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RESEARCH ARTICLE

Effect of the Integrated Weed Control Practices on Sugar Beet Yield, Quality and Associated Weeds

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Abstract
Two-years field trial (2017/18 and 2018/19) was conducted at the Experimental Farm, National Research Centre El-Behaira Governorate, Egypt to compare different herbicidal combinations with different doses on sugar beet yield traits and associated weeds. Sixteen weed control treatment combinations were applied to test their efficiency on sugar beet yield and quality. To form these combinations two broadleaves herbicides (Tigro and Betasana-Trio) were combined with a narrow weed herbicide (Select super) or with the hand weeding treatment. The results showed that Betasana-Trio combination at the lower dose of application 0.675 l fed^{-1}(fed^{-1} = feddan = 4200 m^2) combined with Select Super at 0.375 l fed^{-1} with or without hand weeding as well as Betasana-Trio at 0.9 l fed^{-1} combined with hand weeding or Select Super at 0.5 l fed^{-1} caused high eradication percentages of the total fresh and dry weight of weeds as well as total number of weeds m^{-2} (>90%). The highest sugar beet yield resulted from the combination of Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1}, which gave the greatest sugar yield fed^{-1}. Although the combination Betasana-Trio at 0.9 l fed^{-1} + Select Super at 0.5 l fed^{-1} gave the greatest gross sugar %, it could not achieve the highest sugar yield fed^{-1}.

Key words: Herbicides; sugar beet productivity; sugar quality; weed competition; weed management

Introduction

Sugar beet (*Beta vulgaris* L.) ranks as the second most important sugar crop worldwide after sugar cane. (*Saccharum ofcinarum* L.) (Brar *et al*., 2015). Sugar beet is a temperate crop and its root contains a high amount of sucrose (Paul *et al*., 2019). The total global cultivated acreage of about 4.4 mega tons (Mt) produces approximately 253 Mt of sugar beet roots that provides ~ 30% of the gross world's requirements of white sugar (FAO 2022). However, sugar beet production worldwide is frequently faced ecological challenges (Abd El-Mageed *et al*., 2022; Makhlouf *et al*., 2022) and biotic stresses such as weeds. It is well known that weeds interfere with crop plants causing serious impacts either in the competition for light, water, nutrients and space or in the allelopathy. Weeds suppression by shading only begins after the canopy of sugar beet leaves grown over the rows and early coverage of field. Faster growth of weeds is disadvantageous for light and hence photosynthesis needed for sugar beet plants.

Through this light deprivation less energy is available to crop plant for metabolic production and hence growth, yield and quality of sugar beet will be reduced. In addition, weeds with branched, vigorous root systems inhibit the development of sugar beet plants through severe nutrition deprivation. Competition between sugar beet and annual weeds could be responsible for sugar yield reductions of 25-100% (Poorazar and Ghadiri, 2001). Weed control in crops is mainly based on the use of herbicides because they are efficient and easily applied (Lodovichi *et al*., 2013). The use of herbicides may reduce yield losses, as herbicides can reduce the weed infestation (Mehmeti, 2004). Majidi *et al*. (2011) showed that using a combination of broad-leaved herbicides caused weeds to be controlled and root yield to be increased. Weed control is decisive and one of the most difficult agricultural arrangements in sugar beet growing because of low crop interference with weeds (Jursík *et al*., 2008). The evaluated herbicidal control is a very effective strategy for weed control in sugar beet. 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. Frequently, few herbicides may have to be combined sequentially or as tank mixed to achieve adequate broad-spectrum weed control. Hand hoeing still the conventional weed control practice in sugar beet in Egypt. In recent years, the hand labor is becoming scarce and their wages have been increased. However, the manual weeding could not be perfectly provided. This in turn presents to view the needs for another reasonable alternative. Herbicide treatment alone surpassed some hand hoeing treatments. In this respect, Abo El-Hassan (2010) found that root length, root diameter, root weight, top fresh weight, top yield, root yield, sugar yield of sugar beet were significantly affected by weed control treatments. Also, Tagour *et al*. (2012) found that two hoeing with mulching gave the highest values of tops, roots, biological and sugar yields.

The current research hypothesized that using different herbicide combinations with different doses will have better efficiencies for controlling weeds than conventional methods, hence improving sugar beet yield and quality. Therefore, this study aimed to assess the effect of diversified broad and narrow leaf herbicides types and combination between them compared to the common practices (hoeing) on weed growth, sugar beet yield and quality.

