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PRODUCTIVITY AND QUALITY OF SUGAR BEET AS AFFECTED BY RATES OF POTASSIUM AND SOME MICRONUTRIENTS UNDER TWO LOCATIONS

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ABSTRACT: ***Two field experiments were carried out at two locations, (Al-Reyad, Kafr El-Sheikh Governorate (L1) and Kotour, AlGharbia Governorate (L2), Egypt) during 2006/2007 and 2007/2008 seasons, to study the effect of potassium levels (0, 24 and 48 kg K_2O/fed.) and chelated boron at two levels (½ , 1 liter/fed.), and micronutrients mixture (Fe + Zn + Mn) at two levels (1.5, 2.25 liter/fed.). as well as water as control treatment.***

Root and sugar yields were significantly greater in L2 than in L1. Sucrose% was higher in L1 than L2. Root yield, sucrose %, white sugar % and sugar yield were significantly increase by adding 24 or 48 K_2O/feddan compared with control. Potassium rate had no significant effect on top yield, K content, α-amino N content, lose sugar % and purity %.

Foliar spraying with liquid chelated boron (1Liter/fed.) or chelated microelements mixture (Fe + Zn + Mn at 2.25 Liter/fed.) produced the highest root yield, top yield, white sugar % and sugar yield.

It can be concluded that application 24 Kg K_2O/fed. along with 1 Liter liquid chelated boron or 2.25 Liter chelated microelements mixture (Fe + Zn + Mn)/fed. could be recommended for optimum root yield at Al Gharbia and Kafr El-Sheikh Governorates.

Key words: ***Productivity, Location, micronutrients, microelements, Sugar beet***

INTRODUCTION

Sugar beet ranks the second sugar crop not only in Egypt but also in whole around. Nowadays, fertilization takes a good place in research. Many investigators seriously tried to find out the optimum levels of potassium fertilizer and micronutrients, at different locations. The present work was performed to study the effect of some fertilizers and their levels under different locations on yield and quality of sugar beet. Badr (2009) stated that increasing potassium rate from zero to 48 kg k_2O /fed significantly increased sucrose % and suger yield/ fed . Ibrahim *et al.* (1988) reported that spraying sugar beet with mixture of Zn, Mn, Fe, Cu and B gave the highest top, root and sugar yields. Martens (1991) mentioned that sugar beet is moderately sensitive to deficiencies of most micronutrients. Safe (1991) found a significant response to micronutrients concentration, he mentioned that the increase in white sugar % may be attributed to decreasing impurities in roots of plants sprayed by B and Fe, and that K content in root not affected by Zn

application. Badr (1999) stated that increasing micronutrients as a foliar spray increased sucrose %, purity %, yields of root and top as well as sugar yield and decreased impurities %. Stevens *et al.,*(2004) clear that foliar applications are recommended sometimes to improve the efficiency of Zn and B assimilation. Nemeat Alla (1997) *and Nemeat Alla et al.* (2005) concluded that application of mixture of (Fe + Zn + Mn) and boron significantly increased root, top, sugar yield. Al Baddrani and Al Rashidi (2007) found that sugar beet response to fertilizer (Zn and/or B) by foliar application at two locations, where sugar percentage and sugar yield were increased by application of (Zn and/or B). Albert (2007) in Minnesota, USA, reported that root yield, root quality, recoverable sugar had no significant effect by application of micronutrients in both locations, while sugar loss to molasses significantly affected in Donaldson site only compared to Dorothy site.

MATERIALS AND METHODS

Two field experiments were carried out on clay soil at two locations (Al-Reyad city, Kafr El-Sheikh Governorate and Kotoor city, Al-Gharbia Governorate, Egypt) during 2006/2007 and 2007/2008 seasons. The preceding crop was cotton at both locations in the two seasons. Chemical analysis of soil samples taken to 30 cm depth in the experimental sites before soil preparation in 2006/07 and 2007/08 seasons are given in Table(1). Potassium sulphate (48 % K_2O) was used at rates of 0, 24 and 48 Kg K_2O/fed. on one dose during land preparation before plant.

