weeds under

Table 1. The most frequently weed species occurring in mandarin orchards

Family name	Scientific name	English name
Annual broad-leaved weeds		
Amaranthaceae	<i>Amaranthus retroflexus</i> (L.)	Redroot
Portulacaceae	<i>Portulaca oleracea</i> (L.)	Common Purslane
Polygonaceae	<i>Polygonum salicifolium</i> (Willd.)	Knotweed
Annual grass weeds		
Graminea	<i>Echinochloa crus-gallia</i> (L.)	Barnyardweed
Graminea	<i>Echinochloa colonum</i> (L.)	Jungle Rice
Poaceae	<i>Dinebra retroflexa</i> (Vahi.)	Forssk

under field condition during (2006 and 2007), are presented in Tables 2 and 3. It is obvious that all weed control treatments under study except adjuvants alone, decreased significantly the fresh weight of broad-leaved weeds as compared to unweeded (control) at 60 days from emergence of weeds, in the both seasons (2006 and 2007). The highest efficiency in decreasing fresh weight of broad-leaved weeds was obtained, by glyphosate at half recommended rate + Silwet L-77 at rate 0.05%, followed by glyphosate at recommended rate alone and glyphosate at half recommended rate + Silwet L-77 at rate 0.01% the mean percentages of control. (reduction of fresh weights) were 97.09, 92.04 and 89.65 % in first season and were 97.40, 91.89 and 90.50 % in second season, respectively. Glyphosate at half recommended rate when applied with the Tween 80, either at 0.01 or 0.05% decreased fresh weight of weeds than unweeded (control) by about 85.03 and 89.64 % in first season and by 86.97 and 88.55%, in second season, respectively. Hamadoul A/1000, either at 0.01 or 0.05% when mixed with the glyphosate at half recommended rate caused reduction of fresh

weight by 85.15 and 88.31% in first season, while, the reduction values were 86.77 and 87.71 % in second season, respectively. Hand hoeing treatment caused 81.99 and 85.43%, in two seasons, respectively. However, the adjuvants alone were ineffective at all treatments, it has no toxicity effect against tested weeds. On the other hand, glyphosate applied at half recommended rate controlled 75.40 and 77.56% of broad-leaved weeds, in both seasons, respectively. Results in Tables 2 and 3 revealed that all herbicide treatments used alone or mixed with adjuvants as well as hand hoeing treatment decreased statistically fresh weight of broad-leaved weeds grown as compared with unweeded treatment. Various adjuvants increased broad-leaved weeds control of glyphosate at half recommended rate (0.6 Kg a.i./fed.). The organosilicone, Silwet L-77 used in enhance the uptake of various herbicides (Stevens and Zabkiewicz, 1988). The organosilicone, Silgard 309 (Reddy and Singh, 1992), Silwet L-77 (Zabkiewicz *et al.*, 1993) were reported to increase glyphosate activity. Silwet L-77 enhanced ¹⁴C-glyphosate uptake into bean, *vicia faba* leaf (Zabkiewicz *et al.*, 1993).

Table 2. Effect of glyphosate alone or in combination with certain adjuvants against three broad-leaved weeds after 60 day from emergence (season, 2006)

Treatments	Fresh weight (g/m^2) and percentages of reduction after 21 days of application						Means %
	<i>Amaranthus retroflexus</i>		<i>Portulaca oleracea</i>		<i>Polygonum salicifolium</i>		
	Fresh weight	% of reduction	Fresh weight	% of reduction	Fresh weight	% of reduction	of reduction
Glyphosate *	122.94	94.79	186.63	92.73	155.48	88.62	92.04 ^a
Glyphosate **	529.91	77.58	502.13	80.44	434.55	68.20	75.40 ^a
Silwet L-77 (0.01 %)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Silwet L-77 (0.05 %)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Tween 80 (0.01 %)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Tween 80 (0.05%)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Hamadoul A / 1000 (0.01 %)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Hamadoul A / 1000 (0.05 %)	2363.61	0.00	2567.44	0.00	1366.65	0.00	0.00 ^b
Gly.** + Silwet L-77(0.01%)	138.93	94.12	348.75	86.41	158.13	88.42	89.65 ^a
Gly.** + Silwet L-77(0.05%)	0.00	100.00	0.00	100.00	119.11	91.28	97.09 ^a
Gly.** + Tween 80 (0.01%)	175.37	92.58	450.43	82.45	261.84	80.08	85.03 ^a
Gly.** + Tween 80 (0.05%)	145.82	93.83	284.38	88.92	188.64	86.19	89.64 ^a
Gly.** + Hamadoul A / 1000 (0.01%)	282.83	88.03	368.38	85.65	248.95	81.78	85.15 ^a
Gly.** + Hamadoul A / 1000 (0.05%)	253.25	89.28	272.00	89.40	187.91	86.25	88.31 ^a
Hand hoeing	262.00	88.91	569.02	77.83	283.54	79.25	81.99 ^a
Unweeded (Control)	2363.61	-	2567.44	-	1366.65	-	