Materials and methods

During the winter seasons of 2017/18 and 2018/19, two field experiments were conducted at the Experimental Farm, National Research Centre El-Behaira Governorate, Egypt (30.30° N, 30.18° E and 21 m above sea level).The experimental soil was sandy with a pH and EC of 8.3 and 0.38 dS m^{-1}, respectively. The experiments were conducted to compare different herbicide combinations with different doses on sugar beet yield characters and associated weeds. Two broad leave weeds herbicides (Tigro and Betasana-Trio) were combined with a narrow weed herbicide (Select Super) or with the hand weeding treatment. The treatments were as follow:

1. Tigro 1.0 l fed^{-1}
2. Tigro 0.750 l fed^{-1}.
3. Tigro 1.0 l fed^{-1} + Select Super 0.5 l fed^{-1}.
4. Tigro 1.0 l fed^{-1} + Select Super 0.375 l fed^{-1}.
5. Tigro 0.750 l fed^{-1} + Select Super 0.375 l fed^{-1}.
6. Tigro 1.0 l fed^{-1} + HW.
7. Tigro 0.750 l fed^{-1} + Select Super 0.375 l fed^{-1} + HW.
8. Betasana-Trio 0.9 l fed^{-1}.
9. Betasana-Trio 0.675 l fed^{-1}.
10. Betasana-Trio 0.9 l fed^{-1} + Select Super 0.5 l fed^{-1}.
11. Betasana-Trio 0.9 l fed^{-1} + Select Super 0.375 l fed^{-1}.

12. Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1}.
13. Betasana-Trio 0.9 l fed^{-1} + HW.
14. Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1} + HW.
15. Hand weeding twice.
16. Unweeded control.

The herbicides were sprayed after sowing according to the stages indicated for each herbicide in Table 1. Sowing date was on 21st November 2017 and 2018 seasons. The Experimental design was a randomized complete block design (CRBD) in three replications.

Table 1. Common, trade and chemical names of used herbicides as well as, mode of action, rate and time of application.

Common name	Trade name	Chemical name	Mode of action	Rate of application fed^{-1}	Time of application
Ethofumesate	Betasana-Trio	Ethofumesate – 115g/l (11.5% w/w) Phenmedipham – 75g/l (7.65% w/w) Desmedipham- – 15g/l (1.55% w/w)	Classical Photosynthesis inhibitors	900 cm+900 cm	At the age of two real leaf on sugar beet and repeat treatment after 8 days
Phenmedipham	Tigro 27.4/EC	- 91g/l Desmedipham- 71g/l Ethofumesate – 112g/l	Classical Photosynthesis inhibitors	1.0 L	At the age of two real leaf on sugar beet
Clethodium	Select Super	(±)-2-[(E)-1-[(E)-3-chloroallyloxyimino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxycyclohex-2-enone	Lipid Biosynthesis inhibitors	500 cm	At the age of 2-4 real leaf of weeds

Studied Characters

Weed flora

A sample of weeds in 1 m^2 was taken from each experimental unit to determine the number and fresh weights of broad leave, narrow leave and total weeds. The eradication % of weeds was calculated as follows:

Eradication % (fresh weight m^{-2}) = (Weeds fresh weight of treatment – weeds fresh weight of unweeded control)/ weeds fresh weight of unweeded control x 100

Eradication % (fresh weight m^{-2}) = (Weeds dry weight of treatment – weeds dry weight of unweeded control)/ weeds dry weight of unweeded control x 100

Eradication % (No. of weeds m^{-2}) = (Weeds No. of treatment - weeds No. of unweeded control)/ weeds No. of unweeded control x 100

- Plant samples were taken from three replicates and 10 plants were taken from each experimental unit to estimate root characters involving root length (cm), root diameter (cm), root weight (g) and top weight per plant (g).

- Total chlorophyll content of sugar beet leaves were determined by SPAD value was determined at 90 days according to chlorophyll meter (SPAD-502, Minolta Camera Co., Osaka, Japan, Minolta Co., 1989).
- Yield per fed: Number of plants in the experimental unit area were counted and top and roots weights of 3*3.5 m were determined, then total yield was calculated.

