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(Original Article)

Efficacy of Some New Premixed of Mesosulfuron-Methyl + Iodosulfuron-Methyl-Sodium-Based Herbicides on Annual Weeds in Bread Wheat (*Triticum aestivum* L.)

Amal E. A. Seddik; Sayed A. Ahmed and Ibrahim A. Mohamed*

Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt.

*Corresponding author e-mail: ibrahim.mahmoud@agr.aun.edu.eg
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Abstract

Field experiments were conducted at the Experimental Farm of Plant Protection Department, Faculty of Agriculture, Assiut University, Egypt, during 2022/2023 and 2023/2024. This study evaluates the efficacy of some new premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides and hand weeding treatments compared with untreated control on annual weeds in bread wheat. The tested herbicidal treatments were Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + Diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, and Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160g herbicide fed^{-1} and 500 ml safener fed^{-1}. The bread wheat fields were infested with different annual broad-leaved and grass weeds; however, annual broad-leaved weeds were more dominant than annual grass weeds in both seasons. *Beta vulgaris* was the most dominant broad-leaved weeds in both seasons at 30 days after treatment whereas, *Phalaris minor* and *Avena fatua* were the dominant grass weeds in 2022/2023 and 2023/2024, respectively. All weed control treatments were effective against annual grass, broad-leaved weeds and total weeds and significantly reduced fresh weight of target weeds compared to the untreated control at 30 days after treatment in both seasons. The tested herbicides were more effective than hand weeding treatments, and they achieved the highest increment for wheat grain yield than hand weeding and control. Disciplin® 6% EC, Atlantis® 1.2% OD and Wayetherb® 3.6% WG are considered new promising chemical weed control options in bread wheat in Assiut Governorate.

Keywords: *Annual weeds, Bread wheat, Chemical weed control, Herbicides, Mesosulfuron-methyl + iodosulfuron-methyl-sodium.*

Introduction

Wheat is a deadly food crop for the Egyptian diet and considered an exceedingly essential and political product in Egypt (Abdalla *et al.* 2022). Forty-five percent and about thirty percent of Egyptian's daily protein and caloric intake respectively, come directly from wheat-based food, especially bread baladi (Abdalla *et al.* 2022). However, there is a great gap between the national production and consumption of wheat in

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Egypt, which is equivalent to 538.000 tons annually (Abdalla *et al.* 2022; Mousa 2024**).** Recently, Egypt is the largest wheat-importing countries in the world (Abdalla *et al.* 2022). The Egyptian government was imported about 11-12 million tons from 2018-2023 to fill the wheat gap in Egypt for more than 100 million peoples (Abdalla *et al.* 2022; Mousa 2024).

Weeds are among the main constraints limiting wheat productivity worldwide (Awan *et al.* 2021**)**. Weeds caused severe losses in the grain yield of wheat crop than that caused by other agricultural pests (Zhang *et al.* 2024). Weed species compete directly with wheat plants for water, sunlight, and soil nutrients and reduce the quality and yield of the crop (Mohamed 2023; Zhang *et al.* 2024). Weeds decrease wheat yield by 25-30% (Nayyar *et al.* 1994), 48-52% (Khan and Haq 2002), 37-50% (Waheed *et al.* 2009), and 50-80% (Chhokar and Malik 2002).

Chemical herbicides are a more necessary process in wheat-producing areas for controlling annual and perennial weeds than manual weeding in the world (Khatami *et al.* 2022; Mohamed 2023). Mesosulfuron-methyl and iodosulfuron-methyl-sodium is a sulfonylurea herbicide commonly used to control a diverse range of grassy and some broadleaved weeds in wheat, rye (*Secale cereale* L.), and triticale (*Triticosecale* Wittmack) cultivations (Barros *et al.* 2009; Khatami *et al.* 2022). Mesosulfuron and iodosulfuron suppress weed growth through inhibiting the acetolactate synthase (ALS), which is essential to synthesis the branched-chain amino acids (i.e., valine, isoleucine, and leucine), that are vital substrates for growth and development of weeds and crop plants (Barros *et al.* 2009; Barros *et al.* 2016).

Recently, there were different mesosulfuron and iodosulfuron formulations that are registered with different trade names in Egypt and some of them are quite new. Little information is known on the effect of new mesosulfuron + iodosulfuron-based herbicide formulations on annual weeds in bread-wheat fields. The present study aims to evaluate the efficacy of certain new premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides and hand weeding treatments for weed control in bread wheat fields in Assiut.

Materials and Methods

Field experiments were carried out at the Experimental Farm of Plant Protection Department, Faculty of Agriculture, Assiut University, Egypt, during 2022-2023 and 2023-2024. The soil type was clay loam. A bread wheat cultivar '*cv.* Gemmiza 11' was dressed on December 1, 2022, and November 20, 2023, at 60 kg seed fed^{-1}. The plot size was 3 m × 3.5 m. The experiment was laid out in randomized complete block design (RBCD) with five treatments and replicated thrice.

