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SUGAR BEET PRODUCTIVITY AS INFLUENCED OF TWO COMMERCIAL NUTRIENT COMPOUNDS UNDER TWO LEVEL OF PLANT DENSITY

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ABSTRACT

Tow field experiments were carried out at the experimental farm of Delta Sugar Company, El-Hamoul, Kafr El-Sheikh Governorate, Egypt., during 2011/12 and 2012/13 seasons. The objective of this work was aimed to study the effect of two plant density (46000 and 52000 plants/fed) , three Magnetic Iron Ore rates (0 , 150 and 300 kg/fed) and four Calcium Nitrate rates (0 , 1 , 2 and 3 liter/fed) on root yield and its quality of sugar beet cultivar "Toro". A split-split plot design with three replicates was used. It could be summarized finds results as follows:

Application of plant density of 52000 plants/fed, Magnetic Iron Ore rates of 300 kg/fed and Calcium Nitrate rates 3 liter/fed were recorded highest of root dimensions, plant dry matter as well as top, root yields, sugar and purity percentages in both seasons.

It could be recommended that planting sugar beet plant density of 52000 plants/fed and fertilization using Magnetic Iron Ore at rates of 300 kg/fed and foliar application of Calcium Nitrate at rates of 3 liter/fed maximized sugar beet yield per unit area under El-Hamoul, Kafr ELSheikh condition.

INTRODUCTION

Nowadays, sugar beet (*Beta vulgaris* L.) has been introduced as a new sugar crop in Egypt to take descending order after sugar cane. The aim of this investigators was to decrease the gap between production and consumption of sugar through increase productivity of unite area. Thus, its favorable to choose the optimum plant density and rates of soil fertilization using Magnetic iron ore and foliar fertilization of Calcium Nitrate to maximum yield and quality for sugar beet crop. Therefore, plant density and micronutrients is very important and become target to many investigators. Cakmakc and Oral (2002) found that maximum differences between large and small plant densities were 37.9% for leaf yield, 5% for sugar content, 9.6% for estimated extractable sugar content, 15.8% for root yield and 29.7% for recoverable sugar yield. Rice (2002) reported that yield and sugar concentration continued to increase up to the highest plant density of 65 000 plants/ha., Nikul'nikov (2006) stated that in the highest yield and dry matter content developed at 100 000 plants/ha. Miserque and Donfut (2007) showed that the potential yield increased with increase in plant density but root size decreased. Masri (2008) reported that increasing plant density from 35000 to

40000 plants significantly increased sucrose content by 4.55%, purity by 5.7%, extractable sucrose by 21.9% and sugar yield by 21.3%. El-Sarag (2009) found that the highest plant density (46 000 plants/fed) gave maximum root fresh weight, sugar yield and juice purity. Bhullar *et al*. (2010) reported that planting density of 100,000 plants/ha. produced the highest beet root and sugar yield. Hozayn *et al*. (2013) showed that increasing plant density from 16 to 36 thousands resulted in increased of sucrose, purity, sugar recovery and quality index %.

Moreover, Omran *et al*. (2002) found that highest dry weight, root yield, top yield, and sugar yield and quality was obtained from the soil Zn application combined with B at highest rate. Moustafa and Omran (2006) found that foliar spray with B or Mg significantly increased juice quality, growth traits (i.e., average root diameter, root length, fresh and dry weights of roots and tops, yields of roots, tops and sugar). Yarnia et al. (2008) resulted that used microelements increased root yield, sugar and dry matter. Nemeat-Alla *et al*. (2009) concluded that used micronutrients recorded highest characteristics of quantity i.e. root dimensions, dry matter of plant as well as yields of top, root and sugar. Abido (2012) and Armin and Asgharipour (2012) revealed that boron application increased root yield and sucrose concentration by 12.12% and 26.35%, respectively, decreasing k+, Na+, -amino-N and molasses sugar compared with those of the control.

The objective of this study was aimed to increas sugar beet productivity by determine optimum plant density and fertilization using Magnetic iron ore and foliar spraying of Calcium Nitrate of sugar beet at El-Hamoul, Kafr ELSheikh Governorate.

MATERIALS AND METHODS

Two field experiments were carried out at Agricultural Research Farm of Delta Sugar Company, El-Hamoul, Kafr El-Sheikh Governorate, Egypt, in the two successful growing seasons 2011/12 and 2012/13. Study was aimed to investigate the effect of plant density, fertilization with Magnetic iron ore rates and foliar application with Calcium Nitrate rates on yield and quality of sugar beet (*Beta Vulgaris L*.). The studied factors were as follow:

A- **Plant density (main plots):**

1- Three lines on the ridge (the distance between the lines on the terrace of 40 cm and the distance between hills 20 cm). Where the plant density 52000 plants/fed.
2- Tow line on the ridge (the distance between the lines on the terrace of 45 cm and the distance between hills 20 cm). Where the plant density 46000 plants/fed.

