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Effect of Mole Drain Spacing, Some Soil Amendments and Boron Fertilization on Improving some Soil Properties and Sugar beet Productivity in Salt-Affected Soils

Sahar H. Rashed*

Soils Improvement and Conservation Dept., Soils, Water and Environ. Res. Instit. (SWERI), Agric. Res. Center (ARC), Giza, Egypt

ABSTRACT

Soil salinity and poor drainage are affecting soil properties and hence limiting crop productivity. Poor productivity and increasing population make a great food gap. So increasing soil productivity is important to address food gap. Two field trials were carried out at El-Reyadh district, Kafr El-Sheikh, Egypt during two successive seasons (2018-2019). This study aims to investigate the impact of mole drain spacing and some soil amendments on the physical and chemical soil properties and its fertility as well as applying boron fertilization on sugarbeet productivity. Split-split plot design was implemented. The main plots were occupied by mole drain spacing: at 3 distances i.e.: 3, 6 and 9 meters. The subplots were assigned to amendments with 3 combinations i.e.: (G,C and G+C). The sub-sub plots were assigned to foliar with boric acid with 3 levels i.e.: B_1, (without boron), B_2 (200ppm boron) and B_3 (400ppm boron) application. The results showed that the soil values (ECe) , (ESP), (BD), total porosity, soil basic infiltration rate and its fertility parameters (available NPK) were significantly influenced by the treatments and recorded highest values due to the interaction among studied treatments after sugar beet harvesting. The results showed that (G+C) treatment with 3m mole spacing alleviated the hazardous effects of salinity stress on sugar beet yield. The root yield of sugar beet and sugar yield was significantly increased and recorded the highest values with the interaction S_1*(G+C)*B_3.Therefore, Integrated soil management through soil conservation and some amendments and Boron could be considered a proper approach to sustain soil properties and improve its productivity and increase sugar beet productivity under arid and semi-arid conditions.

Keywords: Mole drain spacing, amendments, Boron foliar application, ECe, ESP, sugar beet

INTRODUCTION

Salt-affected soils occupy 10% of total dry lands, 20% of the irrigated lands in the world (Elbasiouny *et al.* 2017), 30% from Delta lands (2.0Mha) (Mohamed, 2016). In the clayey soil, the high content of clay particles probably affect soil properties directly or indirectly (Sarkar *et al.*, 2018), causing soil compaction (Churchman, 2018) and probably rising many potential problems, e.g. low infiltration rates (Alaoui *et al.*, 2018) beside of poor drainage and aeration conditions. Year's shallow tillage creates hardpan at about 15 cm depth. This hardpan influences bulk density and porosity of soil which directly or indirectly affects the growth and yield of crops. Hardpan due to subsoil compaction of agricultural soils is a global concern due to adverse effects on crop yield and environment (Hokansson and Reeder, 1994).

The sustainable uses of deep tillage breaks up high density soil layer, improves the water infiltration and movement in soil, enhance root growth, develops and increases crop production potentially (Bennie and Botha, 1986 and Amer and Hashem, 2018). Deep tillage of the soil increased corn yield up to 90% (Versa *et al.* 1997).The abiotic stress such as salinity is the main threat to the plant production all over the world, whereas it is one of the most serious factors limiting the productivity of agricultural crops (Munns and Tester, 2008) through their osmotic pressures affected by restricting the uptake of water and nutrients (Tester and Davenport 2003), the root function, growth rates and yields (Munns, 2002). The handling of salt-affected soils should include mobilization of Na^+ and then leaching these ions from soil profile to improve the soil properties in particular hydraulic conductivity (Day *et al.* 2019).

Overcoming salt stress in saline soil can be achieved by leaching or adding gypsum (Egamberdieva, *et al.*, 2019), to improve soil hydro-physical, chemical and biological properties (Morsy *et al.* 1982) such as bulk density (Massoud, 2006) and it remediates saline soils, being low cost, effective and also simple (Sharma and Minhas, (2005); and Makoi and Verplancke, (2010)).

