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INFLUENCE OF FOLIAR SPRAY OF SOME MICRONUTRIENTS AND NITROGEN FERTILIZER ON PRODUCTIVITY OF SUGAR BEET UNDER NEWLY RECLAIMED SOILS.

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ABSTRACT

Two field trials were conducted during 2009/2010 and 2010/2011 seasons in Nubaria Research Station. Alexandria Governorate. The major goal was to study the effect of nine treatments which represented the combination between three foliar spray of some micronutrients solution levels (1/4, 1/2 and 3/4 /300 L water/fed) at 45 and 75 days from sowing and three nitrogen fertilizer levels of (80, 100 and 120 Kg/fed). A split plot design with four replications was used. The main plots were assigned to foliar spray with some micronutrients solution, whereas, nitrogen fertilizer in the sub plots.

The obtained results revealed that: foliar spray of micronutrients solution level at 1/2 l/fed attained a highest values for root diameter and fresh weight/plant, as well as, sucrose%, purity%, root and sugar yields/fed. While, N, Na and K% were decreased in both seasons. Foliar spray of micronutrients solution level at 3/4 l/fed increased root length and macroelements (g/100 g DW) in both seasons.

Application of nitrogen fertilizer at 120 kg N/fed gave the highest mean values of root length, diameter, fresh weight/plant, root and sugar yields/fed. On the contrary, a gradual reduction in sucrose% and purity% had been detected with the increase in nitrogen level over 80 kg N/fed.

Interaction between foliar spray of some micronutrients solution levels 1/2 l/fed and nitrogen fertilizer at 120 kg/fed significantly affected on sucrose%, root and sugar yields/fed in both seasons.

INTRODUCION

Egyptian Government imports large amounts of sugar, i.e. about 1.10 million ton, every year to face the rapid increase of population. Sugar beet plays a prominent role for sugar production, about 37.27% of locally sugar production, (CCSC, 2010). In recent years, sugar beet grown on sandy soils as newly reclaimed soils has shown a variety of visual symptoms that resemble nutrients deficiencies. Sugar beet nutrition had a great effect on beet productivity.

For various crops, micronutrients fertilizers received great attention. Application of micronutrients mineral soluble salts unavailable forms. Many worker for micronutrients metioned that, Osman (1997) and Abd El-Gawad *et al.* (2004) they found that Mn application at a level of 40 g/fed significantly raised purity%. Gezgin *et al.* (2000) found that foliar application of B levels from 0, 500 and/or 750 g/boron as (sodium borate 11% B) increased significantly root and sugar yields via the increase in root sucrose%. Osman *et al.* (2003 and 2004) application of three levels of boron (0, 1 and 2 Kg/fed) (as a borax, sodium borate 11% B) and 2 levels of Mn (0 and 1 Kg/fed) as a manganese sulfate (28% Mn) and the mixture of them 2 kg B + 1 kg Mn/fed. The results observed that, surpassed in root length, TSS%, sucrose%, root and sugar yields/fed. Shafika and El-Masry (2006) found that foliar spray with micronutrients, in mixtures of Zn, Mn and Fe increased significantly root growth, quality traits%, root and sugar yields/fed. Zeinab and Samya (2006) used three concentration from B (0, 0.02 and 0.04% boric acid) as foliar application on root quality and yields of sugar beet. The results, found that (0.02% boric acid) attained the highest root growth, quality traits%, as well as root and sugar yields/fed. Allam (2008) used three concentration from boron (0, 0.02 and 0.04% boric acid) as foliar application on root quality and yields of sugar beet. The results, found that (0.02% boric acid) attained the highest root growth, quality traits%, as well as root and sugar yields/fed. El-Geddawy *et al.* (2007 and 2008) showed that soaking sugar beet seeds with soulutions of micronutrients 0.5 and/or 1 kg B/fed + 4 kg Zn/fed before sowing significantly surpassed the dried method with respect to root diameter, weight/plant, root and sugar yield/fed. Soudi and El-Guibali (2008) and Manal, Hussein (2011) found that foliar application with (B + Zn + Mn + Fe) at the level 2 cm /l /400 l water/fed increased significantly root length, diameter, fresh weight/plant, as well as, sucrose%, purity%, root and sugar yields/fed in both seasons as compared with control treatment (without micronutrients) and 1 cm /l /400 l water/fed. Hellal *et al.* (2009) concluded that in calcareous soil were high level of calcium carbonate are present. Boron should be applied to improve the yield and nutrient balance of sugar beet.

