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Productivity and Quality of Sugar Beet as Affecting by Sowing Methods, Weed Control Treatments and Nitrogen Fertilizer Levels

[1]S.E. Seadh, [1]A.N. Attia, [1]E.M. Said, [2]Samia S. El-Maghraby and [2]M.E.M. Ibrahim
[1]Department of Agronomy, Faculty of Agriculture, Mansoura University, Egypt
[2]Sugar Crops Research Institute, Agriculture Research Center, Giza, Egypt

Abstract: Two field experiments were carried out at Kafr El-Hamam Research Station, Zagazig district, Sharkia Governorate, Agricultural Research Center, Egypt, during 2008/2009 and 2009/2010 seasons to study the effect of sowing methods (manual and mechanical), weed control treatments (one hoeing, Goltix 70 WG (metamitron), Goltix+one hoeing and two hoeing) and nitrogen fertilizer levels (60, 80 and 100 kg N/fed) on yield, its components and quality of sugar beet cv. Hanrike. The obtained results could be summarized as follows; Mechanical sowing method of sugar beet significantly surpassed the traditional sowing method in root and foliage fresh weights/plant, root/top ratio, root length and diameter, root, top and sugar yields/fed in both seasons. Sowing methods showed significant effect on TSS, sucrose and purity percentages in both seasons, except purity% in the second season. Controlling weeds by two hand hoeings significantly recorded the highest values of root, top and sugar yields/fed and its components and purity percentage in both seasons. However, the highest percentages of TSS and sucrose were achieved from controlling weed by one hand hoeing in both seasons. Fertilizing sugar beet plants with 100 kg N/fed significantly increased yields and its components and markedly recorded the highest values in both seasons. From the obtained, it can be concluded that sowing sugar beet using mechanical sowing method (planter machine), controlling weeds by hand hoeing and mineral fertilizing with 100 kg N/fed could be recommended in order to maximize its productivity and quality under the environmental conditions of Sharkia Governorate, Egypt.

Key words: Sugar beet, *Beta vulgaris* L., sowing methods, weed control treatments, nitrogen fertilizer levels, yield, quality

INTRODUCTION

After sugar cane, sugar beet is considered the second important sugar crop in Egypt and also in many countries in the world. In Egypt, sugar beet crop has an important position in crop rotation as winter crop in the fertile soils and also in poor and new reclaimed soils. Sugar beet is considering from the most important cash crops in the rotation, moreover industrial, forage and new reclaimed soils crop. Developing high yielding varieties and its high demand for agricultural practices and other production input is necessary. Thereby, sowing method, weed control and nitrogen fertilizer levels are among factors that enhance sugar beet productivity.

Producers must try to use an optimum sowing methods which is considered to be one of the most important elements of sugar beet production. There are a few investigations with respect to the effect of sowing methods on sugar beet productivity. In this concern; Zahoor *et al.* (2007) showed that planting methods significantly affected the root and foliage weights, root/top ratio, root and top yields/ha of sugar beet crop. El-Geddawy *et al.* (2008) showed that mechanical sowing of sugar beet (planter technique) increased root and sugar yields and its components as compared with traditional method (manual sowing). El-Maghraby *et al.* (2008) reported that sowing of sugar beet at a laser leveled soil+deep ploughing gave a significant increase in root length, root diameter in comparison to other treatments. Sarauskis *et al.* (2010) revealed that highest root yield (79.1 t ha^{-1}) was resulted from using the rotary harrow or rotovator as compared with sowing was conventional drilling.

