P-ISSN: 3009 – 7487
E-ISSN: 3009 – 7886

JOURNAL OF PLANT AND FOOD SCIENCES December 2024

Efficacy of herbicidal treatments in controlling weeds in sugar beet crop and their side effects on subsequent crops

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Received:13rd August 2024; in revised form: 15th August 2024/ Accepted: 22 August 2024/ Published: 1st December 2024
DOI 10.21608/JPFS.2024.312033.1019

ABSTRACT

The field experiments were conducted at Egypt's Future Agency for Sustainable Development in the Al-Dabaa district (Al-Behera Governorate) over two consecutive seasons, 2021–2022, and 2022–2023. The aim was to evaluate the field efficacy of several weed control treatments for managing the biomass of broadleaf, grass, and total weeds in a sugar beet crop. The treatments included the herbicides haloxyfop-methyl (Giako 10.8 EC at 500 ml/feddan), fluazifop-P-butyl (Flozetop Super15% EC at 1250 ml/feddan), a mixture of Phenmedipham, Desmedipham, Ethofumesate, and Lenacil (Betanal MaxxPro 20.9% OD at 650 ml/feddan), and Betasana Trio 20.5% SC at 900 ml/feddan a mixture of Phenmedipham, Desmedipham, Ethofumesate. Hand hoeing twice (21 and 35 days after sowing) was also included as a comparison. The results showed that all the tested herbicides significantly reduced the biomass of the predominant weed species at 60 days after sowing. However, Betanal MaxxPro and Betasana Trio provided poor control of grassy weeds, while Giako and Flozetop Super exhibited limited effectiveness against broadleaved weeds, compared to the hand hoeing treatment and the untreated control. Importantly, all the weed control treatments significantly improved the agronomic traits of the sugar beet crop, as well as sugar content, in both seasons compared to the untreated control. Additionally, no residual effects of the treatments were observed on the subsequent crops of wheat, corn and faba bean grown in the same area after the sugar beet.
Keywords: Herbicides, Sugar beet, Residual effect.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) represents a critical component of agricultural rotations across the principal cultivation areas of Egypt and globally. It contributes significantly to saccharose production. Maier *et al.* (2012) estimated the global cultivation area for sugar beets at approximately 4.78 million hectares. The root possesses a sugar concentration ranging from 17% to 25%, while the upper foliage can serve as fodder for livestock or can be incorporated back into the soil as a natural fertilizer (Mahmoud and Soliman, 2012; Gouda, 2019). Sugar is a primary source of metabolic energy for humans and is predominantly derived from plant sources, primarily sugar cane and sugar beet. In 2021 and 2022, a total of 170.5 million tons of sugar were produced globally, with 37.4 million tons coming from sugar beets and 133.1 million tons from sugar cane. Sugar cane offers several advantages, as it is a perennial species that yields significantly with minimal labor demands. The production of sugar from sugar beet alone reached 2.5 million tons (Anonymous, 2022).

Weeds are major agricultural pests that can adversely affect crops if not properly controlled or managed. Weeds pose a significant challenge in sugar beet cultivation, as they compete with the crop for essential growth factors, such as nutrients, water, space and light. This competition not only reduces the overall yield but also deteriorates the quality of the farm production, ultimately lowering its market value (Kunz *et al.,* 2015; Kucharski *et al*., 2012 and Mesbah, 1993). Also, weeds contribute to reductions in yield, obstruct harvesting processes, diminish the quality of the harvested products, and potentially serve as hosts for pestes that may adversely affect the crop. Weeds can result in approximately 60% losses in the yield of sugar beet crops, and at peak weed densities, these losses may escalate to as much as 100% (Gouda, 2019; Vasileiadis *et al.,* 2007and May, 2003).

Effective weed management is crucial for successful sugar beet production. Uncontrolled weed competition can lead to yield losses of up to 100% if left unaddressed (Bezhin & Gerhards, 2015). As noted by Kucharski (2003), herbicides play a vital role in weed control for sugar beet cultivation.

Building on this, the current study aimed to evaluate the effects of various herbicide treatments, applied alone or in combination, on the growth, yield, and yield components of sugar beet (*Beta vulgaris* L.), the associated weed populations, and any potential residual impacts on subsequent crops.

MATERIALS AND METHODS

Experimental design and herbicides application:

Field experiments were carried out at Egypt's Future Agency for Sustainable Development in Al-Dabaa district (Al-Behera Governorate) to evaluate the herbicidal activity of post-emergence herbicides, haloxyfop-methyl (Giako 10.8 EC), fluazifop-P-butyl 15% (Flozetop Super 15% EC) and tank mixes of (Phenmedipham 6% + Desmedipham 4.7% + Ethofumesate 7.5% + Lenacil 2.7%), Betanal MaxxPro 20.9% OD, and Betasana Trio 20.5 % SC. Hand hoeing twice (at 21 and 35 days after sowing, DAS) and untreated check in controlling weeds during (2021-2022 and 2022-2023) seasons. All weed control treatments were arranged in a randomized complete block design with three replicates for each treatment and an individual plot size of 21 m^{-2} (7.0 x 3.0 m). All herbicide treatments were applied in 200 L of water fed^{-1} by a knapsack sprayer (Gloria Hoppy No. 299 TS. (CP3)), Common names, trade names, formulations, recommended rates, and times of application of used herbicides are provided in Table 1.