Nitrogen supply is the most essential factor in plant nutrition. The optimum dose of nitrogen needed by sugar beet is greatly affected by many factors such as soil type, length of growing period, irrigation system, sugar beet variety..etc. In general, the literature cleared that sugar beet did not produce profitable crop under shortage of nitrogen (Vendergeten and Venstaleen., 1991). High N dressing increased vegetative growth, meantime, decreased root yield and sugar yields/fed and quality of the crop decline greatly (Moustafa, Zeinab *et al.*, 2000 and Moustafa, Shafika *et al.* 2005). Osman (2005) found that the highest sugar yield was recorded due to the addition of 80 kg N/fed. Leilah *et al.* (2005) found that adding 250 kg N/ha (105 kg N/fed) produced the highest values of root length, diameter, fresh weight, root and sugar yields/ha under the newly reclaimed soils in Egypt. Shafika and El-Masry (2006), El-Hosry *et al.* (2010), Osman *et al.* (2010) and Osman and Shehata, Mona (2010) found that increasing N rates from 60 up to 120 kg/fed decreased root sucrose content and sugar yield/fed, while, growth criteria, juice impurities% (Na, K and α- amino N) and root yield showed a vice versa trend.

The present study was carried out to determine the proper foliar spray with micronutrients solutions and nitrogen fertilizer levels under the agro-climatic conditions of Nubaria.

MATERIALS AND METHODS

Two field trials were conducted during 2009/2010 and 2010/2011 seasons in Nubaria Research Station. Alexandria Governorate. The major goal was to study the effect of nine treatments which represented the combination between three spray of some micronutrients solution levels (1/4, 1/2 and 3/4 /300 L water/fed) and three nitrogen fertilizer levels (80, 100 and 120 Kg/fed). Foliar spray of some micronutrients solution comprise of liquid chelated microelements, B, Fe, Zn and Mn, i.e. boron in the form of (boric acid 9% B), iron in the form of iron chelated (7.15% iron oxide), zinc in the form of zinc chelated (7% zinc) and Manganese in the form of manganese chelated (9.03% manganese oxide), which were sprayed at 45 and 75 days from sowing, using hand sprayer with 300 l/fed. Physical and chemical analysis of the Experimental site according to A.O.A.C. (2005) are shown in Table 1. The preceding crop was Maize at both seasons. A split plot design with four replications was used. The main plots were assigned to foliar with micronutrients solution, whereas, nitrogen fertilizer in the sub plots. The sub plot area was 19.60 m^2 including four ridges of 7 m in length and 70 cm apart and spacing between hills 20 cm. Farida variety was sown on 10th and 20th October and harvested after 7 months for the 1st and 2nd seasons, respectively. Nitrogen fertilizer at the levels of 80, 100 and 120 kg/fed in the form of ammonium nitrate (33.5% N) was applied in four equal doses, the first was applied after thinning and the others was applied at 2-weeks interval after the first application. Phosphorus fertilizer level at the rate of 30 kg/fed in the form of calcium super phosphate (15.5% P_2O_5) was added during land preparation. Potassium fertilizer level of 24 kg/fed in the form of potassium sulfate (48% K_2O) was applied in four equal doses with nitrogen fertilizer. Other agricultural practices for sugar beet field were carried out as recommended by Sugar Crops Research Institute.

Table 1: Some physical and chemical analysis of the experimental site.