Sugar beet plants are characterized by their slow rate of growth during the early stages, i.e., from emergence to thinning during which they may be heavily infested with weeds. So, the final stand of beet plants and hence their yield are reduced. Therefore, weed control in sugar beet fields must be to achieved for high growth and sugar yield. Khan *et al.* (2000) found that the most effective treatment in controlling weeds in sugar beet fields and increasing root and sugar yields was application of Goltix

Corresponding Author: S.E. Seadh, Department of Agronomy, Faculty of Agriculture, Mansoura University, Egypt

at rates of 3.52 and 4.00 kg ha^{-1} as compared with 1.5 or 2.0 L ha^{-1} of Dual. Wiltshire *et al.* (2003) pointed out that in order to minimize competition between sugar beet and weeds it must be precise hand hoeing beside band spraying with herbicides as compared with use herbicides only or hand weeding only. Kristek *et al.* (2004) showed that Hand hoeing decreased total number of weeds to 2.9 weeds/m^2, repeated herbicides application resulted 6.3 weeds/m^2 and once herbicides control resulted 9.1 weed/m^2 as compared with without protection application which resulted 83.2 weeds/m^2. Deveikyte (2005) revealed that superior root yield and quality were obtained with hand weeding, this treatment increased the yield by 13.4% and reduced the amount of non-sugar components by 1.6-20.0% as compared with herbicide application. Melander *et al.* (2005) found that in low external input and organic systems, strategy that involved cultural weed management by weed harrowing and inter row hand hoeing provided promising results. Olsson (2008) concluded that using the normal dose of Goltix [metamitron] (0.65 L ha^{-1}), Betanal [desmedipham] (1.0 L ha^{-1}) and Tramat in oil (0.1 L ha^{-1}) gave the best weed control without significant reduction in sugar yield under normal weather conditions. Sugar yield after treatment with half the amount of the same mixture of herbicides reached the level achieved after normal dosing, while double dosing resulted in a 5% lower yield. Domaradzki (2009) studied some herbicide mixtures contained Betanal Progress 274 OF, Safari 50 WG and Adiuvant Trend 90 EC and additionally supplemented with Goltix 70 WP, Flirt 460 SC, Venzar 80 WP or Lontrel 300 SL. He reported that applying mixtures of herbicides excreted high efficiency in weed control amount by 93.7-97.3%.. Armstrong and Sprague, 2010 found that application Glyphosate when weeds averaged 15 cm in height decreased root yield. Meighani and Jahedi (2010) indicated that application of Glyphosate 8 L ha^{-1} is recommended as the best treatment for bindweed control in sugar beet and increased root and yields.

Nitrogen as a macronutrient is considering an essential element for maximizing growth and yield of sugar beet. It is generally needed in most sugar beet soils, especially in places where nitrogen responsive modern sugar beet varieties are grown, like other plants sugar beet, requires number of mineral nutrients for proper growth and development. Nitrogen is considering as balance wheel of sugar beet nutrition due to the fact that the efficiency of other nutrients and productivity of sugar beet are depended on nitrogen availability. In this concern, Ibrahim (1998), Seaada (1998), Abdou (2000), El-Shahawy *et al.* (2001), Ramadan *et al.* (2003), Seadh (2004), Leilah *et al.* (2007), Shewate *et al.* (2008) and JianXin *et al.* (2009), El-Sarag (2008) and Jahedi and Noroozi (2010) concluded that increasing nitrogen fertilizer levels substantially improved root, top and sugar yields as well as its components, whereas quality parameters were decreased.

Therefore, this study aimed to study the effect of sowing methods, weed control treatments and nitrogen fertilizer levels on productivity and quality of sugar beet under the environmental conditions of El-Sharkia Governorate, Egypt.

MATERIALS AND METHODS

The present investigation was carried out at Kafr El-Hamam Research Station, Zagazig district, Sharkia Governorate, Agricultural Research Center, Egypt, during 2008/2009 and 2009/2010 seasons to study the effect of sowing methods, weed control treatments and nitrogen fertilizer levels on yield and its components as well as quality of sugar beet (*Beta vulgaris* L.*)* cv. Hanrike as a monogerm variety.

Each sowing method (manual and mechanical) was performed in separate experiment. Manual sowing method was undertaken workers in ridges 60 cm in width and spaced 20 cm between hills (3-4 seeds/hill) on one side of ridges. Plants were thinned at the age of 30 days from sowing to obtain one plant/hill (35000 plants/fad). However, mechanical sowing treatment was done by using planter machine in ridges 60 cm in width and spaced 20 cm between hills (one seed/hill) on one side of ridges to secure 35000 plants/fed.