Micronutrients solutions were used as foliar spraying as follows:

1- Spraying with water (control).
2- ½ liter liquid chelated boron (boric acid 9 % B) in 200 liters water / feddan.
3- 1 liter liquid chelated boron (boric acid 9 % B) in 200 liters water / feddan.
4- 1.5 liters mixture of liquid chelated microelements (0.5 L Fe + 0.5 L Zn + 0.5 L Mn) in 200 liters water
5- 2.25 liters mixture of liquid chelated microelements (0.75 L Fe + 0.75 L Zn + 0.75 L Mn) in 200 liters water.

The micronutrients mixture were contained three elements chelated in liquied form as follows:

1- Iron (Fe) chelated (7.15% iron oxide and 4% sulphar).
2- Zinc (Zn) chelated (7% zinc and 4% sulphar).
3- Manganese (Mn) chelated (9.03% manganese oxide and 4% sulphar).

Foliar spraing was applied on one spray after three months from sowing using hand sprayer with 200 liter/fed.

Split- plot design with three replications was used. The main plots were assigned to potassium rates and the sub-plots to micronutrients.

Each plot included six ridges each one 50 cm apart and 7 m long. Sowing took place on 20 of October in both seasons. Seeds of multigerm cultivar (pleno) were sown in hills 20 cm apart on one side ridges. Plants were thinned to one plant per hill at four true leaves stage in both seasons. Nitrogen fertilizer was applied as soil fertilizer in form of urea (46.54% N) with 90 kg/fed. in two equal doses, the first after thinning and the other one month later.

At maturity (210 days after sowing), the central four ridges of each plot were harvested to estimate root and top yields and technological characteristics as follows:

1. Root and top yields per plot transformed to metric ton per feddan

2. Sucrose percentage was determined using sucarometer used lead acetate according to method of [Le-Doct 1927).

3. Potassium and sodium were determined using flame photometer and α-amino nitrogen as determined using minhydrain and hidrindantin method according to (Carruther *et al.,* 1962)

4. Purity % was calculated according to (Devillers, 1988) as follows:

Purity % = 99.36-[14.27 (V_1 + V_2 + V_3/V_4].

Where:V_1=Sodium,V_2=potassium,V_3=α-aminoN,V_4 = sucrose %.

5. Sugar loss to molasses (SM), extractable white sugar % (B) were calculated according to (Devillers, 1988) as follows:

5. a. Sugar loss to molasses = (V_1 + V_2) 0.14 + V_1 × 0.25 + 0.5

5. b. Extractable white sugar % (B) = V_4 – SM-0.6 (Deviller *et al.,* 1967).

6. Sugar yield (ton/fed.) was calculated according to the following equation: sugar yield = root yield × sucrose %

Table (1): Chemical analysis of the soil experimental area at the depth 0-30cm.

Locations		pH 1: 2.5	EC m mhos cm	Available nutrients ppm						
				N	P	K	B	Fe	Zn	Mn
Kafr El-Sheikh	2006/07	7.5	3.58	23.2	8.2	390	0.20	2.01	0.48	1.85
	2007/08	7.9	3.49	24.5	8.7	401	0.22	2.65	0.55	1.25
Al-Gharbia	2006/07	8.1	2.1	18.1	6.1	400	0.41	2.62	0.73	1.1
	2007/08	8.0	2.5	20.1	6.5	393	0.51	3.26	0.85	1.9

The analysis of variance was carried out as a combined analysis for the two locations in each season according to Gomes and Gomes (1984). Treatment means differences were compared by Duncan's Multiple Range test (Duncan, 1955). All statistical analysis was performed using analysis of variance technique by means of "MSTAT" computer software package.

RESULTS AND DISCUSSION

1. Root yield (ton/fed.):

Data in Table (2) show that root yield was greater at Ghariba location than with Kafr El-Sheikh location in the two seasons. Potassium application by 48

kg K_2O/fed. gave the highest root yield in the two seasons. Foliar spraying with chelated boron as a liquid form at the rate of 1 L/fed significantly increased root yield per feddan compared with control treatment and mixture of liquid chelated microelements (Fe + Zn + Mn) at the rate 1.5 L/fed. These results are in harmony with those obtained by Ibrahim,1988 and Badr, 1999.

Table (2): Root and top yields as affected by locations, potassium rate and microelements spray and their interactions in combined analysis for the two locations in 2006/07 and 2007/08 seasons.