B- Fertilization with Magnetic Iron Ore rates (sub-plots) (0, 150 and 300 kg/fed):

The Magnetic Iron Ore consists on ($Fe_3 O_4$ 48.8 % + Fe O 17.3 % + $Fe_2 O_3$ 26.7 % + Mg O 2.6 % + Ca O 0.3 % + Si O_2 4.3 %).

C- **Foliar fertilization with Calcium Nitrate rates (sub-sub plot) (0, 1, 2, and 3 liter/fed):**

The Calcium Nitrate consists on (Ca O 17.0 % + N O3 14.0 % + B O 0.5 % + Mg O 1.0 %).

A split-split plot design with three replications was used in both seasons. The experiment included 24 treatments. The tow plant density (46000 and 52000 plants/fed) were distributed at random in the main plots. Whereas, the three fertilizer levels Magnetic iron ore (0, 150 and 300 kg/fed) were allocated randomly in sub-plots as soil application. The sub-sub plots were used four levels of foliar application with Calcium Nitrate (0, 1, 2 and 3 liter/fed).

The experimental soil was fertilized with 30 kg P_2O_5/fed in the form of calcium superphosphate (15.5 % P_2O_5) during soil preparation. The nitrogen fertilizer at the rate of 120 kg N/fed in the form of urea (46 % N) was applied in two equal portions. The first part was applied after 45 days from sowing date and the remainder after 30 days later. Sowing took place on 20 th and 27 th October 2011 and 2012 seasons, respectively. The preceding crop was rice in the both seasons. The chemical analysis of experimental soil is presented in Table (1).

Table (1): Chemical analysis of soil experimental site (0- 30 cm depth)at Agricultural Research Farm of the Delta Sugar Company, El-Hamoul, Kafr EL-Sheikh in 2011/2012 and 2012/2013 seasons.

Season	PH (1:2.5)	EC m mhos /cm	Organic Matter %	Available			Anions Meq/L			
				N ppm	P ppm	K ppm	HCO_3	Cl	SO_4	CO^-_3
2011/12	8.12	5.10	1.34	16.74	10.41	378	3.76	32.12	15.06	0.00
2012/13	8.06	5.32	1.23	16.12	10..24	356	3.56	29.86	13.32	0.00

Seeds of multigerm sugar beet cultivar "Toro" were sown by machine at the rate of one seed per hill. Other cultural practices were done as recommended in sugar beet fields.

The plot area was (50.40 m^2), included eight and six ridges, 7 m long, 90 and 120 cm apart and 20 cm between hills, respectively. At maturity (196 days from sowing). The outer two ridges were considered as belt or band. The central ridges were kept to determine yield and quality of sugar beet. Ten guarded plants were taken at random to estimate root dimensions (length and diameter) as well as yields components and its quality. Sucrose percentage was determined using the method described by Le Docte (1927) and Juice purity was estimated using method of Silin and Silina (1977).

Sugar yield/fed was calculated according to the following formula :

Sugar yield = root yield tons/fed × sucrose %

Statistical analysis:

Data obtained were subjected to procedures of split-split plot design out lined by Gomez and Gomez (1984) by using analysis of variance Technique by means of " MSTAT " computer software package. To compare between means of significance Duncan's multiple sugar test was used (Duncen,1955).

RESULTUS AND DISUTION

A. Root dimensions (length and diameter cm.)

Results presented in Table (2) indicate that increasing plant density to 52000 plant/fed gave tallest roots 32.17 and 34.03 cm however, root diameter recorded the lowest values 14.14 and 14.89 cm, on the other hand, plant density 46000 plant/fed gave the shortest roots 30.14 and 31.58 cm while, root diameter recorded the highest 14.75 and 15.51 cm as compared with all other treatments in 2011/2012 and 2012/2013 seasons, respectively.

