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Effect of some weed control treatments on productivity and quality of some sugar beet varieties (*Beta vulgaris* L.)

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Abstract

Two field experiments were carried out at El-Serw Agricultural Research Station, (latitude of 31.25° N and longitude of 33.49°E), Damietta governorate, Egypt in 2020/2021 and 2021/2022 growing winter seasons. A Randomized Complete Blocks Design (RCBD) arrangement split-plot with three replications was using. Were three sugar beet varieties (Gloria, Laila and Keliopatra) which were randomly in the main plots, while six different herbicides treatments were located in sub-plots randomly (Goltix plus 50% SC at the rate of 1.5 L /feddan (feddan = 4200 m^2 = 0.420 hectares = 1.037 acres) after 30 days from sowing, Goltix 70% SC at the rate of 2.0 L /feddan pre- sowing, Tegro 27.4% EC at rate 1.0 L /feddan after 30 days from sowing, Giako 10.8% EC at rate 450 cm^3 /feddan after 30 days from sowing, hand hoeing thrice at were carried out at three at different times 15, 30 and 45 days after sowing and unweeded treatment "control"). The results showed that sugar beet varieties differed significantly in all studied traits. Laila variety was superior in root length, diameter, number of leaf /plant and (root, top fresh weight and sugar yields /feddan) as well as quality parameters in both seasons compared with other varieties. Gloria and Laila varieties decreased dry at three at different times weight grassy, broad-leaved and total weeds in both seasons. Hand hoeing thrice, Goltix and Goltix plus were give the highest decreased in (dry weight of grassy, broad-leaved and total weeds) and increase in (root fresh weight/plant, foliage fresh weight/plant and No. leaves/plant, top fresh weight, root yield and sugar yield /feddan) as well as quality parameters compared with unweeded treatment in both seasons. Under conditions of the present study, planting Gloria variety of sugar beet, with Hand hoeing thrice and/or using Tegro 27.4% EC herbicide at rate 1.0 L /feddan after 30 days from sowing can tribute to achieving significantly higher roots and sugar yields compared with unweeded treatment (control).

Keywords: varieties, herbicides, weed control, sugar beet, quality.

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1. Introduction

Sugar beet is important crop not only in Egypt but also in many different countries of the world production of sugar was dependent mainly on sugarcane from long time ago. Approximately 50% of the world's sugar production comes from sugar beet. After introducing sugar beet in Egypt and its success as the second source of sugar production as well its more adaptability to our environmental factors, it became the second source for sugar industry. In the world, this value currently amounts to about 4.3 million hectares (FAO, 2023). From a frame mentioned data the local production of sugar is not sufficient to supply the manual demand of increasing population. This resulted in a production-consumption gap of approximately 350,000 to 400,000 tons of sugar in 2022, according to the Sugar Crops Council's annual report for that year. This shortfall necessitated annual imports to meet domestic demand. The needs of local markets. Therefore, increasing sugar beet production is a crucial step towards reducing the production-consumption gap and achieving self-sufficiency. Research has shown that there are significant differences in growth, yield, and mineral content between different sugar beet varieties grown under Egyptian conditions. Al-Sayed and Attaya (2015) found that sugar beet varieties were significantly differed in length, root diameter as well as root and sugar yields /feddan. Salem (2019) revealed that Gloria variety significantly surpassed the other two varieties in root length, root diameter, root fresh weight, root yield (ton /feddan) and recoverable sugar yields. Yasser and Alaa (2021) indicated that sugar beet varieties differed significantly on all studied traits in the two seasons. Post herbicides in sugar beet are effective only when applied to weeds less than 2 cm in height, and repeated applications are usually needed because weeds continue to emerge until the end age of crops. Cioni and Maines (2011) showed that the herbicides Betasana-Trio at 0.9 L /feddan, Tigro at 1.0 L /feddan and Betasana-Trio at 0.675 L /feddan when sprayed twice could effectively and/or completely eliminate the broadleaved weeds associated with sugar beet plants. Moreover, the results indicated and conformed that Tigro and Betasana-Trio herbicides are effective in controlling broadleaved weeds. Tagour *et al*. (2012) found that hand hoeing twice with mulching gave the highest values of tops, roots, biological and sugar yields. Seadh *et al*. (2013) evaluated four weed control treatments on sugar beet using (one hoeing, Goltix 70 WG, Goltix + one hoeing and two hoeing), showed that controlling weeds by two hand hoeing significantly recorded the highest values of root, top, purity percentage and sugar yields and its components per feddan in both seasons however, the highest percentages of TSS, purity and sucrose in beet juice were achieved from controlling weed by one hand hoeing over weedy check. Al-Sayed and Attaya (2015) showed that using Goltex herbicide as a weed control recorded the best values of length, diameter root and quality characters as well as root and sugar yields respectively comparing with hand hoeing. Nowar (2016) indicated that using two hand-hoeing at 4 and 7 weeks after planting resulted in a significant increase

of root yield and its components and gross sugar yield in comparison with other weed control treatments. Majidi *et al*. (2017) reported that several herbicides are registered for selective weed control in sugar beet; however, no single chemical herbicide can control all weeds in beet fields. Gerhards *et al*. (2017) stated that weeds might decrease yields by about 1.5% Day^{-1} for the following 6 weeks when the sugar beet crop at the 4 to 6-leaf phase and therefore, weed removal from sugar beet crops is essential until the 8-leaf stage. Particularly effective weed control is required up to the first 60 days after emergence which is the critical period of sugar beet. Milan *et al*. (2020) stated that all tested beet varieties could be distinguished from weed beets according to beta cyanins, betaxanthins or total beta lain content. Abd El Lateef *et al*. (2021) found that Tigro at 1.0 L /feddan gave the highest values of root and biological yield ton /feddan. Hand weeding twice resulted in the greatest sugar yield /feddan. The highest sugar yield resulted from the herbicidal treatment with Tigro at 1.0 L /feddan, which gave the greatest gross and extract able sugar yield. The objective of this work was to find out the most effective combination among the tested weed control treatments to avoid the negative impact of weeds accompanying sugar beet to get the highest root and sugar yields /feddan.