Factors	Root yield (ton/fed.)		Top yield (ton/fed.)	
	2006/07	2007/08	2006/07	2007/08
Locations (L)	*	**	NS	NS
Kafr El-Sheikh	30.461 b	28.282 b	8.310	9.394
Al-Gharbia	33.879 a	33.611 a	8.908	8.360
Potassium, kg K_2O/fed (K)	*	*	NS	Ns
0 Kg	31.025 b	32.607 b	8.759	8.663
24 Kg	31.938 b	33.365 ab	8.666	9.003
48 Kg	33.547 a	34.366 a	9.001	8.966
Microelements (M)	**	*	*	*
control	31.797 b	32.707 b	8.202 b	8.590 b
Boron ½ L/Fed	31.393 b	33.268 ab	8.265 b	8.729 b
Boron 1 L/Fed	34.260 a	34.642 a	8.648 ab	9.572 a
(Fe+Zn+Mn) 1.5 L/Fed	31.437 b	32.683 b	8.395 ab	8.404 b
(Fe+Zn+Mn) 2.25 L/Fed	31.964 b	33.931 ab	8.855 a	9.092 ab
Interactions				
L x K	*	*	NS	NS
L x M	*	*	NS	NS
K x M	*	NS	NS	NS
L x K x M	NS	NS	NS	NS

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

The interaction between location and potassium rate had a significant effect on root yield per feddan in both seasons (Table 3). Root yield was significantly higher in El-Gharbia site than in Kafr El-Sheikh site at any potassium rate in both seasons. The rate 48 Kg K_2O/fed. significantly increased root yield compared with control at the two locations in both seasons. Application of potassium at 24 or 48 Kg K_2O/fed did not differ in root yield at El-Gharbia site in both seasons. However, no significant difference between 0 and 24 kg K_2o/fed in root yield was recognized in Kafr EL-Sheikh in both seasons.

The effect of interaction between location and microelements was significant on root yield in the two seasons (Table 4). The highest root yield was obtained from foliar spraying with liquid chelated boron at the rate 1 L/fed at Gharbia site in both seasons. Mixture of microelements at the rate 2.25 L/fed did not differ from that at 1 L boron/fed in root yield at Gharbia site. No significant differences among all microelements treatments in root yield were observed at Kafr El-Sheikh site in the second seasons.

Table (3): Root yield (ton/fed.) as affected by the interaction between location and potassium rate in 2006/07 and 2007/08 seasons.

Potassium K_2O/fed	2006/07		2007/08	
	Kafr El-Sheikh	Al-Gharbia	Kafr El-Sheikh	Al-Gharbia
0 kg	29.065 c	32.985 ab	27.647 c	37.567 b
24 kg	29.971 c	33.905 ab	28.063 c	38.667 ab
48 kg	32.347 b	34.747 a	29.135 c	39.597 a

Table (4): Root yield (ton/fed.) as affected by the interaction between location and microelements spray in 2006/07 and 2007/08 seasons.

Microelements	2006/07		2007/08	
	Kafr El-Sheikh	Al-Gharbia	Kafr El-Sheikh	Al-Gharbia
control	30.470 def	33.123 bcd	28.120 c	37.293 b
Boron ½ L/Fed	30.873 def	31.913 cde	27.750 c	38.787 ab
Boron 1 L/Fed	32.640 bcd	35.880 a	29.360 c	39.923 a
(Fe+Zn+Mn) 1.5 L/Fed	29.090 f	33.783 abc	27.810 c	37.557 ab
(Fe+Zn+Mn)2.25 L/Fed	29.232 ef	34.697 ab	28.369 c	39.493 ab

The interaction between potassium and microelements rate had a significant effect on root yield in the first season, only (Table 5). Application of 48 Kg K_2O/fed and 1 L boron produced the highest root yield. No significant differences in root yield were observed among the mentioned combination and 24 Kg K_2O/fed + 1 L boron or 24 Kg K_2O + 2.25 L microelements mixture. Higher response in the root yield of sugar beet, namely increased root size or early growth, to fertilizer (B and /or Fe,Zn,Mn) application was found in the soil of Al- Gharbia site compared to Kafer El-Sheik site.

Table (5): Root yield (ton/fed.) as affected by the interaction between potassium rate and microelements in 2006/07 season.

