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Influence of Compost, Boron and Potassium on some Traits in Cucumber (*Cucumis sativus* L.) Grown in Alluvial Soil

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ABSTRACT

Cucumber (*Cucumis sativus* L.) is among the most important vegetable crops grown in Egypt for local consumption and exportation. The purpose of this investigation was to evaluate the effect of two compost types (plant residues and animal residues) with foliar spraying of potassium and boron elements on improving the fruit yield and quality of the cucumber plants grown in an alluvial soil during the two successive summer seasons of 2015 and 2016. The experimental design was a split plot design with three replicates for each treatment. The compost treatments were (C_1): Animal compost was applied at rate of 0.2 m^3 $plot^{-1}$ and (C_2): compost of rice straw (CRS) was applied at rate of 0.2 m^3 $plot^{-1}$ .While the foliar treatments were (T_1): B was foliar applied as boric acid at rate of 0.44 mg L^{-1}, (T_2): K was foliar applied as potassium acetate at rate of 200 mg L^{-1} and (T_3): combination of B and K was foliar applied at the same rates as mentioned above. The results showed that, the highest values of all studied vegetative growth parameter such as fresh and dry weights (g $plant^{-1}$), stem length and diameter(cm) of cucumber plant in both studied seasons were achieved at (C_2 (Plant compost) × T_3 (B+K)) treatment, while the lowest values were obtained at control treatment (without compost or foliar application).Also, fruit characteristics such as [average fruit weight (g), fruit diameter and length (cm), fruit shape index (LD^{-1})] and yield [early, total yield (kg $plot^{-1}$) and total yield (ton fed^{-1})] gave the same trend in both studied seasons. Also, the values of nitrogen, phosphorus, potassium and boron contents in leaves of cucumber plant were evaluated under the effect of different types of compost and foliar application of B and K at the same time.

Keywords: Alluvial soil, boron, potassium and cucumber plant.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important members of the Cucurbitaceae family that is cultivated for its fruits that are a rich source of vitamins and minerals nutrients (Eifediyi and Remison, 2010). Compost is considered one of the most major sources of organic fertilization. The addition of compost usefully affects the porosity, water holding capacity, structure, compression strength, nutrients availability and organic matter content of the soil , thus enhances plant growth, crop quality and crop yield. The usage of animal and plant compost in agriculture is an age old practice. However, the high yielding varieties of used seeds needed chemical synthetic fertilizers largely superseded the use of organic amendments during the green revolution.The extensive use of chemical fertilizers had a lot of problems. Compost had significant influences on plant growth parameters and yield due to their high O.M content, which enhanced not only soil biological and physical properties, but also chemical properties resulting in more available nutrients (Fahmy, 2012).

Boron (B) is an important micro elements required for normal plant growth and development. It plays an essential role in sugar transport, differentiation, cell-wall synthesis, membrane functioning, regulation of plant hormone levels, root elongation, cell division and generative growth of plants (Dursun *et al*., 2010). B is an exceptionally sensitive element and plants differ exceedingly in their requirements, where the range of toxicity and deficiency level are narrow. Boron management is challenging due to the optimum boron addition range is narrow and optimum boron addition levels can differ from one soil to another (Dursun *et al*., 2010). Boron is considered a beneficial element because it improves plant health status at low concentrations but has toxic effects at high concentrations (El-Agrodi *et al*., 2016).Excess boron in plants is disposed to accumulate in plant leaves and causes negative physiological influences on plants, such as deceleration of growth, leaf burn (chlorotic and necrotic spots), reduction of dry mater, photosynthetic rates, lower leaf chlorophyll content, and decreased suberin and lignin levels (Nable *et al*., 1997).

Potassium (K) added to growing media could be used for reduction of boron toxicity (Cikili *et al*., 2013).Potassium is an essential nutrients for the development of plants. It is important in the biochemical reactions in plants. Potassium is also important in photosynthesis, in the regulation of plants responses to light through closing and opening of stomata. Basically, it is responsible for many other vital processes like starch synthesis and nutrient and water transportation (Samet *et al*., 2015). The objective of this investigation is to enhance the fruit yield and quality of the cucumber plants grown in alluvial soil in Delta region, Egypt and evaluation of two compost types (plant residues and animal residues) with foliar spraying of potassium and boron elements.