Weed control treatments consisted of hand weeding, untreated weed control, and three tested herbicides namely Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}. The tested herbicides were applied at 37 days after wheat sowing as

post-emergence treatments using knapsack battery sprayer (Granada No. Kf-20C-18, China) fitted with a flat fan nozzle at water spray volume of 200 L fed^{-1}. The recommended agricultural practices, mainly fertilization and irrigation, were applied uniformly.

Grass and broadleaf weed species density (number m^{-2}) and their fresh weight (g m^{-2}) were recorded in 1 m^{-2} quadrat in each plot in the experiments. Data of weed parameters of the treatments were transformed using $\sqrt{(X+1)}$. Weed control efficiency was estimated according to the study of Mohamed (2017) and Mohamed (2023). Wheat crop was harvested manually in both seasons. Crop establishment, biological yield, straw yield, and grain yield (Kg fed^{-1}) were estimated to investigate the response of wheat to the tested herbicides.

Statistical analysis

All data of weeds, and wheat yield parameters subjected to ANOVA separately in CoStat 6.303 software and means of treatments were compared by Duncan's Multiple Range test (DMRT) set at 0.05.

Results

The common annual weed species found at the bread wheat experimental fields were *Beta vulgaris* L., *Cichorium pumilum* Jacq., *Ammi majus* L., *Rumex dentatus* L., *Coronopus niloticus* (Del) Spreng, *Phalaris minor* Retz. and *Avena fatua* L. (Table 1). Broadleaf weeds were more dominant than grass weeds. Among the annual weed species, *B. vulgaris* followed by *R. dentatus* and *A. majus* were the most dominant ones in the bread-wheat fields at 30 days after treatment (DAT) in 2022/2023, whereas *B. vulgaris* was found only in 2023/2024 (Table 1). *Phalaris minor* Retz. and *Avena fatua* L. were present as grass weeds only in 2022/2023 and 2023/2024, respectively (Table 1).

All weed control treatments (Disciplin® 6%, Wayetherb® 3.6%, Atlantis®, and hand weeding treatment) were effective against annual grass and broadleaved weeds and provided a significant fresh weight reduction in target weeds compared to the control at 30 DAT in 2022/2023 (Table 2 and 3) and 2023/2024 (Table 4 and 5). The tested herbicides were more efficient in controlling target weeds in bread wheat fields compared to hand weeding treatment in both seasons (Table 2 – 5).

Disciplin® 6%, Wayetherb® 3.6%, and Atlantis® herbicides reduced density of *P. minor*, *B. vulgaris*, *R. dentatus, C. niloticus, A. majus, C. pumilium*, and total weeds by 98.87-99.52%, 99.47-100%, 91.94-99.19%, 94.26-96.72%, 95-100%, 81.58-94.74%, and 97.73-98.87%, respectively compared to the control at 30 DAT in 2022/2023 (Table 2). The tested herbicides significantly reduced the fresh weight of the mentioned weeds by 99.95-99.97%, 99.97-100%, 98.44-99.88%, 97.59-99.13%, 99.15-100%, 96.01-99.2, and 99.83-99.90%, respectively compared with the control at 30 DAT in 2022/2023 (Table 3).

Table 1. Density and fresh weight of annual weed species presented in weedy control plots in a bread wheat "*cv.* Gemmiza 11" 30 days after treatment during 2022/2023 (SI) and 2023/2024 (SII)

Broadleaf weed species	Family	Weed density (n m^{-2})	% Weed density	Weed fresh weight (g m^{-2})	% Weed fresh weight
		SI (2022-2023)			
Phalaris minor	Poaceae	10.67±5.33c	2.51±1.25c	25.93±19.24b	0.68±0.50b
***Ammi majus* L.**	Apiaceae	93.33±24.04ab	21.94±5.65ab	142.31±97.06b	3.72±2.53b
***Beta vulgaris* L.**	Amaranthaceae	125.33±17.94a	29.47±4.22a	3066.67±491.05a	80.07±12.82a
***Cichorium pumilum* Jacq.**	Asteraceae	25.33±12.72bc	5.96±2.99bc	146.41±110.61b	3.82±2.89b
***Coronopus niloticus* DeL.**	Asteraceae	81.33±10.91abc	19.12±2.57abc	128.31±20.77b	3.35±0.54b
***Rumex dentatus* L.**	Polygonaceae	82.67±39.08abc	19.44±9.19abc	288.61±137.78b	7.54±3.60b
Total broadleaf weeds	–	408.00±17.44A	97.49±5.57A	3772.31±779.96A	99.32±21.02A
Total grass weeds	–	10.67±5.33B	2.51±1.25B	25.93±19.24B	0.68±0.50B
Total all weeds	–	418.67±12.72	100.00	3798.24±778.79	100.00
		SII (2023-2024)			
***Avena fatua* L.**	Poaceae	45.33±27.36b	21.38±12.90B	310.80±100.44b	28.85±9.32B
***Beta vulgaris* L.**	Amaranthaceae	166.67±17.64a	78.62±8.32A	766.67±120.19a	71.15±11.15A
Total broadleaf weeds	–	166.67±17.64A	78.62±8.32A	766.67±120.19A	71.15±11.15A
Total grass weeds	–	45.33±27.36B	21.38±12.90B	310.80±100.44B	28.85±9.32B
Total all weeds	–	212.00±18.90	100.00	1077.47±75.45	100.00

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameter in each season.