Table (2): Root length and root diameter (cm.) as affected by plant density, fertilization with Magnetic iron ore rates and foliar spraying of Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Treatment	Root length		Root diameter	
	2011/12	2012/13	2011/12	2012/13
Plant density (A)				
45 x 20 cm. (46000 plants/fed)	30.14 b	31.58 b	14.75 a	15.51 a
40 x 20 cm. (52000 plants/fed)	32.17 a	34.03 a	14.14 b	14.89 b
F test	**	**	**	**
Fertilization with Magnetic iron ore rates (B)				
0	30.00 c	31.60 c	13.80 c	14.50 c
150 kg/fed	31.44 b	33.10 b	14.52 b	15.25 b
300 kg/fed	32.02 a	33.71 a	15.01 a	15.85 a
F test	**	**	**	**
Foliar spraying of Calcium Nitrate rates (C)				
0	29.42 d	31.00 d	13.58 d	14.30 d
1 liter/fed	30.56 c	32.17 c	14.14 c	14.89 c
2 liter/fed	31.92 b	33.60 b	14.83 b	15.60 b
3 liter/fed	32.72 a	34.44 a	15.23 a	16.02 a
F test	**	**	**	**
Interaction				
A x B	**	**	**	**
A x C	**	**	**	**
B x C	**	**	*	**
A x B x C	**	**	Ns	Ns

The increase in root length and decreased its diameter owing to increasing plant density levels might be attributed to increasing cell elongation and cell division, there fore root length increases. These results are in agreement with those of Rice (2002) and Nikul'nikov (2006). The obtained results showed clearly that root dimension increased with increasing Magnetic Iron Ore in both seasons. Tallest roots 32.02 and 33.71 cm as well as root diameter 15.01 and 15.85 cm was obtained with fertilization at rate of 300 kg/fed, on the other side, the lowest values of root length 30.00 and 31.60 cm but root diameter 13.80 and 14.50 cm were obtained with the control treatment in 2011/2012 and 2012/2013 seasons respectively. On the other hand, The results showed that foliar spraying with Calcium Nitrate at rate 3 liter/fed recorded tallest roots 32.72 and 34.44 cm as well as root diameter 15.23 and 16.02 cm in 2011/2012 and 2012/2013 seasons, respectively. The increase in root dimensions due to using micronutrients may be attributed to increasing cell number and size according to increasing concentration of micronutrients especially iron and boron, hence root diameter and length increased. These results are in harmony with those of Nikul'nikov (2005), Yarnia et al. (2008) and Nemeat-Alla *et al*. (2009).

A highly significant interaction were found among all variables tested in there investigation except, the interaction among all variables in the both seasons (Table 3,4, 5 and 6).

Table (3): Mean values of root length and root diameter (cm) of sugar beet cultivar (Toro) as affected by interaction between plant density and Magnetic iron ore rates in 2011/12 and 2012/13 seasons.

Days from sowing	Treatments	Magnetic Iron Ore rates (Kg/fad.)					
		2011/12			2012/13		
	Plant density	0	150	300	0	150	300
Root length cm	46000 plants/fad	28.96 g	30.46 ef	31.00 de	30.33 fg	31.88 e	32.53 d
	52000 plants/fad	31.04 de	32.42 b	33.04 a	32.87 cd	34.32 ab	34.89 a
Root diameter cm	46000 plants/fad	14.12 cd	14.81 b	15.32 a	14.83 cd	15.56 b	16.15 a
	52000 plants/fad	13.48 d	14.23 c	14.70 bc	14.17 d	14.94 c	15.56 b

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Table (6): Mean values of root length and root diameter (cm.) of sugar beet cultivar (Toro) as affected by interaction between Plant density, Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments		Calcium Nitrate rates liter/fed.							
	Plant density	Magnetic iron ore rates (Kg/fad.)	2011/12				2012/13			
			0	1	2	3	0	1	2	3
Root length cm.	46000 plants /fad.	0	27.17 j	28.33 i	29.67 gh	30.67 f	28.57 h	29.73 gh	31.07 g	31.97 ef
		150	28.67 hi	29.83 g	31.17 df	32.17 c	30.07 g	31.23 fg	32.57 e	33.67 cd
		300	29.33 gh	30.33 fg	31.83 cd	32.50 bc	30.73 f	31.83 f	33.43 d	34.10 c
	52000 plants /fad	0	29.17 h	30.50 fg	31.83 cd	32.67 bc	30.97 g	32.30 ef	33.53 d	34.67 bc
		150	30.50 fg	32.00 cd	33.17 b	34.00 ab	32.20 ef	34.00 c	35.17 b	35.90 ab
		300	31.67 d	32.33 c	33.83 ab	34.33 a	33.47 d	33.93 d	35.83 ab	36.33 a

B. Top, root and sugar yields per Fedden (ton).

Results recorded in Table (7) indicated the effect of plant density was significant on top, root and sugar yield per fed. in both seasons. Using plant density at 52000 plants/fed gave highest top yield/fed (13.43 and 15.02 ton/fed), root yield (27.70 and 30.28 ton/fed) and sugar yield (5.24 and 5.96 ton/fed) in both seasons. The increase of top and root yield due to increasing number of plants per fed may be attributed to increasing vegetative growth as well as root length which led to raising top and root yield per fed. The increased in sugar yield per fed may be due to increasing of root yield per fed and quality. These results are in harmony with those of Andreata-Koren *et al* (2000), Miserque *et al*. (2007) and El-Sarag (2009).