Soil samples were taken at random from the experimental field area at a depth of 0-30 cm from soil surface and prepared for both mechanical and chemical analysis, according to Jackson (1973).The results are presented in Table 1.

Each experiment of sowing method was performed in split plot with four replicates in the first and second

Table 1: Mechanical and chemical soil properties at the experimental site during the two growing seasons

Soil analysis	First season 2008/2009	Second season 2009/2010
A: Mechanical properties:		
Sand (%)	9.5	9.5
Silt (%)	33.3	34.8
Clay (%)	57.2	55.7
Texture	Clayey loamy	Clayey loamy
B: Chemical analysis		
Soil reaction pH	7.8	7.6
EC (ds m^{-2}) in soil water extraction (1:5) at 25^{0}C	3.3	3.0
Organic matter (%)	1.69	1.82
Available N (ppm)	19.1	21.5
Available P (ppm)	9.0	10.8
Exchangeable K (ppm)	232.6	243.4

seasons. The main plots were occupied at random with four weed control treatments as follow; 1-one hand hoeing before the second irrigation, 2-Goltix 70 WG (metamitron) as herbicide where the chemical composition was 4-Amino-3-methyl-6-phenyl-1,2,4-triazin-5 (4H)-one, originated by Bayer AG of Germany which applied at 2 L/fed, after planting and before irrigation (pre emergency), 3- Goltix+one hand hoeing and 4-hand hoeing twice before second third irrigations.

The sub-plots were devoted at random with nitrogen fertilizer levels (60, 80 and 100 kg N/fed). Nitrogen was in form of ammonium nitrate (33.5%) was applied in two equal doses, the first was applied after thinning sugar beet plants (30 days after sowing) and the second portion was carried out before the third irrigation.

Each experimental basic unit (sub-plot) included ten ridges, each 60 cm apart and 3.5 m length which resulted an area of 21 m^2 (1/200 fad).The preceding summer crop was rice (*Oryza sativa* L.*)* in both seasons.

The experimental field well prepared by two ploughing, leveling, compaction, division and then divided to the experimental units. Calcium super phosphate (15.5% P_2O_5) was applied during soil preparation at the rate of 150 kg/fed. Potassium sulphate (48 % K_2O) at the rate of 24 kg/fed was applied before the third watering.

Sugar beet balls (coated monogerm) were sown using dry sowing method as previously mentioned in the 1st and 10th of October in first and second seasons, respectively. The plots were irrigated immediately after sowing directly. Weed control and nitrogen fertilization in beet fields were done as previously mentioned. Other cultural practices for growing sugar beet were performed as recommendations by Ministry of Agriculture and were followed, except the factors under study. Harvesting took place after 200 days for sugar beet.

Studied characters

A-Yield components: At maturity (after approximately 195 days from sowing) five plants were chosen at random from the outer ridges of each sub-plot to determine yield components and quality characters as follows:

- Root fresh weight (g $plant^{-1}$)
- Foliage fresh weight (g $plant^{-1}$)
- Root/top ratio
- Root length (cm)
- Root diameter (cm)

B- Yield quality:

- Total soluble solids (TSS %) in roots. It was measured in juice of fresh roots by using Hand Refractometer
- Sucrose percentage (%). It was determined Polarimetrically on lead acetate extract of fresh macerated roots according to the method of (Carruthers and Oldfield, 1961)
- Apparent purity percentage (%). It was determined as a ratio between sucrose % and TSS % of roots

C-Yields: At harvest, plants that produced from the two inner ridges of each sub-plot were collected and cleaned. Roots and tops were separated and weighted in kilograms, then converted to estimate:

- Root yield (t/fad)
- Top yield (t/fad)
- Sugar yield (t/fad). It was calculated by multiplying root yield by sucrose percentage

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for split plot design of each experiment (sowing method), then the combined analysis was carried out as outlined by Gomez and Gomez (1984) by using means of "MSTAT-C" computer software package. Least Significant Difference test (LSD) method was and tests the differences between treatment means at 5% level of probability was reported as described by Waller and Duncan (1969).

