EFFECT OF FOLIAR SPRAY WITH IAA AND/OR KINETIN ON PHYSIO-CHEMICAL PROPERTIES AND YIELDS OF SUGAR BEET PLANTS

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(Manuscript received 10 August 2005)

Abstract

Two field experiments were conducted at Sakha Agricultural Research Station, Kafr-EL-Sheikh Governorate during the two successive seasons 2002 - 2003 and 2003 - 2004 to investigate the effect of soil K-fertilizer at 100 and 50 % of the recommended rate (24 kg K_2O/fed), foliar application with growth regulators (IAA and/or Kinetin) at levels of 10^{-6} and 10^{-4} Molar and their combination on some physio-chemical properties and yields of sugar beet plants. The results indicate the following:

1- Decreasing K-rate from 24 to 12 kg K_2O/fed led to obvious reduction in root diameter and length, fresh and dry weights of root and top, leaf area and yields of roots, tops and sugar. Decreasing the K-rate also decreased the chemical properties namely: individual sugars, invertase activity and mineral elementals composition. Meantime, root impurities (K and α-amino N) and some technological parameters, i.e. sugar lost in molasses (SLM), extractable sugar (Ex s) and alkalinity coefficient (AC) showed the same trend. On the contrary, decreasing the K-rate only increased juice purity and Na % in the juice.

2- Growth regulators (IAA or Ki) affected positively most of above traits except invertase activity and juice purity. This effect was increased with the increase in their concentrations.

3- K- fertilizer combined with IAA or Ki gave the same trend as that of the tested growth regulators when used alone.

4- Foliar sprays with IAA alone or combined with K-fertilizer was more effective than Ki treatments.

Based on, the above results it could be recommended to use K-fertilizer at 12 kg K_2O/fed combined with IAA at 10^{-4} to improve juice quality of sugar beet root and reduce environmental pollution.

INTRODUCTION

Sugar beet is considered the second crop for sugar production in the world and in Egypt as well. About 25 % of the total sugar production in Egypt is from sugar beet, moreover, it provides a higher income to the farmers.

Fertilizers play a great and important role in growth, yield and juice quality of sugar beet.

Potassium is considered as one of the most essential mineral elements for sugar beet production, as it has a great influence on various biochemical processes and enzyme systems.

Meantime, this element is known to cause juice impurities or non-sugars components which is not removed during various processing steps so, it is necessarily to take into account in almost calculations amid at assessing the contribution of the non-sugars to potential loss of sugar into molasses (Van Geijn *et al.,* 1983).

Nowadays great efforts are undertaken to reduce the environmental pollution that caused by continuous application of inorganic fertilizers. Therefore, the main objective of this study is to reduce the rate of K-fertilizer via the use of some growth promoting substances (IAA and kinetin) to attain the best juice quality and high yield.

In modern agriculture IAA and kinetin are widely used due to their unique role in regulating and intensifying the action of same agronomical practices for achieving both qualitative and quantitative improvement in beet production.

Several workers studied the effect of K-fertilization and foliar spraying with the two previous growth regulators, on some physiological and chemical properties and yields of sugar beet. As for K-fertilizer effect, Kandil *et al.,* (1993) found that K-fertilization exhibited an increase in root length, root diameter and weight of leaves/plant and blade leaf area. Individual sugars, i. e. sucrose, glucose, fructose, galactose and raffinose, were enhanced especially sucrose by potassium fertilization. Also, invertase activity followed the same result, (Khalil et al, 2001). For their effect on impurities, Ashmaye (1998) found that K-fertilizer increased the content of K element, while, contrary result was recorded for Na and α amino N in extracted juice. Also, some technological parameters, i. e. sugar lost in molass, extractable sugar, and alkalinity coefficient were increased by increasing K rates. El-Maghraby *et al.,*(1998) showed that further increase in K-fertilizer up to (48 kg K_2 O/fed) caused significant decrease in purity. Moreover, Kristek *et al.,* (1996) found that increasing K fertilizer increased root, top and sugar yields.

Regarding the effect of growth regulators, i. e. IAA and Kinetin, Gurdev-Singh *et al.* (1991) found that growth regulators increased most growth traits as compared with the untreated controls. Individual sugars, i. e. sucrose, glucose, fructose, galactose and raffinose, were increased by kinetin (Moustafa and Moustafa, 2004). In sugar cane both sucrose and purity % were significantly increased compared to the control by kinetin treatment (Kanwar and Kanwar, 1985). Ashmaye (1998) found the same trend for invertase activity. Extractable sugar % and alkalinity coefficient were increased but sugar loss in molass was decreased by increasing IAA or kinetin (Moustafa and Moustafa, 2004). Also, Vach (1999) found that cytokinin caused a statistically significant increases in root and sugar yields of sugar beet.

