J. of Plant Production, Mansoura Univ.,Vol 10 (12):1065 - 1070, 2019

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www. jpp.journals.ekb.eg

Impact of Compost and Boron Fertilization on Yield and Quality of Sugar Beet Grown in a Sandy Soil

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ABSTRACT

Two field trials were conducted in a sandy soil at El-Nubaria district, El- Beheira Governorate, Egypt during 2017/2018 and 2018/2019 seasons to find out the influence the compost mature produced from recycling agricultural residues (0, 10, 20 and 30 m^3 /fed.) added during seed bed preparation and four levels of boron (0, 100, 150 and 200 ppm/fed.) was sprayed twice at 6-8 and 10 leaf stages on growth, yield and quality of sugar beet crop (*Beta vulgaris* L.). A strip plots design in four replicates was used. The results revealed that fertilizing sugar beet with 30 m^3/fed compost led to significant increments in growth traits and root, sucrose%, extractable sugar% as well as yields of top, root and sugar/fed, while sugar lost to molasses% decreased. Meantime, root sodium content was insignificantly affected by compost levels in both seasons. Increasing boron level up to 200 ppm attained significant increases in growth traits, sucrose, extractable sugar percentages, sugar yield/fed and quality index compared with the other levels of boron in both seasons. The interaction between treatment study led to significant effects on root diameter, root and top yields/fed. Regarding the correlation coefficient, it was found that root, top and sugar yields/fed were significantly and positively correlated with diameter, fresh weight of root and sucrose %. On the contrary, the three yields/fed were negatively correlated with quality index. Based upon the obtained results, fertilizing sugar beet with 30 m^3 compost + 200 ppm boron/fed could be recommended for optimum root and sugar yield per unit area under the environmental conditions of these study.

Keywords: sugar beet, compost manure, boron, sandy soil

INTRODUCTION

Sugar beet is one of the most important winter crops in Egypt, as it is well adapted to the Egyptian environment in most types of soils, especially reclaimed ones. The areas under reclamation are mostly calcareous, saline and sandy soils. With regard to the sandy soil, it is characterized with low organic matter, low water holding capacity and high nutrient losses by leaching; these tend to show deficiency symptoms of macro and micro-nutrients (Shafeek *et al.*, 2013). Therefore, the expansion of sugar beet area in such soils necessitates special agricultural practices to improve its nutritional status and to raise its water holding capacity. Applying organic matter as compost and boron as one of the main micro-elements required by sugar beet crop are suggested to raise the productivity of such crop under the poor growth conditions of sandy soils. In this context, Abou El-Soued *et al.* (2009) found that raising compost levels from zero up to 20 ton/fed resulted in a significant increase in root diameter, fresh and foliage weights/plant in both seasons. Safina and Abdel Fatah (2011) noticed that applying 4 ton/fed compost fertilizer significantly increased root diameter, in 1st season, while, top and root fresh weight increased in both seasons. Helal *et al.* (2013) summarized that highest values of root, sugar yields/fed and sucrose% were obtained by fertilizing sugar beet with 20 ton/ha compost in both seasons. Mahmoud *et al.* (2014) found that adding of compost at the rate of 2 ton/fed gave the maximum values of root yield/fed and improved juice quality of sugar beet. Abd El-Lateef (2014) indicated that increasing compost manure up to 20 m^3/fed significantly increased root yield/fed compared to the lower level from it. Soliman *et al.* (2014) obtained a significant increase in root diameter, fresh and foliage weight/plant, sucrose, purity percentages and sugar yield/fed as compost level was increased from zero to 30 m^3/fed in both seasons. Abo stet *et al.* (2015) noticed that the highest root yield/fed amounted to 28.3% and 25.3% in both seasons, respectively when sugar beet fertilized with compost manure. Abbas *et al*. (2018) observed that application of 12 ton/ha compost increased sugar lost to molasses, extracted sugar, sucrose percentages and sugar yield/fed in both seasons.