Sowing:

Sugar beet seeds, "cv. Gustav" were planted on September 25 and 28 during the two consecutive winter seasons of 2021-2022 and 2022-2023, respectively. Planting spaces are 30 cm. between hills and the planting pattern is 55 cm. in width, with a single-sided planting pattern on the ridges or terraces. Harvesting dates were May 9 and 13, 2021–2022 and 2022–2023, respectively.

The experimental field soil was analyzed at the Department of Soil, Water and Environmental Res. Institute, Agricultural Res. Center are provided in Table 2.

Table (1): Common name, trade name, formulation, recommended rate and time of application of the used herbicides.

Trade name and formulations	Common name	Recommended Rate/fed	Time of application
Betanal Maxx Pro 20.9% OD	phenmedipham6% desmedipham4.7% ethofumesate7.5% lenacil2.7%	650 ml	at 2-3 leaves
Betasana Trio 20.5 % SC	phenmedipham7.5% desmedipham1.5% ethofumesate11.5%	900 ml	
Giako 10.8 EC	haloxyfop-methyl10.8%	500 ml	at 2-4 leaves
Flozetop Super 15% EC	fluazifop-P-butyl 15%	1250 ml	
Hand hoeing	21 and 35 days after sowing		
Untreated	00.00		

Table (2): Chemical and mechanical analysis of soil in the experimental field study.

Soil properties	Soil Analysis
Sand%	85.25
Clay%	8.54
Silt%	6.21
Soil texture	Sandy loam
pH	7.95
EC dsm^{-1}	3.72
$CaCO_3$%	-
Available N%	16.60
Available P%	6.36
Available k%	0.56

Evaluation of herbicidal treatments:

After nine weeks after sowing in the two growing seasons (2021-2022 and 2022-2023), weeds in the middle row of each experimental plot were gathered, sorted out, counted, identified, and classified according to Hassanein *et al*., 2000 and Zaki (2000). and fresh weights were recorded as g/m^2. Then, all weeds were individually dried at 70 °C for 72 hours in an oven to determine their dry weight and the following parameters were calculated:

1- Weed density = average number of each weed m^{-2}.

$$\text{2- weed density } \% = \frac{\text{average number of one weed}}{\text{average number of total weeds}} \times 100$$

3- Weed biomass= average fresh or dry weight of each weed (gm^{-2}).

$$\text{4- weed biomass \%} = \frac{\text{average fresh or dry weight of one weed}}{\text{average fresh or dry weight of total weeds}} \times 100$$

5- Weed control efficiency = (C-T/C) ×100
Where:
C = Weed biomass in untreated plots.
T= Weed biomass in treated plots.

At the time of harvest, five randomly selected plants from the two inner rows of each sub plot were harvested to assess the following agronomic traits: root diameter (cm), root length (cm) and root fresh weight yield (tons /feddan).

Quality parameters in sugar yield:
We used an automatic sugar polarimetric hand refractometer (Atago N1, Brix 0-32%) to analyze fresh sugar beet root samples for sugar content. Mahmoud and Soliman, 2012; McGinnus, 1971and Reinefeld *et al*., 1974).
Residual effects of herbicides applied in sugar beet fields on subsequent crops.
In the second season at harvest, soil samples were taken from each experimental plots at depth of 0-30 cm, to determine effect of herbicide residues on the following subsequent crops 50 DAS:

1- Wheat (cv. Sakha 93).
2- Corn (cv. 2031).
3- Faba bean (cv. Giza 402).

Ten seeds of wheat, 10 seeds of corn and 10 seeds of faba bean were sown in plastic pots (30cm diameter, 25cm depth), Three replicates were used for each crop then, following parameters were found:

1- Number of plants.
2- Fresh weight (g/plant)
3- Plant height (cm).

Statistical analysis:
The data was statistically analyzed using the approach outlined by Gomez and Gomez (1984), with comparisons of means performed using the least significant difference (LSD) test at a 0.05 significance level.

RESULTS AND DISCUSSION

A. Predominant weed species:

Results presented in Table (3) indicated that predominant weed species found in experiment fields are Cheese weed mallow (*Malva parviflora* L.), Sow-thistle (*Sonchus oleraceus* L.), Black mustard (*Brassica nigra* L.), White goosefoot (*Chenopodium album* L.), Toothed medik (*Medicago polymorpha* L.), Groundsel (*Senecio glaucus* L.) and Scerlet pimpernel (*Anagallis arvensis* L.) as broadleaved weeds and Wild oats (*Avena fatua* L.) and Lesser canary grass (*Phalaris minor* Retz.) as Grassy weeds in 2021-2022 and 2022-2023 growing seasons.

Table 3: Common broad and grassy weeds in experimental sugar beet fields during 2021–2022 and 2022–2023.