MATERIALS AND METHODS

Two field experiments were carried out at Sakha Agricultural Research Station, Kafr El-Sheikh governorate, to study the effect of soil application of K-fertilizer as potassium sulphate (48 % K_2O), foliar application of IAA or Kinetin and their combinations on some physiochemical properties and yields of sugar beet. Soil samples were taken before sowing and prepared for the determination of physical and chemical soil properties according to Chapman and Pratt (1961). The obtained results are shown in Table 1.

Table 1. Physical and chemical properties of the tested soil.

Soil analysis	2002/2003	2003/2004
EC (d s m^{-1})	2.70	2.90
pH (paste)	7.90	8.10
Particle size distribution		
Sand %	23.7	24.9
Silt %	33.5	30.0
Clay %	42.8	45.1
Textural class	Clay	Clay
Soluble ions (meqL^{-1})		
Ca^{+2}	0.22	0.26
Mg^{+2}	0.09	0.12
Na^{+}	0.16	0.19
K^{+}	0.13	0.15
Cl^{-}	0.23	0.27
So_4^{-2}	0.21	0.24
Hco_3^{-}	0.26	0.21
Co_3^{-2}	0.00	0.00
Available nutrients (ppm)		
N	34.6	36.6
P	21.3	26.7
K	293	315

A multigerm sugar beet variety Oscar poly was planted on October 25^{th} and 13^{th} in 2002 and 2003 seasons, respectively. The experimental design was a split plot design in three replications where, soil K-fertilization was allocated in the main plots while the foliar applications of IAA or Kinetin were distributed randomly in the sub-plots.

The area of each plot was 10.5 m^2 including six ridges, 3.5 m in length and 0.5 m apart. The experiment involved ten treatments, two rates of soil K-fertilizer 100 and 50 % of the recommended rate (24 kg K_2O/fed) as potassium sulfate (48 % K_2O) and five levels of foliar applications of the studied two growth regulators (GR) which were sprayed twice at 45 and 75 days from sowing, as follows:

1. K at 24 kg k_2O/ fed (K_1) + foliar spray with distilled water (DW)
2. K_1 + IAA at 10^{-6} M (IAA_1)
3. K_1 + IAA at 10^{-4} M (IAA_2)
4. K_1 + Ki at 10^{-6} M (Ki_1)
5. K_1 + Ki at 10^{-4} M (Ki_2)
6. K at 12 kg k_2o/ fed (K_2) + foliar spray with distilled water (DW)
7. K_2 + (IAA_1)
8. K_2 + (IAA_2)
9. K_2 + (Ki_1)
10. K_2 + (Ki_2)

Nitrogen fertilization was applied at 80 kg N/fed as urea (46 % N) in two equal doses, the first was added after thinning while, the second one was added one month later. Phosphate fertilizer was applied at seedbed preparation at 30 kg P_2O_5/fed as calcium super phosphate (15.5 % P_2O_5).

The normal practices of sugar beet cultivation were maintained to assure optimum production.

At harvest time, (210 days from sowing) random four samples were taken from each plot to determine the following.

1- Growth traits.
  a- Diameter and length of root (cm).
  b- Fresh and dry weights of root and top (g/plant).
  c- Leaf area (cm^2) was determined using the area meter, Model: L1.3000A

2- Individual sugars (g/100 g dw) were determined according to Black and Bagley (1978) by using (H PLC).

3- Invertase activity of roots (unit/mg.glucose/30 min) was determined according to (Bergmayer 1979).

4- Root quality and some technological parameters were determined using an automatic French system (Hycel).
  a- Root quality
    -Impurities (Na, K and α- amino nitrogen (g/100 g.sugar)

-Purity % (Devillers,1988).

b- Some technological parameters

- Sugar lost in molasses (SLM) (Devillers,1988).
- Extractable sugar (Ex s) (Dexter *et al.,* 1967).
- Alkalinity coefficient (AC) = Na + K / α- amino nitrogen (g/100 g. sugar)

5- Elemental composition (%) and yields:

a- Elemental composition (%)

- Nitrogen was determined using micro-kjeldahl method Chapman and Pratt (1961).
- Phosphorus was determined calorimetrically according to Chapman and Pratt (1961).
- Potassium was determined by flame-photometric method of Brown and lilliand (1964).

b- Roots, tops and sugar yields (tons/fed).

