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Performance of some Sugar Beet (*Beta vulgaris* L.) Cultivars under Annual Weed Control Condition

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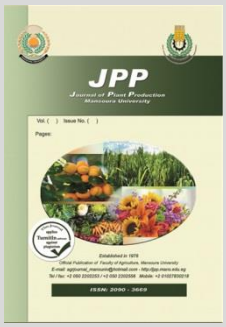

ABSTRACT

Two field experiments were conducted in El-Serw Agricultural Research Station, ARC, during 2015/16 and 2016/17 seasons to study the possible integration between three sugar beet cultivars varied in its growth habitat: Glorius, Lilly and Cleopatra and six weed control treatments which are being: Goltix plus at 1.5 L/fad., Goltix at 2 L/fad., Cross at 2.5 kg/fad. as post emergence herbicides and Harness at 0.75 L/fad. as pre emergence herbicide in addition to hand hoeing twice and unweeded check on weeds associated with sugar beet productivity and its economic feasibility. The main findings showed that both Glorius cultivar suppressed weed growth at 120 DAS by 62.2 and 39.9%, accompanied with increasing sugar beet root yield by 28.4 and 32.6% and with Lilly cultivar by 19.1 and 14.0% reduction on weed growth and increased root yield by 34.5 and 17.0% in both seasons, respectively, compared than Cleopatra cultivar. On other hand, Cross herbicide as ready-made exceeded other herbicides and hand hoeing twice on controlling total weeds until 120 DAS by 85.5 and 71.6% and increasing sugar beet yield by 151.6 and 217.0 % than unweeded check in both seasons. The best integration between Glorius and Lilly cultivars both with application Cross herbicide from view point of weed control by 90.5 and 87.2%, respectively, in 2015/16 season and 88.7 and 71.4%, respectively, in 2016/17 season, respectively and increasing sugar beet root yield by 215.6 and 264.6%, respectively, in 2015/16 season and by 323.9% and 308.6, respectively, in 2016/17 season accompanied with increasing farmer incomes

Keywords: Sugar beet, hand hoeing, herbicides, yield and its components

INTRODUCTION

Weed competition is one of the major obstacles which limit sugar beet production, the total yield losses of sugar beet yield from weed competition which varied from 26 to 100% (Schweizer and Dexter 1987, and May, 2001). The total potential losses from weeds would be between 50 and 100% of the potential crop yield (Deveikyte and Seibutis 2008). Weeds left in beet crops can make harvesting more difficult and costly, interfere with clamping and affect processing if taken into the factory (Cioni and Maines 2010). A lot of weeds can grow above the sugar beet canopy and reduce the amount of photosynthetic radiation reaching the crop, (Schäufele, 1991 and Mittler *et al*., 2002). Another researchers mentioned that yield loss depends from competitiveness and weed density and length of time the weeds are allowed to compete the crop (Schweizer and May, 1993). On the other hand, the average yield loss due to weed interference for the primary sugar beet growing areas of North America was estimated to be 70%. Thus, if weeds are not controlled, growers in the United States would lose approximately 22.4 million tons of sugar beet yield valued at approximately US$1.25 billion (Soltani *et al*., 2018). Also weeds as resource of seed bank, and act as co-hosts for insects and diseases and increase of tillage operation for weed control which caused a reduction of crop yield (Gummer *et al*., 2012). Thus, different control methods should be carried out to get a high depression of weeds in sugar beet. Therefore, weed control is essential component of sugar beet production. In much sugar beet growing areas, the monocots are less important compared to dicot weeds (Soroka and Gadzieva, 2006). Approximately 70% of weeds found in sugar beet crops are broadleaved species (Schweizer and May, 1993). Broadleaf weeds become most competitive after they begin shading the crop (Wicks and Wlison, 1983). Weeds are able to grow two to three times taller sugar beet by mid-summer, and as weed density increases, light becomes more limited and sugar beet root yields decrease (Schweizer and May, 1993), also, (Malik *et al*., 1993) found that, manipulation of row spacing, plant density, and cultivar selection may provide a means of reducing the impact of weed interference on crop yield. .Scott *et al*. (1979) estimated that once sugar beet reached the four to six-leaves stage, weeds could reduce yields by about 1.5% per day for the next 6 weeks. In order to decrease sugar beet infestation, a complex of agro technical, organizational, chemical and other measures are necessary. However, the most available and justifiable technique is the application of herbicides according to the background of high agronomical practices (Soroka and Gadzieva, 2006). Sugar beet cultivars may differ in competitiveness with weeds. A full leaf canopy could be achieved earlier in the growing season by reducing row spacing and selecting cultivar with rapid canopy

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development. The sugar beet cultivars may also influence canopy structure because of varying leaf size and shape (Stebbing *et al*., 2000). Generally sugar- beet cultivar differed in their response to herbicides but most these Cultivar showed slow growing in early stages followed by a recovery of vigor crop growth in later of the growing season (Smith and Schweizer, 1983).

Mixtures of post-emergence herbicides have to be applied to control the wide range of weed species in sugar beet crop, (Scepanovic 2007, Deveikyte and Seibutis, 2006). Chitband *et al.* (2014) found that desmedipham + phenmedipham + ethofumesate, tank mixtures for satisfactory weed control and reduction Portulaca oleracea, Solanum nigrum, Amaranthus retroflexus and Chenopodium album. The objectives of this study, to evaluate the integration between sugar beet cultivars and some ready-made herbicides such as Goltix plus, Goltix, Cross, and/or Harness on weed control and sugar beet yields and its components.

MATERIALS AND METHODS

Two field experiments were conducted at EL-Serw Agricultural Research Station, Agricultural Research Center, Damietta Governorate, Egypt, during 2015/16 and 2016 /17 winter seasons. The experimental design was a split plot design with four replicates in clayey texture soil (Table A). The main plots: included three sugar beet cultivars had multi genotypes differed from its characteristics: Glorius (Germany), Lilly (Denmark) and Cleopatra (France). The split plots devoted to six weed control treatments, namely: Goltix plus 50% SC (metamitron 35% + ethofumesate 15%) applied as post-emergence at 30 days after sowing (DAS) with 1.5 L/fad., Goltix 70% SC (metamitron 70%) applied as pre-emergence with 2 L/fad., Cross 41% WG (phenmedipham 6.5%+ ethofumesate 6.5%+ metamitron 28%) applied as Post-emergence with 2.5 kg/fad. at 30 DAS, Harness 84% EC (acetochlor 84%) applied as pre-emergence at 0.75 L/fad., Hand hoeing twice at 30 and 45 DAS. and unweeded Check. Knapsack sprayer CP_3 was used with water volume 200 L/fad. for herbicide spraying.

The plot area was 21 m^2 (4.2 m x 5 m). The recommended fertilizer rates of N, P and K were applied. The other normal cultural treatments of growing sugar beet were practiced. Sugar beet cultivars were obtained from Sugar Crop Institute Agricultural Research Center. Sugar beet seeds were sown on 13th November in 2015/16 and 2016/17 seasons and harvested in 20th May in both seasons.

Table A. Physical and chemical soil characteristics at the experimental sites during the two seasons.

Physical soil characteristics										
Season	**Coarse sand**	**Fine sand**	**Silt**	**Clay**	**Texture class**	**OM%**	**CaCO3%**	**meq /100g soil**	**pH**	**EC(dSm-1)**
2015/16	1.53	11.33	21.17	65.97	Clayey	1.1	1.40	43.8	8.1	4.20
2016/17	1.46	11.35	22.35	64.84	Clayey	0.86	1.34	42.3	8.0	4.35
Chemical soil characteristics										
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$HCO3^{-}$	Cl^{-}	$SO4^{--}$	N	P	K
2015/16	2.95	2.56	15.25	0.26	1.55	15.12	4.35			487
2016/17	3.13	2.49	15.82	0.29	1.71	15.21	4.81	33	7.94	479

Table B. Trade, common, chemical name and mode of action of used herbicides in the experimental site during 2015/16 and 2016/17.