The application of compost has a positive effect on soil salinity due to its improving soil physical properties; hence it leads to removing Na^+ from root zone (Day *et al.* 2019), soil basic infiltration rate (Aiad. 2019), total porosity (Amer, *et al.* 2019), accelerates the leaching of Na+ decreases the ESP and electrical conductivity (EC), and increases water infiltration, water-holding capacity, and aggregate stability (Tejada *et al.*, 2006 and Mahdy, 2011) and increases soil available nitrogen (Yang, *et al.* 2016) , helps to achieve the long-term stable yields and maintain optimal soil properties Ladislav *et al.* (2018).Compost contains significant amounts of valuable plant nutrients (Madeleine, *et al.* 2005).Integrated management is a judicious use of organic and inorganic sources of soil amendments (Wailare and Kesarwani, 2017). However, organic substances can be used as soil amendments, possibly due to that the nutrients are slowly released from organic compost and not directly absorb by plants (Getinet, 2016). The humical substances stabilize aggregates for a long term in which they are mainly involved in the micro-aggregate formation (Chaney and Swift, 1986). Sugar beet root yield was increased by 7% due to

* **Corresponding author.**
E-mail address: Saharhassanrashed86@Gmail.com
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improvement of the soil fertility by application of compost (Wallace and Carter, 2007). Fresh weight of roots and sugar yield/fed was increased due to application of Boron (200ppm), (Abbas, *et al.* 2018). 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 weight of sugar. There is no much researches carried out on the effects of mole drain spacing , soil amendments and spray with boron on improving soil properties and productivity of sugar beet in salt affected soil. The aim of this scientific work is to evaluate the effect of mole drain spacing, some soil amendments and foliar spray with boron on salt affected soil properties and also its productivity of sugar beet.

MATERIALS AND METHODS

Two field trials were conducted in salt affected soil at El-Reyadh district, Kafr El-Sheikh Governorate, North Nile Delta, Egypt, during winter 2018 and 2019 seasons to study the impact of mole drain spacing, some soil amendments and boron foliar application on soil properties and yield of sugar beet. The salinity of irrigation water was 0.81 dSm^{-1} and drainage water salinity was 3.45 dSm^{-1}. The area is under subsurface drainage system installed at a depth of approximately 2.0 m with 25 m lateral spacing. The water table in this area is 85 cm from the soil surface. The recommended agricultural practices were followed during both seasons. Chemical and physical characteristics of the experimental site during the two growing seasons and chemical characteristics of different compost plant residues are presented in Table 1. Climatic elements were collected from Sakha Agro Meteorological Station and recorded during the two seasons of sugar beet growth and presented in Table 2. The experimental plot was 200 m^{2}and the treatments were arranged in split-split plot design with three replicates as follows: the main plot was occupied by mole spacing at distances 3, 6 and 9 meters. The subplots were assigned to amendments with three combinations (gypsum requirements, compost (4ton/fed.) and (gypsum requirements + compost (4ton/fed.))). The sub-sub plots were assigned to foliar spray with boric acid with 3 levels i.e. B_1, (without boron), B_2 (200ppm boron) and B_3 (400ppm boron)

Table 1. Some physical properties of the experimental soil.

Soil depth (cm)	Soil physical properties								
	Soil moisture characteristics					Particle size distribution (g/kg)			
	F.C. (%)	W.P. (%)	A.W. (%)	BD (kg m^{-3})	Total porosity (%)	Sand	Silt	Clay	Soil texture
0-20	43.5	21.81	21.69	1.35	49.06	181.2	242.2	571.6	clay
20-40	40.36	20.75	19.61	1.45	45.03	187.3	249.4	563.3	clay
40-60	37.21	19.20	18.01	1.58	40.40	192.5	239.7	567.8	clay
mean	40.36	20.59	19.77	1.46	44.83	187.0	243.8	567.6	clay

Some chemical properties of the experimental soil.

Soil depth	pH (1:2.5)	EC	ESP	CEC	OM	$CaCO_3$	N	P	K
(cm)	-	(dSm^{-1})	(%)	(cmole kg^{-1})	(g kg^{-1})	(gkg^{-1})	(mgkg^{-1})		
0-20	8.30	6.53	16.23	39.75	16.5	25.3	36.75	8.43	275
20-40	8.50	7.19	17.36	38.43	14.8	24.1	28.96	8.86	257
40-60	8.55	8.81	20.18	37.85	11.8	22.5	24.38	7.93	210
mean	-	7.51	17.92	38.68	14.4	24.0	30.03	8.41	247.33

Some chemical properties of compost

EC	PH	C	OM	C/N	N	P	K	Fe	Zn	Mn	Moisture
dSm^{-1}	(1:2.5)	(gkg^{-1})		ratio	(mgkg^{-1})						%
3.12	7.71	315.0	541.8	18.0	17.5	9.2	12.5	165	71	120	27.8

F.C.: Field Capacity; W.P.: Wilting Point; A.W.: Available Water; BD: Bulk Density; PH: was determined in soil water suspension (1:2.5);EC: was determined in saturated soil paste extract;ESP: Exchangeable Sodium Percent; CEC: Cation Exchange Capacity; OM: Organic Matter.