L.S.D. at 0.05 level for treatments(T) = 22.18 g

L.S.D. at 0.05 level for weeds (W) = 19.39 g

L.S.D. at 0.05 level for interactions between (TXW) = 36.81 g

* Recommended rate

** Half recommended rate

Table 3. Effect of glyphosate alone or in combination with certain adjuvants against three broad-leaved weeds after 60 day from emergence (season, 2007)

Treatments	Fresh weight (g/m ²) and percentages of reduction after 21 days of application							
	<i>Amaranthus retroflexus</i>		<i>Portulaca oleracea</i>		<i>Polygonum salicifolium</i>		Means % of reduction	
	Fresh weight	% of reduction	Fresh weight	% of reduction	Fresh weight	% of reduction		
Glyphosate *	92.37	96.42	211.85	91.19	183.97	88.06	91.89 a	
Glyphosate **	461.50	82.16	447.16	81.40	475.57	69.14	77.56 a	
Silwet L-77 (0.01%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Silwet L-77 (0.05%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Tween 80 (0.01%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Tween 80 (0.05%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Hamadoul A / 1000 (0.01%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Hamadoul A / 1000 (0.05%)	2586.97	0.00	2405.05	0.00	1541.47	0.00	0.00 b	
Gly.**+ Silwet L-77 (0.01%)	128.41	95.03	277.17	88.47	184.68	88.01	90.50 a	
Gly.**+ Silwet L-77 (0.05%)	0.00	100.00	0.00	100.00	120.21	92.20	97.40 a	
Gly.**+ Tween 80 (0.01%)	209.12	91.91	284.31	88.17	295.20	80.84	86.97 a	
Gly.**+ Tween 80 (0.05%)	200.73	92.24	251.22	89.55	248.51	83.87	88.55 a	
Gly.**+ Hamadoul A/1000 (0.01%)	287.29	88.89	281.73	88.28	259.84	83.14	86.77 a	
Gly.**+ Hamadoul A/1000 (0.05%)	282.58	89.07	243.11	89.89	243.63	84.19	87.71 a	
Hand hoeing	390.52	84.90	317.85	86.78	236.96	84.62	85.43 a	
Unweeded(Control)	2586.97	-	2405.05	-	1541.47	-		

L.S.D. at 0.05 level for treatments(T)= 65.91 g

L.S.D. at 0.05 level for weeds(W)= 57.63 g

L.S.D. at 0.05 level for interactions between (TXW)= 109.39 g

* Recommended rate

** Half recommended rate.

Tween 20 and Triton X- 100 increased biodiesels activity to kill broad-leaved weeds (Vaughn and Holser, 2007). Silwet L-77 have been widely used to deliver water-base pesticide more effectively to the waxy surface of the leaves over two decade (Tang *et al.*, 2008).

Grass weeds

Results presented in Tables 4 and 5 showed that the different weed control treatments caused significant decrease in fresh weight of grass weeds after 60 days post-emergence compared with unweeded (control) in both seasons. Glyphosate at recommended rate controlled more than 91.44% of grass weeds, in both seasons. Mixtures of Silwet L-77, either at 0.01% or 0.05% with glyphosate at half recommended rate decreased fresh weight of grass weeds than unweeded by about 75.22 and 71.45%, in first season and 74.66 and 72.36%, in second season, respectively. While mixtures of glyphosate at half recommended rate with Tween 80, either at 0.01 or 0.05% caused reduction by 86.65 and 89.09%, respectively, while, its mixtures with Hamadoul A/1000 were 82.96 and 88.74%, respectively, in first season. In the same manner, the values of reduction were 83.20 and 86.10 %

with Tween 80, while, were 82.82 and 86.61 % with Hamadoul A/1000, respectively in second season. The treatments with adjuvants alone were ineffective against tested weeds, while hand hoeing treatment caused 87.18 and 83.38% reduction, in both seasons, respectively. On the other hand, glyphosate at half recommended rate decreased fresh weight of grass weeds by 76.21 and 75.67% in both seasons, respectively. Generally, results in Tables 4 and 5 revealed that glyphosate tested single or in binary mixtures with the adjuvants except Silwet L-77 as well as hand hoeing treatments decreased significantly the fresh weight of grass weeds compared with untreated weeds (control). All adjuvants with glyphosate increased efficacy against broad-leaved weeds with compared to unweeded at 3 weeks after application. The promising adjuvant was Silwet L-77. Da Costa *et al.*, (2005) reported that, the addition of Silwet L-77 to glyphosate significantly increased the control of aquatic weeds. Nonionic surfactant increased the efficacy of glyphosate for control of weeds in citrus (Reddy and Singh, 1992). Tween 80 and Hamadoul A/1000 were enhancing