Trade name	Common name	Chemical name	Chemical family	Mode of action
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
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
Cross 41%WG	Ethofumesate 6.5% + metamitron 28% + phenmedipham 6.5%	(I)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate 6.5% & 4-amino-3-methyl-6-phenyl-1,2,4-triazin-5(41H)-one 28% & 3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate 6.5%	Benzofuran & Triazinone & Phenyl-carbamate	Inhibition of lipid synthesis & Inhibition of photosynthesis at photosystem II & inhibition of mitosis division
Harness 84%EC	Acetochlor 84% EC	2-chloro-N-(ethoxymethyl)-N-(2-ethyl-6-methylphenyl)acetamide	Chloroacetamide	Inhibition of cell division

Three seeds were sowing per hills as distance 25 cm apart, and plants were thinned to one plant per hill before first irrigation to provide (28 x 10^3 plants/fad.)

I- Weed survey: Weeds were hand pulled 28000 plants/fad. randomly from one square meter at 70 and 120 days from sowing and identified into species and then the fresh weight was recorded.

II- on sugar beet growth: at harvest time, a sample of ten sugar beet plants were randomly taken at random from each plot to determine the following character were: 1- Number of leaves/plant. 2- Fresh weight of root/plant (g). 3- Fresh weight of top/plant (g). 4- Root length/plant (cm). 5- Root diameter (cm).

III. Sugar beet yields/fad.

Sugar beet yields of whole plots area were taken by hand pulling and the following data were recorded: (1) Root yield (ton/fad). (2) Top yield (ton/fad). (3) Biological yield (root and top yields) "ton/fad" at harvest.

IV. Sugar beet quality:

Five sugar beet roots were taken at random from each plot at harvest to determine the different quality attributes in the analytical sugar laboratory of Sugar Crop Res. Inst. by using official methods (g) as following: (1) Sucrose % was determined by using sucarometer on a lead acetate basis according to the method as described by Carruthers and Oldfield (1960). (2) Purity% was estimated

according to the following formula: purity% = Sucrose% / TSS% X100. 4-Total soluble solids% (TSS %) in root was determined by using digital refractometer, Model PRI (ATAGO).

V. Economic feasibility:

(1) Total costs: land preparation, sowing, hand hoeing, fertilization, irrigation, insect control, harvesting and transportation, (2) gross Income: root yield (ton/fad.) x price L.E. plus top yield (ton/fad.) x price L.E., (3) net Benefit = gross Income - total Cost and (4) benefit cost ratio = net benefit/total cost x100.

Statistical Analysis: Data were subjected to proper statistical analysis of variance according to (Snedecor, and Cochran, 1973). Treatments means were compared by least significant difference test (LSD) at 0.05 level by using MSTAT Computer Program V. 4 (1986).

RESULTS AND DISCUSSION

Results

Weed flora existed in sugar beet of experimental fields in both seasons:

The dominant annual broadleaf weed species were *Melilotus indica* L. All. (sweet clover) and *Rumex dentatus*, L. (dentated dock). Whilst *Chenopodium murale* L. (lambsquarter), C*oronopus squamatus* (Forssk.) Asch. (watercress), *Malva parviflora* L. (cheese weed) and *Spergularia marina L. Griseb (corn spurry)* as annual broadleaf weeds presented in very low infestation rates (rarely and neglected). *Polypogon monspeliensis* L. (annual rabbitsfoot grass) and P*halaris minor, Retz* L. (lesser canary grass) presented as annual grassy weeds. Fresh weight of the total weeds infestation in unweeded check of Cleopatra cultivar as standard check at 70 and 120 DAS were (10.3 and 20.1 ton/fad) in 2015/16 and (7.8 and 11.2 ton/fad.) in 2016/17, respectively.

Effect of sugar beet cultivars:

Annual weeds:

Data in Table (1) show that sweet clover and total weeds were significantly affected by sugar beet cultivars in both weed surveys at 70 and 120 DAS in both seasons. In 2015/16, at 70 DAS, results show that sugar beet cultivars could be arranged in descending order with regard to their effect on suppression the fresh weight of sweet clover and total weeds as follows: Glorius cultivar by 87.9 & 73.1%, respectively, and Lilly cultivar by 55.3 & 35.8%, respectively, as compared to Cleopatra cultivar. Meanwhile, at 120 DAS, Glorius cultivar depressed the fresh weight of sweet clover and total weeds by 84.4 & 62.2%, respectively, whereas Lilly cultivar depressed fresh weight of sweet clover and total weeds by 29.6 & 19.1%, respectively, compared with Cleopatra cultivar**.**

The obtained results in 2016/17 season confirm to those observed in 2015/16 season. At 70 DAS, Glorius cultivar suppressed the fresh weight of sweet clover and total weeds by 62.5% & 47.6%, respectively, and followed with Lilly cultivar by 18.17 & 15.6%, respectively. At 120 DAS, Glorius cultivar suppressed the sweet clover and total weeds by 59.8 and 39.9% and with Lilly cultivar by 23.6 and 14.0 %, respectively, compared to Cleopatra cultivar. Certainly, the significant increasing of infestation rates of Phalaris minor and *Polypogon monspeliensis* as grassy weeds with Glorius and Lilly cultivars were accompanied to the highest significant reduction on the dominant broadleaf weeds as compared with Cleopatra cultivar. That is true in both surveys and both seasons.

Table 1. Effect of sugar beet cultivars on the fresh weight (g/m2) of annual broadleaf and grassy weeds in 2015/16 and 2016/17 seasons.

Cultivars	2015/16 season							
	70 DAS				120 DAS			
	Sweet clover	Dentated dock	*Grassy weeds	Total weeds	Sweet clover	Dentated dock	*Grassy weeds	Total weeds
Glorius	146.3	78.0	154.5	378.9	306.7	284.8	248.3	839.7
Lilly	541.5	177.5	186.3	905.3	1380.8	241.2	177.2	1799.3
Cleopatra	1211.8	167.1	31.4	1410.3	1961.4	244.8	17.3	2223.6
LSD 0.05	121.4	NS	93.9	164.5	384.2	NS	106.9	430.4
	2016/17 season							
Glorius	249.9	234.3	74.0	558.2	455.8	415.6	113.1	984.5
Lilly	545.3	243.9	108.4	897.9	867.0	450.3	90.4	1407.7
Cleopatra	666.4	342.9	54.3	1064.1	1134.8	435.6	66.7	1637.2
LSD 0.05	148.7	NS	24.4	151.2	316.9	NS	NS	200.3

***Grassy weeds = rabbit foot grass and lesser canary grass.**

Glorius and Lilly cultivars depressed the total weeds, that is may be due to increase number of leaves/plant and shortest tall. These results are in agreement with (Stepping *et al*., 2000) who recorded that sugar beet cultivar may differ in competitiveness with weeds. After the six true-leaf stage, the sugar beet canopy will aid to suppression of weeds and become more competitive with weeds for light and nutrients. A leaf canopy could achieved earlier in the growing season by reducing row spacing and selecting cultivar with rapid canopy development. Also the sugar beet cultivars may influence canopy structure because of varying leaf size and shape.

Sugar beet yield components:

Table (2) show that the performance of sugar beet cultivars had non-significant difference for all studied traits except with plant height and number of leaves/plant. These results were true in both seasons. In 2015/16 season, Cleopatra cultivar gave the highest increasing value of plant height by 10.1 and 4.9 cm, respectively, which exceeded by 39 and 15.8% on Glorius and Lilly cultivars, respectively. Lilly and Glorius cultivars gave the highest increasing value of number of leaves/plant by 3.4 and 2.4 leaf, respectively, and exceeded on Cleopatra cultivar by 14.7 and 10.4%, respectively.

The obtained results in 2016/17 season were identical to those observed in the first season. Cleopatra

cultivar gave the highest increasing value of plant height by 9.5 and 3 cm which exceeded on Glorius and Lilly cultivars by 36.5 and 9.2%, respectively. Glorius and Lilly cultivars gave the highest increasing value of number of leaves/plant by 4.4 and 3.5, and exceeded by 19.2 and 15.3 %, respectively, on Cleopatra cultivar. These results are in accordance with recorded by (Joshi *et al*., 2005) who recorded that non-significant differences in sugar beet length among the three studied cultivars.

