J. Plant Production, Mansoura Univ., Vol. 7 (2): 283 - 288, 2016

IMPORTANCE OF NITROGEN AND MICROELEMENTS FOR SUGAR BEET PRODUCTION IN SANDY SOILS

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ABSTRACT

Two field experiments were carried out in 2012/2013 and 2013/2014 seasons at Al-Hossein Agricultural Society Farm at 64 km, Cairo-Alexandria Desert Road, Giza Governorate, Egypt (latitude of 31.14^{0} N and longitude of 31.39^{0} E) to find out the effect of nitrogen and some microelements fertilization on yield and quality of sugar beet variety (Pleno) in a sandy soil. The present work included twelve treatments, which were the combinations of three N levels (70, 90 and 110 kg N/fed) and four levels of microelements (control, 1.5, 2.0 and 2.5 l/fed) of Cetreen including chelated Fe, Zn and Mn. A strip plots design with three replications was used in this work. Results indicated that applying 110 kg N/fed resulted in the highest values of fresh and dry root and top yields/fed, in the 2^{nd} season. There were insignificant differences among N levels in their effect on fresh root yield/fed in the 1^{st} season. Moreover, results showed that adding 70 kg N/fed produced the maximum sucrose%, extractable white sugar%, purity% in both seasons. Sugar yield/fed was significantly increased by increasing nitrogen level up to 90 kg N/fed in both seasons. Foliar applications with 2 and/or 2.5 l Cetreen/fed significantly increased root, top and recoverable sugar yield/fed and improved sucrose% and purity% in both seasons.

In general, it can be concluded that applying 90 kg N/fed with the addition of 2.0 l Citreen/fed can be recommended to produce the highest yield and quality of sugar beet under the environmental conditions of sandy soils.

INTRODUCTION

In Egypt, sugar industry depends mainly on sugar cane and sugar beet crops. Sugar beet share with about 56% with a total production 1.347 million tons of sugar (Sugar Crops Council Report, 2016) which indicates the strategic importance of this crop, especially under new soils conditions.

Most fertilization programs in sugar beet production in North Delta focus on nitrogen and phosphorus, and in some cases, potassium. In recent years, the area under sugar beet plantation is widely increased in sandy soils, which characterized with shortage of the available macro and micro elements, where the deficiency symptoms of some elements are observed obviously on sugar beet plants and negatively reflected on their performance in respect to their yield and quality characteristics. In this connection, Hany and El-Henawy (2009) found that increasing nitrogen rate from 75 to 90 kg N/fed significantly increased dry weight, root weight, top yield, root yield, concentration of α-amino-N% and sugar yield. The inverse was true in gross sugar%, white sugar% and juice purity%. Masri *et al.* (2015) mentioned that increasing N rate up to 120 kg N/fed significantly increased individual root weight, root number/fed and impurities percentage as well as root yield (ton/fed) in both seasons study and white sugar yield (ton/fed) only in the first season. Excessive N application lowered beet quality in terms of sucrose, purity and extractable sugar percentage in both seasons. Abdelaal and Saher Tawfik (2015) stated that the highest values of foliage and root fresh weights, and root yield/fed in the two seasons produced with adding 105 kg N/fed. However, the highest means of sucrose % and apparent purity % were resulted from control treatment (0 kg N/fed) in the two growing seasons.

It mention worth that adequate N application is needed to obtain maximum sugar beet vegetative growth early in the growing season. However, adjusted N supply is required at low levels by midseason to maximize sugar production. High N availability late in the season increases foliage growth and impurities in the beets.

The previous researchs results revealed an appreciable improvement in sugar yield/fed under the newly reclaimed sandy soils by applying micronutrients as a foliar application, especially when the chemical analysis of the soil manifests that iron, zinc and manganese availability under experimental soil conditions is limited due to high pH (>7.0), high free calcium carbonate and low organic matter content. Under such conditions, foliar application with micronutrients is recommended and appeared to be required by sugar beet plants to improve their performance as well as to produce higher root and sugar yields/fed.

