FACULTY OF AGRICULTURE

Minia J. of Agric. Res. & Develop.
Vol. (29) No. 2 pp 283 - 298, 2009

EFFECT OF POTASSIUM FERTILIZER AND FOLIAR SPRY OF MICRONUTRIENTS ON SUGAR BEET GROWN IN NEWLY RECLAIMED SOIL

F. M. F. Abdel-Motagally
Agron. Dept., Fac. of Agric., Assiut University, Assiut

Received 14 May 2009 Accepted 14 June 2009

ABSTRACT

This study was conducted at El-Ghorieb Expt. Farm, Assiut University, Assiut, Egypt during the two successive seasons of 2004/2005 and 2005/2006 to investigate the effect of potassium fertilizer (24 and 48 kg K_2O/fed.) and foliar spray with three levels of micronutrients mixture (0.0, 60 and 120 ppm) from each of Fe, Zn and Mn on yield and quality of sugar beet grown under newly reclaimed soil condition.

The obtained results showed that:

- **All plant characteristics and quality traits of sugar beet crop i.e., top and root fresh and dry weights, sucrose content, sugar recovery, recoverable sugar yield Ton/fed., as well as micronutrient and impurities concentrations in roots were significantly affected by increasing potassium rates from 24 to 48 kg K_2O/fed. in both seasons.**
- **Increasing the rate of foliar spray with micronutrient increased significantly top and root fresh and dry weights, sucrose content, sugar recovery, recoverable and sugar yield Ton/fed.**
- **A significant effects was observed due to the interaction between K and foliar application with micronutrient on root and sugar yields, whereas 48 kg K2O/fed. in combination with 120 ppm of micronutrients had superior effects on root and sugar yields. The highest value of the main traits for roots fresh weight (27.55 and 28.34 Ton/fed.), roots dry weight (5.12 and 5.08 Ton/fed.), sucrose**

(17.80 and 18.54 %), sugar recovery (14.90 and 15.58 %) and recoverable sugar yield (4.11 and 4.41 Ton/fed.) were obtained by applying 48 kg K2O/fed. in combination with 120 ppm of micronutrients in both seasons, respectively.

- **It could be concluded that application of potassium fertilizer at the rate of 48 kg K2O/fed. along with foliar micronutrients had a positive effect in increasing all growth traits of sugar beet.**

INTRODUCTION

Sugar beet (*Beta vulgaris*, L.) represents one-third of world sugar production (FAO 2007). In Egypt, sugar beet is the second crop for sugar production after sugarcane. The cultivated area in 2006/2007 season was 248210 fed. produced about 721825 tonnes of sugar (ISO 2007). The importance of this crop comes from its ability to grow in newly reclaimed lands, and provides the growers under low soils fertility profitable income. Fertilization is one of the most important limiting factors for sugar beet production under Egyptian conditions. Complete and balanced fertilization of NPK are important for high crop productivity. It is well known that newly reclaimed soil is often very poor in macro and micro nutrient elements.

Sugar beet is classified as a high potassium requiring crop (Johanson *et al.*, 1971). According to Mengel, (1999) potassium plays an important role in the transport of metabolites in the phloem, particularly with respect to transport into storage tissues. Plants that accumulate large reserves of protein, carbohydrate and fats in their storage tissue therefore have high potassium requirements. In sugar beet, potassium plays an important role in the tolerance of water stress. It is the most abundant cation in the cytoplasm. Potassium and its accompanying anions make a major contribution to the osmotic potential of cells and tissues of glycophytic plant species. It had a role in nutritional balance, which increases organic compounds through photosynthesis (El-Harriri and Gobarh, 2001). The beneficial effect of K fertilization on growth, yield and quality of sugar beet was emphasized by previous studies carried by Hassanin and Abu El-Dahab, (1991); Abd El- Aziz *et al.*, (1992); Sobh *et al.*, (1992); El-Maghraby *et al.*, (1998); El-Shafai (2000) and Ouda, (2001).