MATERIALS AND METHODS

To achieve the goal of this study, two field experiments were conducted in a private farm located in Grrah Village, Aga District, Dakahlia Governorate, Egypt during the two successive summer seasons of 2015 and 2016 to investigate the response of cucumber plant to two sources of organic manure [animal compost (AC) and compost of rice straw (CRS)] as a main plots and [foliar spraying of boron and potassium elements] as a sub plots under alluvial soil condition. Nutrient solution of potassium acetate was sprayed at rate of 200 mg L-1, while nutrient solution of boric acid was sprayed at rate of 0.44 mg L-1. Organic fertilizers were applied two weeks before sowing. The experimental design was a split plot design with three replicates for each treatment. The organic fertilization treatments were (C1) Animal compost was applied at rate of 0.2 m3 plot-1 and (C2) compost rice straw (CRS) was applied at rate of 0.2 m3 plot-1 .While the foliar treatments were (T1) B was foliar applied as boric acid at rate of 0.44 mg L-1, (T2) K was foliar applied as potassium acetate at rate of 200 mg L-1 and (T3) combination of B and K foliar applied at the same rates as mentioned above. Some physical and chemical properties of the studied soil are shown in Table (1). Chemical analysis of the two composts used is presented in Table (2).

Table 1. Some physical and chemical characteristics of the experimental soil.

Particle size distribution (%)				Textural class class	EC, dSm^{-1*}	pH **	$CaCO_3$	O.M	F.C	SP
C.sand sand	F.sand	Silt	Clay	clay			(%)			
2.50	21.05	23.95	52.5		1.35	7.80	3.20	1.12	35.0	70.0
Soluble ions, meq L^{-1}							Available element, mg kg^{-1}			
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K	B
4.50	2.70	5.10	1.70	-	0.75	6.55	6.70	59.3	5.53	279.2	0.35

* Soil electrical conductivity (EC) and soluble ions were determined in soil paste extract.

** Soil pH was determined in soil suspension (1:2.5).

Table 2. Chemical analysis of the two composts used.

compost	Weight of m^3(kg)	pH (1:5)	EC (1:10) (dSm^{-1})	O.M	O.C	Total N	C/N ratio	Total P	Total K
				%				%	
C_1	645	6.63	4.09	32.82	19.08	1.22	15.7	0.42	0.66
C_2	325	6.14	3.71	35.1	20.41	1.46	13.9	0.49	0.88

C_1: animal compost (AC). C_2: plant compost (CRS). O.C: organic carbon. O.M: organic matter

All agricultural operations were performed according to the traditional local agricultural management practices. Cucumber (*Cucumis sativus* .L. Masera S.C) was cultivated on 27th March in both seasons of the study. At soil preparation, the two different studied composts were applied according to treatments two weeks before sowing at rate of 0.2 m^3 plot $^{-1}$. The amounts of mineral fertilizers were used as recommended by ministry of Agriculture. The plants were irrigated every seven days during the growing season. Other cultural practices; like, plant protection against diseases ,insects and weeds were performed whenever they were thought to be necessary as recommended for commercial cucumber production. Harvesting started on May,2 and continued until June, 15 in both successive seasons. Number of pickings was 25 in both seasons.

Some different morphological traits of cucumber plant were measured and calculated. Five plants from each treatment were randomly chosen for measurements.

The following characteristics were inspected:

1- **Vegetative growth parameters:** (fresh & dry weights (g plant^{-1}) and stem length and diameter (cm)).
2- **Chemical constituents in cucumber leaves:** (N, P, K, B and chlorophyll content were measured in the dried leaves according A.O.A.C (1980)).
3- **Fruit quality and fruit yield characters:** fruit weight (g), fruit diameter and length (cm), fruit shape index (LD^{-1}), early and total yield (kg /plot$^{)}$ and total yield (ton fed^{-1}).

Data were statistically analyzed according to Gomez and Gomez (1984) using CoStat (Version 6.303, CoHort, USA, 1998–2004).

RESULTS AND DISCUSSION

1- Vegetative growth characteristics (morphological performance) as affected by compost, foliar spraying with potassium and boron

Data illustrated in Tables (3 and 4) show the effect of different types of compost, foliar spraying with potassium and boron and their interactions on plant growth parameters of cucumber in expression of fresh and dry weights, stem length and diameter, branches number, leaves number and leaf area for cucumber plants grown on clay soil during 2015 and 2016 seasons.