In this connection, Draycott and Christenson (2003) reported that sugar beet can become deficient in several micronutrients, but is most responsive to the application of B, Mn, and Fe fertilizers when the soil availability of these nutrients is low. Abd El-Gawad *et al.* (2004), Yarnia *et al.* (2008) and Nemeat-Alla *et al.* (2009) showed that application of high rates of micronutrients produced the highest root yield of sugar beet plants, while it produced the lowest values of quality characters such as sucrose. Mehrdad *et al.* (2008) revealed that foliar application of micronutrients increased root yield and sugar content significantly. The highest root yields were obtained when leaves were sprayed with Fe and complete micronutrients were applied to soil, respectively. The percentages of sugar and dry matter were increased appreciably when the seeds were sprayed with Zn. Hany and El-Henawy (2009) added that the foliar application of micronutrients produced the greatest dry weight, root weight, top yield, root yield, gross sugar%, white sugar%, juice purity% and sugar yield. Foliar spraying increased concentration of α-amino-N% and Na + K in roots and the most of mentioned traits compared with the control. Kobraee *et al.* (2011) stated that Zinc deficiency appears to be the most widespread and frequent micronutrient deficiency problem in crop plants worldwide, resulting in severe losses in yield and nutritional quality. They explained that Zinc is an essential micronutrient and has particular physiological functions in all living systems, such as the maintenance of structural and functional integrity of biological membranes and facilitation of protein synthesis and gene expression and is considered as the most limiting factor for producing crops in different regions of the world. Mousavi and Rezaei (2013) reported that crop yield significantly increases with the use of micronutrients such as Zn, Fe, B and Mn that have an important metabolic role in plant growth and development. Amin *et al.* (2013) reported that fertilized sugar beet plants with foliar spray of mixture of micronutrients of iron, sulphate, zinc sulphate and manganese sulphate at the rate of 1.09 g/l of each significantly increased values of dry matter per plant and sugar yield, while decreased TSS, sucrose and purity percentages. The rate of 40 kg Zn SO_4/ha gave the highest yield and sugar percent, while the application of 80 kg Zn SO_4/ha significantly decreased sugar percent. Mekki (2014) investigated the response of yield and quality of sugar beet plants to foliar application with Urea, Zn, Mn in newly reclaimed sandy soil. He found that the highest and significant values of root, top, sugar yields and sucrose percentage as well as purity% were obtained with the application of 2% Urea + 400 ppm Zn + 400 ppm Mn. Masri and Hamza (2015) supplied sugar beet with a mixture of micronutrients of Zn, Mn, Fe and B in ppm/l at three different concentrations, compared with the control treatment of distilled water. Their results revealed that increasing micronutrients mixture significantly increased root weight, root yield and sugar yield, as well as sucrose%, purity% and extractable sucrose% in both seasons.

The purpose of the present work has been to illustrate the effect of nitrogen fertilizer levels as fertigation and a mixture of different micronutrients (Iron, Zinc and Manganese) as foliar application on yield and quality of sugar beet grown under drip irrigation system in sandy soils conditions.

MATERIALS AND METHODS

Two field experiments were carried out in 2012/2013 and 2013/2014 seasons at Al-Hossein Agricultural Society Farm at 64 km, Cairo-Alexandria Desert Road, Giza Governorate, Egypt (latitude of 31.14^0 N and longitude of 31.39^0 E) to find out the effect of nitrogen level and foliar Cetreen (Chelated Fe, Zn and Mn) on yield and quality of sugar beet variety (Pleno) (*Beta vulgaris, var. saccharifera* L.). The present work included twelve treatments, which were the combinations of three levels of nitrogen (70, 90 and 110 kg N/fed) and four levels of foliar Cetreen (control, 1.5, 2.0 and 2.5 l/fed). The fertilizer material namely Cetreen was used as foliar application twice at 60 and 90 days from sowing. It contains a mixture of micronutrients concentrations (Iron 2%, Zinc 2%, Mn 2% + Citric acid 15%), which it was brought from the Public Authority for Balancing Fund, ARC. In the control treatment, sugar beet plants were sprayed with water. Seeds of the multi-germ sugar beet cultivar were sown in hills on one side of ridges in a sandy soil under drip irrigation system. A strip plot design with three replications was used in the two seasons. The three nitrogen levels were distributed horizontally and the four foliar Cetreen levels were vertically applied. Plot size was 21 m^2 including 6 ridges of 5 m in length and 4.2 m in width, 70 cm apart and 25 cm between hills. Sowing took place during the 2nd week of November, while harvesting was done at age of 190 days in both seasons. Plants were thinned at 4- leaf stage to ensure one plant per hill. Phosphorus fertilizer was applied in four equal doses in the form of Phosphoric Acid (80% P_2O_5) at rate of 48% P_2O_5/fed. The first one was added after sowing and the other three doses were added at one-week periods later. Nitrogen fertilizer treatments were applied in the form of Ammonium Nitrate (33.5% N) in eight equal doses after thinning. The first one was added after thinning and the other doses were applied weekly. Potassium fertilizer was added as Potassium Sulphate (48% K_2O) at rate of 48 kg k_2o/fed in four equal doses; the 1st one with the 3rd dose of nitrogen and the other three ones were added weekly. Phosphorus, Nitrogen and Potassium fertilizers were applied with drip irrigation supply. Other agricultural practices were done as recommended. In each plot, 6 ridges were assigned to determine root and top yields at harvest. Five guarded plants were randomly taken from each plot at harvest to determine dry weights of top and root/plant. The different top and root fractions were oven dried to a constant weight at 70^o C for 24 hours. Fresh and dry yields of roots and tops per plot were transformed to metric tons per feddan (4200 m^2).

