J. Plant Production, Mansoura Univ., Vol. 7 (2):289- 297, 2016

EFFECT OF HUMIC ACID AND POTASSIUM ON YIELD AND QUALITY OF SOME SUGAR BEET VARIETIES IN SANDY SOIL

Enan, S.A.A.M.*; E.F.A.Aly and A. I. Badr***
*** Agron., Res. Dept., - ** Var. Maintenance Res., Dept.,**
Sugar Crops Res. Inst., Agric. Res. Center, Giza, Egypt (ARC)

ABSTRACT

Two field experiments were conducted at Al-Noran Farm, Al-Abtal Village-East of Suez Canal, Ismailia Governorate (latitude of 30^0 18 N and longitude of 32^0 30 E) in 2013/2014 and 2014/2015 seasons to evaluate the performance of three sugar beet varieties and their response to different levels of humic acid and potassium fertilizer on growth, yield and quality of sugar beet crop (*Beta vulgaris* var. *saccharifera,* L.) under sandy soils conditions irrigated by center pivot system. The present work included twenty seven treatments, which were the combinations of three mono-germ sugar beet varieties: (1. Natoura, 2. Henrike and 3. Polat varieties), three levels of humic acid (without humic acid; 10 liter and 15 liter of humic acid/400 liter water/fed, furthermore three levels of potassien-P compound (30% K_2O and 8% P_2O_5/l as foliar application): without potassien ; one liter and 2 liters /400 liter water/fed. Humic acid treatments were added twice after full emergence and 10 days later after the initial spray. Potassien levels were sprayed twice at 6-8 and at 8-10 leaf stage later. The treatments were arranged in strip split plots design with three replications in the two seasons.

Results indicated that varieties significantly differed among them where, Polat variety show the superiority over the other two tested varieties and recorded the highest values of root diameter, fresh and top weights/plant, top yield/fed in both seasons as well as root and leaves dry weights% in 2^{nd} season, while insignificant differences were found between Polat and Henrike varieties in root diameter and top fresh weight/plant in the 1^{st} season, root fresh weight/plant and LAI in the 2^{nd} season. There were no significant differences among varieties in their impact on gross and corrected sugar yields/fed in both seasons.

Soil application of 15 l humic acid treatment led to significant increase in most of traits where, it achieved thickest and heaviest tops and roots/plant and higher values of root and top dry weights%, leaf area index, root and top dry weights/plant, root, top and sugar yields/fed in both seasons as well as gross sugar% and corrected sugar% in 2^{nd} season only, as compared to 10 liter humic acid/fed. While, there were no significant differences among the two rates in their impact on gross and corrected sugar yields/fed in both seasons.

Foliar application of 2 l potassien/fed increased LAI, root diameter, root and top fresh weights/plant, root and top dry weights%, gross sugar%, corrected sugar%, quality index, root and sugar yields/fed in both seasons as well as reduced Na and alpha amino-N contents in comparison to the check treatment.

The interaction between tested sugar beet varieties and humic acid levels showed that significant increase in root dry weight% in both seasons, root fresh weight/plant in the first season and quality index in 2^{nd} season when Polat variety planted in soil treated with 15 liter humic acid/fed. While, sowing Polat variety in soil was treated with 10 liter humic acid/fed recorded the highest significant value in top fresh weight/plant in the 1^{st} season only.

The interaction effect between tested sugar beet varieties and potassien levels indicated that Polat variety sprayed with 2 liter potassien/fed was more distinguished as compared to the other two varieties.

The interaction effect between humic acid and potassien levels revealed that the highest significant values in root fresh weight/plant, root dry weight% in both seasons, top fresh and dry weights/plant in the 1^{st} season, as well as root and gross sugar yields/fed in 2^{nd} season were between soil application of 15 liter humic acid along foliar application of 2 liter potassien/fed in both seasons.

it could be concluded that sowing polat variety fertilized with combination of humic acid at rate of 15 liters/fed as a soil applicaion along with sprayed 2 l/potassein/fed to get the maxiumum of root and sugar yields/fed |in sandy soils under center pivot irrigation system.

Keywords: Humic acid, Potassein-P, Sandy soil, Sugar beet varieties.

INTRODUCTION

The progress and development agriculture depend on mechanization and new import seeds with regard to sugar beet crop in newly reclaimed soils and also on the improvement on the soil properties which also help to increase the crop productivity. Unsuitable soil conditions for the plant development generally arise from the lack of organic contents particularly in newly reclaimed soils. To solve this problem, humic substances have started to be given to these soils in Egypt and in other parts of the world as well to increases yield of different varieties. All sugar beet genotypes cultivated in Egypt is imported from foreign countries, so, it is preferable to evaluate them under Egyptian conditions especially under recently reclaimed soils to select the best suited ones. Hozayn *et al*., (2013) recorded significant differences among the tested cultivars in all studied characters of sugar beet grown under newly reclaimed soil. Enan *et al*., (2011) and Nabila, Zaki *et al*., (2014) revealed that all the evaluated sugar beet varieties exhibited significant differences in all yield criteria. As well as it's different in their gene make-up, this plays an important role in plant structure and morphology. Nardi *et al*., (2004) indicated that humic acid improves physical, chemical and biological properties of soils. Mikkelsen (2005) showed that addition of particular concentrations of humic substances can favor the growth of both the root and the aerial parts of the plant and encourage nutrient absorption. He added that application of humic acids had positive effects on the plant growth and nutrient contents of plants. Moreover, Khattak and Mohamed (2006) indicated that humic acid is a vital constituent and an intimate part of soil organic structure. In plants, humic acids have positive effects on enzyme activity, plant nutrients, and growth stimulant. They added that humates are most responsive in high carbohydrate crops like potato, carrot, maize, rice, wheat, sugar beet etc. Selim *et al*., (2009) studied that application of humic acid combined NPK fertilizers significantly increased the tuber yields, tuber quality indicators, NPK nutrient concentrations in tissues of potato and they added that previous treatments resulted in lesser leaching N, K to deeper layer and increased soil fertility as compared with NPK fertilizer alone. In the same respect, Mauromicale *et al*., (2011) showed that humic substance helps in nitrate uptake from soil and facilitate water use efficiency. In addition, they serve to enhance various microbial and enzymatic processes. Shaban *et al*., (2014) indicated that addition 10 kg humic acid/fed as a soil application significantly increased, sucrose% by (2.39 and 3.68%), root yield/fed by (12.86 and 7.60%) and sugar yield/fed by (15.80 and 11.75 %) in the 1^{st} and 2^{nd} seasons respectively, compared to untreated one. As well as exhibited significant increase N, P and K- percentages in sugar beet root in both seasons. Also they added that the interaction between sugar beet varieties and humic acid had a significant effect on root and sugar yields in both season.