2. Materials and methods

Field experiments were conducted at El-Serw Agricultural Research Station (31.25° N, 33.49° E), Damietta Governorate, Egypt during the 2020/2021 and 2021/2022 growing seasons. The objective was to identify the best combinations of sugar beet varieties and weed control treatments for optimal productivity. The physical and chemical properties of the soil samples, taken before planting sugar beet in both seasons, are presented in Table (1). A split-plot design with three replications was employed. The main plots consisted of three sugar beet varieties (Gloria, Lilia, and Keliopatra), while the sub-plots included various herbicide treatments. The herbicide treatments were as follows, as detailed in Table (2):

1. Goltix plus 50% SC at a rate of 1.5 L/feddan
2. Goltix 70% SC at a rate of 2 L/feddan
3. Tegro 27.4% SC at a rate of 1 L/feddan
4. Giko 10.8% SC at a rate of 450 cm^3 /feddan
5. Hand hoeing for three times
6. Unweeded treatment (Control)

The sub-plot area was 21 m^2 (3 m × 7 m). Sowing took place in the first week of November 2020 for the 2020/2021 season and in the second week of November 2021 for the 2021/2022 season. Harvesting was done at 210 days in both seasons. Standard agricultural practices for sugar beet cultivation in the region, as recommended by the Sugar Crops Research Institute, were followed. Weed surveys were conducted using one square meter quadrats. Weeds were separated, identified by species, and classified according to Tackholm (1974).

Table (1): Physical and chemical properties of the soil samples before planting sugar beet in 2020/2021 and 2021/2022 seasons.

Season	Depth (cm)	Particle size distribution				Texture class	O.M. (%)	$CaCo_3$ (%)	Available			Bulk density (g/ cm^3)	Total porosity (%)	W.S.A. (%)
		Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)				N ppm	P ppm	K ppm			
First	0 - 30	1.92	13.50	21.74	62.85	clayey	0.97	2.63	40.5	8.55	5.39	1.25	52.62	46.24
Second	0 - 30	7.09	14.07	22.57	61.28	clayey	1.0	2.64	40.5	8.51	5.35	1.26	52.91	45.50

Table (2): Tread, common, chemical name and chemical family as well as mode of action, rate and time of application in 2020/2021 and 2021/2022 seasons.

Tread name	Common name	Chemical name	Chemical family	Mode of action	Rate of application	Time of application
Goltix plus 50% SC	Metamitron 35% & Ethofumesate 15%	4-amino-3-methyl-6-phenyl-1,2,4-triazin-5(41H)-one 35% & (I)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate 15%	Triazinone & Benzofuran	Inhibition of photosynthesis at photosystem II & Inhibition of lipid synthesis	1.5 L /feddan	after 30 days from sowing
Goltix 70% SC	Metamitron 70%	4-amino-3-methyl-6-phenyl-1,2,4-triazin-5(41H)-one 70%	Triazinone	Inhibition of photosynthesis at photosystem II	2.0 L /feddan	pre- sowing
Tegro 27.4% SC	Phenmedipham 9.1% + Desmedipham 5% + Ethofumesate 20%]	α-[2-(4-chloro phenyl)ethyl]- α-(1,1-dimethyethyl)-l H-1,2,4-triazole-1-ethanol	Benzofuran & Triazinone & Phenyl-carbamate	Inhibition of lipid synthesis & Inhibition of photosynthesis at photosystem II & inhibition of mitosis division	1.0 L /feddan	after 30 days from sowing
Giko 10.8% SC	Haloxyfop-R-Methyl	2-[4-[3-chloro-5[tri fluoro methyl]pyridine-2-yl]oxyphenoxy] propanoic acid	Aryloxyphenoxy propionate	Inhibition synthesis &inducing oxidative strees	450 cm^3 /feddan	after 30 days from sowing
Hand hoeing	-	-	-	-	three times	15, 30 and 45 days after sowing
Unweeded treatment (Control)	-	-	-	-	-	-

2.1 Data recorded

2.1.1 Weed traits

Weeds in one m^2 of each sub-plot were pulled out after 120 days after sowing initiation, separated into broad and grassy-leaved weeds and dried for seven days in the oven at 70 °C for 72 hours to a constant weight to record the following items:

1. Dry weight of broad leaf weeds /m^2 (g).
2. Dry weight of grassy weeds /m^2 (g).
3. Total dray weeds /m^2 (g /m^2).

2.1.2 Root yield attributes

At harvest in both seasons, five guarded plants from each sub-sub plots were randomly chosen from the two inner ridges and harvested to determine the following traits:

1- Root length (cm).
2- Root diameter (cm).
3- Root fresh weight/plant (g).
4- Foliage fresh weight/plant (g).
5- Number leaves/plant.