Table 4. Effect of glyphosate alone or in combination with certain adjuvants against three grass weeds after 60 day from emergence (season, 2006)

Treatments	Fresh weight (g/m ²) and percentages of reduction after 21 days of application						
	<i>Echinochloa crus-gallia</i>		<i>Echinochloa colonum</i>		<i>Dinebra retroflexa</i>		Means % of reduction
	Fresh weight	% of reduction	Fresh weight	% of reduction	Fresh weight	% of reduction	
Glyphosate *	26.26	90.14	44.38	87.78	9.81	96.42	91.44 ^a
Glyphosate **	78.93	70.38	90.78	75.01	46.01	83.25	76.21 ^a
Silwet L-77 (0.01 %)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Silwet L-77 (0.05 %)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Tween 80 (0.01 %)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Tween 80 (0.05%)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Hamadoul A / 1000 (0.01%)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Hamadoul A 1000 (0.05%)	266.50	0.00	363.35	0.00	274.70	0.00	0.00 ^b
Gly.**+ Silwet L-77 (0.01%)	79.17	70.29	94.77	73.91	50.89	81.47	75.22 ^a
Gly.**+ Silwet L-77 (0.05%)	84.52	68.28	114.69	68.43	61.35	77.66	71.45 ^a
Gly.***+ Tween 80 (0.01%)	37.98	85.74	70.42	80.61	17.51	93.62	86.65 ^a
Gly.***+ Tween 80 (0.05 %)	28.58	89.27	58.39	83.93	16.28	94.07	89.09 ^a
Gly.***+ Hamadoul A/1000 (0.01%)	74.01	72.22	66.01	81.83	14.20	94.83	82.96 ^a
Gly.***+ Hamadoul A/1000 (0.05%)	40.61	84.76	51.05	85.95	12.29	95.52	88.74 ^a
Hand hoeing	27.69	89.60	85.28	76.52	12.54	95.43	87.18 ^a
Unweeded(Control)	266.50	-	363.35	-	274.70	-	

L.S.D. at 0.05 level for treatments(T) = 22.26 g

L.S.D. at 0.05 level for weeds (W)= 19.46 g

L.S.D. at 0.05 level for interactions between (TXW) = 36.95 g

* Recommended rate

** Half recommended rate

Table 5. Effect of glyphosate alone or in combination with certain adjuvants against three grass weeds after 60 day from emergence (season, 2007)

Treatments	Fresh weight (g/m ²) and percentages of reduction after 21 days of application						Means % of reduction
	<i>Echinochloa crus-gallia</i>		<i>Echinochloa colonum</i>		<i>Dinebra retroflexa</i>		
	Fresh weight	% of reduction	Fresh weight	% of reduction	Fresh weight	% of reduction	
Glyphosate *	12.38	97.02	46.73	88.95	34.83	90.61	92.19 ^a
Glyphosate **	60.72	85.39	122.49	71.05	107.23	71.10	75.84 ^b
Silwet L-77 (0.01%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Silwet L-77 (0.05%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Tween 80 (0.01%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Tween 80 (0.05%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Hamadoul A / 1000 (0.01%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Hamadoul A / 1000 (0.05%)	415.79	0.00	423.23	0.00	371.10	0.00	0.00 ^c
Gly.** + Silwet L-77(0.01%)	61.53	85.20	125.40	70.37	117.21	68.41	74.66 ^b
Gly.** + Silwet L-77(0.05%)	63.62	84.69	129.59	69.38	137.18	63.03	72.36 ^b
Gly.** + Tween 80 (0.01%)	42.70	89.73	85.68	79.75	73.74	80.12	83.20 ^a
Gly.** + Tween 80 (0.05%)	36.83	91.14	71.34	83.14	59.23	84.03	86.10 ^a
Gly.** + Hamadoul A / 1000 (0.01%)	53.72	87.08	80.44	80.99	72.76	80.39	82.82 ^a
Gly.** + Hamadoul A / 1000 (0.05%)	40.02	90.37	67.55	84.03	53.99	85.45	86.61 ^a
Hand hoeing	63.95	84.61	67.88	83.96	68.37	81.57	83.38 ^a
Unweeded(Control)	415.79	-	423.23	-	371.10	-	