Boron is by far the most important trace elements needed for sugar beet because without an adequate supply, the yield and quality of roots is very depressed (Cooke and Scott, 1993). In this regard, Allen and Pilbeam (2007) stated that boron increases the rate of transport of sugars (which are produced by photosynthesis in mature plant leaves) to actively growing regions and also in developing roots. Abo El-Hamd and Esmail (2008) mentioned that increasing boron levels from 100 to 200 ppm as boric acid/fed significantly increased diameter and fresh weight of roots and sugar yield/fed Enan (2011) indicated that higher values of diameter, fresh weight/plant of root, yields of root, top and sugar/fed, sucrose% and boron concentration in root and leaves as a result of the raising boron applied up to 200

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DOI: 10.21608/jpp.2019.71554

ppm/fed in both seasons. Armin and Asgharipour (2012) studied the effect of boron spraying with (0, 0.35, 0.70 and 1.22 kg B/ha^{-1}) as boric acid, they found that increasing boron levels increased root yield and sucrose%, decreasing impurities contents and sugar lost to molasses% compared to the control in both seasons. Abbas *et al.* (2018) showed that application of boron showed significant increase in most traits where, increasing boron fertilizer up to 0.20 g/l resulted in highest sucrose, sugar recovery percentages, recoverable sugar yield/fed and purity% compared to check treatment. Enan *et al.* (2016) demonstrated that higher values of root diameter, fresh weight/plant, root, top and sugar yields/fed, sucrose, extractable sugar, quality percentages and boron contents in leaves and roots in both seasons, were obtained with spraying boron at 100 ppm/fed in a sandy soil.

The aim of this work includes assessing compost and boron fertilizer levels on yield quantity and quality features of sugar beet in sandy soils conditions.

MATERIALS AND METHODS

Two field trials were conducted in a sandy soil at El-Nubaria district, El-Bahira Governorate, Egypt (latitude of 30.860° N and longitude of 31.160° E at an elevation of 21 m above sea level) in 2017/2018 and 2018/2019 seasons to find out the effect of compost mature and boron fertilization levels on growth, yield and quality of sugar beet crop (*Beta vulgaris var. saccharifera,* L.). The present work included sixteen treatments, which were the combinations among four compost levels produced from recycling plant agricultural residues (0, 10, 20 and 30 m^3/fed) added during seed bed preparation and four levels of boron (0, 100, 150 and 200 ppm/fed as foliar application in the form of boric acid 17% boron) which was sprayed twice at 6-8 and 10 leaf stages. A strip plots design in four replicates was used. The vertical plots were occupied with the four levels of compost, while, the horizontal plots were devoted to the four levels of boron. The sub-plot size was 21 m^2, which included 5 ridges of 7 m in length and 0.6 m in width, and 20 cm between hills. 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 added in the form of ammonium nitrate (33.5% N) at the rate of 90 kg N/fed in three equal doses; the 1st one was added after thinning (4 true leaf stage) and the other two doses were applied at 2-week interval after the first application. Potassium fertilizer was added in the form of potassium sulphate (48% K_2O) at the rate of 48 kg/fed in two equal doses, with the first nitrogen dose and before canopy closer (70 days after planting). Sowing took place during the 1st week of September, using multi-germ sugar beet variety "Kareem", while harvesting was done 7 months later in both seasons.

Some physical properties of the soil were analyzed using the procedure described by Black, *et al.* (1981). Soil chemical analysis was determined according to the method of Jackson (1973). Physical and chemical analyses of the soil (the upper 30 cm) of the experimental site are given in Table 1 & 2

Table 1. Chemical analysis of compost produced by recycling the plant agricultural residues

Moisture content %	EC ds m^{-1} 1:10	p^H 1:2.5	C/N ratio	Organic Matter %	Weed seeds %	Total macro-nutrients			Total micro-nutrients			
						N	P	K	Fe	Mn	Zn	B
						g kg^{-1}			mg kg^{-1}			
23	13.4	8.04	20.91	25.6	-	18.49	8.79	18.99	33.1	72.3	29.4	1.03

Source: Physical and chemical analyses of compost were determined by department of soil chemistry, soils, water and environmental research institute. ARC.