Potassium plays essential roles in enzyme activation, protein synthesis, osmo-regulation, energy transfer, cation-anion balance and stress resistance by enhancing the biosynthesis of organic metabolites and improving nutritional status Draycott (2006). In addition, Enan (2011) indicated that application of 24 kg k_2O/fed + two sprays of potassien significantly resulted in the highest values of root diameter, root and top fresh weight, root, top and sugar yields/fed, quality and sucrose compared with the other two potassium treatment in both seasons and their combined. In this respect, Mehran and Samad (2013) showed that increasing K rates considerably increased root fresh weight/plant, root and sugar yields/fed.

The aim of this study was to evaluate the performance of three sugar beet varieties and extent their response to different levels of soil application with humic acid and foliar spraying with potassien on growth, yield and quality of sugar beet under sandy soils condition irrigated by center pivot system.

MATERIALS AND METHODS

Two field experiments were conducted at El-Noran Farm, Al-Abtal Village-East of Suez Canal, Ismailia Governorate (latitude of 30^0 18 N and longitude of 32^0 30 E) in 2013/2014 and 2014/2015 seasons to evaluate the performance of three sugar beet varieties and their response to different levels of humic acid and potassium fertilizer on growth, yield and quality of sugar beet crop (*Beta vulgaris* var. *saccharifera*, L.) under sandy soils conditions irrigated by center pivot system. The present work included twenty seven treatments, were the combinations of three mono-germ sugar beet varieties: Natoura; Henrike and Polat, three levels of humic acid (added in the sort of the commercial product Humogreen, liquid humic acid 10% produced by Technogreen Co., Nubaria, Egypt) : without humic acid, 10 liter and 15 liter of humic acid/400 liter water/fed, furthermore three levels of potassien-P compound: without potassien; one liter and 2 liters of potassien/400 liter water/fed. Humic acid treatments were added twice after full emergence and 10 days later after the initial spray. Potassien levels were sprayed twice at 6-8 and at 8-10 leaf stage later. Potassien–P compound containing (30% K_2O and 8% P_2O_5/l as a foliar application) it was brought from the Public Authority for Balancing Fund, ARC, Giza. A strip split plots design with three replications was used in the two seasons. The three sugar beet varieties were distributed vertically and the soil application of humic acid levels were horizontally plots, while the three concentrations of potassien were randomlly distributed in the sub plots. The sub plot size was 21.60 m^2 included 12 ridges, 4 m in length and 45 cm in width, 17 cm between hills and 2-3cm deepness. Phosphorus fertilizer was applied in the form of calcium super phosphate (15% P_2O_5) at the rate of 200 kg/fed at seed bed preparation. Nitrogen fertilizer was applied as ammonium nitrate (33.5% N) at the rate of 120 kg N/fed, in 14 weekly doses, as fertigation, where the 1^{st} one was applied at 14 days after sowing. Potassium fertilizer in the form of potassium sulfate (48% K_2O) at the rate of 48 kg/fed was applied after 60 days from sowing. The three sugar beet varieties were sown by mechanization in the 1^{st} week of September, while harvesting was done 7 months later in both seasons. The country of origin and types of the tested sugar beet varieties manifests in Table 1.

Table 1: Origin country, germity and types of varieties.

Sugar beet varieties	Origin country	Germity of seeds	Type
Natoura	Germany	Monogerm	EZ
Henrike	Germany	Monogerm	Z
Polat	Germany	Monogerm	EZ

*** E-type (with emphasis on root yield, *Ertrag*); Z-type (with emphasis on sugar content, *Zucker*), EZ-type (with emphasis on root yield, *Ertrag* and sugar content, *Zucker*); N-type (*Norma*l, intermediate in both characters), Cooke and Scott, (1993).**

Soil physical properties were analyzed using the procedure described by Black *et al*. (1981). Soil and water chemical analysis was determined according to the method described by Jackson (1973) as shown in Table 2 and 3.

Table 2: Particle size distribution and some chemical properties of a representative soil sample site for 2013/2014 and 2014/2015 seasons.