English name	Scientific name	Family name	Weed species
Cheese weed mallow	*Malva parviflora* L.	Malvaceae	Broadleaf weeds
Sow-thistle	*Sonchus oleraceus* L.	Compositae	
Black mustard	*Brassica nigra* L.	Cruciferae	
White goosefoot,	*Chenopodium album* L.	Chenopodiaceae	
Toothed medic	*Medicago polymorpha* L.	Leguminosae	
Groundsel	*Senecio glaucus* L.	Compositae	
Scarlet pimpernel	*Anagallis arvensis* L.	Primulaceae	
Wild oats	*Avena fatua* L.	Gramineae	Grassy weeds
Lesser canary grass	*Phalaris minor* Retz.		

B- Weed biomass (gm^{-2}) and density (m^{-2}):

In the unweeded check in both studied seasons, weed biomass and density were recorded at 9 weeks WAS. Obtained results showed that, in both seasons, *Senecio glaucus* L., recorded the highest biomass (177.03 and 135 g m^{-2}) and density (15.67 and 10 weeds m^{-2}) from total broad-leaf weeds (66.67 and 56.67) weed plant m^{-2} in both experimental seasons, consecutive. On the other hand, (*Avena fatua* L., and *Phalaris minor* Retz.), were found only as narrow-leafed weeds in both studied seasons. with numbers of (7.67, 7.33, and 11; 8.33) m^2 from total numbers of narrow weeds (41.08, 46.81, and 58.92, 53.19) m^2. While the density of the un-weeded control was recorded at 18.67 and 15.66, and the highest biomass was recorded at 52.93 and 56.66 g/m^2 in both studied seasons, respectively.

This suggests that the population of each weed species and the overall weed presence varied annually. These results align with those reported by Mahmoud and Soliman (2012) and Grzanka *et al*. (2023), who noted that weed density in sugar beet fields fluctuated over time due to climatic and agricultural conditions. Mahmoud and Soliman (2012) along with Kryukova and Gresis (2021) identified *Beta vulgaris* as the predominant weed in the initial season, showing an infection rate of 51.6%, followed by *Medicago polymorpha* (33.4%), *Phalaris minor* (8.8%), *Marva parviflora* L. (3.2%), and *Vicia monantha* Retz. (3.1%). In the following season, *Beta vulgaris* continued to lead with an infection rate of 52%, succeeded by *Medicago polymorpha* L. (32.4%), *Phalaris minor* (9.6%), *Marva parviflora* L. (3.3%), and *Vicia monantha* Retz. (2.7%). In contrast, the density of these weeds exhibited variability across the years.

Table (4): Density and biomass of broad and Grassy weeds in sugar beet fields during 2021-2022 and 2022- 2023.

Scientific name	Broadleaf weeds 2021-2022						Broadleaf weeds 2022- 2023					
	Weed density			Weed biomass (g m^{-2})			Weed density			Weed biomass (g m^{-2})		
	number m^{-2}	%from total broad-leaved weeds	% from total Weeds	Average fresh weight (gm^{-2})	%from total broad-leaved weeds	% from total Weeds	Average number m^{-2}	%from total broad-leaved weeds	% from total Weeds	Average fresh weight (gm^{-2})	%from total broad-leaved weeds	% from total weeds
Malva parviflora L.	7.33	10.99	8.59	37.1	8.71	7.75	8.67	15.30	11.99	35.23	10.81	9.34
Sonchus oleraceus L.	6.67	10.00	7.82	20.87	4.90	4.36	6	10.59	8.30	20.23	6.21	5.37
Brassica nigra L.	7.67	11.50	8.99	31.3	7.35	6.54	8.67	15.30	11.99	135	41.42	35.81
Chenopodium album L.	11.33	16.99	13.28	46.97	11.03	9.81	9.67	17.06	13.37	30.27	9.29	8.03
Medicago polymorpha L.	10.33	15.49	12.10	32.73	7.69	6.84	8.67	15.30	11.99	43.03	13.20	11.41
Senecio glaucus L.	15.67	23.50	18.36	177.03	41.58	36.98	10	17.65	13.83	135	41.42	35.81
Anagallis arvensis	7.67	11.50	8.99	79.8	18.74	16.67	7.33	12.93	10.13	31.5	9.66	8.35
Total broad-leaved weeds	66.67			425.8			56.67			325.93		
Scientific name	**Grassy weeds 2021-2022**						**Grassy weeds 2022- 2023**					
	Weed density			**Weed biomass**			**Weed density**			**Weed biomass**		
	Average number m^{-2}	%from total narrow leaved weeds	% from total Weeds	Average fresh weight (gm^{-2})	%from total narrow leaved weeds	% from total weeds	Average number m^{-2}	%from total narrow leaved weeds	% from total Weeds	Average fresh weight (gm^{-2})	%from total narrow leaved weeds	% from total weeds
Avena fatua L.	7.67	41.08	8.99	29.2	55.17	6.10	7.33	46.81	10.13	27.7	54.21	7.35
Phalaris minor Retz.	11	58.92	12.89	23.73	44.83	4.96	8.33	53.19	11.52	23.4	45.79	6.21
Total grassy weeds	18.67			52.93			15.66			56.667		
Total broad and grassy weeds	85.34			478.73			72.33			377.03		