Plant fresh and dry weight

Data of Table (3) show the effect of different types of compost, foliar spraying with potassium and boron and their interactions on fresh and dry weights (g plant^{-1}) of cucumber plant in both seasons of the study.

Table 3. Effect of compost, foliar spraying with potassium and boron and their interaction on fresh and dry weights of cucumber plant during 2015 and 2016 seasons.

Characters		Fresh weight (g plant^{-1})		Dry weight	
Treatments		1st	2nd	1st	2nd
Compost manure					
C_1 Animal compost (AC)		1029.43	1034.30	123.53	124.50
C_2 Plant compost (CRS)		1090.57	1095.13	128.73	131.49
LSD at 5%		0.99	1.08	4.80	1.59
Foliar spraying (B and K)					
T_1 B (0.44ppm)		900.00	904.05	108.00	108.54
T_2 K (200ppm)		1049.40	1054.60	122.30	126.80
T_3 B (0.44ppm)+ K (200ppm)		1230.60	1235.50	148.10	148.65
LSD $_{at 5\%}$		1.91	3.21	2.34	2.60
Interaction					
Control		681.7	685.5	81.5	82.2
C_1	T_1 B (0.44ppm)	889.50	893.70	106.50	107.30
Animal compost	T_2 K (200ppm)	988.30	994.20	118.30	119.70
(AC)	T_3 B (0.44ppm)+ K (200ppm)	1210.50	1215.00	145.80	146.50
C_2	T_1 B (0.44ppm)	910.50	914.40	109.50	109.78
Plant compost	T_2 K (200ppm)	1110.50	1115.00	126.30	133.90
(CRS)	T_3 B (0.44ppm)+ K (200ppm)	1250.70	1256.00	150.40	150.80
LSD $_{at 5\%}$		2.70	4.55	3.31	3.68

Data in Table (3) showed that; the values of fresh and dry weights (g $plant^{-1}$) of cucumber plant treated with plant compost (CRS) were significantly increased comparing with the cucumber plant treated with animal compost (AC). On the other hand, the control treatment (without compost) had the lowest values. This trend was found during both studied seasons. Data in Table (3) show also the individual effect of some foliar spraying applications on fresh and dry weights (g $plant^{-1}$) of cucumber plant and indicated that the highest values were recorded with adding of combining boron at rate of 0.44 mg L^{-1} and potassium at rate of 200 mg L^{-1} (T_3 treatment) following with adding of potassium alone at rate of 200 mg L^{-1} (T_2 treatment) and lately boron alone at rate of 0.44 mg L^{-1}(T_1 treatment). Treatments sequence from top to less was the T_3 (combination of B plus K) > T_2 (K spraying alone) > T_1 (B spraying alone) > control (without any foliar spraying), such effect was the same during the two seasons of 2015 and 2016.Data of the same Table and Figures (1 and 2) indicate that the interaction effect between added composts and foliar spraying applications was significant in both seasons, where the highest values of fresh and dry weights (g $plant^{-1}$) of cucumber plant in both studied seasons were at (C_2 (Plant compost) × T_3 (B+K)) treatment, it were 1250.70 and 150.4 g $plant^{-1}$ in the 1^{th} season for fresh and dry weights, respectively. Also the data of the same Table indicate that the lowest values were at control treatment (without compost or foliar application), it were 681.7 and 81.5 g $plant^{-1}$ in the 1^{th} season for fresh and dry weights, respectively. This trend was found for the two studied seasons.

Stem length and diameter.

The response of stem length and diameter (cm) of cucumber plant to different types of compost, foliar spraying with potassium and boron and their interaction in 2015 and 2016 is given in Table 4. Data indicate that the plants treated with CRS had the highest values of stem length and diameter (cm) comparing with plants treated with AC. On the other hand, plants in control plot had the lowest values of stem length and diameter (cm).This trend was found for the two studied seasons. As for the foliar application effects, data in Table (4) indicate that all foliar applications significantly increased the stem length and diameter values as compared with the non treated plants (control).Also, data reveal that, spraying cucumber plants with combining boron and potassium (T_3 treatment) significantly increased the values of stem length and diameter (cm) of cucumber plants than those obtained from T_2 treatment (spraying cucumber plant with only potassium) and T_1 treatment (spraying cucumber plant with only boron). Also, T_2 treatment (spraying K alone) came in the second order then T_1 treatment (spraying B alone).