Seasons	Partial size			Soil	Soil	E.C.	$CaCO_3$ %	Organic matter%	Available contents %		
	Clay	Silt	Sand	pH (1:2.5)	Textural	ds/m			N	P	K
2009/2010	3.0	3.3	93.7	7.7	Sandy	1.6	10.6%	0.75	4.4	3.21	132
2010/2011	3.6	4.7	91.7	7.8	Sandy	1.9	9.9%	0.90	6.5	3.01	120

Seasons	Soluble cations (meq/l)				Soluble anions (meq/l)				Available contents (ppm)			
	Ca^{++}	Mg^{++}	Na^+	K^+	CO_3^-	HCO_3^-	Cl^-	SO_4^-	B	Fe	Zn	Mn
2009/2010	2.00	3.02	3.24	0.25	2.50	1.10	3.02	2.17	0.31	4.2	2.6	3.8
2010/2011	2.05	3.00	3.14	0.35	2.60	1.09	3.00	2.10	0.35	4.1	3.5	2.4

Recorded data:

At harvest time (210 days from sowing): A sample of 10 roots was randomely taken and the following traits were determined:

I. Root growth traits:

1. Root length (cm/plant).
2. Root diameter (cm/plant).
3. Root fresh weight (g/plant).

II. Juice quality:

4. Sucrose%: was polar-metrically determined on a lead acetate extract of fresh macerated root according to Le Docte (1927).
5. Purity% was calculated according to Purity % = Sucrose% x 100/TSS%.
6. Macro elements content, i.e. nitrogen (N), sodium (Na) and potassium (K)% were determined as described by A.O.A.C. (2005).

III. Yields (tons/fed):

7. Root yields (ton/fed) was determined on the whole plot basis were harvested, topped and weighed to determine root yields/fed.
8. Sugar yield (ton/fed) which was calculated by multiply root yields/fed x sucrose%.

Data statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

I. Effect of micronutrients solution levels as foliar spray.

Results presented in Table 2 indicated that foliar spray with micronutrients solution level at 1/2 l/fed gave the higher values for root diameter and root fresh weight than 1/4 or 3/4 l/fed. The same results were obtained for juice quality as sucrose% and purity% as well as root and sugar yields in both seasons. On the other hand, the treatment with 3/4 l/fed gave the highest values for root length and macroelements, i.e., N, Na and K% than other micronutrients levels. This intensive competition was compensated by a sufficient increase in root fresh weight/plant, sucrose% as well as root and sugar yield. The stimulation effects of microelements on quality traits may be attributed to the increase in sucrose%.

Boron is essential for the formation of new cells in meristems in addition to a vital role in sugar translation to roots.

Manganese activates some of the enzyme reactions. It plays a role in regulating the levels of Auxin in plant tissues by activating the Auxin Oxidase system (Marschner 1986). Mn element acts as an activator for different enzymes, especially those of the interactions of Kerbs cycle and protein synthesis within the plant.

Role of Fe as an electron carrier in photosynthetic phosphorylation and N-fixation, in addition to its role in building-up chlorophyll and the activity of metalloflavoprotein, which may be reflected on plant performance.

The role of Zn in enhancement the vegetative growth, might be due to that Zn is known to be an essential constituent of three plants enzyme i.e. carboning anhydrase, alchohol dehydrogenase and superoxidase dismutase. In addition, Zn has a marked effect on the level of Auxin which appears to be required in the synthesis of intermediates in the metabolic pathway, through tryptophan to Auxin (Ohki 1978) which in turn encourage the meristemic activity of the plant which resulted in more cell enlargement (Devlin and Witham 1983).

(Sandman and Bogger 1983) stated that yield increment might be due to the favorable influence of Zn on plasnt enzyme activity and improving the photosynthetic and mobilization in plants. The pronounced effect of micronutrients is mainly due to their effect on growth hormone production which has a direct effect on plant growth, throughout their influence on the production of plant growth promoting substances and increase in various availability soil nutrients. These results are in agreement with those reported by El-Geddawy *et al.* (2007 and 2008), Soudi and El-Guibali (2008) and Manal, Hussein (2011).