All collected data were statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1- Growth traits

Data in Table 2 show the effect of K-fertilizer at 24 and 12 kg k_2o/fed, foliar spray with IAA and Ki at 10^{-6} and 10^{-4} M and their combination on some growth traits of sugar beet.

a- Root diameter and length

Significant decreases in root diameter and length were observed, by decreasing the rate of K- fertilizer from 24 to 12 kg K_2O/fed, at harvest in the two seasons (Table 2). In this connection, El-Maghraby *et al.* (1998) found that increasing the rate of K-fertilizer from zero to 48 Kg K_2O /fed significantly increased root dimensions (diameter and length).

As for the effect of foliar spray, with IAA or Ki, there was an increase in root diameter and length with the increase of IAA and Ki concentrations to reach the significant. Ki was more effective on root diameter and length than IAA (Table 2).

Regarding the effect of the interaction between K- fertilizer and foliar spray with IAA or Ki, results in Table 2 showed significant increases in root length in both seasons and root diameter in the second season only. Futhermore, the two studied growth regulators at the higher concentration did not significantly affect root length in both seasons under the low K rate, while under the higher K rate, Ki showed superiority over IAA.

It is important to mention that K at 12 kg K_2 O/fed combined with foliar spray with Ki was better than K at the 24 kg K_2O/fed alone. These effects may be due to that phytohormones are involved in regulation of many physiological processes in plants, which participate in induction of cell division and elongation (Ashmaye, 1998).

b- Fresh and dry weights of root and top.

Data in Table 2 indicated that, in general, fresh and dry weights of root and top were significantly decreased as soil K-fertilizer decreased from 24 to 12 kg K_2 O/fed. These results are in full agreement with those obtained by Ashmaye (1998) and Khalil *et al.,* (2001).

Foliar sprays with IAA or Ki alone increased significantly fresh and dry weights of root and top. Data also cleared that the high level of IAA or Ki had a better effect on growth traits than the low level (Table 2).

Regarding K-fertilizer and GR interactions, the results exhibited a significant increase in all previous traits except root fresh weight, which had insignificant increase in both seasons (Table 2). Moustafa and Moustafa (2004) reported that growth promoters are known to enhance cell division, activate cell growth and regulate other growth processes.

c- Leaf area (LA)

Data in Table 2 show that decreasing the rate of K-fertilizer from 24 to 12 kg K_2O/fed significantly decreased leaf area.

Results of foliar spray with GR indicate that either IAA or Ki significantly increased leaf area as compared to the control (K only). Using IAA was more effective on leaf area than Ki. Furthermore, the higher concentration of IAA or Ki exhibited more leaf area than the lower concentration (Table 2).

With respect to K- fertilizer and GR interactions, data in Table 2 cleared that in general, there were significant interaction effects. Worth to mention, that growth regulators with K-fertilizer at the higher rate gave better results for leaf area than K-fertilizer at the lower rate.

It could be noticed that K at low rate combined with IAA or Ki at both levels was more effective than K at the higher rate.

2- Individual sugars (g/100g dw).

Data of sugar beet roots on the following individual sugars, i. e. sucrose, glucose, fructose, galactose and raffinose, revealed that decreasing K-fertilization rate from 24 to 12 kg K_2 O/fed significantly reduced all sugars extracted from sugar beet roots except fructose and galactose, where the reduction was too small to reach the level of significance (Table 3). These effects may be due to that K is very important element in photosynthesis and sugars production. The present results support the data obtained by Khalil *et al.* (2001).

In general, foliar spray with (IAA or Ki) significantly increased sucrose, galactose and raffinose, while, this increase was insignificant for fructose. Data also showed that the concentration of all previous sugars increased by increasing the level of IAA or Ki from 10^{-6} to 10^{-4} M (Table 3). Moreover, IAA was more effective than Ki in this respect.

The interaction between K-fertilizer and studied growh regulators gave insignificant increases in all determined sugars except sucrose, which was significant. It is important to mention that K at 12 kg K_2O/fed combined with IAA especially at the high level gave better results than K at 24 kg K_2O/fed alone. This may be attributed to their positive effect on metabolic processes. It has been proposed that sucrose is co-transported with potassium and counter transported with protons across to tonoblast of the sink cells, this process is apparently stimulated by IAA (Kotyk *et el.,* 1996).