Also, the obtained results indicated that increasing fertilization with Magnetic Iron Ore rates significantly affected top, root and sugar yield per fed Magnetic Iron Ore at rate 300 kg/fed produced the highest top yield/fed (15.26 and 16.30 ton/fed) , root yield (29.81 and 31.00 ton/fed) and sugar yield (5.72 and 6.20 ton/fed). Also foliar application of Calcium Nitrate rates showed a significantly affected top, root and sugar yield per fed. the results showed that highest top yield (15.21 and 18.01 ton/fed), root yield (29.31 and 33.13 ton/fed) and sugar yield (5.84 and 6.89 ton/fed) in 2011/2012 and2012/2013 seasons. The increase top and root yield owing to increasing micronutrients which may be due to (Boron, Iron, Manages and Calcium … etc) concentration raising net assimilation rate used in growth of leaves and root as well as dry matter trans located and accumulated in roots there fore increased top and root yields per fed. These results are in agreement with those of also Omran *et al*. (2002), Nemeat-Alla *et al*. (2009), Abido (2012) and Armin and Asgharipour (2012).

Generally, a highly significant interaction were found among all variables tested in there investigation in the both season (Table 8, 9, 10 and 11).

Table (7): Top, Root and sugar yields (ton/fed) as affected by plant density, fertilization with Magnetic iron ore rates and foliar spraying with Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Treatment	Top yield ton/fed.		Root yield ton/fed.		Sugar yield ton/fed.	
	2011/12	2012/13	2011/12	2012/13	2011/12	2012/13
Plant density (A)						
45 x 20 cm. (46000 plants/fed)	12.18 b	13.98 b	25.61 b	27.70 b	4.65 b	5.22 b
40 x 20 cm. (52000 plants/fed)	13.43 a	15.02 a	27.70 a	30.28 a	5.24 a	5.96 a
F test	**	**	**	**	**	**
Fertilization with Magnetic iron ore rates (B)						
0	9.65 c	12.09 c	22.61 c	26.14 c	3.97 c	4.80 c
150 kg/fed	13.51 b	15.11 b	27.55 b	29.82 b	5.14 b	5.79 b
300 kg/fed	15.26 a	16.30 a	29.81 a	31.00 a	5.72 a	6.20 a
F test	**	**	**	**	**	**
Foliar spraying of Calcium Nitrate rates (C)						
0	10.49 d	11.12 d	24.31 d	25.29 d	4.19 d	4.51 d
1 liter/fed.	11.91 c	13.51 c	25.44 c	27.90 c	4.54 c	5.18 c
2 liter/fed.	13.60 b	15.36 b	27.56 b	29.64 b	5.20 b	5.83 b
3 liter/fed.	15.21 a	18.01 a	29.31 a	33.13 a	5.84 a	6.89 a
F test	**	**	**	**	**	**
Interaction						
A x B	**	**	**	**	**	**
A x C	**	**	**	**	**	**
B x C	**	**	**	**	**	**
A x B x C	**	**	**	**	**	**

Table (8): Mean values of root, top and sugar yields of sugar beet cultivar (Toro) as affected by interaction between plant density and Magnetic iron ore rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Magnetic Iron Ore rates (Kg/fad.)					
		2011/12			2012/13		
	Plant density	0	150	300	0	150	300
Top yield t/fad	46000 plants/fad	21.77 ef	26.37 c	28.67 b	25.03 f	28.48 c	29.59 c
	52000 plants/fad	23.44 de	28.73 b	30.94 a	27.26 e	31.16 b	32.41 a
Root yield t/fad	46000 plants/fad	9.20 e	12.80 c	14.53 b	11.65 e	14.49 c	15.79 b
	52000 plants/fad	10.10 d	14.21 bc	15.99 a	12.52 d	15.73 b	16.81 a
Sugar yield t/fad	46000 plants/fad	3.70 ef	4.83 cd	5.43 bc	4.43 ef	5.43 cd	5.82 bc
	52000 plants/fad	4.25 de	5.44 bc	6.02 a	5.17 d	6.15 b	6.58 a

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C. Quality parameters:

Results presented in Table (12) showed the effect of plant density, Magnetic Iron Ore rates and Calcium Nitrate rates significantly affected sucrose and juice purity percentage in both seasons. The highest sucrose percentage 18.75 and 19.55 % as well as juice purity percentage 80.55 and 81.90 % were obtained with plant density 52000 plants/fed. On the other hand, the lowest sucrose percentage 18.00 and 18.70 % as well as juice purity percentage 78.62 and 80.01 % were recorded with plant density 46000 plants/fed compared to other treatments in 2011/2012 and 2012/2013 seasons, respectively. The increase in sucrose and juice purity percentage may be due to the highest plant density attributed that it gave the lowest root size and lowest root moisture, thus increased concentration of sucrose % and juice purity % in roots. These results are in agreement with those of El-Sarag (2009), Bhullar et al. (2010) and Hozayn et al. (2013). On the other hand, results showed that Magnetic Iron Ore rate 300 kg/fed produced the highest values of sucrose percentage 19.11 and 19.88 % as well as juice purity percentage 81.78 and 83.12 %. Also Calcium Nitrate rate 3 liter/fed recorded highest values of sucrose percentage 19.83 and 20.64 % as well as juice purity percentage 82.16 and 83.48 % in 2011/2012 and2012/2013 seasons. These results agree with Nemeat-Alla *et al.* (2009), Paţuta *et al.* (2010) and Armin and Asgharipour (2012).

Table (12): Sucrose percentage and juice purity percentage as affected by plant density, fertilization with Magnetic iron ore rates and foliar spraying with Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Treatment	Sucrose percentage		Juice purity percentage	
	2011/12	2012/13	2011/12	2012/13
Plant density (A)				
45 x 20 cm. (46000 plants/fed)	18.00 b	18.70 b	78.62 b	80.01 b
40 x 20 cm. (52000 plants/fed)	18.75 a	19.55 a	80.55 a	81.90 a
F test	**	**	**	**
Fertilization with Magnetic iron ore rates (B)				
0	17.48 c	18.19 c	77.14 c	78.54 c
150 kg/fed	18.54 b	19.29 b	79.83 b	81.19 b
300 kg/fed	19.11 a	19.88 a	81.78 a	83.12 a
F test	**	**	**	**
Foliar spraying of Calcium Nitrate rates (C)				
0	17.11 d	17.76 d	76.82 d	78.20 d
1 liter/fed.	17.78 c	18.49 c	78.87 c	80.24 c
2 liter/fed.	18.78 b	19.59 b	80.48 b	81.88 b
3 liter/fed.	19.83 a	20.64 a	82.16 a	83.48 a
F test	**	**	**	**
Interaction				
A x B	**	**	**	**
A x C	**	**	**	**
B x C	**	**	**	**
A x B x C	**	**	**	**

The interaction were found among all variables tested in there investigation showed a highly significant effect between treatments in the both season (Table 13, 14, 15 and 16).

Generally, it could be recommended that increasing plant density of sugar beet up to 52000 plants/fed and fertilizing with Magnetic Iron Ore rate at 300 kg/fed and foliar application of Calcium Nitrate rate at 3 liter/fed produced the highest yield of sugar beet under El-Hamoul, Kafer EL-Sheikh conditions**.**

Table (13): Mean values of sucrose and juice purity percentage of sugar beet cultivar (Toro) as affected by interaction between plant density and Magnetic iron ore rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Magnetic Iron Ore rates (Kg/fad)					
		2011/12			2012/13		
	Plant density	0	150	300	0	150	300
Sucrose percentage	46000 plants/fad	16.93 ef	18.23 c	18.86 b	17.56 ef	18.96 cd	19.57 bc
	52000 plants/fad	18.03 cd	18.85 bc	19.37 a	18.83 d	19.62 bc	20.20 a
Juice purity percentage	46000 plants/fad	75.75 fg	79.20 d	80.90 bc	77.14 fg	80.62 d	82.27 bc
	52000 plants/fad	78.52 de	80.47 c	82.65 a	79.94 de	81.77 c	83.98 a

Table (14): Mean values of sucrose and juice purity percentage of sugar beet cultivar (Toro) as affected by interaction between plant density and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Calcium Nitrate rates liter/fad							
		2011/12				2012/13			
	Plant density	0	1	2	3	0	1	2	3
Sucrose percentage	46000 plants/fad	16.91 ef	17.45 de	18.37 cd	19.28 bc	17.48 ef	18.12 de	19.15 cd	20.03 bc
	52000 plants/fad	17.31 e	18.12 d	19.19 bc	20.38 a	18.03 e	18.86 d	20.04 bc	21.26 a
Juice purity percentage	46000 plants/fad	75.94 gh	77.83 f	79.52 de	81.17 c	77.29 h	79.23 f	80.98 de	82.54 c
	52000 plants/fad	77.70 fg	79.90 d	81.44 bc	83.16 a	79.12 fg	81.25 d	82.79 bc	84.42 a

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إنتاجيه بنجر السكر كنتيجة تأثير مركبين غذائيين تجارين تحت مستوين من الكثافة النباتية