Microelements	potassium rate (K_2O/fed)		
	Zero	24 Kg/fed.	48 Kg /fed.
	2006/07		
control	30.128 c	30.683 c	34.578 ab
Boron ½ L/Fed	30.708 c	31.288 bc	32.183 abc
Boron 1 L/Fed	32.843 abc	34.863 a	35.073 a
(Fe+Zn+Mn) 1.5 L/Fed	30.503 c	31.078 bc	32.728 abc
(Fe+Zn+Mn) 2.25 L/Fed	30.943 c	31.778 abc	33.172a bc

2. Top yield (ton/fed.):

Data in Table (2) pointed out that locations, and levels of k-fertilizer are not significantly affected on top yield in both seasons. At beet plants sprayed with 2.25 liter/fed. of mixture in the first season and with 1 liter/fed. of boron in the second season, only, gave the highest top yield compared to

other treatments spray. Maximum top yield may be attributed to increase doses of both micronutrients and K_2O fertilizers These results are in a good agreement with those obtained by Ibrahim *et al.* (1988) and Nemeat Alla *et al.* (2005). There was no evidence for significant differences in top yield due to the interaction between all treatments in both seasons.

3. Sucrose percentage:

As for the effect of locations, k-fertilizer and microelements, and its levels on sucrose % Table (6) pointed out that significant differences were observed between mean values of sucrose percentage attributed to mentioned factors. Sucrose percentage had a significant difference due to sites difference in the second season, only. The percentage of sucrose was at kafr Elshikh site higher than EL Gharbia site, This resulted from kafr Elshikh gave smallest root size and lowest root yield than EL Gharbia and the small size of sugar beet have high sugar content than big root size.

Maximum sucrose percentage was obtained when sugar beet plants were fertilized by 24 or 48 kg K_2O/fed in the first, only season compared with zero K. These findings are in agreement with the previous results obtained by Badr (2009). Foliar application of microelements resulted significant differences in sucrose % in both seasons. Foliar spraying with liquid chelated boron(1L/fed) in the first season or chelated microelements mixture (Fe + Zn + Mn at 1.5 or 2.25 L/fed.) in the second season produced the highest sucrose %. Similar results were obtained by Albert (2007), and Al Baddrani and Al Rashidi(2007).

There was no evidence for significant difference in sucrose % due to the interaction between both factors in the two seasons.

4. Soluble non-sugars:

The soluble non- sugars K , Na and α-amino N in the roots are regarded as impurities because they interfere with sugar extraction. Means of these impurities as effected by locations, potassium fertilizer and foliar spraying of microelements in 2006/2007 and 2007/2008 seasons are presented in Table(6).

Data confirmed pointed out that locations had highly significant effect on root content from potassium. Sugar beet planted in Kafr El-Sheikh site gave the highest concentration of K in beet juice in both seasons than Gharbia site which recorded the lowest ones. Levels of k-fertilizer not significantly affected on this trait in both seasons.

All impurities were significantly increased by increasing foliar spray in both seasons. Increasing K levels decreased root content from Na this due to the fact of antagonism between Na and K.

Table (6):

Foliar spraying with chelated boron as a liquid form at the rate 0.5 L/fed significantly decreased impureties in root juice compared with control treatment or mixture of liquid chelated microelements in both seasons. Nemeat Alla (1997) reported that concentration of K decreased with foliar spraying, Saif (1991) stated that K content in root not affected by Zn application.

It is clear that application of k-fertilizer and microelements spraying recorded highly significant effect on concentration Na in root content. With increasing levels of all fertilizers due to significantly decrease in sodium root content. Badr (1999) concluded that application of (Fe + Zn + Mn) not affected on Na content ratio.

The results showed that the lowest content from α-amino N in root juice was with micronutrients spraying in the first seasons, only.

All interaction effects among location, K-fertilizer and micronutrients spraying on this trait was not significant in both seasons.

5. Loss sugar %:

Data presented in Table (6) appeared that significant differences were observed among values of loss sugar percentage in both seasons due to locations effect. The highest losses in sugar was found in Kafr El-Sheikh site more than in Gharbia site. These high values related with high root content from impurities (K+ Na+α-amino N) . Albert (2007) stated that loss sugar in molass was increased by increasing B, Fe, Zn and Mn spraying in the two locations. No significant interaction effects were found between all factors under study in both seasons.

6 - Extractable white sugar %

Results in Table (7) showed alternative effect between all factors under study on extractable white sugar % in both seasons. Locations recorded highly significant differences among values of extractable white sugar % in the first season, only and gave maximum value in Gharbia site.