2013/2014 season										
Particle size				**Soil textural**	**EC (dSm^{-1})**		**Soil pH (1:2.5)**	**Organic matter %**		**SP**
Sand%	**Silt %**	**Clay %**		**Sandy**						
91.99	6.88	1.13			4.84		7.63	1.16		19.5
Soluble Cations (mq l^{-1})				Soluble ions (mq l^{-1})				Available nutrients (mg/1kg soil)		
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K
9.5	15.5	20.63	2.75	-	7.5	35.5	5.38	38.9	2.24	97.5
2014/2015 season										
Particle size				Soil textural	EC (dSm^{-1})		Soil pH (1:2.5)	Organic matter %		SP
Sand%	Silt %	Clay %		Sandy						
90.78	6.65	1.77			4.50		7.80	1.20		20.1
Soluble Cations (mq l^{-1})				Soluble ions (mq l^{-1})				Available nutrients (mg/1kg soil)		
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K
8.00	14.30	19.60	2.90	-	6.20	34.05	4.55	40.0	2.٤0	105.4

Table 3: Chemical analysis of the irrigation water.

EC (dSm^{-1})	**pH**	**Soluble ions (mq l^{-1})**				**Soluble Cations (mq l^{-1})**			
		CO_3^{--}	**HCO_3^{-}**	**Cl^{-}**	**SO_4^{--}**	**Ca^{++}**	**Mg^{++}**	**Na^{+}**	**K^{+}**
0.60	7.42	-	0.5	3.2	1.3	1.5	0.7	2.6	0.2
SAR		Soluble Element (mg l^{-1})							
		NH^{+}_4	NO^{-}_3	P	Fe	Mn	Zn	Cu	B
2.48		1.96	-	0.587	-	-	-	0.004	0.089

The recorded data:

1. Leaf area index (LAI): Leaf area measurement determined by the disk method using 10 disks of 1.0 cm diameter according to Watson (1958) and then the following equation was used.

LAI = Leaf area per plant (cm^2)/ Plant ground area (cm^2) was measured at 120 days from sowing date using the leaf area meter, model: 3000 A.

At harvest, a sample of five plants was randomly collected from each sub-plots to determine the following tratis:

2. Root diameter (cm).
3. Root and top fresh weights (g/plant).
4. Root and top dray weights %. Each 100 g of root and top fresh weights were oven dried to a constant weight for 48 hours at 70^0 C.

Juice quality and chemical constituents:

The following quality traits were determined in the Quality Control Laboratory at Alexandria Sugar Factory, Alexandria, Egypt.

1. Gross sugar percentage (Pol % = sucrose %), which was estimated in fresh samples of sugar beet roots, using "Saccharometer" according to the method described in A.O.A.C. (2005).
2. Corrected sugar%, which was calculated using the following equation according to Cooke and Scott (1993).

Corrected sugar % = Pol % - (0.343(K + Na) - α- amino N (0.0939) - 0.29).

3. Juice quality index (QI % = Purity %) was calculated according to Cooke and Scott (1993) using the following equation:

Q I % = (Corrected sugar %)/Pol %.

4. Impurities (α-amino N, Na and K concentrations) of juice were estimated as meq/100 g beet according to the procedures of Sugar Company by Automated Analyzer as described by Cooke and Scott (1993).

At harvest, plants of two guarded ridges were counted, uprooted, topped and weighed to determine the following parameters:

1. Top yield (t/fed). 2. Root yield (t/fed).
3. Gross sugar yield (t/fed), which was calculated according to following equation: Gross sugar yield (t/fed) = root yield (t/fed) x gross sugar%
4. Corrected sugar yield (t/fed), which was calculated according to following equation: Corrected sugar yield (t/fed) = roots yield (ton/fed) x corrected sugar %.

The collected data were statistically analyzed as shown by Gomez and Gomez (1984). Treatments means were compared using LSD test at 5% of probability. All statistical analysis was performed using analysis of variance technique of (MSTAT- c) computer software package.

RESULTS AND DISCUSSION

1. Leaf area index (LAI), top dry weight%, root and top yields/fed:

Data in Table 4 show that the differences among sugar beet varieties in root yield/fed in 1st and 2nd season, LAI and top dry weight % in 1st season only were insignificant. Polat variety showed the superiority over the other two varieties in respect of each top yield/fed in both seasons as well as top dry weight% in 2nd season only, while there was no significant difference between Polat and Henrike varieties in leaf area index in 2nd season. The variations among the tested sugar beet varieties in these traits might be due to their gene make-up. This observation coincide with those found by Hozayn, *et al*. (2013) and Nabila, Zaki *et al*. (2014).

Table 4: Leaf area index (LAI), top dry weight%, root and top yields/fed of three sugar beet varieties as affected by humic acid and potassium levels in 2013/2014 and 2014/2015 seasons.

Treatments	LAI		Top dry weight%		Root yield (t/fed)		Top yield (t/fed)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
				Sugar beet varieties (V)				
Natoura	3.32	3.35	11.2	11.3	32.67	32.92	10.66	11.39
Henrike	3.47	3.49	11.5	11.7	33.26	33.39	11.31	11.65
Polat	3.50	3.53	12.0	12.5	33.73	33.72	11.86	12.13
LSD at 0.05	NS	0.07	NS	0.5	NS	NS	0.22	0.11
				Humic acid (H)				
without (control)	3.25	3.32	10.3	10.9	32.56	30.88	10.83	11.27
10 l/fed	3.48	3.45	11.8	12.0	33.28	34.42	11.34	11.75
15 l/fed	3.56	3.59	12.5	12.7	33.81	34.73	11.66	12.16
LSD at 0.05	0.٢	0.10	0.٦	0.4	0.٤٧	0.31	0.٢٩	0.23
				Potassium (P)				
without (control)	3.29	3.29	10.7	11.0	32.58	32.85	10.42	11.20
One l/fed	3.43	3.46	11.6	11.9	33.27	33.27	11.07	11.65
Two l/fed	3.58	3.61	12.3	12.6	33.80	33.91	12.33	12.33
LSD at 0.05	0.06	0.09	0.2	0.3	0.2٠	0.39	0.32	0.33
VxH	NS	NS	NS	NS	NS	NS	NS	NS
VxP	NS	NS	NS	NS	*	NS	NS	NS
HxP	NS	NS	*	NS	NS	*	NS	NS
VxHxP	NS	NS	NS	NS	NS	NS	NS	NS