Sugar beet yield:

Data in Table (3) show that the three studied sugar beet cultivars had non-significant increasing effect on root, biological and top yields (ton/fad.) in 2015/16 and 2016/17 seasons. That due to the significant interactions between cultivars and weed control treatments which hidden the significances of these traits by the three studied cultivars. Glorius and Lilly cultivars increased root yield by 33.01 and 32.1%, respectively, and in biological yield by 28.4% and 29.3%, respectively, compared with Cleopatra cultivar in 2015/16 season. In 2016/17season, Glorius cultivar exceeded Cleopatra cultivar by 32.1 and 26.3% of root and biological yields, respectively, while Lilly cultivar exceeded by 16,5 and 12.4% of root and biological yields, respectively, compared to Cleopatra cultivar. Similar results were obtained by (Tsialtas and Maslaris., 2010) who recorded that no significant relationship between root width and yield was found for sugar beet cultivars.

Table 2. Effect of sugar beet cultivars on its yield components in 2015/16 and 2016/17 seasons.

Cultivars	Plant height (cm)	Number of leaves	Root length (cm)	Root diameter (cm)	Root weight/ plant (g)	Top weight /plant (g)
			2016/16 season			
Glorius	25.9	25.5	23.7	8.4	793	145
Lilly	31.1	26.5	26.3	8.8	797	146
Cultivar	36.0	23.1	23.2	9.2	595	142
LSD 0 .05	2.9	3.1	NS	NS	NS	NS
			2016/17 season			
Glorius	26.0	27.3	22.8	8.3	717	136
Lilly	32.5	26.4	26.1	8.2	633	126
Cultivar	35.5	22.9	22.5	8.7	543	132
LSD 0 .05	3.3	3.0	NS	NS	NS	NS

Table 3. Effect of sugar beet cultivar on root, top and biological yields (ton/fad.) in 2015/16 and 2016/17 seasons.

Cultivars	2015/16 season			2016/17 season		
	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/ fad.)	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/ fad.)
Glorius	22.94	4.35	27.29	21.52	3.90	25.42
Lilly	24.04	4.38	28.42	18.99	3.79	22.78
Cleopatra	17.87	4.25	22.12	16.23	3.92	20.15
LSD 0.50	NS	NS	NS	NS	NS	NS

Sugar beet quality:

Sugar beet quality were studied in 2016/17 season only as shown in Table (4). Lilly cultivar gave the highest values of sucrose by 17.97% and purity by 77.78% and followed by Glorius cultivar with the previous respective measurements by 17.4 and 77.78%, while the last cultivar was Cleopatra (16.6 and 76.05%, respectively. These results are in general agreement with recorded by (Ereciyes *et al*., 2016) they stated that the digestion rates of sugar and sugar yield beet cultivars were significant among sugar beet cultivars and Joshi et al (2005) they reported that was not much differences in juice quality among the three studied cultivars . It was reported in the previous studies that sugar content of tested cultivars were between %14.0-%17.0 (Rychcik ve Zawiślak 2002).

Table 4. Effect of sugar beet cultivars on sucrose and purity percentages in 2016/17 season.

Cultivars	2016/17 season	
	Sucrose %	purity %
Glorius	17.40	77.78
Lilly	17.97	77.78
Cleopatra	16.60	76.05
LSD 0.05	0.005	0.54

Effect of weed control treatments:

Annual weeds:

Data in table (5) indicated that all weed control treatments reduced significantly the fresh weight of annual broadleaf and grassy weeds in the two surveys at 70 and 120 DAS in both seasons. In 2015/16 season at 70 DAS, Cross (Phenmedipham + ethofumesate + metamitron) at 2.5 kg/fad., Goltix plus (metamitron + ethofumesate) at 1.5 L/fad, Harness (acetochlor) at 0.75 L/fad. and hand hoeing twice, greatly reduced total weeds by 91.6, 78.7, 77.9 and 77.7%, respectively. The previous respective characteristics at 120 DAS were 85.5, 66.9, 50.5 and 76.4%, respectively.

The obtained results in the 2016/17 season had similar trend presented in 2015/16 season at 70 and 120 DAS. There were significant reduction on fresh weight of total weeds with the application of Cross at 2.5 kg /fad. by 74.6 and 71.6, hand hoeing twice by 63.7 and 60.5%, Goltix plus at 1.5 L/fad. by 69.3 and 53.6% and Harness at 0.75 L/fad. by 66.8 and 56.3%, respectively. These results are in good harmony with those obtained by (Chitband et al., 2014) who stated that desmedipham + phenmedipham + ethofumesate were more potent than that of chloridazon and clopyralid against *Portulaca oleracea*, *Solanum nigrum, Amaranthus retroflexus* and *Chenopodium album*. The same conclusion was mentioned by (Mahmoud and Soliman, 2012). Kunz *et al* (2016) reported that mechanical weed control is a useful agronomic tool for weed suppression in sugar beet.

Sugar beet yield components:

Table (6) show that the effects of weed control treatments on sugar beet yield components caused

significant differences at 5% level in both seasons namely [plant height (cm), root length/plant (cm), root diameter/plant (cm), root weight/plant (g) and top weight/plant (g)]. In 2015/16 and 2016/17 seasons, Cross at 2.5 kg/fad. exceeded unweeded check by 21 and 18.3% of plant height, 31.5 and 26.2% of number of leaves, 29.3 and 17.4% of root length/plant, 47.8 and 45.3% of root diameter, 152% and 211.9% of root weight/plant and 200 and142.6% of top weight/plant, respectively. Goltix plus exceeded unweeded check by 19.3 and 19.0% of plant height, 47.4 and 24.6% of number of leaves, 24 and 13.3% of root length/plant, 40.3 and 51.6% of root diameter, 119.9 and 202.3% of root weight/plant and 158.7 and 168.9% of top weight/plant, in both seasons, respectively. Whereas Harness increased plant height by 19.3 and 15.4%, number of leaves/plant by 47.4 and 35.1%, root length/plant by 4.8 and 17.6%, root diameter by 40.3 and 37.5%, root weight/plant by123.5 and 160.9% and top weight/plant by177.8 and 142.6%, in 2015/16 and 2016/17, respectively. Hand hoeing twice exceeded unweeded check by 13.0 and 12.5% of plant height, 36.8 and 16.1% of number of leaves/plant, 16.3 and 18.6% of root length/plant, 29.9 and 40.6% of root diameter, 114.8 and 137.9% of root weight/plant and 130.2 and 111.5% of top weight/plant, in 2015/16 and 2016/17 seasons, respectively. Confirming results in this respect was obtained by (Mahmoud and Soliman, 2012).

Table 5. Effect of weed control treatments on fresh weight (g/m^2) of broadleaf and grassy weeds at 70 and 120 DAS in 2015/16 and 2016/17 seasons.

Weed control treatments		2015/16 season							
		70 DAS				120 DAS			
Trade name (rate/fad.)	Active ingredient (g/fad.)	Sweet clover	Dentated dock	*Grassy weeds	Total weeds	Sweet clover	Dentated dock	*Grassy weeds	Total weeds
Goltix plus 1.5 L	Met. 525+ eth.225	307.7	123.8	39.3	470.8	704.7	302.0	68.3	1075.0
Gpltix 2 L	Met. 1400	1225.3	146.7	168.7	1540.7	2071.8	406.3	85.5	2563.7
Cross 2.5 kg	phe. 162.5 + eth.162.5 + met.700	89.3	14.3	82.7	186.3	224.0	120.8	127.3	472.1
Harness 0.75 L	Ace. 630	285.0	116.3	87.3	488.7	1551.3	39.0	18.7	1609.0
Hand hoeing twice		211.7	205.7	76.2	493.5	417.7	259.0	76.3	753.0
Unweeded check		1680.3	238.5	290.2	2209.0	2328.3	414.3	509.7	3252.3
LSD 0.05		183.9	134.4	111.7	196.7	385.0	186.6	147.4	358.2
		2016/17 season							
Goltix plus 1.5 L	Met. 525+ eth.225	270.7	219.08	70.5	560.3	550.7	546.7	72.50	1169.9
Gpltix 2 L	Met. 1400	626.5	259.50	30.5	916.5	1017.3	479.1	59.25	1555.7
Cross 2.5 kg	phe. 162.5 + eth.162.5 + met.700	217.5	133.92	112.5	463.9	335.9	227.9	151.3	715.2
Harness 0.75 L	Ace. 630	528.6	71.92	6.5	607.0	991.1	110.7	0.0	1101.8
Hand hoeing twice		259.5	318.58	84.7	662.8	548.1	366.6	79.8	994.5
Unweeded check		1021.6	639.00	168.7	1829.3	1472.2	872.1	177.5	2521.8
LSD 0.05		188.7	146.5	74.9	173.5	280.5	218.2	84.5	274.5

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.
*** Grassy weeds: rabbit foot grass and lesser canary grass.**

Table 6. Effect of weed control treatments on sugar beet yield components in 2015/16 and 2016/17 seasons.