RESULTS AND DISCUSSION

Sowing methods effect: From obtained results in Table 2, all yield components (root and foliage fresh weight, root/top ratio and root length and diameter) had a significant effect owing to different sowing method. It can be also statement that mechanical sowing method recorded the highest values of root and foliage fresh weight/plant, root/top ratio and root length and diameter in the two seasons. In the other side, the lowest values of yield components of sugar beet were resulted from manual sowing method in both seasons.

Sowing methods showed significant effect of most quality parameters i.e. TSS, sucrose and purity percentages, except purity % in the second season (Table 3). The highest values of these parameters were achieved with manual sowing, excluding purity % in the second season which attained the highest values with mechanical sowing method. These results clear that manual sowing systems increased percentage of sucrose as compared with the two other one due to the decrease in root weight and root diameter which leads to decreasing tissue water content and non-sucrose

Table 2: Averages of root and foliage fresh weight, root/top ratio, root length and diameter as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons

Characters	Root fresh weight (g plant^{-1})		Foliage fresh weight (g plant^{-1})		Root/top ratio		Root length (cm)		Root diameter (cm)	
Treatments seasons	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
A: Sowing methods										
Manual	727.5	775.6	633.8	616.9	1.15	1.28	25.6	27.9	10.9	11.9
Mechanical	799.4	830.0	661.9	622.3	1.21	1.35	28.5	30.2	12.4	13.5
F. test	*	*	*	*	*	*	*	*	*	*
B: Weed control treatments										
One hand hoeing	657.5	703.8	622.1	576.7	1.06	1.25	22.6	23.8	9.4	10.0
Goltex	736.7	761.3	656.3	614.2	1.13	1.26	26.2	28.0	10.9	12.0
Goltex+one hoeing	811.3	847.9	648.3	625.4	1.25	1.37	28.5	31.3	12.8	14.0
Two hoeing	848.3	898.3	664.6	662.1	1.28	1.38	30.8	33.3	13.5	14.8
F. test	*	*	*	*	*	*	*	*	*	*
LSD.5%	21.2	18.6	14.3	16.8	0.06	0.03	0.3	0.3	0.2	0.2
C: Nitrogen fertilizer levels										
60 kg/fed	688.1	723.8	578.1	496.6	1.19	1.46	24.4	26.5	10.7	11.6
80 kg/fed	764.4	806.9	652.8	622.8	1.17	1.29	27.2	29.1	11.7	12.8
100 kg/fed	837.8	877.8	712.5	739.4	1.17	1.19	29.5	31.7	12.6	13.7
F. test	*	*	*	*	NS	*	*	*	*	*
LSD.5%	18.4	17.6	12.5	15.9	-	0.02	0.2	0.2	0.2	0.1

substance such as proteins and alpha amino nitrogen which consequently increased sucrose % content in roots.

All yield characters (root, top and sugar yields/fed) significantly affected by sowing method, this comment was mostly true in the two seasons of study (Table 3). The optimum sowing method that yielded the highest values of root, top and sugar yields/fed was mechanical sowing method (planter machine) in both seasons. The corresponding data were 28.13 and 29.37 ton roots/fed, 18.66 and 18.82 ton top/fed, 5.014 and 5.225 ton sugar/fed in the first and second seasons, respectively. On the other hand, the lowest values of these traits were recorded under manual sowing condition in the two growing seasons. These results may be attributed to the regularity spacing and numbers of plants between hills in mechanical sowing method which minimizing the intra competition between plants and led to high light use efficiency of solar radiation utilized by beet plants, in turn high in the conversion of light energy to chemical energy and consequently high accumulation of dry matter and improvement of yields and its components. These findings are in harmony with those reported by El-Geddawy *et al.* (2008), El-Maghraby *et al.* (2008) and Sarauskis *et al.* (2010).