Soil application with15 l humic acid/fed significantly increased in leaf area index, top dry weight%, root and top yields/fed amounted by (2.29%, 5.93%, 1.59% and 2.82%), respectively and amounted by (4.05%, 5.83%, 0.90% and 3.48%) in the 1st season and 2nd season, respectively as compared to that given with 10 l humic acid/fed. This may be due to increase the photosynthetic surface per unit area which, promoted growth and nutrient uptake of plants by addition of humic substances which affect membrane permeability. On the other hand, leaf area index reduced by fertilizing with low doses (without and 10 l of humic acid/fed) which is reflected in the root, top fresh weights/plant and root dry weight%. These results are in agreement with Mauromicale *et al*. (2011) they found that application of humic acids had positive impacts on the plant growth and nutrient contents of plants. Moreover, Humic substances are reported to help in nitrate uptake from soil and facilitate water use efficiency. In addition, they serve to enhance various microbial and enzymatic processes.

The obtained results in the same table clear that fertilizing sugar beet with 2 l/fed of potassien recorded a significant increase in values of above mentioned traits in both seasons compared to that gained by fertilizing beets with 1 liter potassien/fed. The positive influence of the applied levels of potassien may be due to the shortage of potassium in the experimental site (Table 2). Hence, the important role of potassium on yield could be attributed to the stimulatory effect of potassium on rate of photosynthesis through carbohydrate metabolism and transport of the photosynthetic product from the leaves to the storage root which reflects on yields. These results are in agreement with those recorded by Zayed (2003) and Enan (2011).

2. Root diameter, root and top fresh weights and root dry weight%:

Results in Table 5 indicated significant differences in root diameter, root and top fresh weights among sugar beet varieties, in both seasons, as well as in root dry weight% in the 2nd season only. Polat variety recoded the highest values of these traits, while Natoura ranked the third, in the two seasons. However, insignificant differences were found between Henrike and Polat varieties in root diameter and top fresh weight/plant in the 1st season, as well as between these two varieties in root fresh weight/plant, in the 2nd season.Moreover, insignficant variance was detected in root dry weight% between Natoura and Henrike, in the 2nd season. The variations among the tested sugar beet varieties in these traits might be due to their gene make-up action, which plays an important role in plant structure and morphology. These results are in line with those repoted by Enan *et al.* (2011) and Hozayn *et al*. (2013).

Increasing soil application level of humic acid from zero up to 15 l/fed was accompanied gradual and significant increase in the recorded mean values of the above mentioned traits in both seasons. This increase in growth traits of sugar beet by increasing humic acid levels may be attributed to its effect on providing plant and soil with a determined dose of essential nutrients and trace elements, which enhancing growth, nutrient uptake, hence leaf canopy and dry matter of sugar beet plants which affected by the level of humic acid, the maximum value obtained when soil was treated with 15 l humic acid and the lowest value was observed when soil untreated. These findings are in line with those reported by Mehdi *et al*. (2013). Likewise, spraying sugar beet plants with potassien levels raised up to 2 liter/fed resulted in ascending increase in the same traits in the 1^{st} and 2^{nd} seasons as compared with the untreated plants. The application of potassium tends to accelerate photosynthetic activity, its role on enhancement of carbohydrate and N-metabolism as well as water absorption and transpiration in plant. These results are in harmony with those obtained by Enan (2011).

Table 5: Root diameter (cm), root fresh weight (g), top fresh weight (g) and root dry weight% of three sugar beet varieties as affected by humic acid and potassium levels in 2013/2014 and 2014/2015 seasons.

Treatments	Root diameter (cm)		Root fresh weight (g)		Top fresh weight (g)		Root dry weight%	
	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season
Sugar beet varieties (V)								
Natoura	11.6	11.9	720	711	293	285	22.5	23.0
Henrike	12.3	12.2	738	740	311	297	23.1	23.1
Polat	12.4	12.5	765	786	318	310	23.6	24.0
LSD at 0.05	0.3	0.2	21	55	8	11	NS	0.7
Humic acid (H)								
without (control)	11.5	11.7	679	683	262	279	21.3	22.0
10 liter/fed	12.1	12.0	740	757	323	300	23.2	23.5
15 liter/fed	12.6	12.8	803	798	337	314	24.6	24.5
LSD at 0.05	0.١	0.4	٣8	41	١٢	8	١.٢	0.6
Potassien (P)								
without (control)	11.2	11.5	696	676	269	270	21.6	22.0
One liter/fed	12.2	12.2	737	756	315	298	23.3	23.6
Two liters/fed	12.9	12.8	789	805	338	325	24.1	24.4
LSD at 0.05	0.2	0.3	2٢	27	9	9	0.7	0.4
VxH	NS	NS	NS	NS	*	NS	*	*
VxP	NS	NS	NS	NS	NS	NS	NS	NS
HxP	NS	NS	*	*	*	NS	*	*
VxHxP	NS	NS	NS	NS	NS	NS	NS	NS

3. Quality index %, potassium, sodium and alpha amino-N contents (meq/100 g beet):

Data in Table 6 showed that differences among sugar beet varieties were insignificant in their effect on quality index, potassium, sodium contents in both seasons. While, the differences among them were significant in their effect on alpha-amino N, where Polat variety recorded the lowest values of alpha-amino N over the other tested varieties in 2^{nd} season.

Table 6: Quality index, potassium, sodium and alpha amino-N contents (meq/100 g beet) of three sugar beet varieties as affected by humic acid and potassium levels in 2013/2014 and 2014/2015 seasons.