Qualitative parameters in terms of sucrose%, impurities (Potassium, Sodium and Alpha-amino nitrogen in meq/100 g and juice purity% (QZ) were determined in Nubria Sugar Company by means of an "Automatic Sugar Polarimeter" according to Le Docte, as described by McGinnus (1971).

Extractable white sugar percentage (B%) of beet was calculated by linking the beet non-sugar K, Na and alpha amino N according to Olddfield *et al.* (1979) as follows:

$$Z_B = pol - 0.343 (K + Na) + 0.094 N_{B1} + 0.29$$

Where:

Z_B = Extractable white sugar % (in beet).

Pol % = Gross sugar

N_{B1}= α-amino N determined by (the blue number) method.

Sugar yield per feddan was calculated from recoverable sugar % multiplied by root yield (ton/fed)

$$\text{Purity percentage} = 99.36 - [14.27 (V1+ V2) + V3/V4]$$

Where: V1 = Sodium meq/100gm. V2 = Potassium meq/100gm.

V3 = α-amino-N meq/100gm.

V4 = Sucrose percentage.

Juice purity % (QZ) was calculated as follows in Nubaria Company:

$$QZ= Z_B/pol$$

Table 1a: Some chemical properties of the irrigation water.

Seasons	pH	EC (ds/m)	E.C (ppm)	S.A.R	R.S.C	S.S.P %	Soluble anions (meq/l)				Soluble cations (meq/l)			
							CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+
2012/2013	7.3	5.53	3200	6.06	-36.6	40.3	-	2.2	48	16.37	22.8	16.2	26.8	0.73
2013/2014	7.5	5.85	3300	7.62	-30.1	44.6	-	2.2	41	12.22	22	15.5	30	0.78

Table 1b: Some chemical properties of the tested soil.

Seasons	EC (ds/m)	pH	$CaCo_3$ (%)	Soluble Anions (meq /l)				Soluble Cations (meq /l)				Macro elements (ppm)			Micro elements (ppm)			
				CO_3^-	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	N	P	K	Fe	Cu	Zn	Mn
2012/13	0.62	7.9	0.56	-	0.41	3	2.14	2.2	0.6	2.54	0.25	30	2	96	0.3	0.22	0.12	0.15
2013/14	0.74	8.1	0.49	-	0.44	3	2.91	2.8	0.4	3.3	0.22	26	2	82	0.3	0.06	0.22	0.10

The obtained data were statistically analyzed according to the method of Gomez and Gomez (1984). Treatments means were compared by Duncan's Multiple Range Test (Duncan, 1955). All statistical analysis was performed using analysis of variance technique by means of "MSTATc" computer software package.

RESULTS AND DISCUSSION

Effect of nitrogen fertilization:

1. Yield traits

Data in Table 2 show that fertilizing sugar beet plants with 90 kg N/fed was enough to produce the highest root yield/fed, without any significant variance with those supplied with 70 and/or 110 kg N/fed, in the 1st season. In the same season, dry root yield/fed had the same tendency, but it was significantly influenced by the applied N levels. Meantime, the results cleared that the fresh and dry top yields/fed were gradually and significantly increased as N fertilization levels were raised from 70 to 90 and 110 kg N/fed, in the 1st and 2nd seasons.