Table 2. Soil physical and chemical properties of the experimental site for 2017-2018 and 2018-2019 seasons

Soil property	2017/2018 season	2018/2019 season
Particle size distribution:		
Sand %	82.77	80.89
Silt %	4.93	5.71
Clay %	12.30	13.40
Soil texture	sandy	sandy
Organic Matter %	0.69	0.74
Available Nitrogen mg/kg soil	23.92	25.54
Available P_2O_5 mg/kg soil	3.81	4.10
Available K_2O mg/kg soil	68.8	78.0
Available boron mg/kg soil	0.25	0.29
p^H at (1:2.5) soil : water suspension	8.10	8.06
EC dS/m^{-1}	0.67	0.69
Soluble Cations meq/l^{-1}		
k^+	1.18	1.35
Na^+	2.48	2.42
Mg^{++}	1.52	1.69
Ca^{++}	0.85	0.75
Soluble Anions meq/l^{-1}		
$So_4^=$	1.78	1.91
Cl^-	3.7	3.8
HCO_3^-	0.55	0.50
$CO_3^=$	-	-

The recorded data:

At harvest, a sample of ten plants was randomly taken from the middle rows of each sub-plot to determine the following traits:

1. Root diameter (cm).
2. Root and foliage fresh weight/plant (g)
3. Impurities (K, Na and α-amino N contents) in root were determined in El-Nile Sugar Company Laboratories at Alexandria Governorate, by an Automated Analyzer as described by Cooke and Scott (1993).
4. Sucrose (Pol%) was estimated in the fresh samples of sugar beet root using Saccharometer according to the method described by A.O.A.C. (2005).
5. Extractable sugar percentage was calculated according the formula of Dexter *et. al.* (1967) as follows:

   Extractable sugar % = sucrose% - SLM% - 0.6
6. Sugars lost to molasses percentage (SLM %) was calculated according to the following formula as shown by Devillers (1988):

   SLM% = 0.14 (Na + K) + 0.25 (α-amino N) + 0.50
7. Quality index (QZ%) = (extracted sugar % ÷ sucrose %) × 100.
8. Root and top yields (ton/fed), which were determined on sub plot weight (kg) and converted to tons/fed.
9. Sugar yield was calculated according to the following method of Devillers (1988):

Sugar yield (ton/fed) = (Root yield ton/fed × Extracted sugar %) ÷100

Statistical analysis:

The collected data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the strip plot design as published by Gomez and Gomez (1984) by means of "MSTAT-c" computer software package. Least significant difference at 5% level of probability was calculated to compare between treatment means as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Root diameter, fresh and top fresh weights.

Data in Table 3 show that root diameter, root and foliage fresh weight of sugar beet increased significantly by raising the applied compost levels up to 30 m^3/fed in both seasons. These results are in full accordance with that reported by Slawon, *et al.* (1998), who explained that applying compost as an organic matter supplies plants with many nutrients, which improve the physical and chemical properties, increases water holding capacity and increases cation exchange capacity of the sandy soil, and consequently improves plant growth. These findings are also in agreement with those reported by Safina and Abdel Fatah (2011), Hellal *et al*. (2013) and Soliman *et al*. (2014). Meanwhile, it was found that the differences in both root and foliage per plant were insignificant, although the gradual increase of these traits when compost levels were increased from zero to 10 and to 20 m^3/fed.

Data in Table 3 cleared that increasing boron micro-nutrient given to beet plants from zero up to 200 ppm led to positive and appreciable effects on root diameter, root and foliage fresh weight/plant during the two seasonal. These results may be due to role of boron element in cell elongation and the formation of new leaves as well as its active role in translation of assimilation product of the leaves and roots. Similar results were reported by Abo El-Hamd and Esmail (2008) and Enan (2011).

Table 3. Averages of root diameter (cm), root and foliage fresh weights/plant affected by compost and boron fertilization levels in 2017/2018 and 2018/2019 seasons

Characteristics	Root diameter (cm)		Root fresh weight/ plant (g)		Top fresh weight/ plant (g)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Compost fertilization level (m^3/fed)						
0	7.63	8.20	537.92	538.83	247.56	267.08
10	8.62	8.31	551.42	544.42	294.06	281.72
20	9.51	9.15	562.50	565.50	324.05	292.65
30	10.52	10.26	676.17	661.50	396.82	388.50
LSD at 0.05%	0.53	0.40	81.41	71.82	89.76	68.87
Boron fertilization level (ppm)						
0	8.12	7.89	493.25	486.25	261.67	236.85
100	8.52	8.39	563.42	539.67	289.60	290.72
150	9.21	9.54	598.92	591.25	332.08	317.38
200	10.42	10.10	672.42	693.08	379.14	385.00
LSD at 0.05%	0.47	0.60	30.07	44.24	52.79	48.98
A×B	**	**	NS	NS	NS	NS

The interaction between compost and boron levels had a significant effect on root diameter only in both seasons (Table 3).