Treatments	Quality index		Impurities (meq/100 g beet)					
			K		Na		α- amino N	
	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season	1^{st} season	2^{nd} season
Sugar beet varieties (V)								
Natoura	86.09	85.79	4.00	4.18	1.65	1.57	1.04	1.06
Henrike	86.14	85.99	4.04	4.18	1.64	1.54	1.00	1.08
Polat	86.08	86.02	4.03	4.17	1.67	1.56	0.97	0.98
LSD at 0.05	NS	NS	NS	NS	NS	NS	NS	0.07
Humic acid (H)								
without (control)	85.93	85.34	3.98	4.14	1.75	1.84	0.97	1.00
10 liter/fed	86.20	86.14	4.00	4.15	1.66	1.48	0.98	1.05
15 liter/fed	86.18	86.33	4.10	4.24	1.55	1.34	1.07	1.07
LSD at 0.05	0.21	0.29	0.0٨	NS	0.11	٠.05	NS	NS
Potassien (P)								
without (control)	85.53	85.59	3.94	4.09	1.82	1.71	0.97	0.96
One liter/fed	86.12	85.79	4.04	4.20	1.66	1.57	0.99	1.05
Two liters/fed	86.65	86.42	4.10	4.24	1.48	1.39	1.05	1.10
LSD at 0.05	0.37	0.37	0.10	0.12	0.08	0.0٨	0.04	0.05
VxH	NS	*	NS	NS	NS	NS	NS	NS
VxP	NS	NS	NS	NS	NS	NS	NS	NS
HxP	NS	NS	NS	NS	NS	NS	NS	NS
VxHxP	NS	NS	NS	NS	NS	NS	NS	NS

As for the effect of humic acid levels, data in the same table indicated that significant differences between humic acid levels were found in quality index and sodium content in both seasons. Soil application of

10 or 15 l humic acid/fed attained higher values of quality index compared to the check treatment in both seasons. However, sodium contents were significantly decreased when sugar beet fertilized by 15 l humic acid/fed. Increasing humic acid levels from zero up to 15 l/fed failed to reach the level of significance in their effect on alpha-amino N content in both seasons and potassium content in 2nd season only.

Raising potassien level from zero to 2 l potassien/fed resulted in a significant increase in quality index amounted to 0.53 and 0.63 in 1st and 2nd season, respectively over those plants fertilized with one l potassien/fed. While, this increase in quality index amounted by 0.59 and 0.20 in 1st and 2nd season, respectively when sugar beet sprayed with one l potassien/fed over those untreated. On the other hand, sprayed beet plants with 2 l potassien/fed decreased Na and alpha amino-N contents compared to the control in both seasons. Reducing Na content in juice quality may be due to potassium role in increasing enzyme activity and concentration of soluble substances in the xylem, resulting in limited sodium adsorption by plants Liang (1999).

4. Gross sugar, corrected sugar percentages, gross sugar and corrected sugar yields/fed:

Data in Table 7 reveal that insignificant differences among sugar beet varieties were found in gross sugar %, gross sugar yield/fed, corrected sugar% and corrected sugar yield/fed in both seasons.

Soil application of high level of humic acid (15 l/fed) had a significant effect on gross and corrected sugar yields/fed compared to medium level or the check treatment in both seasons. Increasing humic acid levels from zero up to 15 l humic acid/fed failed to reach the level of significance in their effect on gross and corrected sugar percentages in 1st season. Supplying beet plants with soil drench of 15 l humic acid/fed gave higher values of gross and corrected sugar percentages compared with untreated treatment and 10 l humic acid/fed in 2nd season. While, the difference between the two soil drenches of humic acid levels (15 and 10 l/fed) was insignificant, but both of them surpassed on the check treatment in its impact on gross and corrected sugar yields/fed in the two growing seasons. Theses finding are in agreement with that mentioned by Shaban *et al*. (2014)

Gross sugar, corrected sugar percentages, gross sugar and corrected sugar yields/fed in the same table were significantly increased as the applied potassium fertilization levels were raised from zero up to 2 l/fed in both seasons. Application of 2 l potassien/fed resulted in the highest values of these traits compared to rest treatments. These results assured the importance role of potassium element in metabolic translocation process. The favorable effect of potassium element on gross, corrected sugar percentage and sugar yield/fed treatments was reported by Enan (2011).

Table 7: Gross sugar %, gross sugar yield/fed, corrected sugar% and corrected sugar yield/fed of three sugar beet varieties as affected by humic acid and potassium levels in 2013/2014 and 2014/2015 seasons.

Treatments	Gross sugar %		Gross sugar yield (t/fed)		Corrected sugar %		Corrected sugar yield (t/fed)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Sugar beet varieties (V)								
Natoura	16.74	16.65	5.47	5.48	14.41	14.29	4.71	4.71
Henrike	16.85	16.80	5.61	5.61	14.52	14.45	4.83	4.83
Polat	16.81	16.79	5.67	5.66	14.48	14.44	4.89	4.87
LSD at 0.05	NS	NS	NS	NS	NS	NS	NS	NS
Humic acid (H)								
without (control)	16.69	16.63	5.44	5.14	14.34	14.19	4.67	4.38
10 liter/fed	16.85	16.72	5.61	5.77	14.52	14.43	4.84	4.97
15 liter/fed	16.87	16.85	5.71	5.85	14.54	14.55	4.92	5.05
LSD at 0.05	NS	0.12	0.14	0.12	NS	0.11	0.13	0.11
Potassium (P)								
without (control)	16.31	16.45	5.31	5.40	13.95	14.08	4.55	4.62
One liter/fed	16.86	16.66	5.61	5.55	14.52	14.30	4.83	4.76
Two liters/fed	17.24	17.12	5.83	5.81	14.94	14.80	5.05	5.02
LSD at 0.05	0.1٦	0.19	0.07	0.09	0.18	0.21	0.07	0.09
VxH	NS	NS	NS	NS	NS	NS	NS	NS
VxP	NS	NS	NS	NS	NS	NS	NS	NS
HxP	NS	NS	NS	*	NS	NS	NS	*
VxHxP	NS	NS	NS	NS	NS	NS	NS	NS