Micronutrients are well known to affect the biological activities and photosynthetic pigments which play an important role in determining the efficiency of conversion of sun light to photosynthate and hence accumulate dry matter in the plant. Ouda (2000) and Nemeat-Alla and El-Geddawy (2001) found that mixed application of micronutrients gave the highest root and sugar yields. Spraying sugar beet plants with solution of micronutrients mixture markedly increased root, top and sugar yields.

The aim of this work was to study the effect of potassium fertilization rates and micronutrients foliar spray on growth, yield, and quality of sugar beet crop grown in newly reclaimed soil.

MATERIALS AND METHODS

Two field experiments were carried out at El-Ghorieb Expt. Farm of Assiut University, Assiut, Egypt during the two successive seasons of 2004/2005 and 2005/2006 to investigate the effect of potassium rates (24 and 48 kg K_2O/fed.) and foliar spray with different levels of micronutrients mixture (0.0, 60 and 120 ppm) from each of Fe, Zn and Mn in chelated form 6% (EDTA) on sugar beet plants grown in newly reclaimed soil condition. Some physical and chemical properties of the experimental soil were determined before sowing and presented in Table 1, according to the methods described by Jackson (1967).

The soil was fertilized with 31 kg P_2O_5/fed. in the form of calcium superphosphate (15.5% P_2O_5) during soil preparation. A split- plot design with three replications was used. The main plots were assigned to the levels of micronutrients as a foliar application of micronutrients mixture. Foliar application of micronutrients was carried out twice (at 60 and 90 days after planting) at the rate of 200 L/fed. Two potassium levels (24 and 48 kg K_2O/fed.) were arranged randomly in the sub-plots. The area of each sub-plot was 10.5 m^2 (3.5 m length x 3 m width), with six ridges 50 cm apart, 3.5 m in length. Sowing was carried out on the 10^{th} and 15^{th} of October in the first and second seasons, respectively.

Table 1: Some physical and chemical properties of representative soil samples in the experimental site before sowing (0-30 cm depth) in 2004/2005 and 2005/2006 seasons.

Soil property		2004/2005*	2005/2006*
Partice size distribution			
Sand	(%)	84.4	86.5
Silt	(%)	8.7	7.3
Clay	(%)	6.9	6.2
Texture grade		Sandy	Sandy
EC (1:1 extract)	dSm^{-1}	1.66	1.74
pH (1:1 suspension)		8.34	8.26
Total $CaCO_3$	(%)	20.26	19.85
Organic matter	(%)	0.097	0.095
Soluble Cattions			
Ca^{++}	(meq/l)	8.32	8.63
Mg^{++}	(meq/l)	5.36	5.46
Na^{+}	(meq/l)	1.86	1.75
K^{+}	(meq/l)	0.22	0.23
Soluble Anions			
$CO_3^{-} + HCO_3^{-}$	(meq/l)	7.65	8.29
Cl^{-}	(meq/l)	6.25	6.65
$NaHCO_3$-extractable P	(ppm)	5.54	6.64
NaOAC-extractable K	(ppm)	52.45	50.23
Total nitrogen	(%)	0.018	0.019
KCl-extractable N	(ppm)	28.26	30.64
DTPA-extractable Zn	(ppm)	1.83	1.80
DTPA-extractable Mn	(ppm)	0.26	0.27
DTPA-extractable Cu	(ppm)	1.19	1.18

* Each value represents the mean of three replications.

Seed balls of multi-germ Kawemira cv. were sown in hills 20 cm apart at a rate of 2-3 balls/hill. Plants were thinned to one plant per hill at 4-6 leaf stage. Nitrogen fertilizer was added at a rate of 90 kg/ fed. in the form of ammonium nitrate (33.5% N) in two equal doses. The first dose was applied after thinning and the second was added 21 days later.