Table 2. Effect of some premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides on annual weeds density and their reduction rates in a bread wheat field "*cv.* Gemmiza 11" 30 days after treatment in 2022/2023 (SI)

Treatment	Weed species							
	Broad-leaved weeds					Grass weed	Total broad-leaved weed	Total weeds
	B. vulgaris	*R. dentatus*	*C. niloticus*	*A. majus*	*C. pumilum*	*P. minor*		
	Weed density (m^{-2})							
Disciplin® 6%	0.67±0.67c	0.67±0.67c	4.67±2.40c	0.00±0.00b	1.33±0.67b	2.00±1.15bc	7.33±4.40c	9.33±5.56c
Wayetherb®3.6%	0.00±0.00c	2.00±2.00c	2.67±1.33c	4.67±3.71b	4.67±3.71ab	4..67±2.91b	14.00±10.76c	18.67±13.66c
Atlantis® 1.2%	0.67±0.67c	6.67±3.71bc	4.00±2.31c	0.00±0.00b	3..33±0.67ab	2.00±2.00bbc	14.67±7.35c	16.67±9.35c
Hand weeding	20.00±4.62b	45.33±27.55ab	40.00±10.07b	17.33±8.74b	0.00±0.00b	0.00±0.00c	122.67±50.98b	122.67±50.98b
Control	125.33±17.94a	82.67±39.08a	81.33±10.91a	93.33±24.04a	25.33±12.72a	414.67±23.7a	408.00±104.69a	822.67±128.39a
	Weed density reduction (%)							
Disciplin® 6%	99.47±0.53a	99.19±0.81a	94.26±2.96a	100±0.00a	94.74±2.63a	99.52±0.28a	98.20±0.71a	98.87±0.32a
Wayetherb®3.6%	100±0.00a	97.58±2.42a	96.72±1.64a	95.00±3.98ab	81.58±14.65a	98.87±0.70a	96.57±1.30a	97.73±0.99a
Atlantis® 1.2%	99.47±0.53a	91.94±4.49a	95.08±2.84a	100±0.00a	86.84±2.63a	99.52±0.48a	96.41±1.63a	97.97±0.72a
Hand weeding	84.04±3.69b	45.16±13.57b	50.82±12.38b	81.43±9.37b	100±0.00a	100±0.00a	69.93±10.29b	85.09±5.10b
Control	-	-	-	-	-	-	-	-

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameter. Data of annual weeds were subjected to square-root transformation equation $\sqrt{(X+1)}$ before analysis. Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}.

Table 3. Effect of some premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides on annual weeds fresh weight and their reduction rates in a breadwheat field "*cv.* Gemmiza 11" 30 days after treatment in 2022/2023 (SI)

Treatment	Weed species							
	Broad-leaved weeds					Grass weed	Total broad-leaved weed	Total weeds
	B. vulgaris	*R. dentatus*	*C. niloticus*	*A. majus*	*C. pumilum*	*P. minor*		
	Weed fresh weight (g m^{-2})							
Disciplin® 6%	0.97±0.97b	0.35±0.35b	3.09±1.90c	0.00±0.00b	1.15±0.69a	1.81±0.93b	5.57±3.92b	7.37±4.85b
Wayetherb®3.6%	0.00±0.00b	0.79±0.79b	2.31±1.31c	1.21±0.94b	5.18±3.22a	1.50±0.76b	9.49±6.26b	10.99±7.02b
Atlantis® 1.2%	0.63±0.63b	4.49±0.95b	0.88±0.55c	0.00±0.00b	5.85±3.94a	1.18±1.18b	11.85±6.07b	13.03±7.25b
Hand weeding	69.48±34.13b	46.07±22.19ab	22.13±1.24b	4.73±2.42b	0.00±0.00a	0.00±0.00b	142.41±59.99b	142.41±59.99b
Control	3066.67±491.1a	288.61±137.8a	128.31±20.8a	142.31±97.1a	146.41±110.6a	3803.93±805.1a	3772.31±857.3a	7576.24±1662.3a
	Weed fresh weight (%)							
Disciplin® 6%	99.97±0.03a	99.88±0.12a	97.59±1.48a	100±0.00a	99.21±0.47a	99.95±0.02a	99.85±0.06a	99.90±0.03a
Wayetherb®3.6%	100±0.00a	99.73±0.27a	98.20±1.02a	99.15±0.66a	96.46±2.20a	99.96±0.02a	99.75±0.08a	99.85±0.05a
Atlantis® 1.2%	99.98±0.02a	98.44±0.33a	99.31±0.43a	100±0.00a	96.01±2.69a	99.97±0.03a	99.69±0.10a	99.83±0.05a
Hand weeding	97.73±1.11b	84.04±7.69b	82.75±0.96b	96.67±1.70a	100±0.00a	100±0.00a	96.22±1.06b	98.12±0.53b
Control	-	-	-	-	-	-	-	-

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameter. Data of annual weeds were subjected to square-root transformation equation $\sqrt{(X+1)}$ before analysis. Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}.