Twenty roots from each plot were randomly taken to determine root quality and technological characteristics at Quality Control Laboratory, El-Nubaria Sugar Factory and El-Behera, Egypt. Sucrose % was determined using Saccharometer according to the method described in AOAC (2012). According to Cooke and Scott (1993) impurities (potassium (K), sodium (Na), and alpha amino nitrogen (α-amino N) were estimated. Moreover, juice purity using Eq. 1 was estimated (Cooke and Scott 1993). After that, sugar yield ha^{-1} was calculated using Eq. 2 as reported by Deviller (1988).

Juice purity % = (Extractable sugar % ⁄ sucrose %) × 100 (1)

Sugar yield (fed^{-1}) = Root yield (fed^{-1}) × extractable sugar % (2)

Statistical analysis

The analysis of variance was carried out using MSTATC Computer Software (MSTAT-C, 1988) after testing the homogeneity of the error by Bartlett's test. Combined analysis for both seasons was done. Means of the different treatments were compared using the least significant difference (LSD) at 5% level of probability.

Results and discussion

Effect of weed control treatments on weed traits

The dominant weed specious in the experiment included common sweet clover (*Melilotus indica* L.), wild beet (*Beta vulgaris* L.), Greater Ammi (*Ammi majus* L.) and London rocket (*Sisymbrium irio* L.) as broadleaved weeds as well as wild oat (*Avena fatua* L.) and ryegrass (*Lolium temulentum* L.) as narrow-leaved weeds. Several investigators reported that approximately 70% of weed species in sugar beet fields are mainly broadleaf annual such as redroot pigweed (*Amaranthus retroflexus*) (Weaver and Williams, 1980; Schwizer and May, 1993 and Heidari *et al*., 2007).

Data in Table 2 show weed flora of the two broad-leaved herbicides regardless herbicide combination. The two herbicides differed significantly in their effect on fresh weight of narrow leaf weeds and dry weight of broad, narrow and total weights as well as number of broad, narrow weeds m^{-2} after 90 days from sowing. The data showed that both herbicides were similar in the eradication of fresh, dry and total number of weeds / after 90 days from sowing Figure 1.

Table 2. Effect of broad leaved herbicides on weed characteristics

Herbicide	Weeds fresh weight ($g\ m^{-2}$)			Eradi-cation* %	Weeds dry weight ($g\ m^{-2}$)			Eradi-cation %	Weeds number m^{-2}			Eradi-cation %	~~SPAD~~
	Broad leaves	Narrow leaves	Total		Broad leaves	Narrow leaves	Total		Broad leaves	Narrow leaves	Total		
Tigro	83.9	131.0	215.0	77.0	14.4	32.5	43.8	97.0	36.5	32.4	68.9	79.8	~~46.8~~
Betasana-Trio	80.0	135.0	215.0	77.0	158.1	29.4	190.5	86.4	34.8	32.1	66.9	80.4	~~45.3~~
LSD 0.05	Ns	1.9	ns	-	2.2	0.5	1.7	-	7.4	5.1	ns	-	~~1.2~~