Table 4. Effect of compost, foliar spraying with potassium and boron and their interaction on stem length and diameter of cucumber plant during 2015 and 2016 seasons.

Treatments	Characters	Stem length (cm) 1st	Stem length (cm) 2nd	Stem diameter (cm) 1st	Stem diameter (cm) 2nd
Compost manure					
C_1 Animal compost (AC)		191.30	193.33	1.80	1.88
C_2 Plant compost (CRS)		194.07	196.67	1.90	1.98
LSD at 5%		1.29	1.54	0.06	0.06
Foliar spraying (B and K)					
T_1 B (0.44ppm)		186.00	188.00	1.64	1.71
T_2 K (200ppm)		193.80	195.90	1.90	1.98
T_3 B (0.44ppm)+ K (200ppm)		198.25	201.10	2.03	2.11
LSD at 5%		1.58	1.81	0.13	0.14
Interaction					
Control (without any application)		167.2	170.3	1.45	1.50
C_1	T_1B (0.44ppm)	184.50	186.00	1.60	1.67
Animal compost	T_2K (200ppm)	193.10	194.50	1.87	1.95
(AC)	T_3 B (0.44ppm)+ K (200ppm)	196.30	199.50	1.94	2.02
C_2	T_1B (0.44ppm)	187.50	190.00	1.68	1.75
Plant compost	T_2 K (200ppm)	194.50	197.30	1.92	2.00
(CRS)	T_3 B (0.44ppm)+ K (200ppm)	200.20	202.70	2.11	2.20
$LSD_{at\ 5\%}$		2.24	2.55	0.19	0.20

The interaction effect between the treatments under study are presented in Table (4). It could be observed that; the values of stem length and diameter (cm) were significantly affected due to the addition of all investigated treatments. It can be shown that the foliar spraying cucumber plants with combining boron and potassium (T_3 treatment) produced higher stem length and diameter than that obtained for T_1 and T_2 treatments under animal compost(C_1 treatment) or plant compost CRS (C_2treatment) . But the highest values of the stem length and diameter (cm) of cucumber plants in the both studied seasons were at (C_2 (Plant compost) × T_3 (B+K)) treatment, it were 200.20 and 2.11 cm in the 1^{th} season and 202.7 and 2.2 cm in the 2^{nd} season for stem length and diameter, respectively.The data show also that applying either CRS or AC before planting gave higher stem length and diameter at any foliar applications compared to the control treatment (without compost or foliar applications),where the lowest values were at control treatment (without compost or foliar applications), it were 167.2 and 1.45 cm in the 1^{th} season and 170.3 and 1.50 cm in the 2^{nd} season for stem length and diameter, respectively.

The present results agree with those obtained by (Mahmoud *et al.*,(2009); Ghehsareh and Kalbasi (2012); Ikeh *et al*., (2012) and Natsheh and Mousa (2014)) who stated that the application of compost combined with or without chemical fertilizer to soil is considered as a good management practices in any agricultural production system because it improves cucumber plant growth parameters and soil fertility. Halvin *et al*., (2005); Wang *et al*., (2008) and Mohamed and Shaaban (2004) stated that the vegetative growth of cucumber plants was negatively affected by boron deficiency. Also, potassium plays significant roles to enhance crop quality, disease resistance, and shelf-life of fruits and feeding values of produces. These results are in harmony with the findings of Ruiz and Romero (2005).

2-N, P, K, B in leaves of cucumber plants as affected by compost, foliar spraying with potassium and boron.

Data illustrated in Table (5) show the effect of different types of compost, foliar spraying with potassium and boron and their interaction on chemical constituents in leaves of cucumber in expression of N, P, K and B concentration for cucumber plants grown on clay soil during 2015 /2016 seasons.

Chemical constituents in leaves.

The effect of compost, foliar spraying with potassium and boron and their interaction on the nutrients concentration of the cucumber plant leaves is given in Table 5. This shows that the leaves of cucumber plants treated with CRS before planting had the highest values of N, P, K and B concentration as compared to the other plants treated with animal compost before planting and plants without compost (control). On the other hand, the leaves of cucumber plants without compost had the lowest values. Treatments sequence from top to less was the C_2> C_1> control.