Hand weeding treatment resulted in full control (100 %) of *C. pumilium* and *P. minor* whereas it controlled *B. vulgaris*, *A. majus, C. niloticus* and *R. dentatus* by 84.04, 81.43, 50.82 and 45.16%, respectively (Table 2), and reduced their fresh weight by 97.73, 96.67, 82.75, and 84.04%, respectively (Table 3), compared with the control in at 30 DAT in 2022/2023.

In 2023/2024, Disciplin® 6%, Wayetherb® 3.6%, and Atlantis® herbicides exhibited high efficacy against *B. vulgaris* and *A. fatua* (except Disciplin® 6%) and significantly reduced fresh weight of *B. vulgaris* by 99.88 to 100% and *A. fatua* by 73.32-100% as well as total weeds by 92.30 to 100%, 30 DAT compared to control. Herbicides also exhibited high efficacy against individual and total weeds than hand weeding treatment and compared with the control in 2023/2024. Hand weeding controlled *B. vulgaris* and *A. fatua* and total weeds by 85.60%, 42.64, and 74.21%, respectively (Table 4) and it reduced their fresh weight by 78.01, 49.49 and 69.78%, respectively compared to the control at 30 DAT in 2022/2023 (Table 5).

Regarding the effect of all weed treatments on bread-wheat production parameters including biological yield, grain yield, and straw yield (kg fed^{-1}) (Table 6). All tested herbicides significantly increased wheat seed yield compared to the control, which had the lowest wheat grain yield in both seasons.

Table 4. Effect of some premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides on annual weeds density and their reduction rates in a bread wheat field "*cv.* Gemmiza 11" 30 days after treatment in 2023/2024 (SII)

Treatments	Weed species		
	Broad-leaved weed	**Grass weed**	**Total weeds**
	B. vulgaris	*Avena fatua*	
	Weed density (m^{-2})		
Disciplin® 6%	0.00±0.00c	27.33±8.97b	27.33±8.97c
Wayetherb®3.6%	1.33±1.33c	0.00±0.00c	1.33±1.33d
Atlantis® 1.2%	0.00±0.00c	0.00±0.00c	0.00±0.00d
Hand weeding	24.00±4.00b	26.00±4.67b	50.0±6.77b
Control	166.67±17.64a	45.33±27.36a	212.00±18.90a
	Weed density reduction (%)		
Disciplin® 6%	100±0.00a	39.70±19.79b	87.11±4.23b
Wayetherb®3.6%	99.20±0.80a	100±0.00a	99.37±0.63a
Atlantis® 1.2%	100±0.00a	100±.0.00a	100±0.00a
Hand weeding	85.60±2.40b	42.64±17.83b	74.21±5.59c
Control	-	-	-

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameters. Data of annual weeds were subjected to square-root transformation equation $\sqrt{(X+1)}$ before analysis. Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}.

Table 5. Effect of some premixed mesosulfuron-methyl + iodosulfuron-methyl-sodium-based herbicides on annual weeds fresh weight and their reduction rates in a bread wheat field "*cv.* Gemmiza 11" 30 days after treatment in 2023/2024 (SII)

Treatments	Weed species		
	Broad-leaved weed	Grass weed	Total weeds
	B. vulgaris	*Avena fatua*	
	Weed fresh weight (g m^{-2})		
Disciplin® 6%	0.00±0.00c	82.92±17.99b	82.92±17.99c
Wayetherb®3.6%	0.93±0.93c	0.00±0.00c	0.93±0.93d
Atlantis® 1.2%	0.00±0.00c	0.00±0.00c	0.00±0.00d
Hand weeding	168.57±109.06b	157.00±21.36b	325.57±106.72b
Control	766.67±120.19a	310.80±100.44a	1077.47±75.45a
	Weed fresh weight reduction (%)		
Disciplin® 6%	100.0±0.00a	73.32±5.79b	92.30±1.67a
Wayetherb®3.6%	99.88±0.12a	100±0.00a	99.91±0.09a
Atlantis® 1.2%	100.0±0.00a	100±0.00a	100.0±0.00a
Hand weeding	78.01±14.23a	49.49±6.87c	69.78±9.90b
Control	-	-	-

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameters. Data of annual weeds were subjected to square-root transformation equation $\sqrt{(X+1)}$ before analysis. Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}.

Table 6. Biological yield, seed yield, and straw yield of wheat (Kg fed^{-1}) and harvest index (%) as well as percentage of increased of the mentioned parameters as affected by different herbicides and hand weeding treatments in bread wheat filed "*cv.* Gemmiza 11" during 2022/2023 (SI) and 2023/2024 (SII).