Weed control treatments		2015/16 season					
Trade name (rate/fad.)	Active ingredient (g/fad.)	Plant height (cm)	Number of leaves	Root length(cm)	Root diameter(cm)	Root weight/ plant (g)	Top weight /plant
Goltix plus 1.5 L	Met. 525+ eth.225	32.2	28	25.8	9.4	816	163
Goltix 2 L	Met. 1400	32.0	25	26.6	8.8	623	129
Cross 2.5 kg	Phe. 162.5+eth. 162.5 +met. 700	32.7	25	26.9	9.9	935	189
Harness 0.75 L	Ace. 630	32.2	28	21.8	9.4	829	175
Hand hoeing twice		30.5	26	24.2	8.7	797	145
Unweeded check		27.0	19	20.8	6.7	371	63
LSD 0.05		3.3	3.2	3.1	0.8	217	37
		2016/17 season					
Goltix plus 1.5 L	Met. 525+ eth.225	33.2	26.3	23.8	9.7	789	164
Goltix 2 L	Met. 1400	30.6	26.4	24.3	8.2	622	126
Cross 2.5 kg	Phe. 162.5+eth. 162.5 +met. 700	33.0	26.5	24.6	9.3	814	148
Harness 0.75 L	Ace. 630	32.2	28.5	24.7	8.8	681	160
Hand hoeing twice		31.4	24.5	24.9	9.0	621	129
Unweeded check		27.9	21.1	21.0	6.4	261	61
LSD 0.05		2.6	3.0	3.9	0.8	242	44.4

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Sugar beet yields:

Data in Table (7) showed that, the highest values of root, top and biological yields in the 2015/16 season, were obtained from the application Cross 2.5 kg/fad. by 28.03, 5.67 and 33.7 ton/fad. and exceeded unweeded check by 151.6, 191.6 and 158.4%, respectively, Harness at 0.75 L/fad. by 24.88, 5.28 and 30.15 ton/fad. and exceeded unweeded check by 123.3, 176.4 and 131.2%, respectively, Goltix plus at 1.5 L/fad. by 24.71, 4.91 and 29.62 ton/ fad. and exceeded unweeded check by 121.8, 157.1 and 127.1%, respectively, and hand hoeing twice by 24.05, 4.34 and 28.4 ton/fad. and exceeded unweeded check by 115.9, 127.2 and 115.0%, respectively .

In 2016/17 season, obviously, the highest increasing values of root and biological yield were obtained with Cross at 2.5 kg/fad. 24.41, 4.45 and 28.86 ton/fad and exceeded unweeded check by 217, 151.4 and 208.8%, Goltix plus at 1.5 L/fad. 23.7, 4.92 and 28.60

ton/fad. and exceeded unweeded check by 208.8, 178.0 and 202%, hand hoeing twice 21.45, 3.86 and 25.32 ton/fad. and exceeded unweeded check by 178.6, 118.1 and 167.4% and Harness at 0.75 L/fad. 20.42, 4.79 and 25.21 ton/fad, and exceeded unweeded check by 165.2, 170.5 and 166.2%, respectively,.

The previous results with regard to the effect of weed control treatments on increasing sugar beet yields root, top and biological and their components show that the best treatments were Cross at 2.5 kg/fad., Goltix plus at 1.5 L/fad., Harness at 0.75 L/fad., respectively from view point of yield increase. These results are in good accordance with recorded by (Majidi *et al*., 2017) who reported that PDE (phenmedipham + desmedipham + ethofumesate) at both pre-emergence and 2-4-leaf period application with recommended dosage could be recommended for obtaining higher root yield.

Table 7. Effect of weed control treatments on root, top and biological yields (ton/fad) in 2015/16 and 2016/17 seasons.

Weed control treatments		2015/16 season			2016/17 season		
Trade name (rate/fad.)	Active ingredient (g/fad.)	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/fad.)	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/fad.)
Goltix plus 1.5 L	Met. 525+ eth.225	24.71	4.91	29.62	23.70	4.92	28.62
Goltix 2 L	Met. 1400	16.88	3.87	20.75	19.05	3.44	22.49
Cross 2.5 kg	Phe. 162.5+eth. 162.5 +met. 700	28.03	5.67	33.70	24.41	4.45	28.86
Harness 0.75 L	Ace. 630	24.88	5.28	30.16	20.42	4.78	25.20
Hand hoeing twice		24.05	4.34	28.39	21.45	3.86	25.31
Unweeded check		11.14	1.91	13.05	7.7	1.77	9.47
LSD 0.05		6.5	1.1	7.6	7.3	1.3	8.6

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Sugar beet quality:

For weed control treatments, it was noticed that from table (8) that unweeded check gave the highest value of sugar% compared to all weed control treatments. Whilst, Goltix at 2L/fad., Cross at 2.5 kg/fad., hand hoeing twice, and Harness at 0.75 L/fad. gave the following increasing values of sucrose percentage by 17.6, 17.2 and 17.0%, respectively. This may be attributed to the small weight and size of sugar beet roots under unweeded check. The values of purity percentage in descending order were obtained by Goltix at 2L/fad. (79.9%), Goltix plus at 1.5 L/fad. (79.4%), Cross at 2.5 kg/fad. (78.7%), hand hoeing twice (77.1%) and Harness at 0.75 L/fad (75.1%). Compared to unweeded check (76.6%).

Table 8. Effect of weed control treatments on sucrose and Purity percentage in the 2016l17 season.

Weed control treatments		2016/17 season	
Trade name (rate/fad.)	Active ingredient t (g/fad.)	Sucrose %	Purity %
Goltix plus 1.5 L	Met. 525+ eth.225	16.90	79.41
Goltix 2 L	Met. **1400**	17.61	79.90
Cross 2.5 kg	Phe. 162.5+eth. 162.5 +met. 700	17.40	78.66
Harness 0.75 L	Ace. 630	16.99	75.05
Hand hoeing twice		17.20	77.09
Unweeded check		17.74	76.58
LSD 0.05		0.011	0.049

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Effect of interaction between sugar beet cultivars and weed control treatments:

Annual weeds:

The effect of interaction between sugar beet cultivars and weed control treatments were statistically significant at 5% level on the fresh weed of sweetclover, dentated duck, grassy weeds as well as total weeds at 70 & 120 DAS in both 2015/16 and 2016/17 winter season (table 9). In 2015/16 winter season at 70 DAS the highest reduction on the fresh weight was obtained from growing Glorius cultivar with application of cross at 2.5 kg/fad.

In 2015/16 at 120 DAS, the interactions between Glorius, Lilly and Cleopatra cultivars with unweeded check gave 2069, 2910 and 4778 fresh weight of total weeds (g/m^2), respectively. The interactions between Glorius and Lilly with unweeded check decreased fresh weight of total weeds by 56.7 and 39.1%, respectively, compared with the interaction between Cleopatra cultivar and unweeded check. and respective value were 2391, 2509 and 2648 which decreased total weeds by 9.7 and 5.2%, respectively, in 2016/17 season it may due to the dense canopies of Glorius and Lilly cultivars wich suppress weed infestation.

In the 2015/16 season, at 70 DAS, results revealed that the interactions between Glorius cultivar gave the highest reduction percentage on fresh weight of total weeds with Cross at 2.5 kg/fad., Goltix plus at 1.5 L/fad., Harness at 0.75 L/fad. and hand hoeing twice gave 90.5, 93.6, 89.7 and 86.9%, respectively compared with Cleopatra cultivar under unweeded check condition, Lilly cultivar interaction with Harness at 0.75 L/fad., Cross at 2.5 kg/fad., with Goltix plus at 1.5 L/fad. and with hand hoeing twice achieved the lowest fresh weight of total weeds by 77.8, 84.6, 74.5 and 88.4%, respectively. Meanwhile interaction between Cleopatra cultivar and cross at 2.5 kg/fad., hand hoeing twice, Goltix plus at 1.5 L/fad. and Harness at 0.75 L/fad. gave reduction percentage of total weeds by 94.4, 83.9, 77.9 and 75.7%, respectively. In 2015/16 season, at 120 DAS Glorius cultivar integration with Harness at 0.75 L/fad. application gave (91.4%) followed by Cleopatra cultivar with Cross at 2.5 kg/fad. application which gave (90.2%) followed by Lilly cultivar with Cross which gave (84.7%) and all exceeded the traditional method by hand hoeing twice under Cleopatra cultivar.