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أجريت تجربتين حقليتين في المزرعة البحثية لشركه الدلتا للسكر بالحامول خلال موسمي ٢٠١٢/٢٠١١ ، ٢٠١٣/٢٠١٢ وذلك بهدف دراسة تأثير مستويين من الكثافة النباتية (٤٦٠٠٠ و ٥٢٠٠٠ نبات/فدان) والتسميد بمعدلات من مركب Magnetic Iron Ore (٠, ١٥٠، ٣٠٠ كجم/فدان) والتسميد الورقي بمركب Calcium Nitrate (٠, ١, ٢, ٣ لتر/فدان) على محصول وجوده بنجر السكر. كان التصميم المستخدم هو القطع المنشقة مرتين في ثلاث مكررات ، حيث اشتملت القطع الرئيسية على مستويين من الكثافة النباتية وهم : (٤٦٠٠٠, ٥٢٠٠٠ نبات/الفدان) والقطع الشقية احتوت على ثلاث تركيزات من التسميد بمركب Magnetic Iron Ore وهم (٠, ١٥٠، ٣٠٠ كجم/فدان) في حين احتوت القطع التحت شقيه على أربع تركيزات من التسميد الورقي بمركب Calcium Nitrate (٠, ١, ٢, ٣ لتر/فدان). ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:

١- أوضحت النتائج أن الكثافة النباتية أثرت معنويا على نباتات بنجر السكر حيث أعطت الكثافة ٥٢٠٠٠ نبات/الفدان أعلى طول جذر و محصول عرش و جذر و سكر طن/الفدان والنسبة المئوية للسكر وكذلك النسبة المئوية لنقاوة العصير في حين انخفض قطر الجذر.
٢- أشارت النتائج إلى أن التسميد بمركب Magnetic Iron Ore بمعدل ٣٠٠ كجم/فدان والتسميد الورقي بمركب Calcium Nitrate بمعدل ٣ لتر/فدان أثر تأثيراً معنوياً على الصفات تحت الدراسة وأدى زيادة التركيز لأي من المركبين إلى زيادة جميع الصفات تحت الدراسة أعلى طول وقطر جذر و محصول عرش و جذر و سكر طن/الفدان والنسبة المئوية للسكر وكذلك النسبة المئوية لنقاوة العصير.

وتوصى هذه الدراسة بزراعه بنجر السكر بالكثافة النباتية ٥٢٠٠٠ نبات/فدان مع التسميد بمعدل ٣٠٠ كجم/فدان من مركب Magnetic Iron Ore والتسميد الورقي بمعدل ٣ لتر/فدان من مركب Calcium Nitrate للحصول على أعلا إنتاجيه محصول بنجر السكر وجودته تحت ظروف شمال الدلتا.

قام بتحكيم البحث

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Table (4): Mean values of root length and root diameter (cm) of sugar beet cultivar (Toro) as affected by interaction between plant density and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Calcium Nitrate rates liter/fad.							
		2011/12				2012/13			
	Plant density	0	1	2	3	0	1	2	3
Root length cm.	46000 plants/fad.	28.39 hi	29.50 g	30.89 e	31.78 cd	29.79 i	30.93 gh	32.36 ef	33.24 d
	52000 plants/fad.	30.44 ef	31.61 d	32.94 b	33.67 a	32.21 ef	33.41 cd	34.84 b	35.63 a
Root diameter cm.	46000 plants/fad.	13.89 de	14.47 c	15.14 ab	15.50 a	14.61 de	15.21 c	15.92 b	16.32 a
	52000 plants/fad.	13.26 ef	13.82 de	14.51 c	14.96 b	13.99 f	14.57 de	15.28 c	15.72 bc

Table (5): Mean values of root length and root diameter (cm) of sugar beet cultivar (Toro) as affected by interaction between Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Calcium Nitrate rates liter/fad.							
	Magnetic Iron Ore rates (Kg/fad.)	2011/12				2012/13			
		0	1	2	3	0	1	2	3
Root length cm.	0	28.17 hi	29.42 g	30.75 e	31.67 cd	29.77 gh	31.02 fg	32.30 e	33.32 cd
	150	29.58 fg	30.92 de	32.17 bc	33.08 ab	31.13 fg	32.62 de	33.87 c	34.78 ab
	300	30.50 ef	31.33 d	32.83 b	33.42 a	32.10 ef	32.88 de	34.63 ab	35.22 a
Root diameter cm.	0	12.88 e	13.51 d	14.18 c	14.63 bc	13.58 f	14.21 e	14.85 d	15.36 cd
	150	13.59 d	14.26 c	14.88 b	15.34 ab	14.27 e	15.01 cd	15.63 bc	16.09 b
	300	14.25 c	14.67 bc	15.42 ab	15.71 a	15.05 cd	15.44 c	16.32 ab	16.61 a