Treatment	Biological yield (Kg fed^{-1})	Seed yield (Kg fed^{-1})	Straw yield (Kg fed^{-1})	Harvest index (%)
SI (2022-2023)				
Disciplin® 6%	5586.7±501.9b	2713.3±24.0a	2873.3±525.9b	49.5±5.3a
Wayetherb®3.6%	6013.3±383.9ab	2653.3±129.8a	3360.0±508.5b	44.7±5.0a
Atlantis® 1.2%	6013.3±13.3ab	2473.3±176.4ab	3540.0±174.4b	41.10±2.9a
Hand weeding	5066.7±186.7b	2033.3±237.9bc	3033.3±421.5b	40.6±6.2a
Control	7120.0±400.0a	1740.0±52.90c	5380.0±450.3a	24.7±2.0b
SII (2023/2024)				
Disciplin® 6%	5860.0±271.6c	2266.7±139.2bc	3593.3±167.5b	38.68±1.3a
Patros-exstra®1.2%	6373.3±112.2b	2246.7±211.8bc	4126.7±313.6ab	35.3±3.9abc
Wayetherb®3.6%	7233.3±106.7a	2693.3±127.2ab	4540.0±23.1a	37.2±1.2ab
Atlantis® 1.2%	6913.3±54.6a	2820.0±20.0a	4093.3±63.6ab	40.8±0.5a
Hand weeding	6453.3±168.3b	1780.0±253.3cd	4673.3±173.3a	27.6±2.4c
Control	5390.0±40.4d	1570.0±155.9d	3820.0±196.3b	29.1±3.1bc

Means within each column with the same letters are not significantly different (at $p < 0.05$) of Duncan's test in each parameter. Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%) at 600 ml fed^{-1}, Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener) at 400 ml fed^{-1}, Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) at 160 g herbicide fed^{-1} and 500 ml safener fed^{-1}

Hand weeding treatment resulted in an increase in the seed wheat yield compared to the control in both seasons without significant differences among them (Table 6). Application of Disciplin® 6%, Wayetherb® 3.6%, Atlantis® 1.2% herbicides and followed by hand weeding treatments resulted in the highest grain wheat yield of 2713.3, 2653.3, 2473.3, and 2033.3 Kg fed^{-1} in 2022-2023 and of 2266.7, 2693.3, 2820.0, and 1780.0 Kg fed^{-1} in 2023-2024, respectively (Table 6). The lowest grain yield 1740.0 and 1570.0 Kg fed^{-1} were recorded in the control plots in the first and second seasons, respectively (Table 6). Thus, the treatments of Disciplin® 6%, Wayetherb® 3.6%, Atlantis® 1.2%, and hand weeding treatments increased the grain yield by 55.93, 52.49, 42.14, and 16.86% in 2022-2023, 44.38, 71.54, 79.62, and 13.38% in 2023-2024, respectively.

Among all weed control treatments, Wayetherb® 3.6% and Atlantis® 1.2% have the maximum values of biological yield (6013.3 and 7233.3 Kg fed^{-1} in 2022/2023; 7233.3 and 6913.3 Kg fed^{-1} in 2023/2024) with a similar statistical difference and followed by Disciplin® 6% (5586.7 Kg fed^{-1} in 2022/2023 and 5860.0 Kg fed^{-1} in 2023/2024) and hand weeding treatment (5066.7 Kg fed^{-1} in 2022/2023 and 6453.3 Kg fed^{-1} in 2023/2024) (Table 6). In the control plots, the biological yield values were 7120.0 and 5390 Kg fed^{-1} in 2022/2023 and 2023/2024, respectively, whereas the straw yields were 5380.0 and 3820.0 Kg fed^{-1}, respectively (Table 6).

Discussion

Bread-wheat is an economically important cereal crops in the world (Safina and Absy 2017; Mohamed 2023), Egypt is the world's largest bread-wheat importer (Abdalla *et al.* 2023; Mohamed 2023). The annual and perennial weeds are the most harmful agricultural wheat pests and the vital obstacles in the production of bread wheat grain in the world (Singh *et al.* 2011; Mohamed 2017). There are several annual narrow weeds (e.g., *Phalaris* sp., *Lolium* spp. and *Avena* spp.) and dicots weeds (e.g., *Ammi majus* L., *Euphorbia helioscopia*, *Melilotus indica* (L.) All*., Rumex dentatus*, *Malva neglecta* Wallr., *Beta vulgaris*, *Cirsium arvense* L., *Snochus oleraceus* L., *Medicago sativa*, *Coronopus niloticus* (Del) Spreng, *Anagallis arvensis*, and *Chenopodium murale* L.) infest the wheat fields worldwide including Egypt (Hossain *et al.* 2009; Singh *et al.* 2011; Amare *et al.* 2014; Mohamed 2017; Safina and Absy 2017; Hameed *et al.* 2019; Mohamed 2023).

In the present study, the bread-wheat experimental fields were infested with different annual broad-leaved and grass weeds, however, annual broad-leaved weeds were more dominant than annual grass weeds. Among all weed species, *B. vulgaris* was the most dominant ones in both seasons at 30 DAT followed by *R. dentatus* and *A. majus* in 2022-2023. *P. minor* and *A. fatua* were present as dominant annual grass weeds only in 2022-2023 and 2023-2024, respectively. The maximum weed density and biomass were recorded in the control plots. In previous studies *P. minor*, *A. fatua*, *L. rigidum*, *B. vulgaris*, *M. indica*, *A. majus*, *C. album*, *R. dentatus*, and *M. parviflora* were among the dominant and competitive annual weeds and were presented in bread wheat; Maximum weed density and weeds biomass were recorded in the untreated control (Singh *et al.* 2011; Amare *et al.* 2014; Mohamed 2017; Safina and Absy 2017; Hameed *et al.* 2019; Mohamed 2023).