1. Interaction effect between varieties and humic acid levels:

Data in Table 8 show that the interaction between the three tested varieties and soil application with humic acid levels was significantly affected in root dry weight% in the two seasons, root and top fresh weights/plant in the first season for both of them as well as quality index in 2nd season only. Polat variety recorded the highest values in root dry weight% in both seasons and in root fresh weight/plant in 1st season only compared with over the other tested ones, when planted in soil treated with 15 l humic acid/fed. Likewise, this variety recorded the highest significant value in top fresh weight/plant when planted in soil was treated with

10 l humic acid/fed in the 1st season. Furthermore, Polat variety gave the highest significant variance with soil treated of 15 l humic acid/fed, compared with the untreated soil with humic acid followed by Henrike variety in quality index trait in 2nd season.

Table 8: Effect of the interactions between varieties and humic acid on root dry weight%, root, top fresh weights/plant and quality index in 2013/2014 and/or 2014/2015 season.

Interaction between Varieties x humic acid (VxH)		Root dry weight %		Root fresh weight (g)	Top fresh weight (g)	Quality index
		1st season	2nd season	1st season	1st season	2nd season
	H1 (control)	19.7	21.5	681	244	85.01
Natoura	H2 (10 l/fed)	21.9	21.7	675	254	86.04
	H3 (15 l/fed)	22.1	22.7	681	288	86.32
	H1 (control)	22.5	23.1	684	308	85.40
Henrike	H2 (10 l/fed)	23.3	23.7	743	330	86.16
	H3 (15 l/fed)	23.7	23.8	794	331	86.41
	H1 (control)	24.4	24.3	794	327	85.60
Polat	H2 (10 l/fed)	24.7	23.7	796	350	86.21
	H3 (15 l/fed)	24.9	25.6	819	333	86.25
LSD at 0.05		0.9	0.7	47	15	0.29

2. Interaction effect between varieties and potassien levels:

Results in Table 9 reveal that the interaction between the tested varieties and potassien levels had significant affected on root yield/fed in 2013/2014 season only. The difference between plants of Polat variety which sprayed with 2 l potassien/fed and those fertilized with 1 liter potassien/fed were more distinguished compared to the other two varieties followed by Henrike variety. This result may be due to potassien compound contains P_2O_5 among its components, which in turn could lead to energy transfer, photosynthesis, transformation of sugars, transfer of genetic information and nutrient movement within the plant where P and K fertilizing increases both, yield and quality of sugar beet.

Table 9: Effect of the interaction between varieties and potassien on root yield/fed in the 2013/2014 season.

Varieties x potassien (Vx P)		Root yield (t/fed)
	Without potassien	31.86
Natoura variety	one liter potassien/fed	32.65
	two liters potassien/fed	33.25
	Without potassien	32.65
Henrike variety	one liter potassien/fed	33.38
	two liters potassien/fed	33.79
	Without potassien	33.50
Polat variety	one liter potassien/fed	33.74
	two liters potassien/fed	34.16
LSD at 0.05		0.35

3. Interaction effect between humic acid and potassien levels:

Root fresh weight/plant and root dry weight% was significant affected by the interaction between levels of humic acid and potassien in both season (Table 10). The difference in root fresh weight/plant between beets unfertilized with potassien and those treated with one l potaasien/fed was insignificant, when soil untreated with humic acid/fed and which treated with 10 l humic acid/fed. Furthermore, the highest significant value was between soil treated with 15 l humic acid and foliar application of 2 l potassien/fed in root fresh weight/plant and root dry weight% in both seasons. On the other hand, both top fresh weight and top dry weight% traits in 1st season as well as root and gross yields/fed in 2nd season recorded the highest values, when sugar beet planted in the soil treated with 15 l humic and sprayed with 2 l potassien/fed.

The highest values of top fresh weight and top dry weight% (368.0 g/plant and 13.3%) respectively, were resulted from soil application of 15 l humic acid/fed and foliar application of 2 l potassien/fed in the first season for both of them. Meanwhile, the difference in root and gross sugar yields/fed between beets sprayed with 2 l potassien and those treated with 1 liter potaasien/fed was insignificant, when soil untreated with humic acid in 2nd seasons for both of them. Meanwhile, the interaction between soil treated with 15 l/fed humic acid along 2 l potassien/fed recorded the highest values (35.6 and 6.1 t/fed) of root and gross sugar yields/fed as compared with set treatments in the second season, respectively.

Table 10: Effect of the interactions between humic acid and potassien on root fresh weight (g), root dry weight%, top fresh weight (g), top dry weight%, root and gross sugar yields/fed in 2013/14 and/or 2014/15 season.