Extractable white sugar % at 24 Kg K_2O/fed did not differ from that at 48 K_2O/fed compared with zero treatment in both seasons. The results not differ than 48 K_2O/fed compared with zero treatment in both seasons.

Application of Microelements had a significant effect on extractable white sugar % in both seasons. The highest of white sugar % was obtained by application mixture of microelements (Fe+Zn+Mn) at the rate 2.25 L/fed, which did not differ from that at 1 L boron/fed in both seasons.

The increase in white sugar % may be attributed to decreasing impurities in root. Similar results were obtained by saif (1991).

No significant interaction effects were found between both factors in this respect in the two seasons. .

Table (7): Extractable white sugar %, purity % and sugar yield ton/fed. as affected by locations, potassium rate and microelements spray and their interactions in combined analysis for the two locations in 2006/07 and 2007/08 seasons.

Factors	White sugar %		Purity %		Sugar yield (ton/fed)	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Locations (L)	**	NS	**	**	*	**
Kafr El-Sheikh	13.7 b	14.5	89.5 b	89.6 b	4.176 b	4.106 b
Al-Gharbia	14.9 a	14.4	91.9 a	91.8 a	5.001 a	5.572 a
Potassium :K_2O/fed (K)	*	*	NS	NS	*	*
0	13.6 b	14.1 b	90.4	90.3	4.236 b	4.609 b
24 kg.	14.9 a	14.5 a	90.6	90.3	4.748 a	4.846 ab
48 kg.	14.2 a	14.7 a	90.8	90.5	4.781 a	5.061 a
Microelements (M)	*	*	*	NS	*	*
Control	13.6 b	14.3 b	90.3 b	90.5	3.637 ab	4.743 b
Boron ½ L/Fed	13.9 b	14.3 b	91.1 a	90.6	4.380 b	4.735 b
Boron 1 L/Fed	14.4 a	14.4 ab	91.1 a	90.4	4.943 a	4.990 a
(Fe+Zn+Mn) 1.5 L/Fed	13.9 b	14.5 ab	89.8 c	90.1	4.387 b	4.747 b
(Fe+Zn+Mn)2.25 L/fed	14.3 a	14.6 a	90.4 b	90.4	4.597 ab	4.980 a
Interactions						
L x K	NS	NS	NS	NS	*	*
L x M	NS	NS	NS	NS	*	*
K x M	NS	NS	NS	NS	*	*
L x K x M	NS	NS	NS	NS	NS	NS

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

7-Juice purity percentage:

The results obtained in Table (7) showed that locations had highly significant effect on juice purity % and gave the highest values in Gharbia site in both seasons. Potassium fertilization had no significant effect on this trait in both seasons. Microelements spraying recorded significant effect on juice purity % in the first seasons, only. Boron element recorded the highest values of purity % when sugar beet plants were sprayed by it. This may be due to decrease impurities in root juice. While the lowest value of purity % was obtained when mixture of (Fe, Zn and Mn) was applied to sugar beet plants at 1.5 L/fed. in the first season. These findings are in agreement with the previous results obtained by Al-Baddrani 2007.

No significant interaction effects were recognized between both factors in this trait in both seasons.

8-Sugar yield (ton/fed.):

Concerning to sugar yield data in Table (7) revealed that locations exhibited significant differences in the two seasons. Results showed that the highest sugar yield was obtained in Gharbia site in both seasons compared to the another site. The superiority of sugar yield in Gharbia may be attributed to increase in root yield in both seasons. Sugar yield per faddan

was increased by increasing K rate to 48 Kg K_2O/ fed in both seasons. Similar results were obtained by Badr (2009). Beet plants sprayed by boron 1 L/ fed or mixture 2.25 L/ fed produced the same sugar yield in the two seasons. Such increase in sugar yield was obtained from increasing rate of microelements spraying may be attributed to the increase in root yield. Nemeat Alla 1997 and Nemeat Alla 2005 reported that application of boron and micronutrients increased sugar yield.

The effect of interaction between locations and K rate was significant on sugar yield per feddan in both seasons (Table 8). The highest sugar yield resulted from 48 kg K_2O/fed. at Al Gharbia site in both seasons. In (Table 9) there was significant difference in sugar yield due to interaction between locations and microelements, whereas the highest values of sugar yield were at Al Gharbia site with spraying of mixture at 2.25 L /fed in the two seasons.