Table 5. Effect of compost, foliar spraying with potassium and boron and their interaction on nitrogen, phosphorus and potassium (%) and B concentration (mg kg^{-1} $_{DM}$) of cucumber leaves during 2015 and 2016 seasons.

Characters		N		P		K		B	
		%						mg kg^{-1} $_{DM}$	
Treatments		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Compost manure									
C_1 Animal compost (AC)		3.26	3.30	0.301	0.301	2.81	2.82	28.67	29.50
C_2 Plant compost (CRS)		3.35	3.40	0.310	0.314	2.97	3.05	29.90	30.77
LSD at 5%		0.06	0.02	0.011	0.010	0.08	0.10	0.99	0.08
Foliar spraying (B and K)									
T_1 B (0.44ppm)		2.88	2.93	0.266	0.267	2.57	2.63	27.85	28.65
T_2 K (200ppm)		3.32	3.36	0.306	0.309	2.87	2.91	29.10	29.85
T_3 B (0.44ppm)+ K (200ppm)		3.72	3.77	0.345	0.347	3.22	3.27	30.90	31.90
LSD $_{at\ 5\%}$		0.07	0.02	0.008	0.007	0.06	0.06	0.51	1.04
Interaction									
Control		2.79	2.80	0.250	0.252	2.43	2.45	21.5	22.5
C_1	T_1 B (0.44ppm)	2.83	2.86	0.263	0.261	2.51	2.52	27.20	28.00
Animal compost	T_2 K (200ppm)	3.26	3.30	0.300	0.300	2.76	2.77	28.50	29.20
(AC)	T_3 B (0.44ppm)+ K (200ppm)	3.69	3.75	0.340	0.342	3.15	3.17	30.30	31.30
C_2	T_1 B (0.44ppm)	2.92	2.99	0.269	0.273	2.63	2.74	28.50	29.30
Plant compost	T_2K (200ppm)	3.38	3.42	0.311	0.317	2.98	3.05	29.70	30.50
(CRS)	T_3 B (0.44ppm)+ K (200ppm)	3.74	3.79	0.350	0.352	3.29	3.36	31.50	32.50
LSD $_{at\ 5\%}$		0.10	0.02	0.011	0.010	0.09	0.09	0.72	1.48

Data in Table (5) show also the individual effect of some foliar applications on N, P ,K and B concentration and indicated that combining B and K (T_3 treatment) recorded the highest values of N, P and K (%) and B (mg kg^{-1} $_{DM}$) in leaves compared with other treatments in this respect. Also, the T_2 treatment (spraying of K alone) increased N, P and K (%) and B (mg kg^{-1} $_{DM}$) in leaves more than T_1 treatment (spraying B alone) and control treatment, where the lowest values were found at the control treatment (without compost or foliar application). This trend was found in both study seasons. Data of the same Table indicate that the interactions of the treatments had significant effect on the concentration of the macronutrients and B examined in the leaves in both seasons. Where the highest values of N, P and K (%) and B (mg kg^{-1} $_{DM}$) of leaves in the both seasons were at (T_3×C_2) treatment . However, the lowest values were at Control treatment (without compost or foliar application). The present results agree with those obtained by (Mathur *et al*., 1993; Bayoumi. (2005); Abo sedera (2009); Xin (2009); Tavakoli and Khoshkam(2013); Kazemi (2013) and Ekinci *et al*., (2015)). These results are supported by the findings of Yasir *et al*., (2016) who showed a significant superiority of adding organic fertilizer in the percentage of nitrogen and potassium .The results are in agreement with those of Dursun *et al*., (2010) who found that the application of B to cucumber plants resulted in an increases in phosphorus and potassium contents of leaves. Also, potassium helps in timely and appropriate nutrients translocation and water uptake by plants (Havlin *et al*., 2005). Our data also confirmed the positive effect of boron plus potassium as reported by Zare (2013).

3-Fruits characteristics and yield as affected by compost, foliar spraying with potassium and boron.

Data illustrated in Tables (6 and 7) show the effect of different types of compost, foliar spraying with potassium and boron and their interaction on fruits characteristics and yield of cucumber plants grown on clay soil during 2015 and 2016 seasons.

- Fruit characters.