Humic acid x Potassien (H x P)		Root fresh weight (g) 1st season	Root fresh weight (g) 2nd season	Root dry weight% 1st season	Root dry weight% 2nd season	Top fresh weight (g) 1st season	Top dry weight % 1st season	Root yield (t/fed) 2nd season	Gross sugar yield (t/fed) 2nd season
H1 (control)	P1(control)	638	629	20.6	20.4	236	9.9	31.14	5.13
	P2 (1 l/fed)	671	673	21.4	22.4	260	10.2	30.62	5.05
	P3 (2 l/fed)	728	746	21.8	23.1	291	10.8	30.87	5.22
H2 (10 l/fed)	P1(control)	713	712	22.1	21.9	282	10.7	33.43	5.43
	P2 (1 l/fed)	715	754	23.3	23.6	333	11.9	34.51	5.77
	P3 (2 l/fed)	793	804	24.2	25.1	354	12.8	35.31	6.11
H3 (15 l/fed)	P1(control)	738	688	22.2	23.7	290	11.6	33.96	5.64
	P2 (1 l/fed)	824	842	25.4	24.6	353	12.7	34.65	5.82
	P3 (2 l/fed)	846	864	26.4	25.1	368	13.3	35.56	6.10
LSD at 0.05 level		37	47	0.9	0.5	14	0.4	90	0.16

CONCLUSION

It could be concluded that under sandy soil, sowing polat variety fertilized with combination of humic acid at rate of 15 liters/fed as a soil applicaion along with sprayed 2 l/potassien-P compound (30% K_2O +8% P_2O_5)/fed to get the maxiumum of root, sugar yields/fed and lowest values of sodium content in the juice under center pivot irrigation system in East of Suez Canal area, Ismailia.

REFERENCES

A.O.A.C. (2005). Association of Official Analytical Chemists. Official methods of analysis, 26th Ed. AOAC International, Washington, D.C; USA.

Black, C.A.; D.D. Evans; L.E. Ensminger; G.L. White and F.E. Clark (1981). Methods of soil analysis. Part 2. Pp. 1-100. Agron. Inc. Madison. WI., USA.

Cooke, D.A. and R.K. Scott (1993). The Sugar Beet Crop. Science Practice. Puplished by Chapman and Hall, London. P., 595-605.

Draycott, A.P. (2006). Sugar Beet, UK: Blackwell publishing Ltd, Oxford, P. 474.

Enan, S.A.A.M. (2011). Effect of transplanting and foliar application with potassium and boron on yield and quality of sugar beet sown under saline soil conditions. J. Biol. Chem. Environ. Sci., 6 (2): 525-546.

Enan, S.A.A.M.; A. M. Abd El-Aal and N.M.E. Shalaby (2011). Yield and quality of some sugar beet varieties as affected by sowing date and harvest age. Fayoum J. Agric. Res. & Dev., 25 (2): 51-65.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agricultural Research (2nd Ed.), pp: 457-423. John Wiley and Sons. International Science Publisher, New York, USA.

Hozayn, M.; A. A. Abd El-Monem and A. A. Bakery (2013). Screening of some exotic sugar beet cultivars grown under newly reclaimed sandy soil for yield and sugar quality traits. J. Appl. Sci. Res., 9 (3): 2213-2222.

Jackson, M. I. (1973). Soil Chemical Analysis. Prentice Hall Inc. Englewood cliffs, N. J., U.S.A.

Khattak, R.A. and D. Muhammad (2006). Effect of pre-sowing seed treatments with humic acid on seedling growth and nutrient uptake. Internship Rep, Depart. of Soil and Environ. Sci., NWFP Agric. 2275 Univ., Peshawar. (C.F. computer search).

Liang, Y.C. (1999). Effect of silicon on enzyme activity and sodium, potassium and calcium concentration in barley under salt stress. Plant and Soil, 209: 217-224.

Mauromicale, G.; M. G. L. Angela and A. L. Monaco (2011). The effect of organic supplementation of solarized soil on the quality of tomato. Scientia Hort., 129 (2): 189-196.

Mehdi, S.S.; P. Farzad; H.D. Hossein; M. Hamid; M. Majid and R.T. Mohamad (2013). Effect of intermittent furrow irrigation, humic acid and deficit irrigation on water use efficiency of sugar beet. Annals of Biol. Res., (3): 187-193 Tehran, Iran.

Mehran, S. and S. Samad (2013). Study of potassium and nitrogen fertilizer levels on the yield of sugar beet in jolge cultivar. J. of Novel Appl. Sci., 2-4/94-100.

Mikkelsen, R.L. (2005). Humic materials for agriculture, Davis, California, USA. Better Crops with Plant Food. 89 (3): 6-7.

Nabila, Zaki M.; Amal, G. Ahmed; M.S. Hassanein and M.M. Tawfik (2014). Foliar application of potassium to mitigate the adverse impact of salinity on some sugar beet varieties. 1: effect on growth and some physiological aspects. J. Appl. Sci. Res., 8 (8): 4405-4416.

Nardi, S.; D. Pizzeghello and S.G. Pandalai (2004). Rhizosphere: A communication between plant and soil. Recent Res. Development in Crop Sci., 1 (2): 349-360.

Selim, E.M.; A.A. Mosa and A.M. El-Ghamry (2009). Evaluation of humic substances fertigation through surface and subsurface drip irrigation systems on potato grown under Egyptian sandy soil conditions. Agric. Water Manage., 96: 1218-1222.

Shaban, KH.A. H.; Eman M. Abdel Fatah and Dalia A. Syed (2014). Impact of humic acid and mineral nitrogen fertilization on soil chemical properties and yield and quality of sugar beet under saline soil. J. Soil Sci. and Agric. Eng., Mansoura Univ., 5 (10):1317-1335.

Watson, D.J. (1958). The dependence of net assimilation rate on leaf area index. Ann. Bot. Lond. N.S., 22:37-54.