Effect of herbicides on weed biomass:

The data presented in Tables 5 and 6 indicate that all weed management strategies had a significant impact on the biomass of broad-leaved, grassy, and total weeds (both fresh and dry weight) during the growing seasons of 2021-2022 and 2022-2023. The most substantial reductions in weed biomass for broad-leaved, grassy, and total weeds were observed in plots treated with hand hoeing, achieving reductions of 91.62%, 100%, and 92.55% in the first season, and 87.96%, 100%, and 89.59% in the second season, respectively. Our results also indicated that, Betanal MaxxPro 20.9% OD and Betasana Trio 20.5 % SC significantly reduced weed biomass of broad- leaved and total weeds and gave the highest weed control efficiency were (29.53 and 69.10 gm^{-2}) and (27. 43 and 67.53gm^{-2}) for Betanal MaxxPro, while Betasana Trio gave (55.66 and102.20 gm^{-2}) and (34.4 and 78 gm^{-2}) compared with untreated check (425.8 and 478.73gm^{-2}) and (325.9 and 377 gm^{-2}) in both seasons, respectively. Giako 10.8 EC. and Flozetop Super 15% EC gave poor weed control efficiency of broad- leaved. Moreover, obtained data showed that, Giako 10.8 EC. and Flozetop Super 15% EC significantly reduced weed biomass of narrow leaved and total weeds and gave the highest weed control efficiency compared with, Betanal MaxxPro 20.9% OD and Betasana Trio 20.5 % SC, it gave the less weed control efficiency percentage of broad- leaved.

Table (5): Effect of herbicides and hand- hoeing on fresh weight (g m^{-2}) of total weeds in sugar beet field, during 2021-2022 and 2022- 2023 seasons at 60 days after treatment.

Treatments	Rate (200 L water fed^{-1})	Season 2021-2022						Season 2022- 2023					
		Total Broadleaf weeds		Total Grassy weeds		Total weeds		Total Broadleaf weeds		Total Grassy weeds		Total weeds	
		Fresh weight (gm^{-2})	% WCE	Fresh weight (g m^{-2})	% WCE	Fresh weight (gm^{-2})	% WCE	Fresh weight (gm^{-2})	% WCE	Fresh weight (g m^{-2})	% WCE	Fresh weight (gm^{-2})	% WCE
Betanal MaxxPro	650ml	29.533	93.06	39.567	25.25	69.10	85.57	27.433	91.58	40.10	21.53	67.53	82.09
Betasana Trio	900 ml	55.666	86.93	46.534	12.09	102.20	78.65	34.4	89.45	43.60	14.68	78	79.31
Giako	500 ml	318.1	25.29	5.133	90.30	323.23	32.48	296.43	9.05	4.87	90.48	301.30	20.08
Flozetop Super	1250 ml	324.433	23.81	0	100.0	324.43	32.23	281.86	13.52	0.00	100	281.86	25.24
Hand hoeing	Twice	35.667	91.62	0	100.0	35.67	92.55	39.234	87.96	0.00	100.00	39.23	89.59
Untreated		425.8	0.00	52.933	0.00	478.73	0.00	325.93	0.00	51.10	0.00	377.0	0.00
L.S.D at 5%		23.51		5.42		19.25		33.54		5.98		22.83	
L.S.D at 1%		29.21		7.98		14.65		37.10		11.65		27.65	

Table (6): Effect of herbicides and hand-hoeing on dry weight (gm^{-2}) of total weeds in sugar beet field, during 2021-2022 and 2022- 2023 seasons at 60 days after treatment.

Treatments	Rate (200L water fed^{-1})	Season 2021-2022						Season 2022- 2023					
		Total Broadleaf weeds		Total grassy weeds		Total weeds		Total Broadleaf weeds		Total grassy weeds		Total weeds	
		Dry weight (gm^{-2})	% WCE	Dry weight (g m^{-2})	% WCE	Dry weight (gm^{-2})	% WCE	Dry weight (gm^{-2})	% WCE	Dry weight (g m^{-2})	% WCE	Dry weight (gm^{-2})	% WCE
Betanal MaxxPro	650ml	10.30	91.23	8.40	25.20	18.70	85.47	6.83	89.97	8.27	20.74	63.47	80.78
Betasana Trio	900 ml	21.87	81.39	9.87	12.14	31.73	75.35	8.87	86.99	9.00	13.71	60.70	77.26
Giako	500 ml	93.25	20.64	1.33	88.13	94.58	26.53	60.57	11.10	0.97	90.73	17.03	21.68
Flozetop Super	1250 ml	95.70	18.55	0.00	100.0	95.70	25.66	60.57	11.10	0.00	100.0	18.00	22.91
Hand hoeing	Twice	6.10	94.81	0.00	100.0	6.10	95.26	5.47	91.98	0.00	100.0	73.10	93.04
Untreated		117.5	0.00	11.2	0.00	128.7	0.00	68.13	0.00	10.43	0.00	0.00	0.00
L.S.D at 5%		4.52		2.12		87		3.43		2.34		72	
L.S.D at 1%		5.76		3.11		98		4.76		4.31		21	

The data additionally showed that, in all seasons, the herbicidal efficacy of all formulations against the biomass of grassy weeds was not significantly different, with Giako 10.8 EC. and Flozetop Super 15% EC demonstrating more efficacy than other herbicide treatments.