Potassium fertilizer was applied in the form of potassium sulphate (48% K_2O) after thinning. All other cultural practices were done as recommended. Two weeks before harvest 5th and 10th May in the two experimental seasons, respectively, the irrigation of sugar beet was stopped.

At maturity (190 days from sowing), sample of 10 plants from each sub- plot were taken at random to record the data of tops and roots fresh weight (g/plant). The tops and roots were separated, dried at 70 °C for 3 days, and at 105 °C for two hours in air forced-draft oven, to determine their dry weight. Dry roots samples were ground and chemically analyzed for micronutrients concentration. Fe, Zn and Mn were determined in the digests using a GBC model 300 atomic absorption spectrophotometer.

At harvest (205 days from sowing), plants of each sub plot were harvested to determine roots and foliage yield (ton/fed.). A sample of 25 kg of roots were taken at random from each plot and sent to the Beet Laboratory at Kafr El-Sheikh Sugar Factory, to determine root quality parameters including:

1- Alpha amino nitrogen (α-amino N), sodium (Na) and potassium (K) concentrations were determined using auto analyzer as described by A.O.A.C., (1995). Results were calculated as mmol per 100 g beet paste.
2- Sucrose content was estimated in fresh samples of sugar beet root using Saccharometer according to the method described by Le-Docte (1927).
3- Sugar loss percentage was calculated using the following formula according to Reinefeld et al. (1974):
   Sugar loss percentage = 0.29 + 0.343 (K + Na) + 0.094 α-amino N.

4- Sugar recovery % (S.R. %) was calculated using the following equation according to Cooke and Scott (1993).

Sugar recovery % (S.R. %) = sucrose % - sugar loss %

5- Recoverable sugar yield (ton/fed.) (R.S.Y.) was calculated using the following equation:

Recoverable sugar yield (ton/fed.) = root yield (ton/fed.) X sugar recovery (%).

6 – Quality index % = (sugar recovery % X 100) / sucrose %

7- Sugar loss yield (ton/fed.) = root yield (ton/fed.) X sugar loss %

8- Nutrient uptake = nutrient concentration in root X root dry weight.

The analysis of variance was carried out according to Gomez and Gomez (1984) using MSTAT computer software after testing the homogeneity of the error according to Bartlett's test. Test revealed that the two seasons were not homogenous. This individual season data are going to be presented herein. Means of the different treatments were compared using the least significant difference (LSD) test at 0.05 level of probability.

RESULTS AND DISCUSSION

Effect of potassium fertilizer rates:

Data in Table 2 reveal that tops and roots fresh and dry weights were significantly affected by increasing potassium rates in both seasons. The increase in tops and roots fresh and dry weights, caused by potassium fertilization, could be attributed to the stimulating effect of potassium on photosynthesis process in plant such as translocation of sugar and carbohydrates of assimilates from the top to root, which lead to increasing in root and sugar yield (El-Kholy *et al*., 2006). Similar results were obtained by Zalat and Nariman Youssif, (2001) who found that N/K ratio and the application time of K fertilizer exhibit significant effects on top, sucrose % and sugar yield/fed.

The soluble non-sugars, Na and α- amino-N (mmol/100g beet paste) are regarded as impurities because they interfere with sugar extraction.

Table 2: Effect of potassium fertilization and foliar spray with micronutrients on some growth traits of sugar beet crop grown in 2004/2005 (I) and 2005/2006 (II) seasons.