In 2016/17 season, at 70 DAS Glorius or Lilly cultivars interactions with Cross application at 2.5 kg/fad., Goltix plus at 1.5 L/fad. Harness at 0.75 L/fad. gave the highest reduction percentage on fresh weight of total weeds with estimated by 88.7, 71.3, 78.8, 73.5, 77.2 and 74.2%, respectively, while the lowest weight of total weeds achieved by interaction between Cleopatra cultivar with Cross at 2.5 kg/fad. and hand hoeing by 66.7 and 59.7%, respectively. The interaction between Glorius and Lilly cultivar with Cross at 2.5 kg/fad., Harness at 0.75 L/fad. and hand hoeing twice gave the highest reduction percentage on fresh weight of total weeds by 81.5, 62.9,

69.7, 60.3, 64.8, and 66.0%, respectively. Meanwhile, Cleopatra cultivar interaction between Cross at 2.5 kg/fad. and hand hoeing twice achieved 71.0 and 51.6% reduction on fresh weight of total weeds, respectively. These results are in general respect by (Smith and Schweizer, 1983) demonstrated that sugar beet cultivars responded differently to herbicides treatments.

In 2016/17 season at 120 DAS, all weed control treatments were lower than the first survey where only with growing Glorius with Cross at 2.5 kg/fad. gave (81.5%) control. Meaning that, this integration between Glorius as a strong competitor cultivar accompanied with the application Cross application at 2.5 kg/fad. as broaden weed control spectrum herbicide realized prolonged weed control up till 120 DAS.

Table 9. Effect of interaction between sugar beet Cultivars and weed control treatments on fresh weight (g/m^2) of broadleaf and grassy weeds in 2015/16 and 2016/17 seasons.

Cultivars	Weed control treatments		2015/16 season							
			70 DAS				120 ADS			
	Trade name (rate/fad.)	Active ingredient (g/fad.)	Sweet clover	Dentated dock	*Grassy weeds	Total weeds	Sweet clover	Dentated dock	*Grassy weeds	Total weeds
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	39.0	40.0	34.0	113.0	95.0	260.0	65.0	420.0
	Goltix 2 L	Met. 1400	266.0	181.0	44.0	491.0	449.0	793.0	136.0	1378.0
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	19.0	12.0	73.0	104.0	69.0	216.0	217.0	502.0
	Harness 0.75 L	Ace. 630	46.0	00	22.0	68.0	108.0	21.0	48.0	177.0
	Hand hoeing twice		210.0	82.0	106.3	398.3	256.0	88.0	148.0	492.0
	Unweeded check		298.0	153.0	648.0	1099.0	863.0	330.0	876.0	2069.0
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	258.0	117.0	76.0	451.0	386.0	514.0	140.0	1040.0
	Goltix 2 L	Met. 1400	942.0	138.0	459.0	1539.0	2534.0	177.0	120.5	2831.0
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	137.0	14.0	109.0	260.0	280.0	81.3	83.0	444.3
	Harness 0.75 L	Ace. 630	38.0	349.0	240.0	627.0	2719.0	78.0	00	2797.0
	Hand hoeing twice		195.0	280.0	44.0	519.0	487.0	214.0	72.0	773.0
	Unweeded check		1679.0	167.0	189.5	2035.5	1879.0	383.0	648.0	2910.0
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	626.0	214.3	8.0	848.3	1633.0	132.0	00	1765.0
	Goltix 2 L	Met. 1400	2468.0	121.0	3.0	2592.0	3232.5	249.0	00	3481.5
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	112.0	17.0	66.0	195.0	323.0	65.0	82.0	470.0
	Harness 0.75 L	Ace. 630	771.0	00	00	771.0	1827.0	18.0	8.0	1853.0
	Hand hoeing twice		230.0	255.0	78.3	563.3	510.0	475.0	9.00	994.0
	Unweeded check		3064.0	395.5	33.0	3492.5	4243.0	530.0	5.0	4778.0
	LSD 0.05		318.6	NS	193.6	340.7	666.8	323.2	255.3	620.5
			2016/17 season							
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	162.5	128.5	38.0	329.-	252.8	463.5	61.8	778.0
	Goltix 2 L	Met. 1400	240.5	74.8	38.5	353.75	581.5	120.8	29.0	731.3
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	71.5	36.8	67.3	175.5	109.5	123.0	209.0	441.5
	Harness 0.75 L	Ace. 630	278.0	74.5	00	352.5	613.3	111.3	00	724.5
	Hand hoeing twice		314.8	197.8	77.0	589.5	335.0	424.3	81.5	840.8
	Unweeded check		432.3	893.3	223.0	1548.5	843.0	1250.8	297.3	2391.0
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	270.5	156.0	124.0	550.5	563.5	599.5	64.3	1227.3
	Goltix 2 L	Met. 1400	737.3	183.3	53.0	973.5	1208.8	571.8	148.8	1928.8
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	222.8	131.0	243.5	597.25	479.3	375.5	76.5	931.3
	Harness 0.75 L	Ace. 630	494.0	22.5	19.5	536.-	858.5	138.5	00	997.0
	Hand hoeing twice		232.8	336.3	80.5	649.5	498.8	272.5	81.0	852.3
	Unweeded check		1314.8	634.3	129.8	2078.75	1593.0	744.5	172.0	2509.5
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	379.0	372.8	49.5	801.3	835.8	577.0	91.5	1504.3
	Goltix 2 L	Met. 1400	901.8	520.5	00	1422.3	1261.8	745.3	00	2007.0
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	358.3	234.0	26.8	619.0	419.0	185.3	168.5	772.8
	Harness 0.75 L	Ace. 630	813.8	118.8	00	932.5	1501.5	82.3	00	1583.8
	Hand hoeing twice		231.0	421.8	96.5	749.3	810.5	403.0	77.0	1290.5
	Unweeded check		1317.8	389.5	153.3	1860.5	1980.5	621.0	63.3	2664.8
	LSD 0.05		327.0	253.8	129.7	300.5	NS	378.0	NS	475.5

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.
*** Grassy weeds: rabbit foot grass and lesser canary grass.**

Sugar beet yield components:

Table (10) show that the effect of interactions between sugar beet cultivars and weed control treatments in sugar beet fields exerted significant differences on various studied growth characters namely: plant height, root length, root diameter, root weight/plant and top weight/plant in 2015/16 and 2016/17 seasons.

Results in 2015/16 and 2016/17 seasons indicated that interaction between Cleopatra cultivar with Cross application at 2.5 kg/fad. gave the highest plant height by 41 and 40 cm, Harness at 0.75 L/fad. by 39 and 37 cm , Goltix plus at 1.5 L/fad by 36 and 38 cm, respectively, whereas, the lowest plant height values were achieved by interaction between Glorius cultivar and Cross at 2.5 kg/fad. by 22 and 25 cm, respectively. On another hand, the highest number of leaves/plant were achieved with the interaction between Lilly cultivar with Harness at 0.75 L/fad. by 33 and 30 leaves and Goltix plus at 1.5 L/fad. by 31 and 29 leaves/plant, in 2015/16 and 2016/17 seasons, respectively, meanwhile, the lowest number of leaves was obtained with interaction between Cleopatra cultivar and unweeded check by 20 and 18 leaves/plant in both seasons, respectively. For the root length of plant, the highest values were achieved by interaction between Lilly cultivar and Cross at 2.5 kg/fad. by 31 and 28 cm, hand hoeing twice by 28 and 27 cm and Goltix plus at 1.5 L/fad. by 27 and 27 cm, respectively, in both seasons, whilst the lowest root length/plant were achieved through interaction between Cleopatra cultivar with Harness at 0.75 L/fad. by 19 cm in 2015/16 season and Cleopatra cultivar with unweeded check by 20 cm in 2016/17 season, respectively. Interaction between Cleopatra cultivar with both Cross at 2.5 kg/fad. and Harness at 0.75 L/fad. gave the highest root diameter by 11 and 10 cm, respectively, in 2015/16 season