Table (9): Mean values of top, root and sugar yield of sugar beet cultivar (Toro) as affected by interaction between plant density and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Calcium Nitrate rates liter/fad.							
		2011/12				2012/13			
	Plant density	0	1	2	3	0	1	2	3
Top yield t/fad.	46000 plants/fad.	10.07 g	11.35 ef	12.88 d	14.41 bc	10.68 h	12.98 fg	14.72 de	17.53 b
	52000 plants/fad.	10.92 f	12.48 de	14.33 bc	16.00 a	11.56 g	14.04 ef	16.00 cd	18.49 a
Root yield t/fad.	46000 plants/fad.	23.31 fg	24.53 f	26.53 de	28.06 cd	24.23 g	26.68 e	28.32 d	31.59 bc
	52000 plants/fad.	25.31 ef	26.35 de	28.60 bc	30.56 a	26.35 ef	29.12 cd	30.97 bc	34.67 a
Sugar yield t/fad.	46000 plants/fad.	3.97 f	4.30 e	4.90 cd	5.44 bc	4.26 f	4.85 e	5.44 de	6.35 bc
	52000 plants/fad.	4.41 de	4.78 d	5.51 bc	6.24 a	4.77 ef	5.50 d	6.22 c	7.38 a

Table (10): Mean values of root and top yield of sugar beet cultivar (Toro) as affected by interaction between Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments	Calcium Nitrate rates liter/fad.							
	Magnetic Iron Ore rates (Kg/fad.)	2011/12				2012/13			
		0	1	2	3	0	1	2	3
Top yield t/fad.	0	7.84 h	8.89 g	10.20 f	11.66 e	8.40 i	11.25 gh	13.13 f	15.57 de
	150	10.92 ef	12.82 d	14.36 c	15.93 bc	11.99 g	14.03 ef	15.75 d	18.68 b
	300	12.72 de	14.04 cd	16.25 b	18.03 a	12.97 fg	15.26 de	17.21 c	19.78 a
Root yield t/fad.	0	20.88 gh	21.43 g	23.33 f	24.80 e	22.02 i	25.12 h	27.25 g	30.19 d
	150	24.80 e	26.59 de	28.46 c	30.36 bc	26.43 fg	28.55 e	30.51 cd	33.78 b
	300	27.25 d	28.29 c	30.91 b	32.78 a	27.41 f	30.02 d	31.17 c	35.41 a
Sugar yield t/fad.	0	3.33 h	3.65 fg	4.20 gh	4.73 f	3.64 h	4.45 g	5.12 f	5.99 d
	150	4.33g	4.76 f	5.36 de	6.10 bc	4.78 fg	5.32 ef	6.00 d	7.05 b
	300	4.91ef	5.23 e	6.05 c	6.70 a	5.12 f	5.76 de	6.36 cd	7.55 a

Table (11): Mean values of top, root and sugar yield of sugar beet cultivar (Toro) as affected by interaction between Plant density, Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments		Calcium Nitrate rates liter/fed.							
	Plant density	Magnetic iron ore rates (Kg/fad.)	2011/12				2012/13			
			0	1	2	3	0	1	2	3
Top yield t/fad.	46000 plants/fad.	0	7.36 j	8.59 ij	9.66 hi	11.19 gh	8.13 ij	10.89 h	12.57 fg	15.03 e
		150	10.58 h	12.11 g	13.65 ef	14.87 de	11.50 gh	13.49 f	15.03 e	17.94 c
		300	12.27 fg	13.34 f	15.33 d	17.17 b	12.42 g	14.57 ef	16.56 d	19.63 ab
	52000 plants/fad	0	8.32 ij	9.19 i	10.75 gh	12.13 g	8.67 ij	11.61 gh	13.69 f	16.12 de
		150	11.27 gh	13.52 ef	15.08 de	16.99 c	12.48 g	14.56 ef	16.47 d	19.41 ab
		300	13.17 fg	14.73 e	17.16 b	18.89 a	13.52 f	15.95 de	17.85 cd	19.93 a
Root yield t/fad.	46000 plants/fad.	0	20.09 i	20.85 hi	22.39 gh	23.77 g	21.16 j	24.07 hi	26.07 gh	28.83 df
		150	23.77 g	25.45 fe	27.45 de	28.83 d	25.30 gh	27.29 fg	29.13 ef	32.20 d
		300	26.07 ef	27.29 de	29.75 de	31.59 bc	26.22 g	28.67 f	29.75 ef	33.73 c
	52000 plants/fad	0	21.67 h	22.01 gh	24.27 fg	25.83 f	22.88 i	26.17 gh	28.43 fg	31.55 de
		150	25.83 f	27.73 de	29.47 cd	31.89 b	27.56 fg	29.81 ef	31.89 de	35.36 b
		300	28.43d	29.29 cd	32.07 b	33.97 a	28.60 f	31.37 de	32.59 cd	37.09 a
Sugar yield t/fad.	46000 plants/fad.	0	3.13 m	3.39 lm	3.90 jk	4.39 ij	3.40 n	4.07 lm	4.73 k	5.52 hi
		150	4.11 j	4.49 i	5.09 gh	5.62 ef	4.52 kl	5.03 j	5.64 h	6.53 ef
		300	4.69 hi	5.03 gh	5.70 e	6.30 cd	4.87 jk	5.45 hi	5.94 gh	7.00 d
	52000 plants/fad	0	3.53 l	3.90 jk	4.50 i	5.06 gh	3.88 m	4.82 jk	5.51 hi	6.46 f
		150	4.55 hi	5.02 gh	5.63 ef	6.57 bc	5.04 j	5.60 hi	6.37 fg	7.58 bc
		300	5.14 g	5.43 f	6.40 c	7.09 a	5.37 i	6.08 g	6.77 e	8.09 a