3-Invertase activity

Invertase is one of the most important enzymes in plant tissue because of its ability to catalase the break down of sucrose, it is known as sugar degradation enzyme. Data presented in Table 3 pointed out that increasing K- fertilization from 12 kg K_2O/fed significantly increased invertase activity in sugar beet roots. Where, potassium is frequently referred as enzyme activator (Ashmaye, 1998).

Concerning the effect of IAA or Ki, It is obvious to note that treatments under study caused significant decrease in the invertase activity. The decrease in invertase activity was directly proportional with IAA or Ki concentrations.

The effect of K-fertilization and IAA or Ki interactions was insignificant. These results agree with those reported by Khalil *et al.,* (2001) and Moustafa and Moustafa (2004).

4- Root quality and some technological parameters

a- Root quality

Data in Table 4 show the effect of K-fertilizer and their combinations with foliar spray of IAA or Kinetin (Ki) on root quality, i. e. juice impurities and purity in sugarbeet roots at harvest.

- Juice impurities

Decreasing K rate from 24 to 12 kg K_2O/fed led to a significant decrease in the concentration of K and α-amino N. On the contrary, Na was significantly increased (Table 4).

Data also show that, in general, foliar application of IAA or Ki significantly increased both K and Na while the increase of α-amino N was not significant as compared to the control. Increasing the concentration of IAA from 10^{-6} to 10^{-4}M increased both α-amino N and K but decreased Na content. While Ki increased K only in sugar beet juice.

Regarding the effect of the interaction between K and IAA or Ki, data showed significant increase for Na while this increase was not significant for α-amino N and K (Table 4). IAA or Ki at the low level gave significant increase in Na content as compared with its higher level or the control under the higher rate of K-fertilizer, while resultes were not significant under the low rate of K-fertilizer.

In general, the best treatment gave the lowest juice impurities was K at 12 kg K_2 O/fed.

- Juice Purity

Significant increase in juice purity was observed by decreasing the rate of K – fertilizer from 24 to 12 kg K_2 O/fed (Table 4). Such increase in purity may be due to the decrease in the level of impurities in juice as mentioned above. While IAA or Ki significantly decreased juice purity as compared to the control. Data also cleared that increasing the level of GR approximately did not affect purity %.

Regarding the effect of the interaction between K and growth regulators, data showed insignificant decrease in juice purity.

b- Some Technological parameters

- Sugar lost in molasses (SLM)

Generally, there was significant decrease in SLM accompanied the reduction in K-fertilizer from 24 to 12 kg K_2 O/fed (Table 4). Such effect may be attributed to the decrease in the level of juice impurities. Whereas foliar sprays with IAA or Ki at both levels significantly increased SLM.

– Extractable sugar (Ex s).

As mentioned before, sucrose increased by increasing K-fertilizer from 12 to 24 kg K_2 O/fed, the same trend was found in Ex s but its content was lower than sucrose %. This may be attributed to the fact that the increase in K level led to an increase in sucrose % and juice impurities, which reduced Ex s. Either IAA or Ki at the two levels increased Ex s. This increase was significant for IAA only at the two levels (Table 4).

The interactions between growth regulators and K level insignificantly increased Ex s. It could be noticed that K at 12 kg K_2O/fed combined with foliar applications of IAA or Ki at both levels produced more Ex s than K at 24 kg K_2 O/fed alone (Table 4).

-Alkalinity coefficient (AC)

Data in Table 4 show that K-fertilizer at 24 kg k_2 O/fed gave higher AC values than at 12 kg K_2 O/fed.

Foliar application with IAA at 10^{-4} M reduced AC compared to the control treatment. On the other hand, Ki application at two levels significantly increased AC.

The interactions between K and growth regulators (IAA or Ki) afforded insignificant effects.

5- Elemental compositions and yields:

a- Elemental compositions

Data in Table 5 revealed that a significant decrease in the concentration of phosphorus and potassium and insignificant for nitrogen as a result of decreasing the rate of K from 24 to 12 kg K_2 O/fed, Khalil et al (2001) found the same results.

Foliar spray with IAA or Ki significantly increased N, P and K as compared to the control. On the other hand, Ki significantly decreased both N and K but significantly increased P.