Table 2: Effect of spray of micronutrients solution on roots growth, quality traits, macroelements% and yields (ton/fed) at harvest during 2009/2010 and 2010/2011 seasons.

Traits	2009/2010 season									
Micronutrients	Root growth traits			Quality %		Macroelements%			Yields	
(l/fed)	RL	RD	RFW	Suc.	Pur.	N	Na	K	RY	SY
1/4	24.20	11.67	813.6	14.90	77.60	1.46	1.70	3.72	22.75	3.39
1/2	28.10	13.25	931.4	16.57	84.97	1.25	1.50	3.47	24.38	4.04
3/4	28.90	12.36	874.2	15.80	81.44	1.53	2.10	3.83	24.13	3.81
LSD at 5%	0.60	0.65	15.0	0.20	0.15	0.08	0.11	0.13	1.45	0.09
	2010/2011 season									
1/4	24.30	12.36	818.7	16.01	75.88	1.47	1.95	3.68	23.57	3.77
1/2	25.20	13.64	946.0	17.00	83.95	1.31	1.36	3.51	25.58	4.35
3/4	29.20	12.98	877.1	16.49	79.47	1.57	2.36	3.74	24.99	4.12
LSD at 5%	0.75	0.45	40.0	0.37	0.25	0.09	0.17	0.15	1.60	0.08

RL= Root length (cm), RD = Root diameter (cm), RFW = Root fresh weight (g/plant), Suc.= Sucrose%, Pur.= Purity%. Macroelements% (g/100 g DW), i.e. (N= nitrogen, Na= sodium, K= potassium). Yield (ton/fed) RY= Root yield and SY = Sugar yield.

II. Nitrogen fertilizer effects.

Results in Table 3 showed that nitrogen fertilizer levels led to significantly differences in root length, diameter, fresh weight, sucrose% and purity%, as well as, root and sugar yields/fed in both seasons. The treatment with nitrogen fertilizer at 120 kg/fed gave the highest mean values for, root length, diameter and fresh weight g/plant, as well as, root and sugar yields/fed, while, it gave the lowest sucrose% and purity%. Such effect may be due to that the increase of nitrogen fertilizer increased the fraction of the assimilate entering the root that was used in growth at the expense of that stored as sugar. Thus, plants with more N had a smaller proportion of their root weight as sugar because more was used in growth. Also, the response of beet to the high N up to 120 kg/fed was expected since the available N content of sandy soil in the experimental site was low. Similar results were reviewed by Osman *et al.* (2010) and Osman and Shehata, Mona (2010) they found that frowth crieteria of sugar beet plants were significantly increased with increasing level of N fertilization up to 120 kg/fed.

For macroelements%, results showed that N, Na and K contents were significantly increased by increasing nitrogen level in both seasons. Application of 80 kg N/fed gave the lowest mean values for N, Na and K content in the two seasons as compared with other levels of nitrogen. This was compensated by a sufficient increase in root fresh weight/plant, sucrose% as well as root and sugar yield. Such effect may be due to that nitrogen fertilizer enhanced the uptake of other minerals which finally reflected in better growth of root and quality, also, due to the especially role of high nitrogen level that stimulate vegetative growth and hence more essential elements absorbed which increased its level in beet roots at harvest (Moustafa, Shafika et al. 2005). These results are in agreement with those obtained by Osman and Shehata, Mona (2010).

Table 3: Effect of nitrogen fertilizer levels on root growth, quality traits, macroelements% and yields (ton/fed) at harvest during 2009/2010 and 2010/2011 seasons.