Fertilization rates		Fresh weight ($g\ plant^{-1}$)				Dry weight ($g\ plant^{-1}$)				Fresh weight ($ton\ fad.^{-1}$)				Dry weight ($ton\ fad.^{-1}$)			
K_2O ($kg\ fad.^{-1}$)	M (ppm)	Top		Root		Top		Root		Top		Root		Top		Root	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
24	0	568.4	562.2	1135.3	1163.7	105.45	104.21	209.35	210.28	3.15	3.45	22.64	23.33	0.82	0.85	3.96	3.92
	60	592.5	586.4	1264.2	1215.2	108.55	106.95	231.12	230.62	3.66	3.74	23.42	24.10	0.84	0.86	4.25	4.13
	120	602.3	594.6	1282.2	1235.4	112.30	111.65	238.24	233.42	4.25	4.33	25.12	25.42	0.87	0.88	4.62	4.52
Mean of K_2O		587.7	581.1	1227.0	1204.6	108.80	107.60	226.20	224.77	3.69	3.84	23.73	24.28	0.84	0.86	4.24	4.28
48	0	605.3	582.5	1275.2	1227.3	110.85	106.45	235.42	226.34	4.22	4.45	24.64	25.32	0.86	0.87	4.54	4.32
	60	610.5	595.2	1363.3	1375.4	112.64	109.23	245.43	238.43	4.75	4.78	25.87	26.34	0.89	0.9	4.68	4.75
	120	612.2	600.4	1383.4	1386.2	114.68	113.24	250.23	245.24	4.89	5.02	27.55	28.34	1.00	1.23	5.12	5.08
Mean of K_2O		609.3	592.7	1340.4	1329.3	112.70	109.60	243.70	236.67	4.62	4.75	26.02	26.67	0.92	1.00	4.83	4.78
Mean of Micro.	0	586.9	572.4	1205.3	1195.4	108.15	105.33	222.39	218.31	3.69	3.95	23.64	24.33	0.84	0.86	4.25	4.12
	60	601.5	590.8	1313.7	1295.4	110.60	108.09	238.28	234.53	4.21	4.26	24.65	25.22	0.87	0.88	4.47	4.44
	120	607.3	597.5	1332.5	1310.5	113.49	112.45	244.24	239.33	4.57	4.68	26.34	26.88	0.94	1.06	4.87	4.80
F test		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD 0.05	M	13.43	19.51	102.62	76.79	3.28	3.12	5.32	6.84	0.11	0.11	1.32	1.52	0.03	0.05	0.11	0.09
	K X M	15.24	14.26	76.45	48.25	4.88	3.32	14.21	12.15	0.14	0.13	1.65	1.92	0.06	0.07	0.15	0.07

M = Micronutrients

The results showed that impurities (Na and α- amino-N) concentrations decreased significantly by increasing potassium fertilization rates, where the lowest value of α- amino-N concentration (4.0 mmol/100g beet paste) and Na concentration (1.27 mmol/100g beet paste) was obtained by using 48 kg K_2O/ fed. in the first season (Table 3). However K concentration was significantly increased by increasing potassium fertilization rates in both seasons. The highest value of K concentration (5.31 mmol/100g beet paste) was obtained with 48 kg K_2O/fed. in the second season.

Sucrose %, sugar recovery %, recoverable sugar yield (ton/fed.) and sugar loss yield (ton/fed.) significantly increased by increasing potassium fertilization rates, except for sugar loss % and quality index in both seasons (Table 4). The highest value of sucrose (16.97 %) and sugar recovery (14.10 %) was obtained by using 48 kg K_2O/fed. in the first season. Also, the highest value of recoverable sugar yield (3.73 ton/fed.) was obtained by using 48 kg K_2O/fed. in the second season. The increase in recoverable sugar yields might be attributed to the role of potassium in nutrients uptake as well as nutritional balance which increase organic compounds through photosynthesis (Attia, 2004).

Micronutrients (Fe, Zn and Mn) concentrations (ppm) and uptake (g/fed.) in sugar beet root significantly increased by increasing potassium fertilization rates from 24 to 48 K_2O/fed. in both seasons (Table 3). Many investigators reported that yield and quality of sugar beet increased significantly with increasing potassium fertilization rates. Sun *et al.*, (1994) found that potassium application increased dry matter in sugar beet roots. Ferweez and Abo El-Wafa, (2004) reported that root, top and sugar yields of sugar beet increased with increasing potassium fertilizer level up to 48 kg K_2O/fed. However, Shalaby *et al.*, (2002) revealed that top, root and sugar yields of sugar beet were not affected by K fertilization.