L.S.D. at 0.05 level for treatments(T) = 6.31 g

L.S.D. at 0.05 level for weeds (W) = 5.52 g

L.S.D. at 0.05 level for interactions between (TXW) = 10.48 g

* Recommended rate

** Half recommended rate

glyphosate activity against grassy weeds. Tan and Sharma (2002) found that three organosilicone adjuvants significantly increased the control and reduced the fresh weight of barnyard grass, *Echinochloa crus-galli* when mixed with diuron. Singh and Singh (2005) reported that, the addition of Blaze and Improve increased the efficiency of glyphosate against, *Echinochloa crus-galli*. Silwet L-77 reduced the efficacy of glyphosate against grassy species. Gaskin and Zabkiewicz (1989) found that organosilicone surfactant, frequently reduced the glyphosate uptake into several grass species when added to Roundup. A super-spreading surfactant reduced glyphosate uptake into 3 grass species (Liu, 2003). Including an oil adjuvant with V-10137 may not increase grass control in same uses (Zollinger and Howatt, 2005). Generally, the addition of surfactant in spray solutions of the herbicides were significantly increased the toxicity to broad-leaved and grassy weeds except Silwet L-77 on grassy weeds. The topography of the leaf surface, the presence of wax, and trichomes may influence the distribution of a given herbicide applied on the leaf, and that the use of adjuvants may reduce the negative influence presented by these leaf structures

(Hess and Falk, 1990). Kirkwood (1993) found that the use of adjuvants in herbicide applications may reduce the surface tension, increase the spreading, retention and penetration of the active ingredient on the leaf surface.

Can be concluded that using various nonionic surfactants, Silwet L-77, Tween 80, and Hamadoul A/1000 improved broad-leaved weeds control of glyphosate at half recommended rate at 3 weeks after application in both seasons. However, Tween 80 and Hamadoul A/1000 were increased grassy weeds control of glyphosate at half recommended rate in both seasons.

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تعظيم الكفاءة الإبادية لمبيد الجليفوسات بواسطة الإضافات في حدائق اليوسفي

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أجريت تجربة حقلية خلال موسمي ٢٠٠٦، ٢٠٠٧ بمزرعة ببليس، محافظة الشرقية لتقييم كفاءة بعض المواد الإضافية سلويت الـ ٧٧، توين ٨٠ وهيمادول /١٠٠٠ على المستحضر التجاري (هريازد ٤٨% معلق مركز قابل للذوبان) لمركب الجليفوسات في مكافحة ثلاثة حشائش عريضة الأوراق، عرف الديك *Amaranthus retroflexus*، الرجلة *Portulaca oleracea* وأبو ظلف *Polygonum salicifolium* وضد ثلاثة حشائش رقيقة الأوراق، الدنيبة *Echinochloa crus-galli*، أبو ركة *Echinochloa colonum* والفورسيك *Dinebra retroflexa*.

أوضحت النتائج أن مركب الجليفوسات عند المعدل الحقل الموصى به (١,٢ كجم مادة فعالة / فدان) أدى إلى إبادة الحشائش عريضة الأوراق ورقيقة الأوراق بنسبة أكبر من ٩١,٨٩ و ٩١,٤٤% في كلا الموسمين على التوالي، بعد ثلاثة أسابيع من المعاملة. إضافة مركب السلويت الـ ٧٧ سواء بتركيز ٠,٠١ أو ٠,٠٥% إلى مركب الجليفوسات عند نصف المعدل الحقل الموصى به (٠,٦ كجم مادة فعالة / فدان) أدى إلى زيادة إبادة الحشائش عريضة الأوراق في كلا الموسمين بعد ثلاثة أسابيع من المعاملة. كما أن إضافة كلا من مركب التوين ٨٠ والهيمادول أ / ١٠٠٠ سواء بتركيز ٠,٠١ أو ٠,٠٥% مع نصف المعدل الحقل الموصى به من مركب الجليفوسات أدى إلى نقص الوزن الغض للحشائش عريضة الأوراق ورقيقة الأوراق في كلا الموسمين بعد ثلاثة أسابيع من المعاملة. أوضحت الدراسة أيضا أن استخدام المواد الإضافية منفردة ليس لها تأثير سام على الحشائش في جميع المعاملات، في حين قللت الطريقة اليدوية بنسبة معنوية نمو الحشائش بالمقارنة بالكنترول في كلا الموسمين.