Table (15): Mean values of sucrose and juice purity percentage of sugar beet cultivar (Toro) as affected by interaction between Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments: Magnetic Iron Ore rates (Kg/fad)	Calcium Nitrate rates liter/fad							
		2011/12				2012/13			
		0	1	2	3	0	1	2	3
Sucrose percentage	0	15.91 i	16.99 h	17.98 f	19.04 d	16.54 h	17.67 g	18.76 f	19.80 d
	150	17.44 g	17.88 fg	18.83 de	20.01 ab	18.06 e	18.60 fe	19.65 de	20.84 b
	300	18.00 f	18.48 e	19.54 c	20.45 a	18.67 fe	19.20 e	20.37 c	21.29 a
Juice purity percentage	0	73.59 k	76.41 hi	78.33 fg	80.22 de	75.06 k	77.82 hi	79.77 fg	81.52
	150	76.93 gh	79.17 ef	80.75 d	82.50 bc	78.26 gh	80.53 ef	82.15 d	83.83 bc
	300	79.95 de	81.02 cd	82.37 bc	83.77 a	81.29 de	82.38 cd	83.73 bc	85.10 a

Table (16): Mean values of sucrose and juice purity percentage of sugar beet cultivar (Toro) as affected by interaction between Plant density, Magnetic iron ore rates and Calcium Nitrate rates in 2011/12 and 2012/13 seasons.

Variable	Treatments: Plant density	Magnetic iron ore rates (Kg/fad)	Calcium Nitrate rates liter/fed							
			2011/12				2012/13			
			0	1	2	3	0	1	2	3
Sucrose percentage	46000 plants/fad	0	15.51 lm	16.28 k	17.42 hi	18.49 fg	16.04 m	16.91 l	18.15 ij	19.13 g
		150	17.26 i	17.65 hi	18.55 fg	19.43 de	17.84 j	18.43 hi	19.33 fg	20.23 de
		300	17.97 gh	18.41 fg	19.14 e	19.91 cd	18.57 hi	19.01 gh	19.96 e	20.73 cd
	52000 plants/fad	0	16.31 jk	17.70 h	18.53 fg	19.58 d	17.04 kl	18.43 hi	19.37 fg	20.47 d
		150	17.61 hi	18.10 gh	19.11 e	20.58 b	18.28 i	18.77 h	19.97 e	21.44 b
		300	18.03 gh	18.55 fg	19.93 cd	20.98 a	18.78 h	19.39 fg	20.77 cd	21.85 a
Juice purity percentage	46000 plants/fad	0	72.47 m	74.69 k	77.06 hi	78.79 g	73.85 m	76.10 jk	78.54 ij	80.06 fg
		150	76.23 ij	78.50 gh	80.08 ef	81.98 cd	77.56 jk	79.98 h	81.51 ef	83.43 cd
		300	79.11 fg	80.31 ef	81.43 de	82.73 c	80.46 fg	81.60 ef	82.87 de	84.14 c
	52000 plants/fad	0	74.70 k	78.13 gh	79.59 fg	81.65 de	76.27 jk	79.53 hi	80.99 g	82.97 de
		150	77.62 h	79.83 f	81.41 de	83.01 bc	78.97 i	81.07 f	82.79 de	84.24 bc
		300	80.78 e	81.73 d	83.31 bc	84.80 a	82.12 e	83.15 d	84.59 bc	86.05 a