Weeds infestation decrease the wheat productivity by competing for space, nutrients, sun light, soil moisture, and CO_2 (Zimdahl 1980; Amare *et al.* 2014; Mohamed 2017; Safina and Absy 2017; Mohamed 2023). In the present study, all weed control treatments were very effective against annual grassy and broadleaf weeds and provoked a significant fresh weight reduction in target annual weeds compared to the untreated control at 30 DAT in both years. Disciplin® 6%, Wayetherb® 3.6%, and Atlantis® 1.2% herbicides reduced density and fresh biomass of *P. minor*, *B. vulgaris*, *R. dentatus, C. niloticus, A. majus,* total broadleaved and total all weeds ranged from 91.94 to 100% and 96.01 to 100%, respectively compared to the untreated control at 30 DAT in 2022-2023. The tested herbicides also elicited high efficacy against *B. vulgaris* and *A. fatua* (except Disciplin® 6%) and significantly decreased fresh weight of *B. vulgaris* by 99.88-100% and *A. fatua* by 73.32-100% as well as total weeds by 92.30-100%, 30 DAT compared to the untreated control in 2023-2024. The selected herbicides were more efficient in controlling annual grassy and broadleaf weeds in bread wheat fields than hand weeding treatment in both years. Hand weeding treatment was effective against *C. pumilium*, *P. minor*, *B. vulgaris* and *A. majus*, but less effective on *C. niloticus* and *R. dentatus*.

Mesosulfuron + iodosulfuron is a selective sulfonylurea herbicide which acts as an ALS-inhibitor and prevented biosynthesis of essential amino acids in susceptible weeds (Rao 2000). Mesosulfuron plus iodosulfuron is widely used in control of narrow and broad-leaf weeds in soft and durum wheat, barley and triticale (Mohamed 2017; Yadav and Dixit 2014; Alfarttoosi *et al.* 2019). Some of the previous studies indicated that mesosulfuron + iodosulfuron exhibited high control efficacy against grass (i.e., *L. rigidum* and *P. minor*) and broad-leaved weeds in wheat that are due to increase in biological and grain yield of wheat crop (Barros *et al.* 2009; Malekian *et al.* 2013).

The variable susceptibility of annual grass and broadleaf weeds to different formulations of mesosulfuron + iodosulfuron-based herbicide was found. It may be due to the variations in the anatomical, morphological, and physiological characteristics of these weed species; the chemically dissimilar among the formulations of mesosulfuron + iodosulfuron-based herbicide (Mohamed 2017). Moreover, differences in the effectiveness of mesosulfuron + iodosulfuron-based formulations on annual weed species in this study may also be due to the herbicide forms and formulations whereas, the mesosulfuron + iodosulfuron-based herbicide formulations contain adjuvants, surfactants and safeners that may enhance the performance of foliar spray application and increase the penetration of the herbicide active ingredients. This suggestion is agreements with the studies of Sharma *et al.* (1993), Sharma and Singh (2001), and Mohamed (2017).

Mesosulfuron + iodosulfuron exhibited efficacy against *Avena ludoviciana*, *P. minor*, *Medicago denticulata*, *Cichorium intybus*, *Euphorbia geniculate* and total weeds and reduced dry biomass by 90.5, 96.8, 74.1, 65.20, 68.0, and 86.20%, respectively and increased wheat grain by 79.8% compared to weedy control (Yadav and Dixit 2014). Mesoulfuron + iodosulfuron was effective in controlling total grass and broad-leaved weeds 88.7% and increased straw and grain wheat yield by 24.4 and 25.7%, respectively compared with control (Singh *et al.* 2019).

In the present study, weeds in untreated control plots reduced grain yield of bread wheat by 13.38-16.86 % over the hand weeding treatment. Disciplin® 6%, Wayetherb® 3.6%, and Atlantis® 1.2% herbicides increased the grain yield of wheat by 55.93, 52.49, and 42.14 % in 2022-2023, and 44.38, 71.54, and 79.62% in 2023-2024, respectively. In the current study, the increment in the grain yield of bread wheat may be coupled with a high efficacy of all weed control treatments including hand hoeing and all mesosulfuron + iodosulfuron-based herbicides for controlling annual weed species and decrease their competition with the wheat crop plants for the vital growth elements like space, soil nutrition water and sunlight. This suggestion is agreements with the studies of Katara *et al.* (2012), Yadav and Dixit (2014), Mohamed (2017), Singh *et al.* (2019), and Mohamed (2023). Application of mesosulfuron-methyl + iodosulfuron-methyl at 21.6 g ha^{-1} and metsulfuron-methyl + sulfosulfuron at 36 g ha^{-1} reduced weed biomass as compared to the control and increased grain yield of wheat by 63.7% and 46.9%, respectively (Malekian *et al.* 2013). Katara *et al.* (2012) indicated that mesosulfuron + iodosulfuron reduced the density and biomass of total weeds by 63.8 and 74.5%, respectively and increased wheat grain by 39.1% versus to the control.