2.1.3 Root yield (ton/feddan)

The three guarded rows of each sub-sub plots were harvested topped, cleaned and weighted in kg, then it was converted to estimate:

1- Top yield (ton/feddan).
2- Root yield (ton/feddan).
3- Sugar yield (ton/feddan).

2.1.4 Quality parameters

All percentages as gross sugar, potassium (K), sodium (Na) and α-amino nitrogen were determined in Belqas sugar factory, Egypt:

1. Sucrose percentage was estimated using "Saccharometer" according to the method described in A.O.A.C. (2005).
2. Extracted sugar percentage (ES%) was calculated using the following equation of Dexter *et al*. (1967): ES% = Sucrose % – SLM % – 0.6.
3. Sugar lost to molasses % (SLM) was calculated according to the equation of Deviller (1988) as follows: SLM = 0.14 (Na + K) + 0.25 (α–amino N) + 0.5.
4. Quality index (QI) was calculated according to Cooke and Scott (1993) equation: QI = (extracted sugar % × 100) / sucrose %.
5. Potassium "K", sodium "Na" and alpha amino nitrogen concentrations (meq/100 g beet) in roots were estimated as shown by Cooke and Scott (1993).

2.2 Statistical analysis

All data were subjected to the statistical analyses according to the technique of analysis of variance (ANOVA) for the treatments' means were presented comparison between means of all traits studied method as mentioned by Steel and Torrie (1980) for comparison between means, L.S.D. at 5% level of probability was used.

3. Results and Discussion

The weed species present in this study during both seasons were primarily annual broad-leaved weeds: *Melilotus indica* L. (sour clover), *Chenopodium album* L. (white goosefoot or lambsquarters), and *Rumex dentatus* L. (dentated dock). Their fresh weight infestation was estimated at 11.0 and 11.5 tons per feddan in the first and second seasons, respectively. Additionally, some annual grassy weeds were observed, though with very low infestation: *Polypogon monspeliensis* L. Desf. (annual beard grass) and *Phalaris minor* Retz. (canary grass).

3.1 Effect of varieties on

3.1.1 Dry weight of weeds(g/m^2)

Upon analyzing the data in Table (3), we notice that the dry weight of grassy, broad-leaved weeds and total annual weeds (g/m^2) differed significantly with the varieties used in the experiment. Planting Gloria and Laila of sugar beet varieties decreased dry weight grassy, broad-leaved and total weeds by (10.44 and 31.82%), (5.61 and 19.85%) and (7.63 and 24.26%) compared to that planted with Keliopatra variety, respectively, in the 1st one, corresponding to (14.56 and 99.25%), (0.71 and 45.35) and (4.82 and

59.34%), in the 2nd one. These results agreed with the results of Al-Sayed *et al*. (2015), Salem (2019), and Yasser and Alaa (2021).

Table (3): Grassy, broad-leaved and total weeds (g/m^2) as affected by sugar beet varieties in 2020/2021 and 2021/2022 seasons.

Sugar beet varieties	Dry weight of weeds(g/m^2)					
	Grassy weeds		Broad-leaved weeds		Total weeds	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	113.42	96.96	185.79	229.54	299.21	326.5
Laila	95.46	55.75	163.71	159.04	259.17	214.79
Keliopatra	125.83	111.08	196.21	231.17	322.04	342.25
LSD at 0.05	18.56	11.07	11.78	14.57	5.11	17.88

3.1.2 Growth attributes

Data in Table (4) illustrate that the tested sugar beet varieties varied significantly on growth characteristic of beet plants *i.e*., root length, diameter, and number leaves /plant in both seasons, however, root fresh weight (g) was significantly affects in the 1st season only. Laila variety of beet gave height values in root length and diameter compared to Gloria and Keliopatra variety in both seasons. The superiority of specific sugar beet varieties in particular of traits under specific agricultural conditions could be attributed to its genetic make-up which enables it to respond differently to the changed environmental conditions. These results agreed with the results of Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021).

Table (4): Length, diameter, root fresh weight/plant (g), foliage fresh weight/plant (g) and number leaves/plant as affected by sugar beet varieties in 2020/2021 and 2021/2022 seasons.

Sugar beet varieties	Root length (cm)		Root diameter (cm)		Root fresh weight /plant (g)		Foliage fresh weight /plant (g)		Number leaves /plant	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	23.10	22.90	8.40	8.66	768.82	717.46	144.85	204.83	25.55	27.33
Laila	25.86	25.78	9.35	8.72	880.23	644.17	146.36	126.50	26.48	26.40
Keliopatra	23.19	22.91	8.86	8.22	630.74	543.35	139.79	148.99	23.08	22.92
LSD at 0.05	1.72	2.20	0.53	0.20	15.02	NS	NS	NS	1.34	1.37

3.1.3 Yields (ton/feddan)

Results in Table (5) demonstrate that the evaluated varieties of sugar beet significantly differed in top, root and sugar yields /feddan in both seasons. Laila variety surpassed significantly by (0.499 and 1.234 tons /feddan), (1.549 and 2.743 tons /feddan) and (0.489 and 0.843 tons/feddan) in top, root and sugar yields /feddan, respectively over the other tested varieties Gloria and Keliopatra, in the 1st one, corresponding to (0.773 and 1.039 tons /feddan), (1.706 and 2.483 tons /feddan) and (0.645 and 0.679 tons /feddan) in top, root and sugar yields/feddan, in the 2nd season. These observations assured that the final output

of the tested varieties was affected by their gene make-up in addition to the surrounded environment. The obtained results are in coincidence with those obtained by Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021).