and by 10 and 10 cm, respectively, in 2016/17 season, while the lowest root diameter achieved by interaction between Glorius cultivar with untreated check by 6 and 6 cm, respectively, in both seasons. The highest root weight/plant in 2015/16 season achieved by interaction between Lilly cultivar both with Cross at 2.5 kg/fad. and Harness at 0.75 L/fad. by 1035 and 970 g/plant, respectively, while the interaction between Glorius and Goltix plus at 1.5 L/fad. gave 891 g/plant. Meanwhile, the lowest values of root weight/plant were obtained by the interaction between Cleopatra cultivar with untreated check by 284 and 255 g/plant in both seasons, respectively. In 2015/16 season the highest values of top weight (g)/plant were obtained by the interactions between Lilly cultivar with Harness at 0.75 L/fad. by 201g/plant. The same value 201 g of top weight /plant was obtained by the interaction between Cleopatra cultivar with Cross at 2.5 kg/fad. the following interaction between Glorius cultivar with Cross at 2.5 kg/fad. gave 196 g of top weight/plant. In second season, the highest values of top weight (g) were obtained by the interactions between Cleopatra cultivar and Goltix plus at 1.5L/fad., Glorius cultivar and Goltix plus at 1.5L/fad. and Lilly cultivar with Harness at 0.75L/fad. gave 180, 179 and 171 g/plant, respectively. In 2015/16 and 2016/17 seasons, the interaction between Glorius and unweeded check gave lowest values of top weight/plant by 45 and 52 g/plant, respectively. Similar results were obtained by (Erciyes *et al*., 2016) they mentioned that significant differences were found among sugar beet cultivars for all the investigated plant parameters.

Table 10.Effect of the interaction between sugar beet cultivars and weed control treatments on sugar beet yield components in 2015/16 and 2016/17 seasons.

Cultivars	Weed control treatments		2015/16 season					
	Trade name (rate/fad.)	Active ingredient (g/fad.)	Plant height (cm)	Number of leaves	Root length (cm)	Root diameter(cm)	Root weight/ plant (g)	Top weight /plant(g)
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	28	29	26	9	891	153
	Goltix 2 L	Met. 1400	29	27	28	9	880	165
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	22	29	26	9	895	196
	Harness 0.75 L	Ace. 630	26	26	21	9	848	159
	Hand hoeing twice		27	26	22	8	866	152
	Unweeded check		24	16	20	6	375	45
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	33	31	27	9	803	154
	Goltix 2 L	Met. 1400	31	26	26	9	639	125
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	35	23	31	10	1035	171
	Harness 0.75 L	Ace. 630	33	33	26	10	970	201
	Hand hoeing twice		29	26	28	9	883	158
	Unweeded check		28	20	20	7	456	70
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	36	23	25	10	753	185
	Goltix 2 L	Met. 1400	35	22	26	9	350	98
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	41	25	24	11	874	201
	Harness 0.75 L	Ace. 630	39	24	19	10	670	167
	Hand hoeing twice		35	25	23	9	643	124
	Unweeded check		30	20	23	7	284	77
	LSD 0.05		4.9	4.9	4.7	1.3	324	56
					2016/17 season			
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	26	25	21	9	827	179
	Goltix 2 L	Met. 1400	28	32	24	9	954	174
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	25	28	23	9	903	137
	Harness 0.75 L	Ace. 630	27	29	23	9	640	149
	Hand hoeing twice		27	26	24	8	671	124
	Unweeded check		24	25	22	6	309	51
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	36	29	27	9	765	134
	Goltix 2 L	Met. 1400	31	25	25	8	458	98
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	35	28	28	9	871	142
	Harness 0.75 L	Ace. 630	32	30	28	8	830	171
	Hand hoeing twice		33	26	27	9	624	150
	Unweeded check		29	20	22	7	248	65
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	38	25	23	9	776	180
	Goltix 2 L	Met. 1400	33	23	23	8	454	106
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	40	24	22	10	668	165
	Harness 0.75 L	Ace. 630	37	27	23	10	572	160
	Hand hoeing twice		34	22	24	10	564	113
	Unweeded check		31	18	20	7	225	68
	LSD 0.05		3.9	4.6	5.9	1.3	362	67

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Sugar beet yields:

Table (11) revealed that, the effect of interaction between sugar beet cultivars and weed control treatments on root, top and biological yields (ton/fad.) were statistically significant at 5% level in both 2015/2016 and 2016/2017 seasons. The highest root yields were obtained from growing Lilly cultivar with the application of Cross herbicide at 2.5 kg/fad., meanwhile the lowest one was come from Cleopatra cultivar under unweeded check. Similar results were obtained from top and biological yields. These results are attributed to the integration effects between growing Lilly or Glorius cultivars which had dense canopies causing suppress of weed growth due to the decrease of light penetration to weeds and the high efficiency of these herbicides on control annual weeds which reflected increasing photosynthetic products and consequently increasing sugar beet yield (ton/fad.) and yield components and vice versa with Cleopatra under unweeded check which had the lowest values.

In 2015/16 season, the highest values of root yield, top yield and biological yield (root + top yields) were obtained by the interactions as follows: Lilly cultivar with Cross application at 2.5 kg/fad. by 31.03, 5.12 and 36.15 ton/fad., respectively, Lilly cultivar and Harness at 0.75 L/fad. by 29.10, 6.04 and 35.14 ton/fad., respectively, and cultivar and hand hoeing twice treatment by 26.47, 4.72 and 31.19 ton/fad., respectively. Meanwhile, the interaction between Glorius cultivar and Cross application at 2 kg/fad. gave 26.86, 5.87 and 32.73 ton/fad., respectively, Glorius cultivar with Goltix at 1.5 L/fad. gave 26.74, 4.58 and 31.32 ton/fad., respectively. Both Glorius cultivar interactions with Goltix at 2 L/fad. and hand hoeing twice gave the same values approximately by 26, 5 and 31 ton/fad., respectively. All the previous interactions compared to interaction between Cleopatra cultivar and unweeded check by 8.51, 2.29 and 10.80 ton/fad., for the previous respective characteristics.

In 2016/17 season, the highest values of root yield, top yield and biological yield (ton/fad.) were achieved with Glorius cultivar and weed control treatments interaction: Goltix application at 2 L/fad. gave 28.62, 5.23 and 33.85 ton/fad., respectively, Cross application at 2.5 kg/fad. by 27.09, 4.12 and 31.22 ton/fad., respectively, Goltix plus application at 1.5 L/fad. by 24.80, 5.36 and 30.16 ton/fad., respectively, and hand hoeing twice by 20.14, 3.70 and 23.84 ton/fad., respectively. Whereas, interaction between Lilly cultivar with Cross application at 2.5 kg/fad. gave 26.11, 4.26 and 30.37 ton/fad., respectively, with Harness application at 0.75 L/fad. gave 24.90, 5.11 and 30.02 ton/fad., respectively, with Goltix plus application at 1.5 L/fad. gave 22.95, 4.01 and 26.96 ton/fad., respectively, and hand hoeing twice by 18.82, 4.49 and 23.31 ton/fad., respectively. Confirming results in this respect by Magidi *et al.* (2017) they reported that weed competition led todecreasing root yield and sugar content and treatment bettanal Progress herbicide was recommended to control broadleaf weeds.

Table 11. Effect of interaction between sugar beet cultivars and weed control treatments on root, top and biological yields (ton/fad.) in 2015/16 and 2016/17 seasons.