*relative to the unweeded control

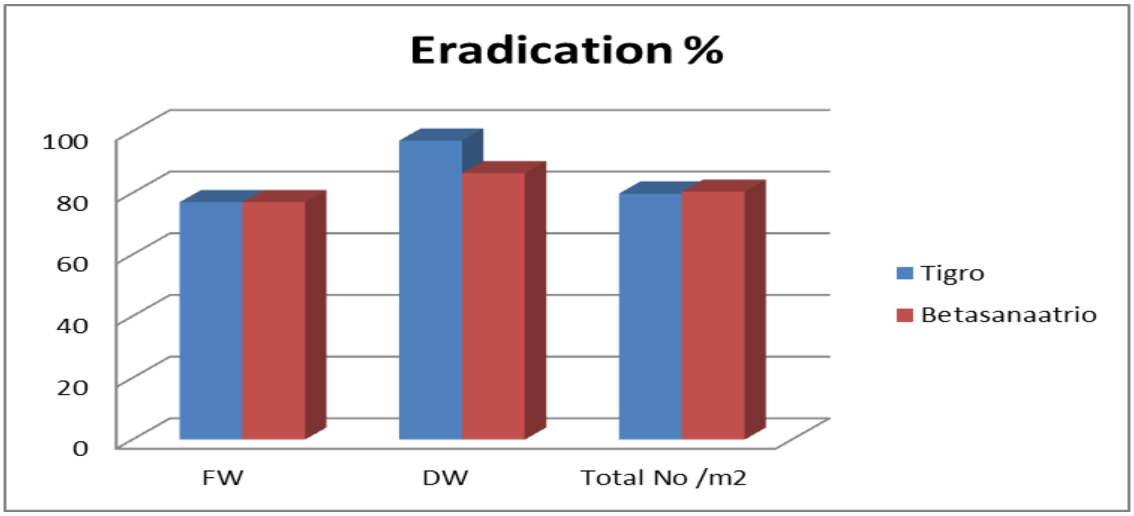

Figure 1. Effect of broad leaved herbicides on weed eradication

Data in Table 3 show that weed control treatments differed significantly in their effect on fresh and dry weight of broad, narrow and total weights as well as number of broad, narrow, and total number of weeds m^{-2} after 90 days from sowing. The data showed that Tigro at 0.750 l fed^{-1}, Betasana-Trio at 0.9 or at 0.675 l fed^{-1} sprayed twice could effectively and completely eliminate the broad-leaved weeds associated with sugar beet plants so the number or fresh and dry weights are nil. Also, the application of Tigro at the lower dose combined with the herbicide Select Super as well as Betasana-Trio combination at 0.900 l fed^{-1} with Select Super at 0.375 l fed^{-1} or one hand weeding or Betasana-Trio combination at 0.675 l fed^{-1} with Select Super at 0.375 l fed^{-1} could effectively and completely eliminate fresh and dry weeds weight of broad, narrow ant total fresh and dry weight of the associated weeds as well as weed numbers m^{-2}. Data in the same table show that Tigro combination at 1.0 l fed^{-1} with Select Super at 0.375 l fed^{-1} or with hand weeding resulted in the highest eradication percent of the total fresh, dry weights and total number of weeds of weeds m-2 > 90%. Similarly, Betasana-Trio combination at the lower dose of application combined with Select Super at 0.375 l fed^{-1} with or without hand weeding as well as Betasana-Trio at 0.9 l fed^{-1} combined with hand weeding or Select Super at 0.5 l fed^{-1} attained high eradication percent of the total fresh and dry weight of weeds as well as the total number of weeds m^{-2} (> 90%). Several investigators pointed out those individual sugar beet herbicides seldom have a wide enough weed control spectrum or sufficient residual activity to control all weeds (Abdollahi and Ghardiri, 2004). The optimization of herbicide application in the sugar beet protection system can be achieved by using mixtures of appropriate components and their selected doses. In this regard, application of acetolactate synthase (ALS) inhibiting herbicides achieved excellent efficacy on common sugar beet weeds (Gotze *et al*. 2018). Furthermore, Jursík *et al*. (2020) recorded that DELP herbicide completely controlled *Amaranthus retrofexus* L., *Echinochloa crus-galli* L., and *Chenopodium album* L. in sugar beet. Several studies demonstrated good weed control with reduced herbicide doses (Deveikyte and Seibutis, 2006; Kucharski, 2009 and Najafi *et al*., 2013). Moreover, Goleblowska and Domaradzki (2010) reported that a 50% and 67% dose of Betanal Progress + Goltix + Safari and Betanal Progress + Venzar + Safari consistently produced 94-97% weed annihilation. The half dose of herbicides reduced weed biomass significantly (Najafi *et al*., 2013).