Interaction effect.

There was insignificant variance in root diameter in case of spraying beets with 100 and/or 150 ppm boron, when zero and/or 10 m^3 of compost was added to the soil. However, the difference between these two levels of boron in their influence on root diameter reached the level of significance when compost level raised to 30 m^3/fed. These results were detected in both seasons (Table 4).

Table 4. Root diameter (cm) as affected by the interaction between compost and boron levels in 2017/2018 and 2018/2019 seasons

Compost fertilization level (m^3/fed)	2107/2018 season				2018/2019 season			
	Boron fertilization level (ppm)							
	0	100	150	200	0	100	150	200
0	7.22	7.12	7.56	8.59	7.57	7.90	8.64	8.68
10	7.69	8.25	8.62	9.94	7.00	7.98	8.73	8.93
20	8.22	9.14	8.84	10.81	8.10	8.22	9.79	10.50
30	9.36	9.57	10.81	12.35	8.28	9.47	10.98	12.29
LSD at 0.05%	0.65				0.58			

2. Sucrose %, potassium, sodium and alpha amino nitrogen contents/beet.

The results in Table 5 manifested a significant effect of the applied compost on sucrose%, potassium and sodium contents in roots. Fertilizing beet plants with 30 m^3/fed compost gave higher values of sucrose amounted to 2.89% and 3.06% in the 1st and 2nd season, respectively over that those fertilized with 20 m^3/fed. These increases in sucrose%, in the effect of compost treatments were seen due to the role of biofertilizers in improving growth and dry-matter accumulation, and consequently enhancement of sucrose content in roots. These results are agree with those stated by Soliman *et al*. (2014) and Abbas *et al*. (2018). At the same time, applying compost levels with 30 and/or 20 m^3/fed without significant difference between them, recorded a significant increase in values of potassium and alpha amino-N contents compared to the other treatments in both seasons. On the other hand, the differences between compost treatments failed to reach the level of significance in their effect on sodium content in roots.

In the same Table, it is evident that applying boron micro-nutrient at the level of 200 ppm gave an increase of 4.90% and 2.56% in sucrose%, more than that enriched with 150 ppm boron, respectively. These results showed the importance of the role of boron in the metabolism transfer process. However, the results revealed that sodium and alpha amino-N were insignificantly influenced by the applied levels of boron in both seasons. These results may point to the important role of boron in increases the rate of transport of sugars (which are produced by photosynthesis in mature plant leaves) to actively growing regions. These findings are in accordance with those mentioned by Allen and Pilbeam (2007), Enan *et.al* (2016) and Abbas *et al.* (2018).

The interaction between the applied compost and boron levels had insignificant effect on the previously mentioned traits in both seasons (Table 5).

Table 5. Averages of sucrose percentage, potassium, sodium and alpha amino-N contents (meq/100 g beet) as affected by compost and boron fertilization levels in 2017/2018 and 2018/2019 seasons

Treatments	Sucrose %		Potassium (meq/100 g beet)		Sodium (meq/100 g beet)		Alpha-amino N (meq/100 g beet)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Compost fertilization level (m^3/fed)								
0	16.87	17.20	3.49	3.36	1.45	1.47	1.09	1.05
10	17.30	17.35	3.57	3.50	1.40	1.42	1.14	1.10
20	17.98	17.60	4.42	4.35	1.16	1.22	1.17	1.14
30	18.50	18.14	4.67	4.63	1.10	1.20	1.20	1.24
LSD at 0.05%	0.44	0.27	0.29	0.37	NS	NS	0.07	0.11
Boron fertilization level (ppm)								
0	16.99	16.88	2.72	2.68	1.40	1.46	1.10	1.09
100	17.31	17.16	3.70	3.56	1.31	1.35	1.14	1.11
150	17.75	17.91	4.81	4.75	1.23	1.30	1.15	1.13
200	18.62	18.37	4.92	4.86	1.18	1.21	1.21	1.17
LSD at 0.05%	0.29	0.51	0.29	0.23	NS	NS	NS	NS
A×B	NS	NS	NS	NS	NS	NS	NS	NS