The practice of hand hoeing resulted in a significant reduction (p=0.05) in both fresh and dry weight (gm^{-2}) of broad-leaved, grassy, and total weed populations when compared to the untreated control group. Our results indicated that different herbicide formulations exhibited diverse levels of efficacy against grassy, broad-leaved, and total weed species within the sugar beet cultivation environment. These disparities in efficacy may stem from the differing sensitivity rates of the predominant weed species, alongside the distinct modes of action of the herbicides employed. Similar findings were reported by Mousa *et al.* (2015) and Kryukova and Gresis (2021), who demonstrated that all weed management techniques significantly influenced weed populations in comparison to the untreated control. The hand hoeing technique, applied twice, proved to be the most effective strategy for weed management throughout both growing seasons, producing the greatest reduction in weed populations, especially noted in the latter season. Specifically, the implementation of hand hoeing on two occasions resulted in the most considerable decrease in biomass across all categories of weeds relative to the untreated control. Additionally, in contrast to the untreated control group during the second season, total broadleaf and grassy weed populations were reduced by 54% and 91%, respectively. The outcomes of this investigation align with the observations made by Attia *et al*. (2011), Vasel *et al.* (2012), Wujek *et al*. (2012), and Deveikte *et al.* (2015).

The data presented in Tables (5 and 6) demonstrated that weed management strategies markedly reduced the fresh and dry biomass of broadleaved, narrow-leaved, and total weed populations after a duration of 60 days in both growing seasons of 2021-2022 and 2022-2023. The untreated control exhibited the highest levels of fresh and dry weed biomass, measuring 478.73 and 377.0 gm^{-2}, respectively. These findings align with the results reported by Abou-Zied *et al.* (2017). Furthermore, Hamed *et al.* (2023) and Grzanka *et al.* (2023) identified that all formulations of BetanalMax Pro (Desmedipham 4.7% + Ethofumesate 7.5% + Lenacil 2.7% + Phenmedipham 6%), Tegrospecial (Desmedipham 20% + Phenmedipham 20%) for total annual weeds, C Factor (Haloxyfop-R-Methyl 7.5% + Fluazifop-p-putyl 15%), and Clictar (Clethodium 24%) for grassy weeds, along with mechanical weed control measures, resulted in the most significant reductions in both fresh and dry biomass across the two growing seasons. Additionally, the weed control treatments demonstrated exceptional efficacy in managing weed populations throughout both seasons. Among the treatments tested, Clethodium proved to be the most effective in diminishing both fresh and dry weed biomass when compared to the control.

Effect of weed control methods on agronomic characteristics of sugar beet:

Data presented in Tables (7 and 8) show effect of herbicidal treatments on some agronomic traits (*i.e.*, root length (cm.), root diameter (cm.) and root fresh weight yield ($tonfed^{-1}$) of sugar beet in the experimental field as well as sugar content, compared to unweeded check in the both growing 2021-2022 and 2022-2023 seasons. Obtained data demonstrated that all tested weed control treatments significantly (*p=0.05)* increased all agronomic traits intended compared to control treatment in the two studied seasons.

Data presented in Tables 7 and 8 demonstrated a significant impact of weed control treatments on the root length and diameter of sugar beets. The highest root length and diameter were observed in the plots that received the hand hoeing treatment, Betanal MaxxPro, while the lowest fresh weight $plant^{-1}$ was recorded in untreated plots. Results clearly indicated that Betanal MaxxPro and Flozetop Super gave the highest yield comparing to untreated during these studies. Betanal MaxxPro and Flozetop Super treatments increased sugar beet yield in both seasons. On the other side, hand hoeing treatment resulted in 39.50 and 38.76% ton/fed increment in both seasons, respectively, whereas the corresponding grain values with untrated control were 16.70 and 16.70 ton/fed. Similar trend was observed with sugar content in both seasons. The findings unequivocally demonstrated that the utilization of Betanal MaxxPro, manual hoeing performed twice, and Betasana-Trio were the most effective strategies for weed management and enhancing root yield per fed^{-1}. These interventions notably elevated root yield ton fed when compared to the unweeded control. However, the application of herbicide treatments did not have a discernible impact on sucrose content or other characteristics of sugar beet.

Generally, our results indicated that all herbicidal treatments significantly increased agronomic traits of sugar beet crop particularly weight of yield compared to unweeded control with a significant difference between all the tested herbicides and hand hoeing on agronomic traits.