Table 3. Effect of weed control treatments on weed characteristics

Weed control treatment	Fresh wt. broad leaves weeds m^{-2}	Fresh wt. Narrow leaves weeds m^{-2}	Total fresh wt. m^{-2}	Eradi-cation %	Dry wt. of broad weeds m^{-2}	Dry wt. of narrow weeds m^{-2}	Total dry wt. m^{-2}	Eradi-cation %	No. of Broad weeds m^{-2}	No. of narrow weeds m^{-2}	Total no. of weeds m^{-2}	Eradic-ation %
Tigro 1.0 l fed^{-1}	28.3	236.7	265.0	72.1	4.95	52.7	57.6	68.1	12.3	58.5	70.8	79.3
Tigro 0.750 l fed^{-1}	0.1	183.1	183.2	80.7	0.10	40.8	40.9	77.4	0.1	43.4	43.5	87.2
Tigro 1.0 l fed^{-1}+ Select Super 0.5 l fed^{-1}	0.1	20.5	20.6	97.8	0.10	4.6	4.7	97.4	0.1	4.9	5.0	98.5
Tigro 1.0 l fed^{-1} + Select Super 0.375 l fed^{-1}	0.1	238.1	238.2	74.9	0.10	53.0	53.1	70.7	0.1	56.4	56.5	83.4
Tigro 0.75 l fed^{-1} +Select Super 0.375 l fed^{-1}	42.5	86.1	128.6	86.4	7.33	19.2	26.5	85.3	18.5	20.5	39.0	88.8
Tigro 1.0 l fed^{-1}+ HW	39.1	34.7	73.8	92.2	6.75	7.8	14.5	92	17.0	15.1	32.1	90.8
Tigro 0.75 l fed^{-1}+ Select Super 0.375 l fed^{-1} + HW	13.9	0.1	14.0	98.5	2.45	0.1	2.5	98.6	6.1	0.1	6.2	97.9
Betasana-Trio 0.9 l fed^{-1}	0.1	229.0	229.1	75.9	0.10	51.0	51.1	71.7	0.1	54.3	54.4	84.0
Betasana-Trio 0.675 l fed^{-1}	0.1	77.7	77.8	91.8	0.10	17.4	17.5	90.3	0.1	18.5	18.6	94.3
Betasana-Trio 0.9 l fed^{-1} + Select Super 0.5 l fed^{-1}	0.1	0.1	0.2	99.9	0.10	0.1	0.2	99.9	0.1	0.1	0.2	99.9
Betasana-Trio 0.9 l fed^{-1} (twice) + Select Super 0.375 l fed^{-1}	0.1	300.1	300.2	68.4	0.10	66.8	66.9	63	0.1	71.1	71.2	79.1
Betasana-Trio 0.75 l fed^{-1} (twice) + Select Super 0.375 l fed^{-1}	87.9	221.7	309.6	67.4	15.09	49.4	64.4	64.4	38.2	52.6	90.7	73.2
Betasana-Trio 0.9 l fed^{-1} (twice) + HW	0.1	0.1	0.2	99.9	0.10	0.1	0.2	99.9	0.1	0.1	0.2	99.9
Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1}+ HW	0.1	0.1	0.2	99.9	0.10	0.1	0.2	99.9	0.1	0.1	0.2	99.9
HW Twice	40.7	27.9	68.6	92.8	7.02	6.26	13.28	92.7	17.74	6.66	24.4	92.6
Unweeded control	591.1	359.9	951	-	100.94	80.06	181	-	256.62	85.26	-	342.0
LSD at 0.05	17.33	18.69	17.65	-	11.36	3.83	10.79	-	7.53	5.07	7.02	-

Yield

Data in Table 4 show the single effect of the broad-leaved herbicides on sugar beet crop characteristics regardless herbicide combination. The two herbicides differed significantly in their effect on chlorophyll content expressed as SPAD value. The data showed that both herbicides were similar in the studied characters except root weight and length per plant.

Table 4. Effect of broad leaved herbicides on sugar beet yield characteristics.

Herbicide	SPAD value	Root Wt. (g)	Shoot yield (g)	Root length (cm)	Root diameter (cm)	Stand thousand plants fed^{-1}	Biological yield fed^{-1} (t)	Root yield fed^{-1} (t)	FW. yield fed^{-1} (t)
Tigro	46.8	354.0	104.0	28.9	8.0	37.3	32.7	25.2	7.5
Betasana-Trio	45.3	457.0	116.0	30.1	8.3	36.2	37.0	28.8	8.2
LSD at 0.05	1.2	49.1	ns	1.25	ns	ns	Ns	ns	ns

Effect of different herbicide combinations on sugar beet traits

Chlorophyll content

The chlorophyll content data expressed as SPAD reading indicate that there is no clear tendency of the tested herbicides in their effect on chlorophyll content of sugar beet leaves (Table 5). However, Tigro combination at 1.0 l fed^{-1} with Select Super at 0.375 l fed^{-1} or with hand weeding and Betasana-Trio at the higher dose of application (1.0 and 0.9 l fed^{-1}) recorded the greatest chlorophyll content in sugar beet leaves as compared with the other weed control treatments, whereas the lowest chlorophyll content was recorded by the unweeded control. There were no significant differences among the other herbicidal treatments and hand weeding twice in SPAD values. Although the mode of action of the most of these herbicide combinations is a classical photosynthesis inhibitor but similarly they possessed higher selectivity and did not affect the sugar beet leaf chlorophyll content.