K-fertilizer at higher rate x (IAA or Ki) interactions caused a better result than in the presence of K at a low rate for N, P and K (Table 5). The obtained results are in harmony with those reviewed by Moustafa *et al.* (2001).

b-- Roots, tops and sugar yield (ton/fed).

Data illustrated in Table 5 indicate that K at 24 kg K_2O/fed exhibited higher values of root and top yield as well as sugar yield (ton/fed) compared with K at 12 kg k_2 O/fed. The increase in yields could be attributed to the positive effect of abundant K on fresh and dry weight of root and tops, leaf area and sucrose percentage as revealed before and reflected on yields.

Concerning the effect of foliar spray with IAA or Ki at the two levels, it was noticed that such growth regulators caused significant increases in all accounted yields. Foliar spray with IAA surpassed foliar spray with Ki in this respect (Table 5).

Either IAA or Ki in the presence of K at 100 % of RR had more beneficial effect than K at 12 kg k_2 O/fed. Thus, the best treatment which gave the highest sugar yield was IAA at the high level in the presence of K at 24 kg K_2 O/fed.

It is worthy to mention that K at low rate could be better than K at higher rate when combined with foliar applications of IAA or Ki at high level (10^{-4}M), where it gave the highest roots, tops and sugar yields. Similar results were obtained by Moustafa *et al.* (2001).

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Table 2. Effect of K- fertilizer, foliar application with IAA or Kinetin and their combination on some growth traits of sugar beet plants at harvest.

Treatments		Root diameter (cm)		Root length (cm)		Root fresh weight (g/plant)		Root dry weight (g/plant)		Top fresh weight (g/ plant)		Top dry weight (g/plant)		Leaf area (cm^2)	
K_2O (kg/fed)	GR (IAA and kinetin)	first season	second season	first season	second season	first season	second season	first season	second season	first season	second season	first season	second season	first season	second season
24	Zero	12.6	12.1	30.6	31.2	1168	1143	337.9	339.8	707.8	700.3	115.8	111.0	111.1	117.1
	IAA_1	13.3	12.8	31.6	32.2	1322	1300	386.2	385.2	830.2	815.5	131.6	130.7	125.1	127.2
	IAA_2	14.0	14.2	32.4	32.5	1443	1435	403.1	410.1	852.3	863.6	143.8	145.6	133.4	130.1
	Mean	13.7	13.5	32.0	32.4	1383	1368	394.7	397.7	841.3	839.6	137.7	138.2	129.3	128.7
	Ki_1	13.8	13.4	33.9	35.4	1262	1288	366.2	387.4	783.4	792.7	124.7	128.3	119.5	119.6
	Ki_2	14.7	15.2	34.3	36.2	1341	1351	395.0	398.0	795.0	811.4	128.2	129.5	118.2	121.0
	Mean	14.3	14.3	34.1	35.8	1302	1320	380.6	392.7	789.2	802.1	126.5	128.9	118.9	120.3
Mean		13.7	13.5	32.6	33.5	1307	1303	377.6	384.1	793.7	796.7	128.8	129.0	121.5	123.0
12	Zero	11.8	11.0	28.3	28.0	1098	1084	250.1	251.2	660.6	669.1	112.4	113.8	95.7	100.8
	IAA_1	12.0	12.3	29.2	30.5	1216	1225	326.6	332.0	750.4	761.2	120.4	123.1	115.5	116.4
	IAA_2	12.6	13.5	31.3	32.4	1349	1340	391.8	390.5	792.5	791.4	138.8	140.0	121.1	119.8
	Mean	12.3	12.9	30.3	31.5	1283	1283	359.1	361.3	771.5	776.3	129.6	131.6	118.4	118.1
	Ki_1	13.2	13.8	30.3	30.9	1189	1273	325.5	349.8	721.6	700.8	120.3	122.4	110.2	113.1
	Ki_2	14.0	14.0	31.8	31.9	1243	1311	332.1	377.3	743.3	734.7	119.9	115.5	118.1	117.7
	Mean	13.6	13.9	31.1	31.1	1216	1292	328.8	363.6	732.5	717.9	120.1	119.0	114.5	115.4
Mean		12.7	12.9	30.2	30.7	1219	1247	325.2	340.1	727.7	731.5	122.4	122.9	112.2	113.6
Over Means	Zero	12.2	11.6	29.5	29.6	1133	1113	294.0	295.5	684.2	684.7	114.1	112.4	103.4	109.0
	IAA_1	12.7	12.6	30.4	31.4	1269	1263	356.4	358.6	790.3	788.4	126.1	126.9	120.3	121.8
	IAA_2	13.3	13.9	31.9	32.5	1396	1388	397.5	400.3	822.4	827.5	141.3	142.8	127.4	125.0
	Ki_1	13.5	13.6	33.1	33.2	1226	1281	345.9	368.6	752.5	746.8	122.5	125.9	114.9	116.4
	Ki_2	14.4	14.6	32.1	34.1	1292	1331	363.6	387.7	769.2	77.3.2	125.1	122.5	118.2	119.4
LSD at 0.05%															
K(A)		0.30	0.39	0.32	0.66	27.9	26.6	7.32	9.50	4.26	7.70	1.39	NS	1.30	2.56
GR(B)		0.66	0.22	0.53	0.50	44.1	42.0	10.5	6.54	7.40	10.9	1.62	4.40	1.45	2.39
A x B		NS	0.31	0.76	0.71	NS	NS	14.9	9.24	10.5	15.4	2.29	6.22	2.06	3.38