The interaction between K rate and microelements spraying had a significant effect on sugar yield in both seasons (Table10). Applying 24 or 48 kg K_2O /fed., with born at 1 L/ fed recorded the highest sugar yield per feddan in both seasons. These results indicate a positive association between sucrose % and root yield. Stevens *et al.,* 2004 clear that foliar application are recommended sometimes to improve the efficiency of Zn and B assimilation.

It can be concluded that rate of 48 kg K_2O/fed., foliar spraying of chelated Boron as a liquid form at 1 L/fed and mixture of chelated microelements (Fe+Zn+Mn) at 2.25 L/fed could be recommended for optimum root and extractable white sugar yields feddan area at Kafr El- Sheikh and Al- Gharbia Governorates.

Table (8): Sugar yield (ton/fed.) as affected by the interaction between location and potassium rate in 2006/07 and 2007/08 seasons.

Potassium rate	2006/07		2007/08	
	Kafr El-Sheikh	Al-Gharbia	Kafr El-Sheikh	Al-Gharbia
Zero	3.681 d	4.791 b	3.921 d	5.297 b
24 kg K_2O/fed.	4.443 c	5.053 ab	4.103 cd	5.589 ab
48 kg K_2O/fed.	4.403 c	5.159 a	4.293 c	5.829 a

Table (9): Sugar yield (ton/fed.) as affected by the interaction between location and microelements spray in 2006/07 and 2007/08 seasons.

Microelements	2006/07		2007/08	
	Kafr El-Sheikh	Al-Gharbia	Kafr El-Sheikh	Al-Gharbia
control	4.527 cd	4.747 bcd	4.067 c	5.420 b
Boron ½ L/Fed	4.200 de	4.560 cd	4.033 c	5.437 b
Boron 1 L/Fed	4.603 cd	5.283 ab	4.273 c	5.707 ab
(Fe+Zn+Mn) 1.5 L/Fed	3.697 e	5.077 abc	4.033 c	5.460 b
(Fe+Zn+Mn) 2.25 L/Fed	3.853 e	5.340 a	4.123 c	5.837 a

Table (10): Sugar yield (ton/fed.) as affected by the interaction between potassium rate and microelement spray in 2006/07 and 2007/08 seasons.

Microelements	2006/2007			2007/2008		
	potassium rate					
	zero	24 kg K_2O/fed.	48 kg K_2O/fed.	zero	24 kg K_2O/fed.	48 kg K_2O/fed.
control	4.048 c	4.803 abc	5.058 ab	4.238 e	4.838 a-d	5.153 ab
Boron ½ L/Fed	4.103 c	4.538 abc	4.498 abc	4.518 de	4.748 a-d	4.938 a-d
Boron 1 L/Fed	4.618abc	5.178 a	5.033 ab	4.793 a-d	4.998 abc	5.178 a
(Fe+Zn+Mn) 1.5 L/Fed	4.078 c	4.508 abc	4.573 abc	4.608 cde	4.718 bcd	4.913 a-d
(Fe+Zn+Mn) 2.25 L/Fed	4.333 bc	4.713 abc	4.743 abc	4.888 a-d	4.928 a-d	5.123 ab

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تأثير السماد البوتاسي وبعض العناصر الصغري على إنتاجية وجودة بنجر السكر في موقعين

علاء ابراهيم بدر ، نبيل مرسى محمد عوض ، سحر مامون ابراهيم

معهد بحوث المحاصيل السكرية ـ مركز البحوث الزراعية ـ جيزة- مصر

الملخص العربي

أجريت تجربتان حقليتان فى كل موقع من موقعى الدراسة (مركز الرياض ـ محافظة كفرالشيخ)، (مركز قطور ـ محافظة الغربية) فى موسمى ٢٠٠٦/٢٠٠٧م ، ٢٠٠٧/٢٠٠٨م لدراسة تأثير معدلات التسميد البوتاسيى (صفر ـ ٢٤ ـ ٤٨كجم بو٢أ/فدان) ورش بعض العناصر الصغرى المخلبية وهى البورون بمعدلات ½ – ١ لتر/ فدان ومخلوط العناصر الصغرى (حديد ـ زنك ـ منجنيز) بمعدلات ١.٥ – ٢.٢٥ لتر/فدان وقد استخدم التصميم الإحصائى قطع منشقة مرة واحدة فى ثلاث مكررات . حيث تم توزيع التسميد البوتاسي فى القطع الرئيسية ورش العناصر الصغري في القطع الشقية . وتم استخدام التحليل المشترك بين المواقع فى كل موسم . وكانت اهم النتائج ما يلى:

- **زاد محصول الجذور والسكر معنويا فى موقع محافظة الغربية عما فى موقع محافظة كفرالشيخ بينما ارتفعت نسبة السكروز فى محافظة كفر الشيخ عنها فى محافظة الغربية.**
- **ادى استخدام التسميد بالبوتاسيوم بمعدل ٢٤ او ٤٨كجم بو٢أ/ف الى زيادة محصول الجذور ونسبة السكروز ونسبة السكر الابيض ومحصول السكروذلك مقارنة بمعاملة الكنترول .وادى الرش الورقى بالبورون عند المعدل ١ لتر/ف الى الحصول على قيم لمعظم الصفات إذا ما قورن بباقى االعناصر .**
- **تساوى تاثيرى رش عنصر البورون المخلبى بمعدل ١ لتر للفدان مع رش مخلوط العناصر الصغرى بمعدل ٢.٢٥ لتر/فدان على بعض صفات بنجر السكر، فقد تبين من النتائج ان هناك زياده معنوية فى محصول العرش والجذور ونسبة السكر الابيض ومحصول السكر نتيجة اضافة هذه العناصر الغذائية .**

- ويستنتج من هذا البحث ان يوصى باضافة ٤٨كجم بو٢أ/ف مع الرش الورقى بالبورون المخلبى بمعدل ١لتر/فدان ومخلوط العناصر الصغرى المخلبية (حديد– زنك– منجنيز) بمعدل ٢.٢٥لتر/فدان للحصول على اعلى محصول جذور ومحصول سكر من بنجر السكر فى محافظتى كفر الشيخ والغربية.

Table (6): Sucrose, concentration of potassium , sodium , α amino N and loss sugar in root juice as affected by locations, potassium rate and microelements spray and their interactions in combined analysis for the two locations in 2006/07 and 2007/08 seasons.

Factor	Sucrose %		Potassium meq/100gm		Sodium meq/100gm		α-amino N meq/100gm		Loss sugar %	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Locations (L)	NS	**	*	**	NS	NS	NS	NS	*	*
Kafr El-Sheikh	16.6	17.9 a	6.9 a	7.2 a	1.8	2.2	2.5	2.7	2.3 a	2.5 a
Al-Gharbia	17.0	17.0 b	5.2 b	5.3 b	1.4	1.8	2.4	2.7	2.0 b	2.2 b
Potassium:K_2O/fed(K)	*	NS	NS	NS	**	**	NS	NS	NS	NS
0 kg	16.3 b	17.0	6.0	6.2	1.9 a	2.1 a	2.4	2.7	2.2	2.3
24 kg.	17.1 a	17.5	6.0	6.2	1.8 a	2.1 a	2.5	2.7	2.2	2.4
48 kg.	17.0 a	17.6	6.2	6.4	1.4 b	1.6 b	2.4	2.7	2.4	2.3
Microelements (M)	*	*	*	*	*	*	*	NS	NS	NS
control	16.6 b	17.0 b	6.1 b	6.1 b	1.8 a	2.2 a	2.6 a	2.6	2.1	2.1
Boron ½ L/Fed	16.5 b	17.1 b	5.6 c	5.7 c	1.5 b	1.8 b	2.2 b	2.8	2.1	2.2
Boron 1L/Fed	17.0 a	17.2 ab	5.7 c	6.1 b	1.5 b	2.0 ab	2.3 b	2.8	2.3	2.3
(Fe+Zn+Mn)1.5 L/Fed	16.9 a	17.5 a	6.7 a	5.8 a	1.5 b	2.0 ab	2.3 b	2.6	2.3	2.4
(Fe+Zn+Mn)2.25L/Fed	16.9 a	17.6 a	6.5 a	6.6 a	1.6 ab	2.0 ab	2.5 ab	2.6	2.4	2.4
Interactions										
L x K	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L x M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
K x M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L x K x M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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