Yield traits

Data in Table (5) show significant differences in root yield plant^{-1}. The greatest significant root yield plant^{-1} was recorded when the herbicide Betasana-Trio was applied at the lower dose tested (0.675 l fed^{-1}) combined with hand weeding. The differences among other weed control treatments on root and shoot yields plant^{-1} were insignificant. The greatest shoot yield plant-1 was reported when Betasana-Trio was applied at the lower dose tested (0.675 l fed^{-1}) combined with hand weeding. Data in the same table show significant differences among weed control treatments in their effect on sugar beet root length and diameter. The greatest significant root length was recorded when the herbicide Tigro was applied at the lower dose tested (0.750 l fed^{-1}). The difference between other weed control combinations and hand weeding twice in root length was insignificant in this criterion. The greatest root diameter was recorded by Betasana-Trio when applied alone at 0.675 l fed^{-1} or combined with Select Super at 0.375 l fed^{-1}. The greatest top weight fed^{-1} was reported when Tigro was applied at 1.0 l fed^{-1} combined with Select Super at 0.375 l fed^{-1} or when Betasana-Trio was applied alone at 0.675 l fed^{-1} or combined with Select Super at 0.375 l fed^{-1} without significant difference with the hand hoeing twice treatment. The difference among other treatments were insignificant in top weight fed^{-1}. From the same Table (13), there were significant differences among weed control treatments in root and biological yields fed^{-1}. The data of root and biological yields fed^{-1} took similar tendency and the greatest significant root yield fed^{-1} was recorded when the herbicides Tigro was applied at 1.0 l fed^{-1} combined with Select Super at 0.375 l fed^{-1} or when Betasana-Trio was applied alone at 0.675 l fed^{-1} or combined with Select Super at 0.375 l fed^{-1} followed by hand weeding twice without significant differences. Soroka and Gadzhieva (2006) reported that when sugar beet and weeds grow together 30 days after emergence of sugar beet, the root yield is decreased by up to 45%). Also, Majidi *et al*. (2011) reported that the use of herbicides may reduce yield losses, as herbicides can reduce the weed infestation. Mehmeti (2004) showed that using a combination of broad-leaved herbicides caused weeds to be controlled and root yield to be increased.

Table 5. Effect of different herbicide combinations on sugar beet yield traits.

Treatment	SAPD value	Root length (cm)	Root diameter (cm)	Root weight (g)	Shoot weight (g)	Root yield fed^{-1} (ton)	Shoot Yield fed^{-1} (ton)	Biological yield fed^{-1} (ton)
Tigro 1.0 l fed^{-1}	46.5	30.0	7.0	301.1	84.1	24.1	6.3	30.4
Tigro 0.750 l fed^{-1}	43.4	36.7	8.6	597.6	72.1	33.1	3.9	37.0
Tigro 1.0 l fed^{-1} + Select Super 0.5 l fed^{-1}	49.1	34.5	9.4	474.1	115.4	36.2	8.7	44.9
Tigro 1.0 l fed^{-1} + Select Super 0.375 L fed^{-1}	54.8	33.3	8.9	411.5	193.1	31.6	14.1	45.7
Tigro 0.750 l fed^{-1} + Select Super 0.375 l fed^{-1}	46.4	28.2	7.2	162.9	63.1	13.3	5.2	18.5
Tigro 1.0 l fed^{-1} + HW	51.3	24.3	7.8	184.2	43.8	13.9	3.2	17.1
Tigro 0.750 l fed^{-1} + Select Super 0.375 l fed^{-1} + HW	48.4	28.5	7.3	293.1	101.8	23.1	8.0	31.1
Betasana-Trio 0.9 l fed^{-1} (twice)	52.8	23.7	6.6	272.8	81.6	20.6	6.7	27.3
Betasana-Trio 0.675 l fed^{-1} (twice)	43.5	33.3	9.3	535.2	100.1	34.7	7.1	41.8
Betasana-Trio 0.9 l fed^{-1} (twice) + Select Super 0.5 l fed^{-1}	47.8	31.0	8.3	388.5	129.7	32.5	11.6	44.1
Betasana-Trio 0.9 l fed^{-1} (twice) + Select Super 0.375 l fed^{-1}	45.5	29.7	9.4	530.8	116.8	27.0	1.4	28.4
Betasana-Trio 0.750 l fed^{-1} (twice) + Select Super 0.375 l fed^{-1}	45.4	26.7	7.7	270.6	117.2	18.3	8.0	26.3
Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1} + HW	46.5	33.0	9.8	816.0	245.3	39.5	12.6	52.1