3. Extractable sugar, sugar lost to molasses percentages and quality index.

The results in Table 6 revealed that extractable sugar, sugar lost to molasses percentages were significantly affected by the applied compost levels. Supplying sugar beet with 30 m^3 compost/fed recorded a significant increase in values of extractable sugar% amounted to 3.16% in the 1st season and 2.84% in 2nd season, compared to those gained by fertilizing with 20 m^3 compost/fed. The lowest quantities of sugar lost to molasses were observed when beet plants fertilized with 10 m^3compost and those that untreated (control). It had been noted that quality% was insignificantly influenced by the applied compost levels in both seasons. These observations coincide with those found by Soliman *et al.* (2014) and Abbas *et al.* (2018).

Table 6. Averages of extractable sugar, sugar lost to molasses percentages and quality index as affected by compost and boron fertilization levels in 2017/2018 and 2018/2019 seasons

Treatments	Extractable sugar %		Sugar lost to molasses %		Quality index	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Compost fertilization level (m^3/fed)						
0	14.81	15.16	1.46	1.44	87.77	88.15
10	15.22	15.28	1.48	1.47	87.99	88.11
20	15.80	15.48	1.61	1.55	87.92	87.78
30	16.30	15.92	1.57	1.36	88.06	87.73
LSD at 0.05%	0.50	0.32	0.09	0.08	NS	NS
Boron fertilization level (ppm)						
0	15.03	14.93	1.46	1.35	88.51	88.44
100	15.22	15.10	1.48	1.47	87.93	87.97
150	15.52	15.68	1.57	1.63	87.41	87.56
200	16.37	16.13	1.61	1.64	87.87	87.81
LSD at 0.05%	0.32	0.50	0.09	0.04	0.51	0.34
A×B	NS	NS	NS	NS	NS	NS

4.Root, top and sugar yields/fed (ton).

In respect to boron effect, data in the same Table affirmed that raising the applied boron levels from zero up to 200 ppm led to a significant ascend increase in extractable sugar% and descending increase in quality index values in both seasons. Adding boron at the rate of 200 ppm gave 5.47% and 2.86% increase in extractable sugar% over that sprayed with 150 ppm boron, successively. The results are similar to those achieved by Armin and Asgharipour (2012) and Abbas et al. (2018). On the other hand, it was shown that the highest values of sugar lost to molasses% were produced from sprayed sugar beet plants by the high two levels of boron applied, as compared with the lower levels (untreated and 100 ppm) in the two growing seasons.

The interaction between compost and boron fertilization levels failed to reach the level of significance in their effect on the above–mentioned traits in both growing seasons.

Data in Table 7 revealed that root, top and sugar yields/fed of sugar beet were markedly affected by the applied compost levels in both seasons. Applying of 30 m^3 compost/fed resulted in a pronounced increase in root, top and sugar yields/fed. An increase in root yields/fed amounted to (2.08 and 2.18 tons/fed), compared to that gained by unfertilized plants (control) in 1st season and second one, successively. However, this increase was (1.81 and 1.54 tons/fed) in sugar beet fertilized using 10 m^3 compost in both seasons respectively. These findings may point to the synergistic effect of organic matter and the presence of beneficial microorganisms in soil, furthermore the essential micronutrients and other bioactive compounds in compost manure (Table 1). This finding agreed with obtained by Mahmoud *et al.* (2014), Abo stet *et al.* (2015) and Abas *et al.* (2018).

As for as the effect of boron levels, it must be noted that a significant influence of the applied boron levels on top and sugar yields/fed in the two growing seasons. The application of 200 ppm boron/fed resulted in the highest value of top and sugar yields/fed compared to the other two boron treatments. Meantime, application of boron levels insignificantly increased the values of root yield/fed in both seasons. The positive influence of the applied levels of boron on top and sugar yields/fed may be due to the shortage of boron in site of experimentation (Table 2). The beneficial effects of boron on growth and yield of sugar beet was emphasized by previous studies carried by Armin and Asgharipour (2012) and Enan *et. al.* (2016).