As shown in Table (6) different estimated fruit traits such as average fruit weight, fruit diameter and length and fruit shape index were increased to reach the level of significance with addition of two different composts before planting and different foliar applied treatments. Data of Table (6) indicated that the cucumber plants treated with

CRS before planting had the highest values of average fruit weight, fruit diameter and length and fruit shape index. On the other hand, untreated cucumber had the lowest values. From data of this Table, the highest values of all aforementioned traits were found at C_2 treatment compared to other treatments. The C_1 treatment came in the second order then the control treatment during the two studied growth seasons.

Table 6. Effect of compost, foliar spraying with potassium and boron and their interaction on average fruit weight, fruit diameter and length and fruit shape index of cucumber during 2015 and 2016 seasons.

Characters / Treatments		Average fruit weight (g) 1st	2nd	Fruit diameter (cm) 1st	2nd	Fruit length (cm) 1st	2nd	Fruit shape index ($L D^{-1}$) 1st	2nd
Compost manure									
C_1 Animal compost (AC)		88.69	88.94	2.33	2.36	12.70	13.50	5.47	5.72
C_2 Plant compost (CRS)		90.59	90.87	2.62	2.68	13.63	14.10	5.22	5.27
LSD at 5%		1.81	0.23	0.07	0.09	0.66	0.17	0.19	0.31
Foliar spraying (B and K)									
T_1 B (0.44ppm)		83.72	84.10	2.26	2.28	12.30	12.75	5.46	5.61
T_2 K (200ppm)		91.02	91.05	2.48	2.53	13.35	13.75	5.42	5.46
T_3 B (0.44ppm)+ K (200ppm)		94.17	94.57	2.69	2.76	13.85	14.90	5.16	5.42
LSD $_{at\ 5\%}$		1.62	1.43	0.07	0.09	0.34	0.65	0.18	n.s
Interaction									
Control		79.97	80.25	1.90	2.00	11.5	12.0	4.25	4.30
C_1 Animal compost (AC)	T_1 B (0.44ppm)	82.77	83.10	2.18	2.20	12.00	12.50	5.50	5.69
	T_2 K (200ppm)	90.07	90.10	2.27	2.31	12.90	13.30	5.69	5.76
	T_3 B (0.44ppm)+ K (200ppm)	93.22	93.62	2.53	2.57	13.20	14.70	5.22	5.72
C_2 Plant compost (CRS)	T_1B (0.44ppm)	84.67	85.10	2.33	2.35	12.60	13.00	5.41	5.53
	T_2K (200ppm)	91.97	92.00	2.68	2.75	13.80	14.20	5.15	5.16
	T_3 B (0.44ppm)+ K (200ppm)	95.12	95.52	2.84	2.95	14.50	15.10	5.11	5.12
LSD $_{at\ 5\%}$		2.29	2.03	0.10	0.12	0.24	0.93	0.26	0.31

Also, data in Table (6) show the individual effect of some foliar applications on average fruit weight, fruit diameter and length and fruit shape index in the both studied seasons and indicated that combination of B plus K (T_3 treatment) recorded the highest values of all aforementioned traits of fruit cucumber compared with other treatments in this respect. Also, the T_2 treatment (K spraying alone) increased the values of all aforementioned traits more than T_1treatment (B spraying alone) and control treatment, where the lowest values were found at the control treatment (without compost or foliar application). This trend was found in the both studied growth seasons.

The interaction effect among the treatments under study on average fruit weight, fruit diameter and length and fruit shape index are presented in Table (6). It could be observed that; the values of all aforementioned traits were significantly affected due to the addition of all investigated treatments. It can be shown that the foliar spraying cucumber plants with combination of boron plus potassium (T_3 treatment) produced higher average fruit weight, fruit diameter and length, fruit shape index and hardness than that obtained for T_1 and T_2 treatments under animal compost (C_1treatment) or plant compost CRS (C_2treatment) . But the highest values of the all aforementioned traits of cucumber plant in both studied seasons were at (C_2 (Plant compost) × T_3 (B+K)) treatment, it were 95.12 g , 2.84cm, 14.5cm and 5.11 LD^{-1} in the 1^{th} season for average fruit weight, fruit diameter and length and fruit shape index , respectively. This trend was found in the second season. The data show also that applying either CRS or AC before planting gave higher average fruit weight, fruit diameter and length and fruit shape index at any foliar applications compared to the control treatment (without compost or foliar applications), where the lowest values were at control treatment (without compost or foliar applications), it were 79.97 g , 1.9 cm, 11.5cm and 4.25 LD^{-1} in the 1^{th} season for average fruit weight, fruit diameter and length and fruit shape index , respectively. This trend was found in the second season.