Traits	2009/2010 season									
Nitrogen	Root growth traits			Quality %		Macroelements%			Yields (ton/fed)	
(kg/fed)	RL	RD	RFW	Suc.	Pur.	N	Na	K	RY	SY
80	23.90	12.44	753.3	16.37	83.95	1.32	1.50	3.52	22.70	3.72
100	25.80	12.93	859.3	15.60	75.18	1.50	1.70	3.81	23.26	3.63
120	28.60	13.62	1012.7	15.30	71.16	1.73	1.90	4.00	25.30	3.87
LSD at 5%	0.80	0.95	35.0	0.55	0.20	0.10	0.16	0.23	1.65	0.10
	2010/2011 season									
80	23.40	12.98	769.6	17.17	81.76	1.42	1.70	3.46	23.55	4.04
100	26.50	13.40	875.5	16.58	76.06	1.51	1.90	3.79	24.11	4.00
120	28.60	13.82	1025.6	15.75	71.92	1.72	2.00	3.99	26.47	4.17
LSD at 5%	1.15	0.75	50.0	0.45	0.15	0.09	0.18	0.17	1.85	0.07

RL= Root length (cm), RD = Root diameter (cm), RFW = Root fresh weight (g/plant), Suc.= Sucrose%, Pur.= Purity%. Macroelements% (g/100 g DW), i.e. (N= nitrogen, Na= sodium, K= potassium). Yield (ton/fed) RY= Root yield and SY = Sugar yield.

III. Effect of interactions.

The tabulated results in Tables 4 and 5 mentioned that the interaction between foliar spray of some micronutrients solution and nitrogen fertilizer levels affected significantly root fresh weight, N and K in Table 4 and sucrose%, root and sugar yields/fed in Table 5. The high mean values for root fresh weight/plant, root and sugar yields/fed were obtained when applied 120 kg N/fed and foliar spray of some micronutrients solution at the level of 1/2 l/fed in both seasons. While, sucrose% recorded the highest values when applied 80 kg N/fed and foliar spray of micronutrients solution at the level of 1/2 l/fed in both seasons. For N and K%, the results observed that the interaction between nitrogen 120 kg/fed and spray of micronutrients solution at the level of 3/4 l/fed gave the maximum increase for N and K% in both seasons.

Table 4: Interaction effect on root growth traits and macroelements% at harvest during 2009/2010 and 2010/2011 seasons..

	2009/2010 season								
Interactions	Root fresh weight (g/plant)			Nitrogen%			Potassium%		
Micronutrients	Spray of micronutrients solution levels (B + Fe + Zn + Mn) l/fed								
x nitrogen	1/4	1/2	3/4	1/4	1/2	3/4	1/4	1/2	3/4
80	710.1	772.4	741.39	1.19	1.10	1.37	3.45	3.27	3.54
100	800.2	890.9	850.6	1.46	1.25	1.48	3.77	3.50	3.85
120	900.5	1100.9	1000.7	1.72	1.41	1.75	3.95	3.65	4.10
LSD at 5%	0.01			0.09			0.06		
	2010/2011 season								
80	725.2	802.3	754.19	1.33	1.17	1.45	3.41	3.24	3.42
100	815.3	920.8	863.45	1.38	1.27	1.57	3.72	3.53	3.81
120	915.6	1120.8	1013.6	1.69	1.49	1.70	3.91	3.75	4.00
LSD at 5%	0.02			0.08			0.10		

The beneficial effects of the studied micronutrients and nitrogen are more related to their active role for building new meristemic cells, enhanced cell elongation and increased the ability rate of leaves for photosynthetic process. The beneficial effect of the interaction between these micronutrients may be attributed to each one by increasing plant growth or maintaining favorable balance between them. The positive effect of micronutrients as individually or mixture on sugar beet plants was also reported by Soudi and El-Guibali (2008) and Manal, Hussein (2011).

Table 5: Interaction effect on sucrose, root and sugar yields (ton/fed) at harvest during 2009/2010 and 2010/2011 seasons.