Table (7): Effect of herbicidal treatments on some agronomic traits of sugar beet crop during 2021-2022 season

Treatments	Rate (200L water fed-1)	Root Length (cm)	Root Diameter (cm)	Root Fresh Weight Ton/fed	Sugar Content
		Mean	Mean	Mean	Mean
Betanal MaxxPro	650ml	31.37	8.07	39.30	16.33
Betasana Trio	900 ml	25.30	7.33	35.43	15.50
Giako	500 ml	24.80	7.03	32.17	14.90
Flozetop Super	1250 ml	25.80	7.20	33.07	14.67
Hand hoeing	Twice	31.37	7.27	39.50	16.90
Untreated		22.47	6.03	16.70	11.03
L.S.D at 5%		2.26	0.7	2.06	0.73
L.S.D at 1%		3.03	0.94	2.77	0,98

Table (8): Effect of herbicidal treatments on some agronomic traits of sugar beet crop during 2022-2023 season.

Treatments	Rate (200L water fed-1)	Root Length (cm)	Root Diameter (cm)	Root Fresh Weight Ton/fed	Sugar Content
		Mean	Mean	Mean	Mean
Betanal MaxxPro	650ml	31.50	8.23	39.26	16.53
Betasana Trio	900 ml	25.20	7.30	35.83	15.90
Giako	500 ml	25.60	7.73	32.23	14.6
Flozetop Super	1250 ml	26.43	7.33	33.70	14.76
Hand hoeing	Twice	33.46	7.60	38.76	16.56
Untreated		24.33	7.50	16.70	11.20
L.S.D at 5%		1.85	0.7	1.67	0.91
L.S.D at 1%		2.48	0.95	2.24	1.22

Increasing yields of sugar beet using hand hoeing or herbicidal treatments may be attributed to their effect on controlling the weeds and consequently decreasing the period of weed competition with sugar beet plants for space, light, nutrients, and water. The observed efficacy of these treatments in enhancing sugar beet yield characteristics may stem from the diminished competition posed by weeds during the early growth phases of the sugar beet plants, which is reflected in the quantity and weight of various species. Comparable findings were reported Soroka and Gadzhiev (2006), who noted that when sugar beet and weeds coexisted for 30 days' post-emergence, root yields experienced a decline of 45%. Furthermore, Attia *et al*. (2011) and Majidi *et al*. (2011) indicated that the application of herbicides could mitigate yield losses and decrease weed prevalence. Mehmeti (2004) demonstrated that the utilization of a mixture of broadleaf herbicides resulted in a reduction of weed growth while simultaneously enhancing root yield. These findings align with those documented) Wujek *et al*. (2012), Mobarak *et al*. (2012) and Abou-Zied *et al*. (2017). Dale *et al.* (2005) discovered that the quantity of white sucrose produced per unit area remained consistent across post-herbicide applications, and neither sugar nor non-sugar components were affected by the herbicide treatments. It was also noted that sugar yield metrics paralleled those of root yield, as the herbicide did not impact the quality parameters of sugar beet roots (Dale *et al.* 2006).

Residual effect of herbicides treatments on subsequent crops:

Residual effect of tested herbicides after suger beet harvesting, were determined. Results in table (9) showed that the growth of all crops tested as (wheat and corn) were affected by these herbicides except faba bean crop was not affected by these herbicides, as indicated by the growth parameters (number of plants, fresh weight g/plant and plant height (cm) of all crops 50 days after planting.

The residual impact of the herbicides tested was studied on three crops that might be sown in the same suger beet field; those crops were wheat, corn and faba bean. The effect was estimated when determine the Fresh weight g/plant of the three crops grown in soil pretreated with those herbicides under investigation. The data were recorded in table (9).

The information presented in table (9) reveals that the evaluated herbicides did not exert a significant influence on the seed germination rate of the faba bean crop. In fact, the number of plants, fresh weight per g/plant, and plant height (cm) of faba bean were not significantly impacted by any residual effects of the tested treatments in the soil. Consequently, no harmful effects stemming from residual presence were detected. Balluff *et al.* (1992) noted that in sugar beet soil, radiolabeled pyridate was swiftly decomposed. Conversely, CL 9673 exhibited a notably greater persistence, with a half-life ranging from 16 to 40 days under aerobic conditions, contingent on soil type, and an even longer persistence under anaerobic conditions. According to the Weed Science Society of America (1994) and Kidd and James (1991), fluazifop-p-butyl decomposes rapidly in moist soils into fluazifop acid, which also demonstrates low persistence. Ibrahim (1995) reported that generally, no residual effect was detected with fluazifop-p-butyl applied postemergence in groundnut at 62, 125 and 187 g a.i./fed, with the tested winter crops (wheat, barley, lentil and flax) grown in pots filled with soil from the experimental plots.

Table (9): Herbicidal residual effect estimation on seed germination of subsequent crops.