Table 3. Effect of K- fertilizer, foliar application with IAA or Kinetin and their combination on individual sugars (g/100 g dw) and invertase activity (unit/mg.glucose/30min)of sugar beet plants at harvest.

Treatments		Sucrose		Glucose		Fructose		Galactose		Raffinose		Invertase activity	
K_2O (kg/fed)	GR (IAA and kinetin)	first season	second season	first season	second season	first season	second season	first season	second season	first season	second season	first season	second season
24	Zero	78.7	79.1	3.21	3.18	2.75	2.72	1.17	1.11	2.05	2.08	2.14	2.18
	IAA_1	82.3	82.6	3.52	3.48	2.88	2.91	1.24	1.23	2.20	2.23	1.97	2.00
	IAA_2	86.4	85.1	3.64	3.65	3.27	3.00	1.39	1.35	2.38	2.32	1.83	1.83
	Mean	84.4	83.9	3.58	3.57	3.08	2.96	1.32	1.29	2.29	2.28	1.90	1.93
	Ki_1	79.6	80.4	3.39	3.41	2.85	2.84	1.20	1.19	2.16	2.18	2.08	2.10
	Ki_2	81.7	81.9	3.63	3.58	2.91	2.90	1.26	1.27	2.25	2.28	1.92	1.95
	Mean	80.7	81.2	3.51	3.50	2.88	2.87	1.23	1.23	2.21	2.23	1.91	2.05
Mean		81.5	81.8	3.48	3.46	2.93	2.87	1.24	1.24	2.21	2.22	1.99	2.02
12	Zero	73.1	73.6	3.14	2.99	2.59	2.60	1.00	1.08	1.83	1.79	1.85	1.91
	IAA_1	79.0	79.5	3.23	3.25	2.80	2.77	1.16	1.18	1.96	2.00	1.71	1.76
	IAA_2	83.4	82.7	3.29	3.33	2.86	2.85	1.24	1.22	2.15	2.28	1.66	1.65
	Mean	81.2	81.1	3.26	3.29	2.83	2.81	1.20	1.20	2.06	2.14	1.69	1.71
	Ki_1	76.1	76.2	3.15	3.18	2.70	2.69	1.10	1.10	1.93	1.91	1.79	1.80
	Ki_2	76.8	77.6	3.20	3.24	2.73	2.76	1.08	1.16	2.08	2.15	1.70	1.73
	Mean	76.5	76.9	3.18	3.21	2.72	2.73	1.09	1.13	2.01	2.03	1.75	1.77
Mean		77.7	77.9	3.24	3.20	2.74	2.73	1.14	1.15	1.99	2.03	1.74	1.77
Over Means	Zero	75.9	76.4	3.18	3.09	2.67	2.66	1.06	1.13	1.95	1.94	2.00	2.05
	IAA_1	80.7	81.1	3.38	3.36	2.84	2.84	1.20	1.21	2.08	2.12	1.84	1.88
	IAA_2	84.4	83.9	3.46	3.49	3.07	2.93	1.32	1.29	2.25	2.32	1.75	1.73
	Ki_1	77.9	78.3	3.27	3.30	2.78	2.77	1.15	1.15	2.05	2.05	1.94	1.96
	Ki_2	79.3	79.8	3.42	3.41	2.80	2.83	1.22	1.22	2.18	2.20	1.81	1.84
LSD 0.05%	K(A)	0.94	0.91	0.15	0.16	N.S	N.S	N.S	N.S	0.08	0.11	0.05	0.06
	GR(B)	0.85	0.52	0.20	0.23	N.S	N.S	0.13	0.07	0.12	0.07	0.06	0.05
	A x B	1.21	0.74	N.S	N.S	N.S	N.S	N.S	N.S	N.S	0.10	N.S	N.S

Table 4. Effect of K- fertilizer, foliar application with IAA or Kinetin and their combination on root quality and some technological parameters of sugar beet plants at harvest.