Table 7. Averages of root, top and sugar yields (ton/fed) of sugar beet as affected by compost and boron fertilization levels in 2017/2018 and 2018/2019 seasons

Treatments	Root yield/fed (ton)		Top yield/fed (ton)		Sugar yield/fed (ton)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Compost fertilization level (m^3/fed)						
0	20.95	20.65	7.10	7.15	3.10	3.12
10	21.22	21.29	7.93	7.97	3.42	3.26
20	22.32	22.08	8.35	8.29	3.53	3.42
30	23.03	22.83	8.85	8.87	3.76	3.63
LSD at 0.05%	1.48	1.18	0.30	0.44	0.22	0.19
Boron fertilization level (ppm)						
0	21.06	20.95	7.15	7.35	3.17	3.13
100	21.73	21.50	7.77	7.71	3.31	3.25
150	21.97	21.78	8.38	8.36	3.41	3.42
200	22.76	22.54	8.92	8.46	3.73	3.64
LSD at 0.05%	NS	NS	0.45	0.19	0.29	0.20
A×B	**	**	**	**	NS	NS

The interaction between compost and boron fertilization levels had a significant effect on root and top yields/fed in both seasons.

Interactions effect.

The results in Table 8 show that insignificant variance in root yield/fed in case of fertilizing beet plants with 150 and/or 200 ppm boron/fed, when zero and/or 30 m^3 of compost was added to the soil. However the variance in this trait between those two levels of boron was significant when compost level raised to 10 and 20 m^3/fed in the first season. In the 2nd one, there was insignificant difference in this trait between these two levels of boron, in case of applying plants with zero, 20 and/or 30 m^3/fed, while the difference in this trait reached the level of significance as affected by the two levels of boron when the level of the applied compost raised to 10 m^3/fed only.

Table 8. Root yield/fed as affected by the interaction between compost and boron levels in 2017/2018 and 2018/2019 seasons

Compost fertilization level (m^3/fed)	2107/2018				2018/2019			
	Boron fertilization level (ppm)							
	0	100	150	200	0	100	150	200
0	20.52	20.69	20.90	21.70	20.36	20.04	20.28	21.57
10	19.35	21.25	21.56	22.73	19.35	21.53	21.58	22.70
20	21.75	22.07	22.18	23.27	21.29	21.72	22.41	22.89
30	22.63	22.91	23.23	23.35	22.80	22.71	22.84	22.98
LSD at 0.05%	0.94				1.21			

The interaction between compost and boron levels in Table 9 had a significant effect on top yield/fed in both seasons. It was found that insignificant variance in top yield in case of spraying beets with 200 and/or 150 ppm boron, when zero, 10 and/or 30 m^3 of compost was added to the soil. However, the difference between these two levels of boron in their influence on top yield/fed reached the level of significance when compost level raised to 20 m^3/fed in the two seasonal.

Table 9. Top yield/fed as affected by the interaction between compost and boron levels in 2017/2018 and 2018/2019 seasons

Compost fertilization level (m^3/fed)	2107/2018 season				2018/2019 season			
	Boron fertilization level (ppm)							
	0	100	150	200	0	100	150	200
0	6.60	7.07	7.43	7.44	6.89	7.15	7.54	7.82
10	6.75	7.43	8.47	8.43	6.99	7.43	8.07	8.36
20	7.32	8.46	8.11	9.64	7.11	8.64	8.12	9.55
30	7.74	8.75	9.38	9.81	7.61	8.66	9.30	9.75
LSD at 0.05%	0.46				0.58			

4. Correlation coefficient analysis of some studied traits.

As respects the correlation analysis of some studied traits, the data in Table 10 obtained that root yield had positive and significant correlation with root diameter (r = 0.972** and 0.937**), root fresh weight/plant (r = 0.903** and 0.875**) and sucrose% (r = 0.974** and 0.883**) at 1% probability level in the 1st and 2nd season, respectively. There were high positive correlation between top yield/fed and both of root diameter (r = 0.971** and 0.919**), root fresh weight/plant (r = 0.908** and 0.821**), sucrose% (r = 0.969** and 0.881**) and root yield (r = 0.939** and 0.952**) at 1% probability level in the two seasonal. Furthermore, positive correlation was observed between sugar yield/fed and each of root diameter (0.983** and 0.976**), root weight/plant (r = 0.895** and 0.943**), sucrose% (r = 0.972** and 0.959**), root yield/fed (r = 0.938** and 0.979**) and top yield/fed (r = 0.969** and 0.946**) at 1% probability level in 1st and 2nd season, successively. On the contrary, a negative correlation was detected between quality index and each of the above-mentioned characteristics. These results were in accordance with those reported by Assey, *et al.* (2005) and Nasr, *et al.* (2011).