Table (5): Top yield, root yield and sugar yields (tons/feddan) as affected by sugar beet varieties in 2020/2021 and 2021/2022 seasons.

Sugar beet varieties	Top yield ton/feddan		Root yield ton/feddan		Sugar yield ton/feddan	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	5.308	4.280	22.716	21.850	2.524	2.409
Laila	5.807	5.054	24.265	23.556	3.013	3.054
Keliopatra	4.573	4.015	21.522	21.073	2.179	2.375
LSD at 0.05	0.216	0.231	0.272	0.478	0.164	0.205

3.1.4 Quality parameter and impurities of juice (meq/100 g beet)

Data in Tables (6 and 7) indicate that the examined sugar beet varieties differed significantly in quality traits in both seasons. The results illustrated the marked superiority of Laila beet over ones in all quality parameters determined. Keliopatra variety recorded the lowed mean value of these traits. The superiority of specific sugar beet varieties in particular of traits under specific agricultural conditions could be attributed its genetic make-up. These findings are in agree mat with those reported by Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021).

Table (6): Sucrose, ES, SLM and quality index as affected by sugar beet varieties in 2020/2021 and 2021/2022 seasons.

Sugar beet varieties	Sucrose (%)		ES (%)		SLM		Quality index	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	14.17	14.18	10.88	10.78	2.68	2.71	76.70	77.95
Laila	15.50	16.04	12.21	12.66	2.69	2.79	78.72	78.76
Keliopatra	12.96	14.08	9.74	10.69	2.44	2.51	76.45	76.47
LSD at 0.05	0.76	0.88	0.74	0.88	0.07	0.08	1.23	1.39

Table (7): Impurities of juice “K, Na and α-amino N %” (meq/100 g beet) as affected by sugar beet varieties in 2020/2021 and 2021/2022 seasons.

Sugar beet varieties	Impurities of juice (meq/100 g beet)					
	K		Na		α-amino N	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	5.65	5.50	2.47	2.73	4.16	4.24
Laila	5.75	5.48	2.94	3.16	4.22	4.38
Keliopatra	5.20	5.40	2.29	2.40	3.24	3.62
LSD at 0.05	0.32	0.09	0.09	0.10	0.17	0.26

3.2 Effect of weed control treatments

3.2.1 Dry weight of weeds (g/m^2)

The effect of weed control treatments on dry weight (g/m^2) of grassy, broad-leaved and total weeds growth with sugar beet plants at 120 days after sowing (DAS) are presented in Table (8). The results indicated clearly weed management caused a significant effect on dry weight (g/m^2) of which associated with sugar beet plants. The results manifested that controlling weeds using herbicides and hoeing affected significantly on the dray weight of grassy leaved, broad-leaved weeds and total weeds in both seasons. Practicing hand hoeing thrice resulted in the lowest values previously mentioned weed traits, followed by the use of herbicides Goltix 70% SC and Goltix plus 50% SC. without significant variance mostly between hand hoeing thrice with Goltix 70% SC herbicide, concerning the dry weight of grassy-leaved weeds, in both seasons. These results showed the effectiveness of hand hoeing in eliminating both broad and total weeds. The highest values of weed traits were recorded in the un-weeded plots. These results are in agreement with that mentioned by Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021).

Table (8): Dry weight of weeds (g/m^2) as affected by weed control treatments at 120 (DAS) in 2020/2021 and 2021/2022 seasons.

Treatments	Dry weight of weeds(g/m^2)					
	Grassy weeds		Broad-leaved weeds		Total weeds	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Goltix plus 50% SC	62.67	47.75	168.75	164.50	251.42	212.25
Goltix70% SC	29.08	27.92	124.42	122.58	165.83	150.50
Tegro 27.4% EC	109.58	92.08	118.83	172.17	242.25	264.25
Giko 10.8% EC	138.50	99.25	177.75	189.92	319.58	289.17
Hand hoeing thrice	20.67	23.08	40.33	54.58	76.25	77.66
Unweeded treatment	308.92	237.50	461.33	535.75	646.83	773.25
LSD at 0.05	16.48	19.61	24.37	27.51	29.67	41.10

3.2.2 Growth parameters

The results pointed that growth parameters *i.e*., root length diameter root fresh weight /plant (g), foliage fresh weight and number leaves /plant was significantly affected by the used weed control treatments in both seasons (Table 9). The highest values of growth parameters were obtained by practicing hand hoeing thrice and spraying herbicides Goltix and/or Goltix plus to get rid of the associated weeds with sugar beet compared with the other herbicides and un-weeded treatment in both seasons. Probably due to the reduction in weed population, growth and hence their competition with beet plants on the growth factors as solar radiation, water and nutrients. On the contrary, the lowest values of sugar beet traits were recorded in the un-weeded plots due to the severe competition of weeds with sugar

beet plants. These results are in agreement with those found by Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021). Tegro and Giko herbicides gave the lowest averages root fresh weight /plant, foliage fresh weight /plant and number of leaves /plants compared to untreated check in both seasons.

Table (9): Root length, diameter, root fresh weight/plant (g), foliage fresh weight/plant (g) and number leaves/plant as affected by weed control treatments in 2020/2021 and 2021/2022 seasons.