In the 2nd season, there were significant effects on fresh and dry yields of sugar beet roots. Application of 110 kg N/fed gave the highest values of these traits. It was found that raising N-level given to sugar beet plants from 90 to 110 kg N/fed increased fresh root yield by 3.416 t/fed and 3.421 t/fed, as compared with that produced by applying 70 kg N/fed, respectively. Where, the differences in this trait was insignificant as affected by applying 90 and 110 kg N/fed. Dry root yield/fed had the same trend. These results are in agreement with Hany and El-Henawy (2009), Abdelaal and Tawfik (2015) and Masri *et al.* (2015).

The positive effect of increasing N-dose on top and root yields may be due to the role of nitrogen in synthesis of nucleic acids and also to its effect in stimulating the meristematic growth activity which contributes to the increase in number of cells in additions to cell enlargement.

Table 2 : The studied characteristics of sugar beet as affected by three nitrogen levels in 2012 / 2013 and 2013 / 2014 seasons.

Treatments	Fresh top yield (t/fed)	Fresh root yield (t/fed)	Dry top yield (t/fed)	Dry root yield (t/fed)	Sucrose %	Extractable white sugar %	Sugar yield (t/fed)	K	Na	α amino N	Purity %
								Meq/100 g			
Nitrogen level	2012 / 2013 season										
70 kg N/fed	8.167 b	33.413	1.165 b	6.012 b	19.1 a	17.4 a	5.740 a	4.6	1.7 b	2.5 b	85.8 a
90 kg N/fed	9.438 a	34.697	1.482 b	7.971 a	18.9 a	17.0 a	6.049 a	4.6	2.7 a	3.7 a	83.3 b
110 kg N/fed	10.507a	33.845	3.474 a	7.505 a	17.1 b	14.9 b	5.072 b	4.9	3.2 a	3.5 a	77.3 c
F - test	**	Ns	**	**	*	*	*	Ns	**	**	**
	2013 / 2014 season										
70 kg N/fed	8.577 b	29.017 b	1.522 b	6.275 b	19.4 a	17.9 a	5.221 a	4.4 b	1.7 b	4.0	84.3 a
90 kg N/fed	9.660 b	32.433 a	1.728 b	7.774 a	19.1 a	17.7 a	5.748 a	4.5 b	1.7 b	4.3	83.4 ab
110 kg N/fed	12.544 a	32.438 a	2.643 a	8.530 a	17.2 b	14.9 b	4.838 b	5.5 a	3.3 a	4.5	82.2 b
F-test	**	*	**	*	**	**	*	**	**	Ns	*

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's multiple range test.

2. Sugar yield/feddan:

Results in Table 2 show that sugar yield/fed was considerable affected by nitrogen fertilizer levels in both seasons. Sugar beet plants fertilized with 90 kg N/fed produced the highest sugar yield/fed out-yielding those given 70 and/or 110 kg N/fed by 0.309 t/fed and 0.977 t/fed, respectively, in the 1st season, correspond to 0.527 t/fed and 0.910 t/fed in the 2nd one. However, the variance between 70 and 90 kg N/fed in their influence on sugar yield/fed was insignificant, in both seasons. These results are in agreement with those reported by Hany and El-Henawy (2009), and Masri *et al.* (2015).

The increase in sugar yield/fed can be referred to the increase of root yield/fed accompanying the increase in N-fertilizer level. On the other hand, the reduction in sugar yield/fed recorded with 110 kg N/fed application may be due to the negative influence of increasing N levels on sugar recovery %.

3. Quality traits

Root quality traits, in terms of sucrose%, extractable white sugar % and purity % as well as impurities % were significantly affected by N levels in both seasons, except K, in the 1st season and Alfa amino N in the 2nd season (Table 2). Decreasing N level from 110 to 90 and 70 kg N/fed gradually increased sucrose%, extractable white sugar % and purity%, in the first and second seasons. However, the difference between 70 and 90 kg N/fed in their influence on sucrose%, extractable sugar % was insignificant, in both seasons. On the contrary, there were positive relations between N fertilization levels and impurities% in roots (K, Na and Alfa amino N), in the 1st and 2nd seasons. These results coincided with that reported by Abdelaal and Saher (2015). These results may be due to that high N availability late in the season increases impurities in the beet.