Weed control effect: Root and foliage fresh weight, root/top ratio as well as root length and diameter were significantly affected by weed control treatments in both growing seasons as shown in Table 2. The highest values could be obtained for all yield components were achieved when controlling weeds associated with sugar beet plants by two hand hoeings treatment in both season. The same trend of other weed control treatments was observed with respect its effect on all yield components in both seasons. On the other hand, the minimum values for whole these characters were resulted from control treatment (one hand hoeing) in both seasons.

Weed control treatments caused a significant effect on TSS %, sucrose % and apparent purity % in the first and second seasons (Table 3). The highest percentages of TSS and sucrose were achieved as a result of controlling weed by one hand hoeing in the first and second seasons. On the other side, the lowest percentages of TSS and sucrose were resulted from two hoeings treatment, whereas Goltix herbicide treatment came in the second rank, then Goltix+one hoeing treatment came in the third rank in both seasons. With respect to apparent purity percentage, the highest averages were obtained under two hand hoeings as a weed control system, followed by one hand hoeing then Goltix + one hoeing and lastly Goltix treatment in the first and second seasons. The distinct influence of numbers of hoeing quality parameters may be due to the encouraged effect of hoeing to root diminution and weight and to the pronounced increase in assimilation organs (tops), consequently increasing the assimilation and storage process which in turn reflected on the amount of stored sugar in root tissue. Similar results were reported by Deveikyte (2005).

All yield characters under study i.e. root, top and sugar yields/fad were significantly responded due to weed control treatments in both seasons (Table 3). Noteworthy, controlling sugar beet field from weed by using two hoeings treatment yielded the highest values of root, top and sugar yields/fed as well as harvest index in the first and second seasons. Concerning application of Goltix+one hoeing treatment, its ranked after two hoeings

Table 3: Averages of TSS (%), sucrose (%), apparent purity (%), root, top and sugar yields/fed as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons

	TSS (%)		Sucrose (%)		Apparent Purity (%)		Root yield (t/fed)		Top yield (t/fed)		Sugar yield (t/fed)	
Characters treatments seasons	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
A: Sowing methods												
Manual	22.2	23.1	18.4	18.3	82.9	79.2	25.45	27.15	17.13	17.84	4.654	4.947
Mechanical	21.9	22.5	17.9	17.9	81.9	79.4	28.13	29.37	18.65	18.82	5.014	5.225
F. test	*	*	*	*	*	NS	*	*	*	*	*	*
B: Weed control treatments												
One hand hoeing	23.4	23.9	19.4	19.1	82.9	79.9	23.97	25.98	17.15	17.54	4.629	4.963
Goltex	22.5	23.2	18.3	18.4	81.3	79.3	26.00	27.82	17.56	18.00	4.740	5.095
Goltex+one hoeing	21.5	22.4	17.7	17.6	82.3	78.6	28.07	29.31	17.92	18.56	4.942	5.131
Two hoeing	20.8	21.6	17.3	17.3	83.2	80.1	29.13	29.95	18.96	19.23	5.025	5.155
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	0.07	0.06	0.08	0.08	0.3	0.4	0.16	0.13	0.41	0.37	1.801	2.102
C: Nitrogen fertilizer levels												
60 kg/fed	22.6	23.4	18.8	18.7	82.9	79.2	24.09	25.84	16.34	16.78	4.522	4.820
80 kg/fed	22.1	22.8	18.2	18.0	81.9	79.4	26.81	27.96	18.09	18.37	4.851	5.038
100 kg/fed	21.4	22.2	17.5	17.5	81.8	78.8	29.47	30.98	19.25	19.84	5.128	5.399
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	0.06	0.08	0.07	0.07	0.3	0.3	0.15	0.12	0.35	0.34	1.611	2.721

Table 4: Means of root and sugar yields/fed as affected by the interaction between sowing methods (A) and weed control treatments (B) during 2008/2009 and 2009/2010 seasons