Betasana-Trio 0.9 l fed^{-1} (twice) + HW	45.5	28.7	7.9	417.8	106.1	30.1	7.6	37.7
Control	39.4	24.7	7.4	305.8	117.3	19.5	7.7	27.2
HW twice	45.2	30.7	8.7	458.1	145.9	31.52	10.28	41.8
LSD at 0.05	4.85	11.75	3.26	432.1	NS	4.12	10.7	15.87

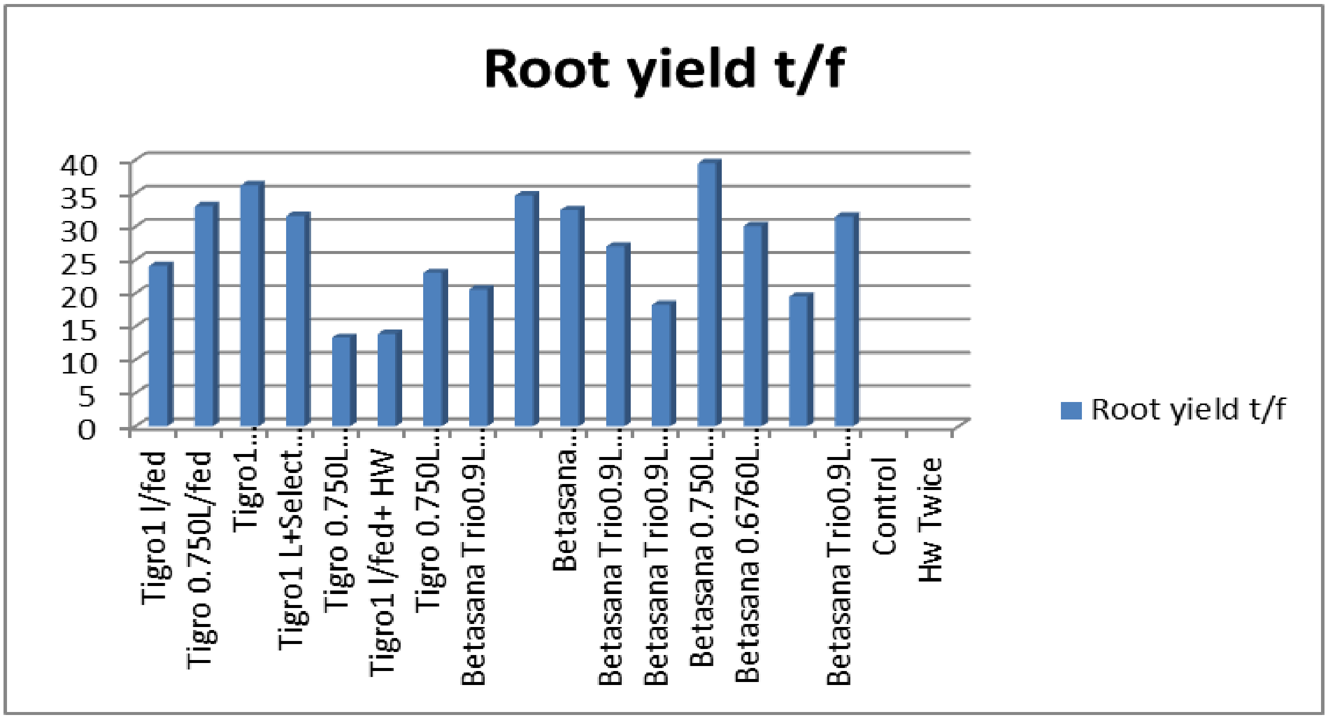

Figure 2. Effect of different herbicide combinations on sugar beet root yield fed^{-1} (t)

Effect of weed control treatments on chemical composition of roots and sugar yield

Data presented in Table (6) show that weed control treatments exhibited clear differences in sugar beet quality parameters, which affected sugar extraction. The highest sugar beet yield resulted from the combination of Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1} which gave the highest sugar yield fed-1. Although the combination Betasana-Trio 0. 900 +Select Super 0.5 l fed^{-1} contained the greatest gross sugar % but it could not achieve the highest sugar yield fed-1. Sugar beet plants treated with (Tigro 1.0 l fed^{-1}) possessed the highest purity parameters (increased Qz but it did not contain the lowest soluble non-sugars (potassium, sodium and α-amino nitrogen content of beet). In this respect, Dale *et al*. (2005) found that white sucrose produced per unit area did not differ among post herbicide treatments and sugar and non-sugar contents were not affected by the herbicide treatments. Sugar yield data followed the root yield data because the herbicide did not have any influence on the amount of sugar beet root quality parameters (Dale *et al*., 2006).