Effect of foliar Cetreen application:

1. Fresh root and top yields/feddan

The results in Table 3 show that root and top yields/fed were substantially increased with increasing the applied amount of micronutrients mixture up to 2.5 l Cetreen/fed, in the1st and 2nd seasons, except root yield, in the 1st season, where it was found that applying 2.0 l Cetreen/fed was enough to get the highest mean value of this trait. Plants received 2.5 l Cetreen /fed recorded 2.741, 2.253 and 1.067 t/fed in top yield/fed higher than those given control, 1.5 and 2.0 l Cetreen/fed, respectively, in the 1st season, correspond to 3.780, 3.260 and 1.347 t/fed, in the 2nd one. Likewise, supplying sugar beet plants with 2.0 l Cetreen/fed produced the highest root yield/fed, which out-yielded those given control, 1.5 and 2.5 l/fed of Cetreen by 2.669, 1.605 and 1.154 t/fed in the 1st season, respectively. However, spraying sugar beet plants with 2.5 l Cetreen/fed out-yielded those given control, 1.5 and 2.0 l Cetreen/fed by 4.801, 3.298 and 0.732 t/fed, respectively, in the 2nd season. The increase in top and root yields may be due to the role of micronutrients involved in Cetreen as Fe, Zn and Mn. These results are in harmony with those of Abd El-Gawad *et al.*(2004), Yarnia *et al.* (2008) and Nemeat-Alla *et al.* (2009). However, the variances between (the control and 1.5 l/fed) as well as (2.0 and 2.5 l/fed) in their influence on top and root yields were insignificant, in the 1st seasons. In the 2nd one, there was insignificant variance between the control and 1.5 l Cetreen/fed in their effect on top yield/fed. Also, the difference between 2.0 and 2.5 l Cetreen was insignificant on root yield/fed.

2. Dry top and root yields/fed:

Data in Table 3 indicate that spraying sugar beet plants with micronutrients significantly affected dry top and root yields per feddan in the two seasons. The increase in these traits may be due to role of micronutrients. The differences between the application of (2 and 2.5 l Cetreen/fed) and (1.5 and 2 l Cetreen/fed) in their influences on these traits did not reach the level of significance, respectively.

Dry root yield/fed was significantly increased by 1.451 and 1.161 t/fed, and 2.671 and 1.970 t/fed by increasing level of micronutrients spraying up to 2 l/fed as compared with the control, in the 1st and 2nd seasons, respectively. The increases of dry top and root yields may be due to effect of zinc, manganese and iron elements, which play roles as coenzymes and increase the assimilates, which reflected on growth of leaves and root and increased dry matter accumulation in root and consequently increased top and root yields per/fed. These results are in agreement with those obtained by Amin, *et al.* (2013).

Table 3 : The studied characteristics of sugar beet as affected by four microelements foliar levels in 2012 / 2013 and 2013 / 2014 seasons.

Foliar Cetreen level	Fresh top yield (t/fed)	Fresh Root yield (t/fed)	Dry top yield (t/fed)	Dry root yield (t/fed)	Sucrose %	Extractable white sugar %	Sugar yield (t/fed)	K (Meq/100g)	Na (Meq/100g)	α α amino N (Meq/100g)	Purity %
						2012/2013 season					
Control	8.145 b	32.673 b	1.789 b	6.478 b	17.8 b	15.8 b	5.181 b	4.7	2.7	3.4	81.7
1.5 l/fed	8.633 b	33.737 b	1.928 ab	7.929 a	18.5 ab	16.9 a	5.673 a	4.4	2.4	2.8	83.9
2 l/fed	9.819 a	35.342 a	2.115 a	7.639 a	19.0 a	17.1 a	5.982 a	4.7	2.5	3.3	82.1
2.5 l/fed	10.886 a	34.188 a	2.332 a	6.605 b	18.1 ab	16.1 b	5.645 a	4.9	2.6	3.4	81.0
F - test	**	*	*	**	*	*	**	Ns	Ns	Ns	Ns
						2013/2014 season					
Control	8.577 c	28.703 c	1.599 b	6.100 c	17.8 b	15.7 c	4.478 c	5.3 a	3.1 a	4.9 a	82 b
1.5 l/fed	9.097 c	30.206 b	1.630 b	8.771 a	18.4 ab	16.6 b	5.017 b	4.9 ab	2.2 b	4.2 b	83.6 a
2 l/fed	11.010 b	32.772 a	2.108 a	8.070 a	18.8 a	17.2 a	5.631 a	4.5 b	1.9 bc	3.9 b	84 a
2.5 l/fed	12.357 a	33.504 a	2.521 a	7.165 b	19.2 a	17.8 a	5.949 a	4.5 b	1.7 c	4.1 b	84 a
F-test	**	**	**	**	**	**	**	*	**	**	*

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's multiple range test.