Treatments		Root quality				Some technological parameters		
K_2O (kg/fed)	GR (IAA and kinetin)	Juice impurities (g/100 g beet)			purity %	SLM	Ex s	AC
		α–amino N	K	Na				
24	Zero	1.54	2.21	1.12	94.9	1.35	13.6	2.18
	IAA1	1.69	2.52	1.27	94.7	1.45	14.8	2.24
	IAA2	1.83	2.78	1.18	94.6	1.51	15.1	2.18
	Mean	1.76	2.65	1.23	94.7	1.48	15.0	2.21
	Ki1	1.66	3.15	1.22	94.0	1.53	13.8	2.63
	Ki2	1.55	3.30	1.16	94.2	1.51	14.4	2.90
	Mean	1.61	3.23	1.19	94.1	1.52	14.1	2.77
Means		1.65	2.79	1.19	94.5	1.47	14.5	2.43
12	Zero	1.13	1.19	1.20	95.9	1.12	12.8	2.12
	IAA1	1.20	1.26	1.25	96.0	1.15	14.1	2.09
	IAA2	1.26	1.33	1.18	96.2	1.17	15.0	2.00
	Mean	1.23	1.30	1.22	96.1	1.16	14.6	1.05
	Ki1	1.28	1.45	1.39	95.5	1.22	13.3	2.22
	Ki2	1.31	1.30	1.42	95.7	1.21	13.9	2.11
	Mean	1.30	1.38	1.41	95.6	1.22	13.6	2.17
Means		1.24	1.31	1.29	95.9	1.17	13.9	2.11
Over Means	Zero	1.34	1.70	1.16	95.5	1.23	13.4	2.15
	IAA1	1.45	1.89	1.26	95.4	1.30	14.5	2.17
	IAA2	1.55	2.06	1.16	95.4	1.34	15.1	2.09
	Ki1	1.47	2.30	1.31	94.8	1.37	13.8	2.42
	Ki2	1.43	2.32	1.29	94.9	1.36	14.2	2.51
LSD 0.05%								
K(A)		0.09	0.13	0.02	0.37	0.03	N.S	0.14
GR(B)		N.S	0.36	0.05	0.48	0.07	0.86	0.28
A x B		N.S	N.S	0.06	N.S	N.S	N.S	N.S

Table 5. Effect of K- fertilizer, foliar application with IAA or Kinetin and their combination on elemental composition and yields in sugar beet plants at harvest.

Treatments		Elemental compositions (g/100 g dw)			Roots yield		Tops yield		Sugars yield	
K_2O (kg/fed)	GR (IAA and kinetin)	N	P	K	first season	second season	first season	second season	first season	second season
24	Zero	1.26	0.132	1.95	29.7	28.9	17.6	18.0	4.19	4.63
	IAA_1	1.90	0.151	2.08	32.9	32.4	21.2	20.8	5.16	5.57
	IAA_2	2.07	0.171	2.53	36.3	35.8	21.9	22.2	5.87	6.28
	Mean	1.99	0.161	2.31	34.6	34.1	21.6	21.5	5.53	5.93
	Ki_1	1.15	0.194	1.80	31.4	32.1	19.7	20.4	4.91	5.12
	Ki_2	1.20	0.202	1.71	34.5	34.0	20.3	21.6	5.32	5.73
	Mean	1.18	0.198	1.76	33.0	33.1	20.0	21.0	5.12	5.43
Mean		1.52	0.170	2.01	33.0	32.6	20.2	20.6	5.09	5.47
12	Zero	1.21	0.114	1.51	27.6	26.5	16.5	16.7	3.60	4.09
	IAA_1	1.82	0.133	1.85	30.0	30.9	19.0	19.3	4.59	4.77
	IAA_2	1.90	0.150	2.01	34.3	33.6	20.3	20.5	5.32	5.76
	Mean	1.86	0.142	1.93	32.2	32.3	19.7	19.9	4.96	5.27
	Ki_1	1.20	0.140	1.42	29.3	29.8	16.1	17.6	4.21	4.45
	Ki_2	1.15	0.161	1.34	30.8	32.7	19.8	19.1	4.85	4.87
	Mean	1.18	0.151	1.38	30.1	31.3	18.0	18.4	4.53	4.66
Mean		1.46	0.140	1.63	30.4	30.7	18.8	18.6	4.51	4.79
Over Means	Zero	1.25	0.123	1.73	28.7	27.7	17.1	17.4	3.89	4.36
	IAA_1	1.86	0.142	1.96	31.5	31.6	20.1	20.1	4.88	5.17
	IAA_2	1.98	0.161	2.27	35.3	34.7	21.2	21.4	5.60	6.02
	Ki_1	1.18	0.167	1.61	30.3	31.0	18.9	19.0	4.56	4.79
	Ki_2	1.18	0.182	1.53	32.7	33.4	20.1	20.4	5.08	5.30
LSD 0.05% :	K(A)	N.S	0.02	0.06	0.68	0.51	0.48	0.22	0.43	0.41
	GR(B)	0.07	0.02	0.05	0.55	0.43	0.51	0.56	0.29	0.33
	A x B	N.S	N.S	0.08	0.78	0.60	0.72	0.80	N.S	N.S