Treatments	Root length (cm)		Root diameter (cm)		Root fresh weight/plant (g)		Foliage fresh weight/plant (g)		Number of leaves /plants	
	20/2021 season	21/2022 season	20/2021 season	21/2022 season	20/2021 season	21/2022 season	20/2021 season	21/2022 season	20/2021 season	21/2022 season
Goltix plus 50% SC	25.88	24.35	9.39	8.73	892.13	696.83	163.98	148.87	27.45	26.37
Goltix70% SC	26.78	24.68	9.58	9.08	912.75	764.68	175.44	159.70	24.88	26.34
Tegro 27.4% EC	23.40	24.00	8.88	8.68	862.35	663.83	144.75	137.22	25.53	26.48
Giko 10.8% EC	21.80	23.98	8.73	8.17	632.27	420.11	129.25	142.67	25.93	24.48
Hand hoeing thrice	26.95	24.90	9.95	9.31	913.60	796.27	189.08	310.73	27.70	28.45
Unweeded treatment	20.88	21.27	6.68	6.48	345.05	345.05	98.89	74.12	18.72	21.12
LSD at 0.05	2.27	0.25	0.61	0.62	93.22	72.92	27.65	12.25	2.38	2.23

3.2.3 Sugar beet yields

The results in Table (10) pointed to a significant response of top, root and sugar yields /feddan due to the applied weed control treatments (herbicides and hoeing) in both seasons. Using hand hoeing thrice to eradicate weeds resulted in increases in top, root and sugar yields /feddan amounted to 2.78, 12.68 and 2.10 tons /feddan from top, root and sugar yields respectively compared with unweeding in the 1st one, corresponding to 2.23, 13.96 and 2.27 tons /feddan from top, root and sugar yields respectively in the 2nd season. These results manifested the importance of hand hoeing as an effective means in getting rid of weeds completion with sugar beet plants. These results were in agreement with the results of Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021). Tegro and Giko gave herbicides gave the lowest averages top yield (ton /feddan), root yield (ton /feddan) and sugar yield /feddan compared to untreated check in both seasons.

Table (10): Top, root and sugar yields (tons/feddan) as affected by weed control treatments in 2020/2021 and 2021/2022 seasons.

Treatments	Top yield (ton/feddan)		Root yield (ton/feddan)		Sugar yield(ton/feddan)	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Goltix plus 50% SC	5.77	4.81	24.47	24.12	2.93	2.80
Goltix70% SC	6.13	5.16	25.55	25.76	3.16	3.1
Tegro 27.4% EC	4.89	4.39	24.44	23.17	2.74	2.68
Giko 10.8% EC	4.98	4.29	23.32	23.90	2.71	2.8
Hand hoeing thrice	6.35	5.29	25.96	25.98	3.24	3.27
Unweeded treatment	3.57	3.06	13.28	12.02	1.14	1.0
LSD at 0.05	0.31	0.44	0.69	0.83	0.23	0.20

3.2.4 Quality traits

The results in Tables (11 and 12) revealed that the applied weeds herbicides and hoeing treatments had significant effects in quality traits in both seasons, except quality index. It was found that practicing hand hoeing thrice was the most effective treatment in eradicating weeds accompanied to sugar beet, which resulted in getting the highest values of the three traits. These results can be attributed to better growth conditions free of weed competition with beet plants, which was positively reflected on more photosynthesis and sugar accumulation in roots. On the contrary, the lowest values of the studied quality traits were recorded by beet plants suffered from being grown among severe competition with weeds left to grow without any control. These findings are in agree mat with those reported by Safina and Fatah (2011), Al-Sayed *et al*. (2015), and Yasser and Alaa (2021).

Table (11): Sucrose, ES, SLM and quality index as affected by weed control treatments in 2020/2021 and 2021/2022 seasons.

Treatments	Sucrose (%)		ES (%)		SLM (%)		Quality index (%)	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022season
Goltix plus 50% SC	14.42	14.75	11.22	11.44	2.60	2.71	77.66	77.38
Goltix70% SC	14.00	14.67	10.74	11.31	2.66	2.74	76.43	77.13
Tegro 27.4% EC	15.58	15.75	12.16	12.25	2.83	2.90	77.84	77.59
Giko 10.8% EC	14.50	15.25	11.15	11.90	2.75	2.78	76.62	77.80
Hand hoeing thrice	15.83	16.67	12.26	13.06	3.02	3.00	77.01	78.24
Unweeded treatment	10.92	11.33	8.55	8.88	1.77	1.86	78.18	78.21
LSD at 0.05	0.98	1.14	0.97	1.02	0.13	0.23	NS	NS

Table (12): Impurities of juice "K, Na and α-amino N %" (meq/100 g beet) as affected by weed control treatments in 2020/2021 and 2021/2022 seasons.

Treatments	K		Na		α-amino N	
	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Goltix plus 50% SC	5.60	5.93	2.55	2.65	3.85	4.07
Goltix70% SC	5.47	5.76	2.71	2.85	4.09	4.20
Tegro 27.4% EC	5.67	5.81	2.93	3.07	4.51	4.67
Giko 10.8% EC	6.01	5.64	2.47	2.64	4.28	4.40
Hand hoeing thrice	6.46	5.74	3.23	3.39	4.50	4.94
Unweeded treatment	3.99	3.90	1.48	1.98	2.02	2.17
LSD at 0.05	0.71	1.02	0.16	0.34	0.35	0.39

3.3 Effect of interaction between sugar beet varieties and weed control treatments on

3.3.1 Dry weight of weeds (g/m^2)

Results in Table (13) show that the interaction between varieties × weed control treatments was had a significant effect on dry weight of weeds /m^2 in both seasons. Using any of the three types, with using manual hoeing three times, resulted in a significant decrease in the dry weight of weeds in both seasons.