3. Sugar yield/fed:

Results in Table 3 cleared that sugar yield/fed was significantly increased by increasing the foliar application of Cetreen to 2 l/fed, in the 1st season and to 2.5 l/fed in the 2nd one. Such increase amounted to 0.801, 0.309 and 0.337 ton/fed, respectively in the first season and 1.471, 0.932 and 0.318 ton/fed, in the second one. However, the increases in sugar yield/fed accompanying high micronutrients level might have been due to the increase in root yield and extractable sucrose percentage. Such results are in accordance with those reported by Masri and Hamza (2015). However, the variances between 1.5, 2.0 and 2.5 l/fed in their influence on sugar yield were insignificant, in the 1st season. In the 2nd one, there was insignificant variance between the 2 and 2.5 l Citreen/fed in their effect on sugar yield/fed.

4. Quality attributes:

Root quality traits, in terms of sucrose % and extractable white sugar%, in the 1st and 2nd seasons, as well as purity % and impurities (K, Na and α-amino N), in the 2nd season were significantly affected by the sprayed micronutrients (Table 3). Increasing Cetreen level up to 2 l/fed (in the 1st season) and to 2.5 l/fed (in the 2nd season) increased these two traits. In the 2nd season, it can be noticed that all of sucrose, sugar recovery and purity percentages were gradually increased, simultaneously with the reduction of root contents of impurities, as Cetreen level was raised up to the highest level. Similar trends were observed by Masri and Hamza (2015). These results could be referred to the fact that root sucrose content is adversely correlated with its content of impurities.

Effect of the interaction:

The following part will discuss the significant characters only.

Results in Table 4 indicate that sugar beet root fresh and dry yields/fed as well as Alfa amino-N (in the 1st season), top fresh and dry yields/fed as well as percentages of sucrose, extractable white sugar and purity (in the 2nd season) and sugar yield (in both seasons) were significantly affected by the interaction between the applied N and Cetreen (Fe, Zn and Mn micronutrients) levels.

It was found that the best combination to get the maximum root fresh and dry yields/fed as well as the highest sugar yield/fed was the application of 90 kg N + 2.0 l Cetreen/fed. Meantime, both N and Cetreen levels should be raised to 110 kg N and 2.5 l/fed, respectively to produce the highest fresh and dry yields of tops/fed. Moreover, reducing N-fertilizer level to 70 kg N/fed with the highest Cetreen level (2.5 l/fed) was required to get the maximum record of purity %. However, raising N-level up to 110 kg N/fed without the application of any micronutrient gave the maximum root content of alpha amino-N. In addition, fertilizing beets with 70 and/or 90 kg N/fed + 2.5 l Cetreen/fed was enough to get the highest sucrose and extractable white sugar percentages. These results are in line with those of Mekki (2014).

Table 4 : The studied characteristics of sugar beet as affected by the interaction effect among all factors under study in 2012 / 2013 and 2013 / 2014 seasons.