Table 10. Correlation coefficient analysis for yields of root, top and sugar /fed and some studied traits under different levels of compost and boron in the two seasons

Characteristics	Root yield/fed (ton)		Top yield/fed (ton)		Sugar yield /fed (ton)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Root diameter (cm)	0.972**	0.937**	0.971**	0.919**	0.983**	0.976**
Root fresh weight/plant (g)	0.903**	0.875**	0.908**	0.821**	0.895**	0.943**
Sucrose %	0.974**	0.883**	0.969**	0.881**	0.972**	0.959**
Quality index	-0.191	-0.744**	-0.335	-0.816	-0.125	-0.777*
Root yield/fed (ton)	1.000	1.000	0.939**	0.952**	0.938**	0.979**
Top yield/fed (ton)	0.939	0.952**	1.000	1.000	0.969**	0.946**

***Significant at the 5% probability level.**
**** Significant at the 1% probability level.**

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تأثير مستويات التسميد بالكمبوست والبورون علي حاصل وجودة بنجر السكر في تربة رمليه

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أقيمت تجربتان حقليتان في منطقة النوبارية - محافظة البحيرة (دائرة عرض 30.86 شمالاً وخط طول 31.16 شرقاً) في موسمي 2108/2017 و 2019/2018 لدراسة تأثير أربعة معدلات من سماد الكمبوست النباتي (بدون ، 20م^3 و 30م^3 للفدان – تم إضافتهم أثناء تجهيز التربة للزراعة) ، وأربعة تركيزات من البـورون (بدون ، 100 ، 150 و 200 جزء في المليون - تم إضافتهم رشاً علي دفعتين بعد تكوين 4-6 ، وبعد تكوين 10 أوراق حقيقية) علي صفات النمو وحاصل وجودة بنجر السكر. تم ترتيب المعاملات في تصميم الشرائح المُتعامِدة في أربعة مكررات في كلا الموسمين. النتائج المتحصل عليها ما يلي: أدي تسميد نباتات بنجر السكر بمعدل 30م^3 بالكمبوست إلي زيادة معنوية في قطر الجذر والوزن الطازج للجذر والأوراق ، وحاصل السكر/فدان والنسبة المئوية للسكروز والنسبة المئوية للسكر المُستخلَص ودليل الجودة مقارنةً بالمعاملات الأخري في الموسمين. أدي الرش الورقي بالبورون بتركيز 200 جزء في المليون إلي زيادة معنوية في القطر والوزن الطازج للجذر والاوراق/نبات والنسبة المئوية لكلٍ من (السكروز والسكر المُستخلَص) ، و دليل الجودة ، فضلاً عن حاصلي الأوراق والسكر/ فدان ، في حين لم يتأثر محتوي الجذور من الصوديوم والألفا أمينو نيتروجين معنوياً بمستويات البورون المُضافة في كلا الموسمين. أدي التفاعل بين مستويات الكمبوست والبورون إلي زيادة معنوية في قطر الجذر وحاصلي الأوراق والجذور/فدان في كلا الموسمين. فيما يتعلق بمعامل الارتباط ، وُجِدَ أن حاصلي الجذور، والأوراق والسكر مُرتبطان إرتباطاً موجباً ومعنوياً بقطر الجذر والوزن الطازج للجذور ونسبة السكروز٪ ، بينما كان إرتباطهما سلبياً بدليل الجودة. توصي الدراسة بإضافة الكمبوست للتربة الرملية بمنطقة النوبارية بمعدل 30م^3 ورش نباتات بنجر السكر بالبورون بتركيز 200 جزء في المليون للحصول علي أعلي حاصل جذور وسكر/فدان و أفضل صفات جودة.