Treatments	Rate (200L water fed^{-1})	Wheat seedlings			Corn seedlings			Faba bean seedlings		
		Number of plants	Fresh weight gram/ plant	Plant height (cm)	Number of plants	Fresh weight gram/ plant	Plant height (cm)	Number of plants	Fresh weight gram/ plant	Plant height (cm)
Betanal maxxpro	650	1.00	0.16	9.66	1.00	0.90	10.00	4.00	3.98	9.85
Betasana trio	900	1.33	0.26	8.66	0.67	0.67	4.73	4.00	3.68	9.77
Giako	500	0.33	0.43	2.66	0.00	0.00	0.00	5.00	3.97	9.87
Flozetop Super	1250	1.33	0.40	5.00	0.33	0.16	1.33	5.00	4.12	9.89
Untreated		5.00	3.70	14.00	5.00	4.90	12.00	5.00	4.01	9.98
L.S.D at 5%		1.65	0.6	9.26	0.93	0.96	3.87	N.S	N.S	N.S
L.S.D at 1%		2.26	0.83	12.69	1.27	1.32	5.31	N.S	N.S	N.S

N.S = NO Significant

Kucharski and Sadowski (2009) discovered that the application of phenmedipham mixtures with oil adjuvants to soil resulted in a deceleration of pesticide degradation. Damalas and Eleftherohorinos (2011) indicated that the presence of herbicide residues in agricultural products is unavoidable, even when applied according to manufacturer guidelines; this circumstance has consequently garnered attention from stakeholders within the sweet potato value chain due to its potential risks to human health and environmental safety. Pesticide residue in food (2019) established the following residue definitions: the total fluazifop residues in blackberry were observed (n = 3): < 0.020 (3) mg/kg. The total fluazifop residues in raspberry were documented (n = 2): < 0.020, 0.05 mg/kg. The total fluazifop residues in strawberry were recorded (n = 6): 0.27, 0.37, 0.60, 0.70, 1.1, and 1.4 mg/kg.

Conclusion

In this study, when compared to the control, the greatest reduction in weed biomass was achieved by hand hoeing twice (21 and 35), using equipment, all herbicides in both seasons. Some agronomic traits of sugar beet crop, all rose with all weed control treatments, according to the results. In addition, sugar degree (sugar content) were compared to the unweeded control.

REFERENCES

Abou-Zied, K.A., Abd El-All, A.E., Osman, A.M. (2017). Response of sugar beet yield and water use efficiency to deficit irrigation and weed competition under drip irrigation system. J. of Plant Production, Mansoura Univ., 8 (12): 1295–1302. Available at, http: Library.mans. edu.eg / eulc _v5/ Libraries/start. Herbol 5(1):85–94.

Anonymous. (2022) https:// www. turks eker. gov. tr/ data/ dokum anlar/ 2021_ Sektor_ Raporu. pdf. Accessed Dec 31, 2022.

Attia, A.N., Said, E.M., Seadh, S.E., El-Maghraby, Samia S., Ibrahim, M.E.M. (2011) Effect of sowing methods and weed control treatments on growth of sugar beet and weed characters under nitrogen fertilizer levels. J. of Plant Production, Mansoura Univ., 2 (6): 773 - 785.

Balluff, M., Muench, E., Mueller, F., Hurle, K. (1992). Investigations on the fate of pyridate in plants and soil. *Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz (Germany, FR)*, (13).

Bezhin, K.H., Santel, J., Gerhards, R. (2015). Evaluation of two chemical weed control systems in sugar beet in Germany and the Russian Federation. Plant Soil Environ, 61(11): 489–495, https:// doi. org/ 10. 17221/ 482/ 2015- PSE.

Dale, T. M., McGrath, J.M., Renner, K.A. (2005). Response of sugar beet varieties and populations to post emergence herbicides. J. of Sugar Beet Res., 42:119–126.

Damalas, C.A., Eleftherohorinos, I.G. (2011). pesticide exposure, safety issues, and risk assessment indicators. International Journal of Environmental Research and Public Health, 8(5), 1402–1419. https:// doi.org/ 10.3390/ ijerph8051402Darko.

Deveikte, I., Seibutis, V., Feiza, V., Feiziene, D. (2015). Control of annual broadleaf weeds by combinations of herbicides in sugar beet. Zemdirbyste-Agriculture, 102(2):147–152. https ://doi.org/10.13080 /z-a.2015.102.019.

Gerhards, R., Weber, J.F., Kunz, C. (2020). Evaluation of weed control efficacy and yield response of inter-row and intra-row hoeing technologies in maize, sugar beet and soybean. *Landtechnik*, *75*(4), 247-260.

Gomez, K.N., Gomez, A.A. (1984). Statistical procedures for Agric. Res. J. of Wiley and Sonc, Inc, New York 2nd. Ed68p.

Gouda, N.A. (2019). Efficacy of some Herbicides and Agricultural Practices on the Productivity of Sugar Beet (*Beta vulgaris* L.). J. of Plant Prot. and Path., Mansoura Univ.,10 (5): 245 - 250.

Grzanka, M., Sobiech, Ł., Idziak, R., Filipczak, A., Skrzypczak, G. (2023). Impact of chemical weed management in sugar beet (*Beta vulgaris*) on productivity, quality and economics. Journal of Plant Protection Research, 63(4): 459–467.