Nitrogen level (kgN/fed)	Foliar Cetreen level (l/fed)	2012/2013 season				2013/2014 season					
		Fresh root yield (t/fed)	Dry root yield (t/fed)	Sugar yield (t/fed)	α-aminoN (Meq/100g)	Fresh top yield (t/fed)	Dry top yield (t/fed)	Sucrose %	Extract-able white sugar %	Sugar yield (t/fed)	Purity %
70	Control	30.035 d	4.717 f	5.219 ef	2.2 c	6.813 e	1.344 d	18.8 d	17.0 c	4.425 fg	82.3 def
	1.5	31.817cd	6.440 de	5.571 cde	2.3 c	8.017 de	1.331 d	19.0 cd	17.5 c	4.764 efg	84.3 bc
	2	34.449 b	6.025 e	5.946 bcd	2.6 c	8.979 cd	1.495 d	19.4 bc	18.1 b	5.543 c	84.7 ab
	2.5	37.352 a	6.867 d	6.223 b	2.7 c	10.500 c	1.918 c	20.3 a	19.1 a	6.151 b	85.7 a
90	Control	33.992 bc	7.082 cd	5.523 de	3.7 ab	8.783 cd	1.317 d	17.9 e	16.2 d	4.682 efg	82.3 def
	1.5	34.627 b	8.497 b	5.911 bcd	3.4 b	9.193 cd	1.391 d	18.6 d	17.2 c	5.429 cd	83.3 cd
	2	37.371 a	9.196 a	6.782 a	3.9 ab	10.360 c	2.104 c	19.5 b	18.2 b	6.210 b	84.7 ab
	2.5	32.797 bc	7.106 cd	5.980 bc	3.8 ab	10.304 c	2.100 c	20.3 a	19.0 a	6.669 a	84.7 ab
110	Control	33.992 bc	7.633 c	4.801 fg	4.1 a	10.136 c	2.136 c	16.8 h	13.9 f	4.329 g	81.3 f
	1.5	34.767 b	8.849 ab	5.537 cde	2.6 c	10.080 c	2.167 c	17.6 ef	15.2 e	4.857 ef	83.1 d
	2	34.207 bc	7.697 c	5.217 ef	3.5 b	13.692 b	2.723 b	17.4 fg	15.3 e	5.141cde	82.7 de
	2.5	32.415 bcd	5.842 e	4.731 g	3.8 ab	16.268 a	3.544 a	17.1 gh	15.2 e	5.025 de	81.7 f

Means of each factor designated by the same letter are not significantly different at 5% level using Duncan's multiple range test.

CONCLUSION

To get the highest root and sugar yields/fed, applying 90 kg N + 2.0 l Cetreen/fed is recommended for sugar beet grown under conditions of the sandy soil of the present work.

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أهمية النيتروجين والعناصر الصغرى لإنتاج بنجر السكر فى الأراضى الرملية

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أُقيمت تجربتان حقليتان فى موسمى ٢٠١٣/٢٠١٢ و ٢٠١٤/٢٠١٣ بمزرعة جمعية الحسين بالكيلو ٦٤ طريق مصر-الأسكندرية الصحراوى – محافظة الجيزة (دائرة عرض ٣١.١٤ درجة شمالاً و خط الطول ٣١.٣٩ درجة شرقاً) لدراسة تأثر التسميد بالنيتروجين وبعض العناصر الصغرى على حاصل وجودة بنجر السكر(الصنف بلينو) فى تربة رملية.

إشتملت الدراسة على ١٢ معاملة مثلت التوافق بين ٣ مستويات للنيتروجين (٧٠ ، ٩٠ و ١١٠ كجم ن/فدان) و ٤ مستويات للعناصر الصغرى (المقارنة ، ١.٥ ، ٢.٠ و ٢.٥ لتر/فدان) من السترين المحتوى على المنجنيز ، الحديد و الزنك فى صورة مخلبية). إستُخدِم التصميم التجريبى "الشرائح المتعامدة" فى ٣ مكررات لتوزيع المعاملات.

دلت النتائج أن إضافة ١١٠ كجم ن/فدان أعطت أعلى القيم لحاصلى الجذور و الأوراق الطازج والجاف فى الموسم الثانى ، ولم تصل الفروق بين مستويات السماد النيتروجينى حد المعنوية فى تأثيرها على الحاصل الطازج للجذور فى الموسم الأول. كذلك ، فقد أوضحت النتائج أن إضافة ٧٠ كجم ن/فدان أعطى أقصى نسب مئوية للسكروز ، ناتج السكروز والنقاوة فى الموسمين. إزداد حاصل السكر/فدان بزيادة مستوى السماد النيتروجينى إلى ٩٠ كجم ن/فدان فى كلا الموسمين.

أدى الرش الورقى بمعدل ٢.٠ و/أو ٢.٥ لتر سترين/فدان إلى زيادة معنوية لكلٍ من حاصل الجذور ، الأوراق والسكر للفدان ، كما حسَّنَ النسبة المئوية لكلٍ من السكروز والنقاوة ، فى الموسمين .

يمكن التوصية بإضافة ٩٠ كجم نيتروجين والرش الورقى بمعدل ٢.٠ لتر سترين للفدان لإنتاج أعلى حاصلى جذور وسكر/فدان من بنجر السكر تحت ظروف التربة الرملية بمنطقة البحث .