Table 3: Effect of potassium fertilization and foliar spray with micronutrients on some micronutrients concentration, uptake and impurities concentrations in root of sugar beet crop grown in 2004/2005 (I) and 2005/2006 (II) seasons.

Fertilization rates		Micronutrients concentrations						Micronutrients uptake						Impurities concentrations					
K2O (kg fad.-1)	M (ppm)	Fe (ppm)		Zn (ppm)		Mn (ppm)		Fe (g fad.$^{-1}$)		Zn (g fad.$^{-1}$)		Mn (g fad.$^{-1}$)		K (mmol/ 100 g beet paste)		Na (mmol/ 100 g beet paste)		α- amino-N (mmol/100 g beet paste)	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
24	0	79.3	78.2	22.2	20.7	46.7	42.5	313.8	306.7	87.7	81.3	184.9	166.4	3.82	3.62	1.62	1.76	4.54	4.67
	60	98.2	96.3	31.2	32.2	60.2	57.3	417.5	397.5	132.8	132.8	255.9	236.6	3.95	3.83	1.56	1.62	4.22	4.17
	120	110.3	107.5	40.7	38.5	74.3	68.4	509.6	485.7	187.8	173.8	343.0	309.3	4.24	4.15	1.53	1.54	3.92	3.94
Mean of K_2O		95.9	94.0	31.4	30.5	60.4	56.1	413.6	396.6	136.1	129.3	261.3	237.4	4.00	3.87	1.57	1.64	4.23	4.26
48	0	81.4	80.4	25.4	23.5	48.7	43.3	369.6	347.4	115.4	101.3	220.9	187.2	4.82	4.92	1.42	1.33	4.45	4.62
	60	113.9	108.2	35.3	33.5	70.6	60.9	532.8	514.1	165.0	159.0	330.3	289.0	5.22	5.42	1.25	1.34	3.87	3.93
	120	116.3	112.5	48.3	46.3	76.5	73.3	595.7	571.3	247.1	235.2	391.4	372.2	5.45	5.58	1.14	1.22	3.68	3.62
Mean of K_2O		103.9	100.4	36.3	34.4	65.3	59.2	499.4	477.6	175.8	165.2	314.2	282.8	5.16	5.31	1.27	1.30	4.0	4.06
Mean of Micro.	0	80.3	79.3	23.8	22.1	47.7	42.9	341.7	327.1	101.5	91.3	202.9	176.8	4.32	4.27	1.52	1.55	4.50	4.65
	60	106.0	102.2	33.3	32.8	65.4	59.1	475.1	455.8	148.9	145.9	293.1	262.8	4.59	4.63	1.41	1.48	4.05	4.05
	120	113.3	110.0	44.5	42.4	75.4	70.8	552.6	528.5	217.4	204.5	367.2	340.7	4.85	4.87	1.34	1.38	3.80	3.78
F test		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD 0.05	M	4.74	5.13	3.13	3.43	4.26	3.33	13.24	17.45	11.45	10.26	12.45	10.48	0.11	0.08	N.S.	N.S.	0.13	0.14
	K X M	4.46	4.75	2.86	2.74	3.21	2.43	15.46	17.87	11.25	11.67	9.45	12.42	0.12	0.16	N.S.	N.S.	0.13	0.14

N.S = not significant. M = Micronutrients

Table 4: Effect of potassium fertilization and foliar spray with micronutrients on some quality traits of sugar beet crop grown in 2004/2005 (I) and 2005/2006 (II) seasons.