- Early and total yield.

The early and total yield of cucumber plants as affected by compost, foliar spraying with potassium and boron and their interaction in both seasons is presented in Table (7). Data in Table (7) showed that; the values of number and weight of early and total yield $plot^{-1}$ of cucumber plant treated with plant compost (CRS) were significantly increased comparing with the cucumber plant treated with animal compost (AC). On the other hand, the control treatment (without compost) had the lowest values. Furthermore, the obtained results indicate that total yield (ton fed^{-1}) was significantly influenced by added compost. Since, the greatest total yield (ton fed^{-1}) values were observed in cucumber plants treated with CRS before planting, while plants without compost gave the lowest values of total yield (ton fed^{-1}). Generally, the treatments sequence from top to less was C_2> C_1> control. This trend was found during both studied seasons. Data in Table (9) show also the individual effect of some foliar spraying applications on number and weight of early and total yield $plot^{-1}$ as well as total yield (ton fed^{-1}) of cucumber plant and indicated that the highest values were recorded with combination of boron plus potassium (T_3 treatment) following with adding of potassium alone (T_2 treatment) and lately boron alone (T_1 treatment). Treatments sequence from top to less was T_3 (combination of B plus K) > T_2 (K spraying alone) > T_1 (B spraying alone) > control (without any foliar spraying), such effect was the same during the two seasons of 2015 and 2016.

Table 7. Effect of compost, foliar spraying with potassium and boron and their interaction on early, total yield of cucumber during 2015 and 2016 seasons.

Characters	Early yield				Total yield				Total yield (Ton fed^{-1})	
	Number of fruits/plot		Weight of fruit (Kg $plot^{-1}$)		Number of fruits/plot		Weight of fruit (Kg $plot^{-1}$)			
Treatments	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Compost manure										
C_1 Animal compost (AC)	242.33	246.00	14.43	14.76	951.67	985.00	57.17	59.10	15.24	15.76
C_2 Plant compost (CRS)	266.67	271.67	16.07	16.20	1016.33	1036.33	61.00	62.18	16.27	16.58
LSD at 5%	6.62	4.97	1.24	0.20	9.94	14.90	2.90	2.06	3.28	0.09
Foliar spraying (B and K)										
T_1 B (0.44ppm)	204.00	207.50	12.20	12.45	774.50	787.50	46.50	47.25	12.40	12.60
T_2 K (200ppm)	224.50	229.00	13.50	13.74	990.00	1002.50	59.50	60.15	15.87	16.04
T_3 B (0.44ppm)+ K (200ppm)	335.00	340.00	20.05	20.25	1187.50	1242.00	71.25	74.52	19.00	19.87
T_1B (0.44ppm)	8.49	1.88	0.64	0.89	4.17	6.15	0.61	1.40	1.94	1.89
Interaction										
Control	160	163	9.2	9.5	440	490	26.5	29.5	7.066	7.86
C_1 Animal compost (AC) T_1 B (0.44ppm)	198.00	200.00	11.80	12.00	750.00	765.00	45.00	45.90	12.00	12.24
T_2 K (200ppm)	209.00	213.00	12.50	12.78	980.00	995.00	59.00	59.70	15.73	15.92
T_3 B (0.44ppm)+ K (200ppm)	320.00	325.00	19.00	19.50	1125.00	1195.00	67.50	71.70	18.00	19.12
C_2 Plant compost (CRS) T_1 B (0.44ppm)	210.00	215.00	12.60	12.90	799.00	810.00	48.00	48.60	12.80	12.96
T_2 K (200ppm)	240.00	245.00	14.50	14.70	1000.00	1010.00	60.00	60.60	16.00	16.16
T_3 B (0.44ppm)+ K (200ppm)	350.00	355.00	21.10	21.00	1250.00	1289.00	75.00	77.34	20.00	20.62
$LSD_{at 5\%}$	12.01	2.66	0.90	1.26	5.90	8.70	0.87	1.98	2.74	2.67

Data of the same Table indicate that the interaction effect between added composts and foliar spraying applications was significant in both seasons, where the highest values of number and weight of early and total yield $plot^{-1}$ as well as total yield (ton fed^{-1}) of cucumber plant in the both studied seasons were at (C_2 (Plant compost) × T_3 (B+K)) treatment. Also, the data of the same Table indicate that the lowest values were at control treatment (without compost or foliar application).This trend was found for the two studied seasons.