Conclusion

In conclusion, Disciplin® 6% EC (Mesosulfuron-methyl 0.75% + iodosulfuron-methyl-sodium 0.25% + diflufenican 5%), Atlantis® 1.2% OD (Mesosulfuron-methyl 1% + iodosulfuron-methyl-sodium 0.2% + mefenpyr safener), Wayetherb® 3.6% WG (Mesosulfuron-methyl 3% + iodosulfuron-methyl-sodium 0.6% + mefenpyr safener) herbicides and hand weeding treatments were effective against common annual grass and broad-leaved weeds in bread wheat fields in both seasons compared to the control. Premixes of Disciplin® 6% EC, Atlantis® 1.2% OD, and Wayetherb® 3.6% WG elicited the highest improvement in the wheat grain yield followed by hand weeding treatments compared to the control.

References

Abdalla, A., Stellmacher, T., and Becker, M. (2023). Trends and prospects of change in wheat self-sufficiency in Egypt. Agricuture, 13: 7.

Alfarttoosi, H. A. K., Lahmod, N. R., and Slomy, A. K. (2019). Activity of herbicide iodosulfuron-mesosulfuron affected by magnetic treatment to weed control in five wheat cultivars. Plant Archives, 19 (2): 4463-4469.

Amare, T., Sharma, J.J., and Zewdie, K. (2014). Effect of weed control methods on weeds and wheat (*Triticum aestivum* L.) yield. World Journal of Agricultural Research, 2: 124-128.

Awan, T. H., Iqbal S., Saleem, M. U., Hussain, S., Khalid, U. B., and Ahmed, S. (2021). Herbicide options for effective and economical weed management for sustainable wheat production. International Journal of Agriculture and Biology, 26:479–489.

Barros, J.C., Basch, G., Freixial, R., and Carvalho, M.D. (2009). Effect of reduced doses of mesosulfuron + iodosulfuron to control weeds in no-till wheat under Mediterranean conditions. Spanish Journal of Agricultural Research, 7: 905-912.

Barros, J.C., Calado, J.M., Basch, G., and Carvalho, M.J. (2016). Effect of different doses of post-emergence-applied iodosulfuron on weed control and grain yield of malt barley

(*Hordeum distichum* L.), under Mediterranean conditions. Journal of Plant Protection Research, 56: 15-20.

Chhokar, R.S., and Malik, R.K. (2002). Isoproturon-resistant littleseed canarygrass (*Phalaris minor*) and its response to alternate herbicides. Weed Technology, 16: 116-123.

Hameed, Z., Malik, M.A., Ali, S., Ansar, M., Shaheen, F., Ahmad, I., and Kalim, K. (2018). Comparative efficiency of different post-emergence herbicides for controlling broadleaved weeds in rain-fed wheat. Pakistan Journal of Agricultural Research, 32(1): 78-86.

Hossain, M.I., Haque, M.E., and Talukder, S. (2009). Herbicidal effect on the growth and yield of wheat. International Journal of Sustainable Crop Production, 4(5): 1-4.

Katara, P., Kumar, S., Rana, S., and Chander, N. (2012). Combination of pinoxaden with other herbicides against complex weed flora in wheat. Indian Journal of Weed science, 44: 225-230.

Khan, M., and Haq, N. (2002). Wheat crop yield loss assessment due to weeds. Sarhad Journal of Agriculture, 18(4): 449-453.

Khatami, S.A., Barmaki, M., Alebrahim, M.T., and Bajwa, A.A. (2022). Salicylic acid pre-treatment reduces the physiological damage caused by the herbicide mesosulfuron-methyl + iodosulfuron-methyl in wheat (*Triticum aestivum*). Agronomy, 12: 3053.

Malekian, B., Ghadiri, H., Kazemeini, S. A., and Edalat, M. (2013). Efficacy evaluation of sulfosulfuron, metsulfuron-methyl plus sulfosulfuron, mesosulfuron-methyl plus iodosulfuron-methyl and iodosulfuron plus mesosulfuron herbicides in winter wheat (*Triticum aestivum* L.). Journal of Biological and Environmental Sciences, 7(21).

Mohamed, I. A. (2017). Efficiency of selected post emergence herbicides against broadleaved weeds in wheat grown in the new reclaimed land and in the Nile valley land, Egypt. Journal of Phytopathology and Pest Management, 4(1): 17-27.

Mohamed, I. A. (2023). The Potency of separated and new premix formulations of carfentrazone-based herbicide against annual broadleaved weeds in wheat. Egyptian Academic Journal of Biological Sciences F. Toxicology & Pest Control, 15(1): 35-45.

Mousa, Y. (2024). The Natural of Wheat International Market and Its Effect on Egyptian Wheat Imports. Alexandria Journal of Agricultural Sciences, 69(3): 368-380.

Nayyar M., Shafi, M. M., Shah, M. M., and Mahmood, T. (1994). Weed eradication studies in wheat, Abstracts, 4th Pakistan Weed Science Conference, UAF.