Hamed, L.M., Absy, R., Elmenofy, W., Emara, E.I. (2023). Enhancing Sugar Beet (*Beta vulgaris* L.) Yield and Quality: Evaluating the Efficiency of Chemical and Mechanical Weed Control Strategies. *Agronomy*, *13*(12), 2951. https://doi.org/10.3390/agronomy13122951

Hassanein, E.E., Ibrahim, H.M., Kholosy, A.S., Al-Marsafy, H.T., Abo-Elenin, R. A. (2000). Manual of weed identification and control in wheat. ARC. *Field Crop Research Institute. Weed Control Research Section in collaboration with the European Union/the International Center for Agricultural Research in The Dry Areas (ICARDA).*

Ibrahim, M.F.A. (1995). Effect of some herbicides on groundnut in newly reclaimed soils. M. Sc. Thesis, Fac. of Agric. Al-Azhar University.

Kidd, H., James, D.R. (1991). The Agrochemicals Handbook, Third Edition. Royal Society of Chemistry Information Services, Cambridge, UK, (as updated).7-7.

Kobusch, H. (2003). Unkrautbekämpfung in Zuckerrüben-Ermittlung der Kritischen Periode. [Ph.D. thesis]. Hohenheim, Universität Hohenheim.

Kryukova, K.D., Gresis, V.O. (2021). Differences in biological efficiency of one-and two-component graminicide on sugar beet crops in Tula region. RUDN Journal of Agronomy and Animal Industries. DOI 10.22363/2312-797X-2021-16-2-129-136.

Kucharski, M., Sadowski, J. (2009). Influence of adjuvants on behavior of phenmedipham in plant and soil. Polish Journal of Agronomy, 1: 32-36.

Kucharski, M., Sadowski, J., Domaradzki, K. (2012). Degradation rate of chloridazon in soil as influenced by adjuvants. Journal of Plant Protection Research, 52 (1): 114-118.

Kunz, C., Weber, J., Gerhards1, R. (2015). Benefits of Precision Farming Technologies for Mechanical Weed Control in Soybean and Sugar Beet - Comparison of Precision Hoeing with Conventional Mechanical Weed Control. *Agronomy* (2015), 5 (2), 130-142.

Mahmoud, S.M., Soliman, F.S. (2012). Chemical weed control in sugar Beet. Alexandria Science Exchange Journal, 33(October-December), 341-350.

Maier, K., Baron, O., Bruhns, J. (2012). Zuckerwirtschaft Europa. 58. Auflage. Bartens, Berlin.

Majidi, M., Heidari, G., Mohammadi, K. (2011). Management of broad- leaved weeds by combination of herbicides in sugar beet production. Adv. Environ. Biol., 5(10):3302–3306.

May, M.J. (2003). Economic consequences for UK farmers of growing GM herbicide tolerant sugar beet. Ann. appl. Biol., 142:41-48.

McGinnus, R.A. (1971). Sugar beet technology 2nd ed. Sugar beet Development Foundation, Fort., Color, USA.

Mehmeti, A. (2004). Three-year average effects of herbicides on weeds in potato and the yield of the crop." (2004): 85-94.

Mesbah, A. (1993). Interference of broadleaf and grassy weeds in sugar beet. [Ph.D. Thesis.] University of Wyoming, USA

Mobarak, O.M., Galal, A.H., Mekky, M.S., Motagally, F.M. (2012). Various methods for determining the critical period of weed infestation to sugar beet. The 4th field crops conference “Field crops facing future challenges.” Egyptian J. of Agric. Res., 90(4):515–530.

Mousa, R.A., Tagour, R.M.H., Fakar, A.A.O. (2015). Efficacy of irrigation intervals and some weed control treatments on weeds and sugar beet (*Beta vulgaris* L.) productivity. *Alex. J. of Agric. Res.*, *60*(3), 253-268.

Pesticide residue in food (2019) Fluazifop-P-butyl (283) residue and analytical aspects (179 – 182).

Reinefeld, E., Emmerich, A., Baumgarten, G., Winner, V., Beiss, U. (1974). ZurVoraussage des Melassezukersaus Rübenanalysen. Zuker, 27:2-15.

Soroka, S.V., Gadzhieva, G.J. (2006). State of weed infestation and features of sugar beet protection in Belarus. Proc. Nat. Sci., 110:165–172. https ://doi. org/10.2298/ ZMSPN 06101 65S

Vasel, E.H., Ladewig, E., Marlander, B. (2012). weed composition and herbicide use strategies in sugar beet cultivation in Germany. J. of Kulturpflanzen 64(4):112–125. https ://doi.org/10.5073/JfK.2012.04.02

Vasileiadis, V.P., Froud-Williams, R.J., Eleftherohorinos, I.G. (2007). Vertical distribution, size and composition of the weed seedbank under various tillage and herbicide treatments in a sequence of industrial crops. European Weed Res. Soc., 47: 222–230.

Weed Science Society of America, Herbicide Handbook Committee (1994). Herbicide handbook of the weed science society of America, 7th Edition. Champaign, IL,7-6.

Wujek, B., Kucharski, M., Domaradzki, K. (2012) Weed control programs in sugar beet (*Beta vulgaris* L.): influence on herbicidal residue and yield quality. J. of Food Agric. Enviro., 10(3 & 4):606–609.

Zaki, M.A. (2000). Identification and control of important weeds in Egypt. *Al-Ahram Commercial Press, Kalyoub, Egypt*, 266.