In this concern, many authors proved that compost, boron, potassium and their interaction affected fruit yield of cucumber (Bayoumi., 2005; Abo sedera 2009; Xin 2009; Tavakoli and Khoshkam2013; Kazemi (2013); Shnain 2014 and Ekinci *et al*., 2015). Besides, Mahmoud *et al*.,(2009) stated that plant residues and animal residues composts increased early and total yield of cucumber fruits . Also, These results are supported by the findings of ((Meena, 2015),who suggested that superior results of boron treatments to participate a beneficial role during cell division, nucleic acid synthesis, uptake of calcium and transport of carbohydrates. It also plays an important role in flowering and fruit formation (Alpaslan and Gunes 2001 and Meena, 2015). Also, these results are supported by the findings of Ruiz and Romero (2005) who stated that potassium is involved in activation of enzymes important to energy utilization, starch synthesis, N metabolism and respiration. Potassium plays significant roles to enhance crop quality, disease resistance, and shelf-life of fruits and feeding values of produces. Also, Samet *et al*., (2015) stated that addition of K to the growing media can be beneficial in alleviating plant growth reduction and mineral imbalances caused by excess B.

CONCLUSION

According to the obtained results in this investigation, cucumber c.v (*Masera*) treated with compost of rice straw before planting and sprayed with combination of B (at rate of 0.44 mg L^{-1}) and K (at a rate of 200 mg L^{-1}) was the best treatment that could be recommended to obtain the highest yield, in the meantime improving fruit quality and total yield of cucumber plant in Delta area and other regions with similar agro-climate conditions.

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تأثير الكومبوست والبورون والبوتاسيوم علي بعض صفات الخيار النامي بالأراضي الرسوبية

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يعد الخيارمن أهم الخضروات التي تزرع في مصر إما للإستهلاك المحلي أوالتصدير. الغرض من هذة الدراسة هو تقييم تأثير نوعين مختلفين من الكومبوست (بقايا نباتية وبقايا حيوانية) مع الرش بكل من البوتاسيوم والبورون على تحسين إنتاجية وجودة نباتات الخيار المزروعة بتربة رسوبية خلال موسميين صيفيين متتاليين 2015 و 2016. تم إستخدام تصميم القطع المنشقة مع 3مكررات لكل معاملة. كانت معاملات الكومبوست كما يلي (C_1 : كومبوست حيواني بمعدل 0.2 م3/قطعة - C_2 : كومبوست نباتي بمعدل 0.2 م3/قطعة) في حين أن معاملات الرش الورقية كانت (T_1 : الرش الورقي للبورون بمعدل 0.44 ملجرام /لتر وكان مصدره حمض البوريك - T_2: الرش الورقي للبوتاسيوم بمعدل 200 ملجرام /لتر وكان مصدره أسيتات بوتاسيوم - T_3 :الرش الورقي لكل من البورون والبوتاسيوم مجتمعين بنفس المعدلات المذكورة أعلاه). أوضحت النتائج أن أعلى القيم لكل مدلولات النمو الخضري المدروسة مثل الوزن الطازج والجاف للمجموع الخضري لنباتات الخيار (جرام/النبات) و كذلك طول الساق وقطره(سم) كانت عند المعاملة [T_3(رش بوتاسيوم + بورون)× C_2 (كومبوست نباتي)] بينما أقل القيم تم الحصول عليها عند المعاملة الكنترول (بدون كومبوست او رش) وذلك خلال كلا موسمي الدراسة. وكذلك خصائص الثمار [متوسط وزن الثمار (جم) ، وقطر الثمار وطولها (سم) ، دليل شكل الثمرة] والعائد المحصولي (المحصول المبكر والكلي (كجم /القطعة) والمحصول الكلي (طن/الفدان)] أعطى نفس الإتجاه في الموسمين. أيضا تم تقييم محتوى أوراق نباتات الخيار من النيتروجين والفوسفور والبوتاسيوم والبورون تحت تأثير أنواع الكومبوست المختلفة والرش الورقي لكل من البورون والبوتاسيوم في نفس الوقت.