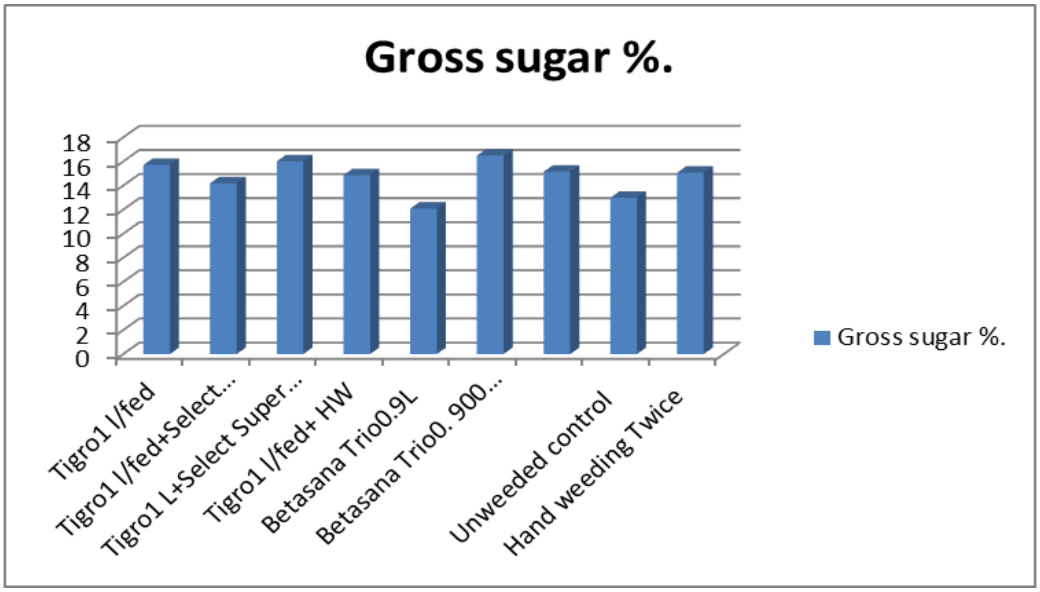

Figure 3. Effect of different weed control treatments on gross sugar %

Table 6. Effect of different weed control treatments on sugar beet quality.

Treatment	Gross sugar %	Juice purity % (Qz)	K	Na	α-amino	Sugar yield fed^{-1} (t)
Tigro 1.0 l fed^{-1}	15.70	80.02	4.16	3.03	4.05	3.78
Tigro 1.0 l fed^{-1} + Select Super 0.5 l fed^{-1}	14.18	78.91	3.72	2.55	5.85	5.13
Tigro 1.0 l fed^{-1} + Select Super 0.375 l fed^{-1}	16.00	79.93	3.78	3.11	5.94	5.06
Tigro1.0 l fed^{-1} + HW	14.86	78.63	3.91	3.06	5.26	2.06
Betasana-Trio 0.9 l fed^{-1}	12.08	74.28	3.65	3.26	4.76	2.48
Betasana-Trio 0.9 l fed^{-1} + Select Super 0.5 l fed^{-1}	16.48	74.99	4.37	3.07	5.62	5.35
Betasana-Trio 0.675 l fed^{-1} + Select Super 0.375 l fed^{-1}	15.14	79.09	3.80	3.40	4.32	5.98
Unweeded control	12.98	69.77	3.85	5.46	4.70	2.53
Hand weeding Twice	15.06	78.53	4.64	3.00	3.40	4.75

Conclusion

It could be concluded that the herbicide combinations of Tigro at the lower dose combined with the herbicide Select Super as well as Betasana-Trio combination at 0.900 l fed^{-1} with Select super at 0.375 l fed^{-1} or one hand weeding or Betasana-Trio combination at 0.675 l fed^{-1} with Select super at 0.375 l fed^{-1} could effectively and completely eliminate fresh and dry weeds weight of broad, narrow ant total fresh and dry weight of the associated weeds as well as weed numbers m^{-2}.

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