Table (13): Significant interaction effect between beet varieties and weed control treatments on dry weight of weeds (g/m^2) in 2020/2021 and 2021/2022 seasons.

Treatments		Dry weight of weeds(g/m^2)					
		Grassy weeds		Broad-leaved weeds		Total weeds	
		2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Interactions (A × B)							
Gloria	Goltix plus 50% SC	74.50	67.25	152.75	134.75	227.25	202.00
	Goltix70% SC	35.50	33.50	122.25	179.00	157.75	212.5
	Tegro 27.4% EC	88.75	86.25	179.75	227.25	268.5	313.5
	Giko 10.8% EC	158.00	154.25	165.25	266.00	323.25	420.25
	Hand hoeing thrice	16.50	20.75	39.75	44.25	56.25	65.00
	Unweeded treatment	307.25	219.75	487.50	535.75	794.75	755.5
Laila	Goltix plus 50% SC	41.25	19.50	144.50	80.25	185.75	99.75
	Goltix70% SC	29.00	18.25	78.25	99.00	107.25	117.25
	Tegro 27.4% EC	86.50	63.25	85.25	122.75	171.75	186.00
	Giko 10.8% EC	120.00	22.00	197.75	184.75	317.75	206.75
	Hand hoeing thrice	19.25	19.00	33.75	45.25	53.00	64.25
	Unweeded treatment	276.75	192.50	442.75	422.25	719.5	614.75
Keliopatra	Goltix plus 50% SC	72.25	57.75	140.25	152.75	212.5	210.5
	Goltix70% SC	32.50	30.75	142.25	119.00	174.75	149.75
	Tegro 27.4% EC	153.50	126.75	149.00	166.50	302.5	293.25
	Giko 10.8% EC	137.50	121.50	182.00	215.50	319.5	337.00
	Hand hoeing thrice	16.50	29.50	47.60	74.25	64.10	103.75
	Unweeded treatment	342.75	300.25	453.75	649.25	796.50	949.5
LSD at 0.05		28.55	33.97	42.21	47.65	51.39	71.19

3.3.2 Growth parameters

The results obtained in Table (14) indicate that the interaction between sugar beet varieties and application weed control treatment significant on growth characters in both seasons. Laila and Gloria varieties with treatments under applied hand hoeing thrice, Goltix and Goltix plus increased valued characteristic of sugar beet plants *i.e*. root length, root diameter and number of leaves /plant in both seasons.

Table (14): Significant interaction effect between beet varieties and weed control treatments on growth characters in 2020/2021 and 2021/2022 seasons.

Treatments		Root length (cm)		Root diameter (cm)		Number of leaves/plant	
		2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	Goltix plus 50% SC	26.00	26.80	9.30	8.40	31.00	29.40
	Goltix70% SC	27.15	28.03	9.80	8.55	25.75	24.65
	Tegro 27.4% EC	25.55	24.40	8.50	8.00	22.75	27.85
	Giko 10.8% EC	25.75	25.50	8.90	8.10	32.88	30.05
	Hand hoeing thrice	30.90	28.43	9.98	8.75	26.30	26.30
	Unweeded treatment	19.80	21.55	6.70	8.50	20.18	20.15
Laila	Goltix plus 50% SC	25.75	23.45	9.05	8.80	28.95	25.15
	Goltix70% SC	26.00	23.72	9.40	8.82	27.20	31.68
	Tegro 27.4% EC	21.80	21.20	7.85	8.65	29.10	27.55
	Giko 10.8% EC	21.05	22.75	8.60	8.80	26.45	28.85
	Hand hoeing thrice	28.00	24.48	9.35	8.45	26.00	25.60
	Unweeded treatment	20.20	21.75	6.15	8.25	15.60	25.15
Keliopatra	Goltix plus 50% SC	22.85	23.13	9.05	8.50	22.40	24.55
	Goltix70% SC	24.75	25.23	10.50	8.15	21.70	22.70
	Tegro 27.4% EC	23.95	22.18	8.75	8.70	24.75	24.05
	Giko 10.8% EC	18.60	22.28	9.60	8.45	24.45	26.55
	Hand hoeing thrice	26.35	24.15	11.00	8.80	24.80	21.60
	Unweeded treatment	22.65	20.50	7.20	6.70	20.38	18.05
LSD at 0.05		3.92	3.92	1.06	0.50	4.13	3.86

3.3.3 Sugar beet yields

Data in Table (15) indicate that the interaction between sugar beet varieties and weed control treatments showed significant differences only top yield in the 1st season and sugar yield in the 2nd season only, while the root yield was affected in the two seasons.

Table (15): Effect of interaction between beet varieties and weed control treatments on sugar beet yields in 2020/2021 and 2021/2022 seasons.