تأثير التسميد بحمض الهيومك والرش الورقي بالبوتاسيوم علي حاصل وجودة بعض أصناف بنجر السكر في الأراضي الرملية

*** صلاح علي عبد اللاة محمود عنان , **إسلام فتحي عبد الفتاح علي و *علاء ابراهيم بدر**
*** قسم بحوث المعاملات الزراعية - ** قسم بحوث المحافظة علي الأصناف**
معهد بحوث المحاصيل السكرية- مركز البحوث الزراعية

أُقيمت تجربتان حقليتان بمزرعة خاصة بقرية الأبطال شرق قناة السويس- محافظة الإسماعيلية (دائرة عرض ٣٠.١٨ ' شمالاً وخط طول ٣٢.٣٠ ' شرقاً) في موسمى ٢٠١٣/٢٠١٤ و ٢٠١٤/٢٠١٥ لتقييم أداء ثلاث أصناف وحيدة الأجنة من بنجر السكر هي: ١- ناتورا ، ٢- هنريك ،٣- بولات، ومدي إستجابتها للتسميد بثلاث مستويات من الإضافة الأرضية بحمض الهيومك هي : ١- بدون إضافة حمض الهيومك ، ٢- إضافة ١٠ لتر/فدان ، ٣- إضافة ١٥ لتر/فدان و ثلاث تركيزات من البوتاسين تم إضافتهم رشاً علي دفعتين (عند تكوين من٦-٨ ورقات حقيقية و عند تكوين ٨-١٠ ورقات حقيقية من الزراعة) هي:

١- الرش بالماء بدون بوتاسين (مقارنة).

٢- الرش بتركيز واحد لتر بوتاسين/فدان/٤٠٠ لتر ماء.

٣- الرش بتركيز إثنين لتربوتاسين/فدان/٤٠٠ لتر ماء على نمو وحاصل وجودة بنجر السكر.

* أستخدم تصميم الشرائح المتعامدة المنشقة ذات ثلاث عوامل في ثلاث مكررات في الموسمين ، حيث زرعت الأصناف في الشرائح الرأسية ، فى حين وزعت معاملات الإضافة الأرضية من حمض الهيومك في الشرائح الأفقية ووزعت معاملات الرش بالبوتاسين في القطع الشقية.

أوضحت النتائج ما يلي:

١- أظهر الصنف وحيد الأجنة "بولات" تفوقاً علي الصنفين الآخرين في قطر ووزن الجذر والعرش الطازج وحاصل الأوراق/فدان في الموسمين ، وكذلك نسبة المادة الجافة للجذور و الأوراق في الموسم الثاني، بينما لم يكن هناك فروق معنوية بين الصنف "بولات" والصنف "هنريك" في كل من قطر الجذر ووزن الأوراق الطازج/ نبات في الموسم الأول ، وكذلك وزن الجذر الطازج/نبات ودليل مساحة الورقة في الموسم الثاني ، فضلا عن انة لم يكن هناك فروق معنوية بين الأصناف في تأثيرهم علي محصول السكر/فدان في الموسمين.

٢- أدي التسميد الأرضى بحمض الهيوميك أرضياً بمعدل ١٥ لتر/فدان زيادة معنوية في قطر ووزن الجذر والأوراق وحاصل الجذور والأوراق والسكر طن/فدان ، كما أدي إلي زيادة دليل مساحة الأوراق فضلاً عن أعلي القيم للنسبة المئوية لكل من المادة الجافة للجذور والأوراق في الموسمين والسكروز في الموسم الثاني فقط مقارنة بالمعاملات الأخري.

٢- أشارت النتائج أن التسميد الورقي بإضافة ٢ لتر بوتاسين/فدان أدي الي زيادةً معنويةً في قطر ووزن كلا من الجذرو والأوراق والنسبة المئوية للسكروز والجودة ، وكذلك حاصل الجذور والأوراق والسكر المستخلص طن/فدان في الموسمين.

٣- أظهر التفاعل بين الأصناف المختبرة ومستويات التسميد الأرضي بحمض الهيومك تأثيرا معنوياً ، حيث أدت إضافة ١٥ لتر هيوميك أرضياً/فدان إلي زيادة معنوية في نسبة المادة الجافة لجذور الصنف " بولات " في الموسمين ، وزن الجذر الطازج في الموسم الأول فقط فضلاً عن جودة الجذور في الموسم الثاني ، مقارنة بالأصناف الأخري

٤- أوضح التفاعل بين الأصناف المختبرة و مستويات الرش الورقي بالبوتاسين تأثيراً معنوياً علي حاصل الجذرو/فدان ، حيث تفوق الصنف "بولات" بالتسميد الورقي بـ٢ لتر/فدان من مركب البوتاسين في الموسم الأول فقط مقارنةً بالأصناف الأخري.

٥- أشار التفاعل بين مستويات الإضافة الأرضية من حمض الهيومك ومستويات الرش الورقي بالبوتاسين زيادة معنوية في وزن الجذر الطازج ونسبة المادة الجافة في الجذور في الموسمين ، وكذلك وزن العرش الطازج ونسبة المادة الجافة في الأوراق في الموسم الأول ، فضلاً عن حاصل الجذور والسكر/فدان في الموسم الثاني فقط.

* يمكن التوصية بزراعة صنف بنجر السكر وحيد الأجنة "بولات" مُسمداً بتوليفة من حمض الهيومك بمعدل ١٥ لتر/فدان كإضافة أرضية مع الرش الورقي بمعدل ٢ لتر/ فدان من مركب البوتاسين- ف (٣٠ % بو٢أ + ٨ % خامس أكسيد الفوسفور/لتر) للحصول على أعلى حاصل جذور/الفدان وأعلى نسبة مئوية للسكروز وأقل محتوي للصوديوم فى العصير تحت نظام الري الرزازي المحوري بمنطقة شرق قناة السويس- الإسماعيلية.