Rao, M. V. (2002). Field crops: Wheat. In: Viswanath CS ed. Handbook of Agriculture. New Delhi: ICAR Publication, pp. 744-754.

Safina, S. A. and Absy R. (2017). Broadleaf weed control with some recent post-emergence herbicides in bread wheat (*Triticum aestivum* L.) in Egypt. Egyptian Journal of Agronomy, 39(1): 41-50.

Singh, R., Kumar, R., Kumar, M., and Pandey, D. (2019). Effect of herbicides to control weeds in wheat. Indian Journal of Weed Science. 51(1): 75–77.

Singh, S., Punia, S. S., Yadav, A. and Hooda V. S. (2011). Evaluation of carfentrazone-ethyl+ metsulfuron-methyl against broad-leaf weeds of wheat. Indian Journal of Weed Science, 43: 12-22.

Singh, V.K., and Sharma, B.B. (2001). Productivity of rice (*Oryza sativa*) as influenced by crop diversification in wheat (*Triticum aestivum*) - rice cropping system on Mollisols of foothils of Himalayas. Indian Journal of Agricultural Sciences, 71.

Waheed A. R., Qureshi R., Jakhar G. S., Tareen, H. (2009). Weed community dynamics in wheat crop of district Rahim Yar Khan, Pakistan. Pakistan Journal of Botany, 41(1): 247–254.

Yadav, N., and Dixit, A. K. (2014). Bioefficacy of some herbicides and their mixtures against complex weed flora in wheat. Indian Journal of Weed Science, 46: 180-183.

Zhang, J., Xu, X., Lv, Y., Zhao, X., Song, J., Yu, P., Wang, X., and Zhao, E. (2024). Droplet Deposition and Efficacy of Real-Time Variable-Rate Application of Herbicides at Reduced Dose in Winter Wheat Fields. *Agronomy*, 14: 211.

Zimdahl, R.L. (2018). Fundamentals of Weed Science. Academic Press.

فعالية بعض مبيدات الحشائش الجديدة الممزوجة مسبقاً من ميسوسلفيوران ميثيل + ايودوسلفيوران ميثيل الصوديوم ضد الحشائش الحولية في قمح الخبز (*Triticum aestivum* L.)

أمل السيد عبد اللطيف صديق، سيد عاشور أحمد، إبراهيم عبد الوهاب محمد*

قسم وقاية النبات، كلية الزراعة، جامعة أسيوط، أسيوط، مصر.

الملخص

إجريت تجارب حقلية في المزرعة البحثية لقسم وقاية النبات، كلية الزراعة، جامعة أسيوط، مصر خلال عامي 2023/2022 و2024/2023 لتقييم فعالية بعض مبيدات الحشائش الحديثة المجهزة في صورة مخاليط ممزوجة من ميسوسلفيوران-ميثيل + ايودوسلفيوران–ميثيل-الصوديوم ومعاملة النقاوة اليدوية للحشائش بالمقارنة بالكنترول ضد الحشائش الحولية في قمح الخبز بمحافظة أسيوط. أما مبيدات الحشائش التي تم اختبارها بالدراسة فهي: مركب ديسيبلين 6% EC (0.75% ميسوسلفيوران ميثيل + 0.25% ايودوسلفيوران ميثيل الصوديوم + 5% دايفلوفينيكان) بمعدل 600 مل للفدان، مركب اطلانتس 1.2% OD (1% ميسوسلفيوران ميثيل + 0.2% ايودوسلفيوران ميثيل الصوديوم + المادة الناشرة ميفينبير) بمعدل 400 مل للفدان، مركب وايت هيرب 3.6% WG (3% ميسوسلفيوران ميثيل + 0.6% ايودوسلفيوران ميثيل الصوديوم + المادة الناشرة ميفينبير) بمعدل 160 جم للفدان للمبيد + 500 مل للمادة الناشرة. أظهرت النتائج أن حقول قمح الخبز كانت موبوءة بانواع مختلفة من الحشائش الحولية ضيقة وعريضة الاوراق فى كلا الموسمين، وكانت الحشائش الحولية عريضة الاوراق الاكثر انتشاراً من الحشائش الحولية ضيقة الاوراق. اثبتت النتائج أن كل المعاملات كانت ذات فاعلية كبيرة ضد الحشائش الحولية عريضة وضيقة الاوراق والحشائش الكلية وخفضت الوزن الخضري للحشائش المستهدفة في حقول القمح بعد 30 يوماً من المعاملة بالمبيدات في كلا الموسمين، وحققت أعلى زيادة إنتاجية حبوب القمح مقارنةً بالنقاوة اليدوية والكنترول. مركبات ديسيبلين 6% EC، اطلانتس 1.2% OD، وايت هيرب 3.6% WG تعتبر خيارات واعدة جديدة لمكافحة الحشائش في قمح الخبز في أسيوط.

الكلمات المفتاحية: *الحشائش الحولية، المكافحة الكيميائية للحشائش، قمح الخبز، مبيدات الحشائش، ميسوسلفيوران ميثيل + ايودوسلفيوران ميثيل الصوديوم.*