Cultivars	Weed control treatments		2015/16 season			2016/17 season		
	Trade name (rate/fad.)	Active ingredient (g/fad.)	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/fad.)	Root yield (ton/fad.)	Top yield (ton/fad.)	Biological yield (ton/fad.)
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	26.74	4.58	31.32	24.80	5.36	30.16
	Goltix 2 L	Met. 1400	20.98	4.94	25.92	20.14	4.23	24.37
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	26.86	5.87	32.73	27.09	4.12	31.22
	Harness 0.75 L	Ace. 630	25.43	4.78	30.21	19.18	4.47	23.66
	Hand hoeing twice		26.40	4.58	30.98	28.62	3.70	32.32
	Unweeded check		11.23	1.35	12.58	9.28	1.53	10.81
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	24.8	4.62	29.42	22.95	4.01	26.96
	Goltix 2 L	Met. 1400	19.17	3.75	22.92	13.73	2.93	16.67
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	31.03	5.12	36.15	26.11	4.26	30.37
	Harness 0.75 L	Ace. 630	29.10	6.04	35.14	24.90	5.11	30.02
	Hand hoeing twice		26.47	4.72	31.19	18.82	4.49	23.31
	Unweeded check		13.67	2.08	15.75	7.43	1.95	9.38
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	22.59	5.54	28.13	23.27	5.40	28.67
	Goltix 2 L	Met. 1400	10.05	2.93	13.43	13.62	3.17	17.80
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	26.21	6.02	32.23	20.03	4.96	25.00
	Harness 0.75 L	Ace. 630	20.10	5.01	25.11	17.17	4.78	21.95
	Hand hoeing twice		19.29	3.73	23.02	16.92	3.40	20.32
	Unweeded check		8.51	2.29	10.80	6.39	1.83	8.23
	LSD 0.05		9.7	10.86	1.9	9.7	1.68	11.36

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

On the other hand, the highest root yield, top yield and biological yield by Cleopatra interaction with Goltix plus at 1.5 L/fad. interaction gave 23.27, 5.40 and 28.67 ton/fad., respectively, and Cleopatra cultivar with Cross at 2.5 kg/fad. interaction gave 20.03, 4.96 and 25.00 ton/fad., respectively.

Sugar beet quality:

Results in Table 12, revealed that the effect of interactions between sugar beet cultivars and weed control treatments caused significant increases in sucrose% and purity% in 2016/17 season. The interactions between sugar beet cultivars with weed control treatments on the two characteristics could be arranged in descending order according to their increasing on sucrose% in the following order; Lilly cultivar and Goltix at 2 L/fad. by 19.3%, Lilly cultivar and Harness at 0.75 L/fad. by 18.5, Glorius cultivar and unweeded check by 18.2%, Glorius cultivar and Goltix at 2 L/fad. by 18.1% and Lilly cultivar and unweeded check by 18.1% compared with the interaction between Cleopatra cultivar and unweeded check (16.9%). Meanwhile, the interactions between the two studied characteristics could be arranged in a descending order according to their increasing on purity% in the following order; Cleopatra cultivar and Goltix plus at 1.5 L/fad. by 82.5%, Lilly cultivar and Goltix plus at 1.5 L/fad. by 82.4%, Lilly cultivar and Goltix at 2 L/fad. by 80.8% and Glorius cultivar and Goltix at 2 L/fad. by 80.3%, compared to the interaction between Cleopatra cultivar and unweeded check (71.1%). The behavior of Glorius and Lilly cultivars under unweeded check tend to increase sucrose and purity percentage compared to Cleopatra cultivar under unweeded check. Also Cleopatra cultivar gave the lowest values sucrose and purity percentage compared the two others cultivars under all weed control treatments.

Determination economic feasibility of sugar beet cultivars and weed control treatments for sugar beet productivity:

Results in table (13) show four economic criteria to asses economic feasibility for sugar beet productivity being; (1) sugar beet production (inputs) which include total fixed and variable costs L.E. (land preparation, sowing, fertilization, irrigation, insect control, harvesting

and transportation) in addition; to the variable cost of weed control treatments, (2) gross income (outputs) L.E., (3) net benefit L.E. and (4) benefit/ cost ratio L.E. The lowest total cost of weed control treatments was with unweeded check because no cost were spend for weed control. The total cost, gross income, net benefit and benefit cost ratio values were the lowest under unweeded check condition which estimated by 10700 L.E., 6531.5 L.E. -4168.5 and -39%, respectively, in 2015/16 season and the respective values by 10700 L.E., 5153.5 L.E., - 5546.5 L.E. and -52% L.E. in 2016/17 season. This mean that the farmer will lose approximately 50% of all one Egyptian pound spent in sugar beet production due to the severe weed competition for sugar beet. Meanwhile, the highest total cost, gross income, net benefit and benefit cost ratio belong to Lilly cultivar with the application Cross herbicide were 11500.0, 21169.5 L.E., 9669.5 L.E. and 0.84 L.E., respectively, in the 2015/16 season and by 11500.0, 17971.5, 6471.5 L.E. and 0.56 L.E. respectively, in 2016/17 season. Meanwhile, total cost, gross income, net benefit and benefit/cost ratio belong to Glorius cultivar with Cross herbicide by 11500.0, 18459, 6959 and 0.61 L.E., respectively, in 2015/16 season and by 11500.0, 18608.5, 7108.5 and 0.62, respectively in 2016/17 season. On the other hand, hand hoeing twice had total cost, gross income, net benefit and benefit cost ratio values by 11500, 13538.5, 2038.5 and 0.18 L.E., respectively, in 2015/16 season, the previous respective values by 11500, 11998, 489 and 0.04 L.E., in 2016/17 season. The results are confirmed with those obtained by (Soltani *et al*., 2018) who stated that the high economic return on investment in weed management and highlighted the importance of continued weed science research for sustaining high crop yield and profitability of sugar beet production in North America. The same conclusion was mentioned by (Miller and Fornstorm, 1989) was mentioned that a large portion of the cost of sugar beet production is spent in obtaining an adequate stand of weed-free sugar beets. Careful selection and application of herbicides and planting to stand can reduce costs considerably very good weed control can be obtained with complementary preplant incorporated/post-emergence herbicide treatments.

Table 12. Effect of interaction between sugar beet cultivar and weed control treatments on sucrose % and Purity % in 2016/17 season.

Cultivars	Weed control treatments		Sucrose %	Purity %
	Trade name (rate/fad.)	Active ingredient (g/fad.)		
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	16.09	73.38
	Goltix 2 L	Met. 1400	18.07	80.30
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	17.26	78.61
	Harness 0.75 L	Ace. 630	17.15	79.51
	Hand hoeing twice		17.62	76.71
	Unweeded check		18.23	78.73
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	16.89	82.40
	Goltix 2 L	Met. 1400	19.34	80.81
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	18.06	78.74
	Harness 0.75 L	Ace. 630	18.45	79.54
	Hand hoeing twice		17.00	75.11
	Unweeded check		18.06	79.96
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	17.71	82.45
	Goltix 2 L	Met. 1400	15.43	78.60
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	16.90	78.64
	Harness 0.75 L	Ace. 630	15.37	66.09
	Hand hoeing twice		16.97	79.46
	Unweeded check		16.94	71.05
LSD 0.05			0.017	0.073

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Table 13. Determination economic for weed control treatments in sugar beet during 2015/16 and 2016/17 seasons**.**

Cultivars	Weed control treatments		2015/16 season				2016/17 season			
	Trade name (rate/fad.)	Active ingredient (g/fad.)	Total cost L. E.	Gross income L.E.	Net benefit L.E.	B/C	Total cost L. E.	Gross income L.E.	Net benefit L.E.	B/C
Glorius	Goltix plus 1.5 L	Met. 525+ eth. 225	11200.0	18381	7181	0.64	11200.0	17120	5920	0.53
	Goltix 2 L	Met. 1400	11200.0	14637	3437	0.31	11200.0	14091	2891	0.26
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	11500.0	18459	6959	0.61	11500.0	18608.5	7108.5	0.62
	Harness 0.75 L	Ace. 630	10900.0	17529.5	6629.5	0.61	10900.0	13467	2567	0.24
	Hand hoeing twice		11500.0	18160	6660	0.58	11500.0	19603	8103	0.70
	Unweeded check		10700.0	8299.5	-2400.5	-0.22	10700.0	7032	-3668	-0.34
Lilly	Goltix plus 1.5 L	Met. 525+ eth. 225	11200.0	17120	5920	0.53	11200.0	15917.5	4717.5	0.42
	Goltix 2 L	Met. 1400	11200.0	13460.5	2260.5	0.20	11200.0	9924.5	-1275.5	-0.11
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	11500.0	21169.5	9669.5	0.84	11500.0	17971.5	6471.5	0.56
	Harness 0.75 L	Ace. 630	10900.0	19915	9015	0.83	10900.0	17185	6285	0.58
	Hand hoeing twice		11500.0	18205.5	6705.5	0.58	11500.0	13233	1733	0.15
	Unweeded check		10700.0	9885.5	-814.5	-0.08	10700.0	5829.5	-4870.5	-0.46
Cleopatra	Goltix plus 1.5 L	Met. 525+ eth. 225	11200.0	15683.5	4483.5	0.40	11200.0	16125.5	4925.5	0.44
	Goltix 2 L	Met. 1400	11200.0	7825	-3375	-0.30	11200.0	9853	-1347	-0.12
	Cross 2.5 kg	Phe. 162.5+ eth. 162.5+ met.700	11500.0	18036.5	6536.5	0.57	11500.0	14019.5	2519.5	0.22
	Harness 0.75 L	Ace. 630	10900.0	14065	3165	0.29	10900.0	12160.5	1260.5	0.12
	Hand hoeing twice		11500.0	13538.5	2038.5	0.18	11500.0	11998	498	0.04
	Unweeded check		10700.0	6531.5	-4168.5	-0.39	10700.0	5153.5	-5546.5	-0.52