Fertilization rates		Sucrose (%)		Sugar loss (%)		S. R. (%)		R.S.Y. (ton fad.$^{-1}$)		Quality index (%)		Sugar loss yield (ton fad.$^{-1}$)	
K_2O (kg fad.$^{-1}$)	M (ppm)	I	II	I	II	I	II	I	II	I	II	I	II
24	0	14.35	14.14	2.58	2.57	11.77	11.57	2.66	2.70	82.00	81.79	0.58	0.60
	60	15.23	15.87	2.58	2.55	12.65	13.32	2.96	3.21	83.08	83.92	0.60	0.61
	120	16.22	17.45	2.64	2.61	13.58	14.84	3.41	3.77	83.74	85.03	0.66	0.66
Mean of K_2O		15.27	15.82	2.60	2.58	12.67	13.24	3.01	3.23	82.94	83.58	0.61	0.63
48	0	15.79	15.25	2.85	2.87	12.94	12.38	3.19	3.14	81.96	81.19	0.70	0.73
	60	17.32	16.82	2.87	2.98	14.45	13.84	3.74	3.65	83.41	82.29	0.74	0.78
	120	17.80	18.54	2.90	2.96	14.90	15.58	4.11	4.41	83.73	84.02	0.80	0.84
Mean of K_2O		16.97	16.87	2.87	2.94	14.10	13.93	3.68	3.73	83.03	82.50	0.75	0.78
Mean of Micro.	0	15.07	14.70	2.72	2.72	12.36	11.98	2.93	2.92	81.98	81.49	0.64	0.67
	60	16.28	16.35	2.73	2.77	13.55	13.58	3.35	3.43	83.25	83.11	0.67	0.70
	120	17.01	18.00	2.77	2.79	14.24	15.21	3.76	4.09	83.74	84.53	0.73	0.75
F test		*	*	N.S.	N.S.	*	*	*	*	N.S.	N.S.	*	*
LSD 0.05	M	0.32	0.39	N.S.	N.S.	0.30	0.37	0.14	0.14	N.S.	N.S.	0.02	0.01
	K X M	0.44	0.35	N.S.	N.S.	0.38	0.45	0.18	0.14	N.S.	N.S.	0.04	0.05

N.S = not significant. M = Micronutrients

Effect of foliar spray with micronutrients:

Data presented in Table 2 show gradual increases in root and top fresh weights by increasing micronutrients rates from 60 to 120 ppm in both seasons.

Results showed that α- amino-N concentration significantly decreased by increasing micronutrients rates. However, K concentration increased significantly in both seasons. By using 120 ppm micronutrients the lowest values of α- amino-N concentration (3.78 mmol/100g beet paste), Na concentration (1.34 mmol/100g beet paste), however the highest value of K concentration (4.87 mmol/100 g beet paste) were obtained (Table 3). The highest value of yield and quality traits of sugar beet i.e. sucrose %, S.R. %, S.R. ton/fed. were obtained by the higher rate of foliar application with micronutrients (120 ppm) compared with the untreated plant. It could be concluded that the application of high level of foliar spry with micronutrient (120 ppm) led to an increase in yield or quality of sugar beet plant grown in newly reclaimed soil. The beneficial effects of micronutrients in improving sugar beet plant productivity could be attributed to their enhancement effects on increasing plant metabolic activity. Generally, micronutrients work as enzymes Co-factors. However, high level of fertilizer via foliar spray had the superiority. Similar results were obtained by Nemeat-Alla and El-Geddawy, (2001).

Fe, Zn and Mn concentrations and uptake in sugar beet root increased significantly by increasing foliar spray with micronutrients from 60 to 120 ppm compared with untreated plant in both seasons. The positive effect of micronutrient on sugar beet growth and quality traits was reported by several investigators. Abdel-Ala and Ibrahim, (1990) found that foliar spray with chelated Zn, Mn and Fe caused an increase in top and root dry weight of sugar beet. Gobarh and Thalooth, (2001) reported that it is of great importance to add some micronutrients such as Fe, Mn and Zn in order to compensate for the deficiency of these elements during the growth period and to increase yield components and yield quality of sugar beet.