	Seasons							
	Root yield (t/fed)				Sugar yield (t/fed)			
Characters	2008	2009	2009	2010	2008	2009	2009	2010
B A	Man.	Mech.	Man.	Mech.	Man.	Mech.	Man.	Mech.
One hoeing	22.3	25.7	24.6	27.4	4.305	4.952	4.705	5.221
Goltex	24.3	27.7	26.8	28.9	4.481	4.999	4.966	5.225
Goltex +one	27.3	28.9	28.4	30.3	4.880	5.003	5.019	5.242
Two hoeing	28.0	30.3	28.9	31.0	4.950	5.10	5.098	5.211
LSD at 5%	0.2		0.1		1.823		3.132	

treatment, respectively with respecting their effect on root, top and sugar yields/fed as well as harvest index in both seasons. On the other hand, chick treatment (one hand hoeing treatment) resulted in the lowest means of yield characters. Such enhancement in sugar beet yields due to goodness of weed control through two hand hoeings may be due to high efficiency in safety weed control, disassembly surface layer of soil and then increasing root system consequently improvement beet productivity. In this connection Meigham and Jahedi, 2010 reported similar results.

Nitrogen fertilizer levels effect: From obtained results in Tables 2 and 3, nitrogen fertilizer levels significantly affected yield components, root, top and sugar yields/fed in both seasons. It can be easily consider that raising nitrogen levels markedly accompanied with obvious increase in all studied characters in both seasons. Application of 100 kg N/fed significantly resulted in the highest values of all studied characters in the two growing seasons. In addition, application of 80 kg N/fed produced the best results after aforementioned level in both seasons. However, the lowest values of all studied characters were resulted from application of 60 kg N/fed in the two seasons. The increment of sugar beet yields and its components gained by increasing nitrogen levels may be due to the role of nitrogen in developing root dimensions by increasing division or elongation of cells and also enhancing leaf initiation and increment of chlorophyll concentration in leaves and photosynthesis process. The aforementioned results generally are in good agreement with those stated by Seadh (2004), Shewate *et al.* (2008), El-Sarag, 2008 and JianXin *et al.* (2009).

All yield quality determinations of sugar beet i.e., TSS (%), sucrose (%) and apparent juice purity (%) were significantly affected due to nitrogen fertilizer levels in both seasons (Table 3). Nitrogen fertilizer at the level of 60 kg N/fed produced the highest TSS, sucrose and apparent juice purity percentages. While, the further increment rates 80 and 100 kg N/fed reduced quality determinations of sugar beet juice as compared to the lowest level of nitrogen fertilizer (60 kg N/fed) in both season. These results may be due to the decrease in root weight and root diameter which led to decreasing tissue water content and non-sucrose substance such as proteins and alpha amino nitrogen which consequently increased sucrose% content in roots, also increased purity%. Similar results were obtained by El-Sarag, 2008.

Regarding the effect of interactions, there are many significant effect of the interactions among studied factors on studied characters. We reported enough the significant interactions on root and sugar yields only.

A significant effects on root and sugar yields/fed in both seasons resulted from the interaction between sowing methods X weed control treatments are presented in Table 4. Root and sugar yields/fed reached its maximum values with combination between mechanical sowing method and using two hoeings as a weed control method. It was followed by mechanical sowing method and using Goltex+one hoeing as a weed control method. Meanwhile, the maximum root yield/fed values were obtained from manual sowing and one hoeing as a weed control method in the first and second seasons.

Effect of the interaction between sowing methods X nitrogen fertilizer on root and sugar yields/fed was significant in both seasons, as shown in Table 5. Maximum means of root and sugar yields/fed were produced from mechanical sowing method and fertilizing with 100 kg N/fed. On the other hand, minimum ones were induced from control treatment (manual sowing and fertilizing with 60 kg N/fed) in the first and second seasons.

Data presented in Table 6 indicate that the interaction between weed control treatments and nitrogen fertilizer levels had a significant effect on root and sugar yields/fed during the first and second seasons. Root and sugar yields/fed was significantly increased with every increase in nitrogen fertilizer under weed control treatments. Moreover, the highest means of root yield were produced with the application of two manual hoeings+100 kg N/fed.