تأثير الرش الورقي باندول حمض الخليك او الكينتين على حاصل وجودة نبات بنجرالسكر

زينب رمضان مصطفى ، شفيقة نصر مصطفى ، خالد على ابو شادى ، خليل الشناوى محمد

معهد بحوث المحاصيل السكريه– مركزالبحوث الزراعيه – الجيزه

اقيمت تجربتان حقليتان بمحطة البحوث الزراعيه بسخا محافظة كفر الشيخ فى موسمى نمو ٢٠٠٢/٢٠٠٣، ٢٠٠٣/٢٠٠٤ لدراسة تاثير التسميد الارضى بالبوتاسيوم عند ١٠٠٪ ، ٥٠٪ من المعدل الموصى به(٢٤ كيلوجرام اكسيد بوتاسيوم لكل فدان) والرش بمنظمات النمو(اندول حمض الخليك او الكينتين) عند١٠$^{-٦}$و١٠$^{-٤}$ مولروالتداخل بينهم على بعض الصفات الفسيوكيميائية والحاصل فى نبات بنجرالسكر وأظهرت النتائج ما يلى :

١. أدى انخفاض معدل البوتاسيوم من١٠٠٪ الى ٥٠ ٪ من المعدل الموصى بـه الـى إنخفـاض قياسات النبات مثل قطر وطول الجذر والوزن الطازج والجاف للجذور والعرش وايضا الصفات الكيميائيه مثل السكريات المنفرده ونشاط انزيم الانفرتيز وايضا انخفضت نسبة العناصر المعدنية بانخفاض معدل البوتاسيوم.

- أدى انخفاض معدل البوتاسيوم إلى انخفاض محتوى البوتاسيوم والفا امينو نيتـروجين وبعـض الصفات التكنولوجية (السكر المفقود فى المولاس والسكر المستخلص ومعامل القلويـة) . كمـا انخفض كلا من حاصل الجذر والعرش والسكر بانخفاض التسميد بالبوتاسيوم من١٠٠ ٪ الى٥٠ ٪ من المعدل الموصى به وعلى العكس من ذلك زاد كل من نقاوه ومحتـوى الصـوديوم فـي العصير.

٢. كان لمنظمات النمو(اندول حمض الخليك او الكينتين) تأثيرايجابي على معظم الصفات السابقه ما عدا نشاط أ نزيم الانفرتيز و نقاوة العصير ويزداد هذا التأثيربزيادة المعدل .

- اعطى التسميد بالبوتاسيوم مع الرش باندول حمض الخليك او الكينتين نفـس إتجـاه المعاملـه بمنظمات النمو بمفردها.
- كان للرش الورقى بواسطة اندول حمض الخليك منفردا او مع التسميد بالبوتاسيوم تـأثير أكبـر مقارنة بالمعامله بالكينتين.
- توصى الدراسه باستخدام التسميد بالبوتاسيوم عند معدل٥٠ ٪ من الموصى به (١٢ كيلو جـرام اكسيد بوتاسيوم لكل فدان) مع الرش بأندول حمض الخليك عند تركيز ١٠$^{-٤}$مولر لتحسين جـودة العصيرفى جذر البنجر وتقليل التلوث البيئ .