Effect of interaction:

Obtained results showed that the interaction between potassium fertilization rates and foliar application with micronutrients had a significant effect on plant characteristics and quality traits of sugar beet crop except for Na concentration, sugar loss % and quality index in both seasons. The highest value of the main traits for roots fresh weight (27.55 and 28.34 ton/fed.), roots dry weight (5.12 and 5.08 ton/fed.), sucrose (17.80 and 18.54 %), sugar recovery (14.90 and 15.58 %) and recoverable sugar yield (4.11 and 4.41 ton/fed.) were obtained by applying 48 kg K_2O/fed. in combination with 120 ppm of micronutrients in both seasons, respectively. This effect could be due to the superior effects resulted from the higher level of each main effect (Tables 2, 3 and 4).

These results clearly revealed the significant effects of K and micronutrients fertilization rates on all studied traits. The highest values were always obtained when the highest K and micronutrient fertilizations rate were used. It could be concluded that the best K and micronutrient fertilizations rate for attaining the maximize sugar yield and obtaining the best technological quality of sugar beet crop is 48 kg K/fed. with 120 ppm foliar micronutrients.

Acknowledgements

The author would like to express his deepest gratitude and greatest appreciation to Prof. Dr. Samy El-Syiad Food Science and Technology. Dept. Faculty of Agriculture, Assiut University, for his help during chemical analysis.

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تأثير السماد البوتاسى والرش الورقي بالعناصر الصغرى على بنجر السكر النامي في الأراضي حديثة الاستصلاح

د. فتحي محمد فتحي عبد المتجلي
قسم المحاصيل – كلية الزراعة – جامعة أسيوط – أسيوط

أجريت هذه الدراسة في محطة البحوث والتجارب الزراعية بالغريب – كلية الزراعة جامعة أسيوط خلال موسمي ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ لدراسة تأثير التسميد البوتاسى والرش بالعناصر الصغرى على حاصل وجودة بنجر السكر ومحتواه من بعض العناصر الغذائية تحت ظروف الأراضي حديثة الاستصلاح. تم استخدام القطاعات كاملة العشوائية في تصميم القطع المنشقة مرة واحدة في ثلاث مكررات حيث وزعت معدلات الرش بالعناصر الصغرى (صفر و٦٠و١٢٠ جزء في المليون) في القطع الرئيسية في حين وزعت معدلات التسميد البوتاسى (٢٤و ٤٨ كجم بو٢أ للفدان) عشوائيا في القطع المنشقة.

أشارت النتائج إلى:-

١- أدت إضافة المعدل الأعلى من التسميد البوتاسى (٤٨ كجم بو٢أ للفدان) إلى زيادة معنوية لصفات الوزن الخضري والجاف لكل من العرش والجذور و حاصل السكر بالطن/ فدان في موسمي الزراعة بينما أدى إلى تقليل نسبة الشوائب (الصوديوم ، البوتاسيوم ، الالفا أمينو نيتروجين).

٢- وجد أن الرش الورقي بالعناصر الصغرى قد أدى إلى زياده حاصل الجذور والسكر (الطن/فدان) وأيضا النسبة المئوية للسكروز في العصير. فضلا على الصفات الخضرية والمحصولية وكذلك على جودة المحصول من حيث درجة النقاوة وتقليل نسبة الشوائب وكمية السكر المفقود في المولاس في موسمي الزراعة.

٣- وجد أن التفاعل بين التسميد البوتاسى والرش الورقي بالعناصر الصغرى قد أدى إلى زيادة معنوية في جميع الصفات الخضرية والمحصولية وصفات الجودة

من نتائج هذه الدراسة يمكن التوصية باستخدام ٤٨ كجم بو٢أ للفدان والرش الورقي بالعناصر الصغرى بمعدل ١٢٠ جزء في المليون للحصول على أعلى حاصل من الجذور والسكر وأعلى معامل جودة وأقل فقد للسكر في المولاس تحت ظروف الأراضي حديثة الاستصلاح.