Treatments		Top yield/feddan (ton)		Root yield/feddan (ton)		Sugar yield/feddan (ton)	
		2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Gloria	Goltix plus 50% SC	5.250	4.575	24.630	24.350	3.065	3.229
	Goltix70% SC	6.435	5.457	26.060	25.375	2.979	3.010
	Tegro 27.4% EC	6.997	5.925	27.367	26.523	3.682	3.603
	Giko 10.8% EC	5.725	5.400	25.020	24.850	3.207	3.301
	Hand hoeing thrice	6.347	5.775	27.007	26.500	3.673	3.911
	Unweeded treatment	4.083	3.192	15.432	13.737	1.471	1.269
Laila	Goltix plus 50% SC	4.842	4.412	23.525	23.012	2.551	2.245
	Goltix70% SC	6.122	4.777	24.102	23.365	2.699	2.578
	Tegro 27.4% EC	6.560	5.292	25.382	24.725	3.149	2.998
	Giko 10.8% EC	4.865	3.962	24.182	23.270	2.513	2.488
	Hand hoeing thrice	5.985	4.975	25.630	25.175	3.136	3.174
	Unweeded treatment	3.472	3.150	13.475	11.553	1.094	0.969
Keliopatra	Goltix plus 50% SC	4.215	4.175	22.245	22.153	2.314	2.507
	Goltix70% SC	4.923	4.200	23.153	22.363	2.221	2.464
	Tegro 27.4% EC	5.000	4.267	25.079	24.122	2.655	2.659
	Giko 10.8% EC	4.360	3.500	23.765	23.825	2.424	2.778
	Hand hoeing thrice	5.790	5.122	23.975	23.200	2.602	2.740
	Unweeded treatment	3.150	2.825	10.895	10.775	0.857	0.992
LSD at 0.05		0.53	NS	NS	NS	NS	0.35

3.4 Quality traits

Data in Tables (16 and 17) illustrate that the interaction between sugar beet varieties and weed control treatment did not show significant differences in quality traits in both seasons, except for the percentage of sodium (Na) and α-amino nitrogen in both seasons.

Table (16): Effect of interaction between beet varieties and weed control treatments on quality traits and in 2020/2021 and 2021/2022 seasons.

Treatments		Sucrose (%)		ES (%)		SLM (%)		Quality index (%)	
		2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Interactions (A × B)									
Gloria	Goltix plus 50% SC	14.00	13.00	10.84	9.76	2.57	2.64	77.25	75.03
	Goltix70% SC	14.50	14.50	11.18	11.03	2.72	2.87	77.03	76.08
	Tegro 27.4% EC	16.00	15.75	12.44	12.14	2.96	3.01	77.55	76.98
	Giko 10.8% EC	14.00	14.25	10.42	10.75	2.98	2.91	74.00	75.08
	Hand hoeing thrice	16.00	16.25	12.25	12.62	3.15	3.04	76.50	77.58
	Unweeded treatment	10.50	10.75	8.17	8.40	1.73	1.77	77.85	78.08
Laila	Goltix plus 50% SC	15.75	16.75	12.46	13.27	2.70	2.88	78.98	79.18
	Goltix70% SC	14.75	15.25	11.43	11.85	2.73	2.80	77.13	77.60
	Tegro 27.4% EC	17.00	17.25	13.45	13.58	2.95	3.07	79.10	78.73
	Giko 10.8% EC	16.25	16.75	12.83	13.30	2.83	2.85	78.95	79.33
	Hand hoeing thrice	17.25	18.50	13.57	14.67	3.08	3.14	78.55	79.73
	Unweeded treatment	12.00	11.75	9.55	9.17	1.85	1.98	79.63	78.00
Keliopatra	Goltix plus 50% SC	13.50	14.50	10.37	11.29	2.53	2.61	76.75	77.93
	Goltix70% SC	12.75	14.25	9.62	11.09	2.53	2.57	75.13	77.70
	Tegro 27.4% EC	13.75	14.25	10.58	11.03	2.57	2.63	76.88	77.08
	Giko 10.8% EC	13.25	14.75	10.20	11.66	2.45	2.59	76.90	79.00
	Hand hoeing thrice	14.25	15.25	10.84	11.82	2.81	2.84	75.95	77.43
	Unweeded treatment	10.25	11.50	7.93	9.07	2.73	1.84	77.050	78.55
LSD at 0.05		NS	NS	NS	NS	NS	NS	NS	NS

Table (17): Effect of interaction between beet varieties and weed control treatments on impurities of juice (meq/100g beet) in 2020/2021 and 2021/2022 seasons.

Treatments		Impurities of juice (meq/100 g beet)					
		K (%)		Na (%)		α-amino N (%)	
		2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season	2020/2021 season	2021/2022 season
Interactions (A × B)							
Gloria	Goltix plus 50% SC	5.61	5.73	2.31	2.45	3.85	4.00
	Goltix70% SC	5.41	6.17	2.61	2.80	4.45	4.50
	Tegro 27.4% EC	5.78	5.70	3.03	3.25	4.92	5.08
	Giko 10.8% EC	6.82	5.97	2.32	2.52	4.82	4.91
	Hand hoeing thrice	7.08	5.78	3.20	3.45	4.88	5.03
	Unweededtreatment	3.82	3.66	1.32	1.91	2.06	1.90
Laila	Goltix plus 50% SC	5.14	5.85	2.97	3.08	4.28	4.58
	Goltix70% SC	5.70	5.69	2.97	3.17	4.08	4.25
	Tegro 27.4% EC	5.42	5.83	3.17	3.30	5.01	5.18
	Giko 10.8% EC	5.56	5.25	2.73	2.95	4.69	4.84
	Hand hoeing thrice	5.47	5.52	3.80	3.97	5.17	5.27
	Unweededtreatment	3.92	4.29	1.99	2.49	2.10	2.15
Keliopatra	Goltix plus 50% SC	6.06	6.20	2.39	2.43	3.43	3.63
	Goltix70% SC	5.31	5.41	2.54	2.58	3.76	3.86
	Tegro 27.4% EC	5.82	5.90	2.59	2.65	3.60	3.75
	Giko 10.8% EC	5.66	5.72	2.36	2.44	3.32	6.47
	Hand hoeing thrice	6.82	5.94	2.69	2.74	3.45	4.54
	Unweeded treatment	4.24	3.73	1.14	2.53	1.91	2.45
LSD at 0.05		NS	NS	0.28	0.59	0.61	0.67

4. Conclusion

Under conditions of the present study, sowing Gloria variety of sugar beet, with Hand hoeing thrice and/or spraying Tegro 27.4% EC to get rid of weeds, can be concluded to attain the highest roots and sugar yields /feddan.