2009/2010 season									
Interactions	Sucrose%			Root yields (ton/fed)			Sugar yields (ton/fed)		
Micronutrients	Spray of micronutrients solution levels (B + Fe + Zn + Mn) l/fed								
x nitrogen	1/4	1/2	3/4	1/4	1/2	3/4	1/4	1/2	3/4
80	15.35	17.30	16.45	21.50	23.50	23.10	3.30	4.07	3.80
100	14.85	16.25	15.70	22.65	23.68	23.45	3.36	3.85	3.68
120	14.51	16.15	15.25	24.10	25.95	25.85	3.50	4.18	3.94
LSD at 5%	0.30			0.03			0.10		
2010/2011 season									
80	16.52	17.85	17.13	22.35	24.35	23.95	3.69	4.35	4.10
100	16.10	17.05	16.60	23.50	24.53	24.31	3.78	4.18	4.04
120	15.41	16.10	15.75	24.85	27.85	26.70	3.83	4.48	4.21
LSD at 5%	0.40			0.20			0.09		

Conclusion

It is concluded that foliar application at the level of 1/2 l/fed with applied N fertilizer level at 120 kg/fed produced the highest mean values of the most traits under study.

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تاثير الرش ببعض العناصر الصغرى والتسميد النيتروجينى على انتاجيــة بنجــر السكر تحت ظروف الاراضى حديثة الاستصلاح

عادل محمود حسن عثمان
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اجريت تجربتان حقليتان فى موسمى ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ فى محطة البحوث الزراعية بالنوبارية بمحافظة الاسكندرية وذلك بهدف دراسة تاثير ثلاثة مستويات من محلول مكون من بعض العناصر الغذائية الصغرى (بورون - حديد - زنك - منجنيز) التى اضيفت رشا بمعدل ٤/١ و ٢/١ و ٤/٣ لتر/٣٠٠ لتر ماء/فدان بعد ٤٥ و٧٥ يوم من الزراعة وثلاثة مستويات مــن التسميد النيتروجينى وهى ٨٠ و ١٠٠ و ١٢٠ كجم/فدان. استخدم تصميم القطع المنشقة مرة واحدة فى اربع مكررات حيث وضعت معدلات الرش بالعناصر الغذائية الصغرى فـــى القطـــع الئيـــسية ووضعت معدلات التسميد الازوتى فى القطع الشقية.

اوضحت النتائج ما يلى:

- الرش بمعدل ٢/١ لتر/فدان للعناصر الغذائية الصغرى المستخدمة ادى الى زيادة قطــر ووزن الجذر والنسبة المئوية للسكروز ومحصول الجذور والسكر طن/فدان بينمـــا انخفــضت النــسبة المئوية للعناصر الكبرى (نيتروجين وصوديوم وبوتاسيوم) وعلى العكـــس زاد طـــول الجـــذر والنسبة المئوية للعناصر الكبرى بزيادة مستوى الرش الى ٤/٣ لتر/فدان.
- ادى زيادة التسميد النيتروجين من ٨٠ الى ١٢٠ كجم/فدان الى زيادة طول وقطر ووزن الجــذر الطازج والنسبة المئوية للعناصر الكبرى (نيتروجين وصوديوم وبوتاسيوم) ومحصول الجــذور والسكر للفدان. وعلى العكس لوحظ انخفاض فى النسبة المئوية للسكروز والنقاوة بزيادة مستوى النيتروجين مقارنة بالمستوى الاقل ٨٠ كجم ن/فدان.
- كان للتفاعل بين الرش بمحلول العناصر الغذائية الصغرى بمعدل ٢/١ لتر/فدان واضافة التسميد النيتروجينى بمعدل ١٢٠ كجم/فدان تاثير معنوى علـــى صـــفات النـــسبة المئويـــة للـــسكروز ومحصولى الجذور والسكر/فدان.

توصـى الدراسة بالرش بمحلول العناصر الغذائية الصغرى بمعدل ٢/١ لتر/فــدان مـــع اضافة التسميد الازوتى بمعدل ١٢٠ كجم/فدان للحصول على اعلى انتاجيـــة لمحـــصولى الجـــذر والسكر وجودة تحت ظروف منطقة الدراسة.

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