Table 5: Means of root and sugar yields/fed as affected by the interaction between sowing methods (A) and nitrogen fertilizer levels (C) during 2008/2009 and 2009/2010 seasons

	Root yield (t/fed)				Sugar yield (t/fed)			
Characters	2008	2009	2009	2010	2008	2009	2009	2010
C A	Man.	Mech.	Man.	Mech.	Man.	Mech.	Man.	Mech.
60 kg N/fed	22.7	25.5	23.9	27.7	4.330	4.715	4.532	5.108
80 kg N/fed	25.4	28.2	28.3	27.6	4.683	5.020	5.173	4.904
100 kg N/fed	28.2	30.7	29.2	32.8	4.950	5.307	5.136	5.663
F-test	*		*		*		*	
LSD at 5%	0.1		0.2		2.305		3.806	

Table 6: Means of root and sugar yields/fed as affected by the interaction between weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons

	Root yield (t/fed)						Sugar yield (t/fed)					
Characters	---------2008/2009--------			--------2009/2010---------			----------2008/2009---------			----------2009/2010----------		
B C	60	80	100	60	80	100	60	80	100	60	80	100
One hoeing	21.5	24.0	26.4	23.2	26.6	28.1	4.319	4.643	4.924	4.571	5.061	5.257
Goltex	23.2	26.1	28.7	25.3	27.7	30.4	4.371	4.768	5.083	4.796	5.088	5.403
Goltex +one hoeing	25.3	28.1	30.9	27.0	28.8	32.2	4.651	4.950	5.224	4.929	5.035	5.428
Two hoeing	26.3	29.1	32.0	27.8	28.8	33.3	4.749	5.044	5.283	4.986	4.969	5.509
F-test	*			*			*			*		
LSD at 5%	0.1			0.2			3.201			5.400		

Table 7: Means of root and sugar yields/fed as affected by the interaction between sowing methods (A), weed control treatments (B) and nitrogen fertilizer levels (C) during 2008/2009 and 2009/2010 seasons

	Root yield (t/fed)					
Characters	----------2008/2009----------			----------2009/2010----------		
A/B C	60	80	100	60	80	100
Man.						
One hoeing	19.9	22.3	24.6	21.6	25.9	26.3
Goltex	21.6	24.4	27.0	23.6	28.1	28.6
Goltex +one hoeing	24.4	27.3	30.2	25.0	29.7	30.5
Two hoeing	25.1	27.9	31.0	25.7	29.7	31.4
Mech.						
One hoeing	23.2	25.8	28.1	24.9	27.4	29.9
Goltex	24.9	27.8	30.4	27.1	27.4	32.2
Goltex +one hoeing	26.2	28.9	31.6	29.1	27.9	33.9
Two hoeing	27.6	30.4	32.9	29.9	27.9	35.2
LSD at 5%	0.1			0.3		
	Sugar yield (t/fed)					
	----------2008/2009----------			----------2009/2010----------		
Man.						
One hoeing	4.004	4.316	4.594	4.250	4.911	4.953
Goltex	4.104	4.516	4.824	4.533	5.233	5.131
Goltex +one hoeing	4.576	4.910	5.156	4.624	5.273	5.161
Two hoeing	4.634	4.988	5.227	4.723	5.273	5.298
Mech.	One hoeing	4.633	4.970	5.255	4.891	5.210
5.561						
Goltex	4.640	5.020	5.342	5.059	4.943	5.674
Goltex +one hoeing	4.276	4.991	5.293	5.234	4.797	5.695
Two hoeing	4.864	5.098	5.338	5.250	4.665	5.720
LSD at 5%	4.504			7.621		

On the other wise, the lowest ones gave from one manual hoeing+60 kg N/fed in the first and second seasons.

The highest averages of root and sugar yields/fed were obtained with under mechanical sowing and using two hoeings as a weed control method along with fertilizing by 100 k g N/fed, while the lowest ones were obtained with manual sowing+one manual hoeing+60 kg N/fed in both seasons (Table 7).

CONCLUSION

From the obtained data in this study, it can be concluded that sowing sugar beet using mechanical

sowing method (planter machine), controlling weeds by hoeing at two times and mineral fertilizing with 100 kg N/fed in order to maximizing its productivity and quality under the environmental conditions of Sharkia Governorate, Egypt.

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