Met.=metamitron, eth.=ethofumesate, phe.=phenmedipham, ace.=acetochlor.

Discussion

From the previous results the average yield losses in sugar beet yield due to weed interference through the whole growing season of sugar beet at weed infestation with Cleopatra and unweeded check by 20.07 and 11.19 ton/fad caused yield losses by 55.9 and 59.5% with economic loss 4168.5 and 5546.5 L.E./fad in 2015/16 and 2016/17 seasons, respectively (Tables 9, 13). Similar results were obtained by (Soltani *et al*., 2018). Magidi (2017) mentioned that the weed competition decreased root yield of sugar beet up to 84%. This is due to competition of weeds associated of sugar beet plants than the yield of hoeing treatment. These results emphasized the importance of weed elimination for the whole season to sustain sugar beet productivity. On the other hand, the mechanical weed control is usually done in the small farms and chemical weed control can be used in big farms. Both Lilly and Glorius cultivars had lower yield losses than Cleopatra cultivar that it may be attributed to closed canopy which shed soil surface and light penetration arrived to weeds and consequently arrest weed growth than Cleopatra cultivar it had an open canopy. Also, used weed control by single herbicides were not sufficient and there is a need for ready-made herbicides consist of two or three active ingredients to broaden weed control spectrum. These mixtures, should be added in the earlier period to minimize weed competition to sugar beet for expand and extent period weed control.

Recent results show that the efficiency of Cross and Goltix plus as ready- made herbicides led to weed control expanded to 120 days and exceeded hand hoeing twice where dominant weed species in the two experiments were sweet clover, dentated dock, lambsquarter, watercress, cheese weed and corn spurry as annual broad leaved and rabbit foot grass and lesser canary grass as annual grassy weeds can be controlled by these studied herbicides.

CONCLUSION

Thus, it's preferable to improve integrated weed management packages by growing strong competitor cultivars such as Glorius or Lilly with read- made herbicides application as post emergence i.e. Cross (phenmedipham + ethofumesate + metamitron) at 2.5 kg/fad. and Goltix plus (metamitron + ethofumesate) at 1.5 L/fad both differ in mode of action. These interactions were excellent alternative to hand hoeing twice from view point of prolonged weed control associated with broaden weeds spectrum and delay the appearance of weed resistance to herbicides applied in sugar beet.

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أداء بعض أصناف بنجر السكر تحت ظروف مكافحة الحشائش الحولية

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المعمل المركزي لبحوث الحشائش – مركز البحوث الزراعية بالجيزة – مصر

يأتي محصول بنجر السكر في المرتبة الرابعة بعد محصول القمح والبرسيم وذلك من حيث المساحة في محافظة دمياط حيث أن التربة طينية متأثرة بالملوحة. ويتميز بنجر السكر ببطء نموه في مراحله الأولي وضعف منافسته للحشائش كإجهاد حيوي مما يؤثر علي إنتاجية بنجر السكر بشدة مما يتطلب إدارة متكاملة لمكافحة الحشائش والتي تشتمل على زراعة اصناف ذات نمو قوي وقدرة تنافسية عالية للحشائش , مع استخدام مبيدات حشائش ذات مدي واسع لمقاومة الاجهادات الحيوية والغير حيوية للحصول علي أعلي إنتاجية للمحصول. ولهذه الأسباب فقد تم اجراء تجربتين حقليتين بمحطة البحوث الزراعية بالسرو- محافظة دمياط - مركز البحوث الزراعية - مصر في الموسمين الشتويين ١٦/٢٠١٥ و ١٧/٢٠١٦ وذلك لدراسة امكانية التكامل بين ثلاثة اصناف من بنجر السكر مختلفة في طبيعة نموها وهي أصناف جلوريا وليللي وكليوباترا وذلك بالتكامل مع ست معاملات لمكافحة الحشائش وهي الجولتكس بلس بمعدل ١,٥ لتر/ف والجولتكس بمعدل ٢لتر/ف والكروس بمعدل ٢,٥ كجم/ف رشاً بعد الانبات والهارنس بمعدل٧٥, لتر/ف رشاً بعد الزراعة وقبل الري بالإضافة الي معاملة العزيق مرتين ومعاملة المقارنة لمعرفة تأثير ذلك علي الحشائش المصاحبة لمحصول بنجر السكر وانتاجيته مع دراسة الجدوى الاقتصادية لهذا المحصول. وكان التصميم المستخدم في التجربة هو نظام القطع المنشقة مرة واحده في اربعة مكررات. وكانت الاصناف في القطع الرئيسية ومعاملات مكافحة الحشائش في القطع الشقية وكانت مساحة القطع التجريبية هي ٢١م^2 في أرض طينية متأثرة بالملوحة. وتوضح أهم النتائج المتحصل عليها من خلال الدراسة أن كلا من صنفي بنجر السكر جلوريا وليللي ذات النمو الكثيف وأحدثت خفضا في الحشائش الحولية الكلية بنسبة ٧٣,١% و ٣٥,٨% في الموسم الاول و ٤٧,٦% و١٥,٧% في الموسم الثاني على التوالي عند ١٢٠ يوم من الزراعة وصاحب ذلك زيادة في محصول جذور بنجر السكر بمقدار ٢٨,٣% و ٣٤,٥% في الموسم الاول و ٣٢,٥% و ١٧% في الموسم الثاني مقارنة بالصنف كليوباترا ذات النمو المفتوح. بينما أظهر استخدام مبيد كروس بمعدل ٢,٥ كجم/ف والمكون من ثلاث مواد فعالة تفوقا كبيرا علي المبيدات المستخدمة في التجربة والعزيق اليدوي مرتين وذلك في مكافحة الحشائش الحولية الكلية بمقدار ٨٥,٥% و ٧٨,٦% وممتدة حتي ١٢٠ يوم من الزراعة وصاحب ذلك زيادة في محصول جذور بنجر السكر بمقدار ١٥١,٦% الحولية الكلية و٢١٧% مقارنة بمعاملة المقابلة (بدون معاملة) كما حقق العزيق اليدوي مرتين مكافحة للحشائش الحولية الكلية بمقدار ٧٦,٨% و٦٠,٦ وزيادة في محصول جذور بنجر السكر بمقدار ١١٥,٩% و١٧٨,٦% مقارنة بالغير معامل. ومن ناحية اخري فقد احدث التكامل بين صنفي جلوريا وليللي ذواتا النمو القوى مع استخدام مبيد كروس مكافحة للحشائش الحولية الكلية بمقدار ٩٠,٥% و٨٧,٢% على التوالي في موسم ١٦/٢٠١٥ و٧ ,٨٨% و٤ ,٧١ على التوالي وزيادة في محصول جذور بنجر السكر بمقدار٢١٥,٦ و ٢٦,٦% على التوالي في الموسم الاول وبمقدار٣٢,٩ و٣٠٨,٦% على التوالي في الموسم الثاني وصاحب ذلك زيادة في دخل المزارع من انتاجية بنجر السكر بالمقارنة مع المعاملة بدون معاملة.