References

Abd El-Lateef, E. M., Mekki, B. B., Abd El Salam, M. S. and El Metwally, I. M. (2021), "Effect of different single herbicide doses on sugar beet yield, quality and associated weeds", *Bulletin of the National Res. Centre*, Vol. 45, Article No. 21.

AOAC (2005), *Official Methods of Analysis*, 18th ed., Association of Official Analytical Chemists International, Washington, D.C., USA.

Al-Sayed, H. M. and Attaya, A. S. (2015), "Response of four sugar beet varieties to seed treatment and weed control methods under Giza conditions", *Sinai Journal of Applied Sciences*, Vol. 4 No. 2, pp. 131–146.

Cooke, D. A. and Scott, R. K. (1993), "The Sugar Beet Crop", in Cooke, D. A. and Scott, R. K. (Eds.), *The Sugar Beet Crop: Science into Practice*, Chapman & Hall, London, Egypt, pp. 595–605.

Cioni, F. and Maines, G. (2011), "Weed control in sugar beet", *Sugar Tech*, Vol. 12, pp. 243–255.

Deviller, P. (1988), "Prévision du sucre-mélasse en sucrerie de betteraves", *Sucrerie Française*, Vol. 129, pp. 190-200.

Dexter, S. T., Frankes, M. G. and Snyder, F. W. (1967), "A rapid and practical

method of determining extracted white sugar as may be applied to the evaluation of agronomic practices and grower deliveries in the sugar beet industry", *Journal of the American Society of Sugar Beet Technologists*, Vol. 14, pp. 433–454.

FAO (2023), *FAOSTAT*, Food and Agriculture Organization of the United Nations, Rome. Available at: www.fao.org/faostat/en/#data (Accessed 18 August 2023).

Gerhards, R., Bezhin, K. and Santel, H. (2017), "Sugar beet yield loss predicted by relative weed cover, weed biomass and weed density", *Plant Protection Science*, Vol. 53, pp. 118–125.

Majidi, M., Heidari, G. and Emam, Y. (2017), "Qualitative characteristics of sugar beet as affected by different broadleaf herbicide combinations", *Iranian Journal of Agricultural Research*, Vol. 36 No. 2, pp. 1–6.

Milan, S., Kubes, J., Shokoofeh, H., Tahjib-Ul-Arif, M., Vachova, P. and Hejnak, V. (2020), "Betacyanins and betaxanthins in cultivated varieties of *Beta vulgaris* L. compared to weed beets", *Molecules*, Vol. 25, Article No. 5395.

Nowar, M. El-Sayed (2016), *Root yield and quality of sugar beet (Beta vulgaris L.) in response to potassium fertilization and weed control treatments under water stress conditions*, M.Sc. Thesis, Faculty of Agriculture, Benha University, Moshtohor, Egypt.

Safina, S. A. and Fatah, E. M. (2011), "Response of three sugar beet varieties to compost, mineral nitrogen fertilizer and their combination under sandy soil conditions: II- Yield and quality", *Bulletin of the Faculty of Agriculture, Cairo University*, Vol. 62 No. 4, pp. 447–456.

Salem, E. S. R. (2019), "Response of three sugar beet varieties to mineral and bio-fertilizers at west Nubariya region", *Menoufia Journal of Plant Production*, Vol. 4, pp. 39–55.

Seadh, S. E., Attia, A. N., Said, E. M., El-Maghraby, S. S. and Ibrahim, M. E. M. (2013), "Productivity and quality of sugar beet as affected by sowing methods, weed control treatments and nitrogen fertilizer levels", *Pakistan Journal of Biological Sciences*, Vol. 16 No. 15, pp. 711–719.

Shalaby, N. M. E., Osman, A. M. H. and El-Labbody, A. H. S. A. (2011), "Evaluation of some sugar beet varieties as affected by harvesting dates under newly reclaimed soil", *Egyptian Journal of Agricultural Research*, Vol. 89 No. 2, pp. 605–614.

Steel, R. G. and Torrie, J. H. (1980), *Principles and Procedures of Statistics: A Biometrical Approach*, 2nd ed., McGraw-Hill, New York, USA.

Tackholm, V. (1974), *Students' Flora of Egypt*, 2nd ed., Cairo University, Cairo, Egypt.

Tagour, R. M. H., Abd El-Hamed, G. M., Mousa, R. A. and Sarhan, H. M. (2012), "Integration effects of mulching and burning with hoeing on sugar beet and associated weeds", *Journal of Plant Production*, Vol. 3 No. 5, pp. 715–722.

Yasser, A. M. H. and Alaa, A. S. (2021), "Effect of nano-micronutrients fertilization on yield and quality of some sugar beet varieties under early and late sowing dates", *Egyptian Journal of Agronomy*, Vol. 43 No. 1, pp. 55–68.