Before the winter season 2018, mole drain was conducted with 3, 6, 9 m spacing and 60 cm depth perpendicular to the open drain. Open drainage was used to collect the drainage water brought by mole laterals. All plots received 100 kg fed^{-1}mono-super phosphate (15.5% P_2O_5) and 50 kg Fed.$^{-1}$potassium sulfate, (48% K_2O) during soil tillage (1 feddan = 0.42 ha). The recommended N for sugar beet crop (80 kg N fed^{-1}) was added to the plots that didn't receive compost. Before the application of treatments, the area was ploughed with chisel plough and laser land dead leveled. Leaching requirements was calculated according EC_w of irrigation and the permissible salinity of drainage water and applied (about 20 %). Gypsum and compost (4 ton fed^{-1}) were applied in the first season only then soil ploughed followed by irrigation. Gypsum requirements were determined according to the methods described by U.S., salinity laboratory staff (FAO and IIASA, 2000) and Richards (1954) , so 3.94 Mg fed^{-1}, (Mg = metric tons; 1 fed = 0.42 ha) are sufficient to reduce the initial ESP from 17.92 to 12% for 30-cm soil matrix as follows:

$$GR= (ESP_i – ESPF)/100 \times CEC \times 1.72$$

Where GR: gypsum requirement (Mgfed^{-1}), ESP_i: initial soil ESP, ESPf: the required soil ESP and CEC: cation exchange capacity (cmolekg^{-1}).

The soil in the experimental site is clayey salt affected soil. Soil samples were taken from each treatment before experiment and after harvesting. Electrical conductivity, EC (dSm^{-1}), soluble cations and anions were determined in saturated soil paste extract, and cation exchange capacity was determined according to Page (1982). Particle size distribution of soil was measured using pipette method according to Gee and Bauder (1986). Soil bulk density and total porosity were determined for each treatment according to Klute (1986). Field capacity and permanent wilting point were calculated from soil moisture tension curve (Black, 1965).

Plant sampling and analysis:

At harvest, plants were taken from each plot to determine root and top yield (Mg fed.$^{-1}$). 10 kg of roots were taken randomly from each plot to determine root quality by sugar beet Laboratory at EL-Hamool Sugar Factory. Sugar yield (Mg fed^{-1}) was calculated by multiplying root yield by sucrose percentage. The data were analyzed statistically by the statistical analysis according to Gomez and Gomez (1984) Duncan test according to Duncan (1955) was used for paired mean comparisons.

Table 2. Climatological data of Sakha Agricultural Research Station during the two sugar beet growing seasons (2018 and 2019)

Month	T (C°)	R.H. (%)	W.S. (km day^{-1})	P. E. (cm day^{-1})
		1st season		
August	29.6	65.7	87.1	0.642
Sept.	28.2	65.7	68.7	0.498
Oct.	25.1	66.1	57.9	0.324
Nov.	21.2	70.6	24.2	0.160
Dec.	16.7	67.8	33.1	0.108
Jan.	15.6	72.6	28.6	0.114
		2nd season		
August	31.6	68.15	76.9	0.683
Sept.	30.2	57.20	68.4	0.590
Oct.	25.2	66.2	58.0	0.325
Nov.	21.5	70.8	24.3	0.161
Dec.	17.1	67.9	33.3	0.109
Jan.	15.8	72.5	28.9	0.115

T. (C°), average of maximum and minimum temperature; R.H.: relative humidity; W.S.: wind speed (at 2 m height); P.E.: Pan Evaporation. Source: Meteorological station at Sakha Agric. Res. Station.

RESULTS AND DISCUSSION

Soil chemical properties

The effects of mole spacing, soil amendments and boric acid foliar application and their interactions on soil chemical properties are given inTable 3 and Fig. 1.The obtained data clearly revealed that EC, dSm^{-1} and exchangeable sodium percentage (ESP) significantly decreased by mole drain spacing treatment and recorded the lowest values (6.16 dSm^{-1}) with S_1. ECe and ESP were affected by different treatments according to the following descending order: $S_1 > S_2 > S_3$.With regard to effect of soil amendments, EC, dSm^{-1}and ESP were significantly decreased and recorded the lowest values with application of compost +gypsum, and it could be put in this order: (compost +gypsum) > gypsum > compost . These results may be due to the role of gypsum in providing Ca^{+2} to replace the exchangeable Na^{+} on the exchange positions as observed by (Khuder *et al.*, 2017 and Amer and Hashem, 2018)

On the other hand, EC, dSm^{-1} and ESP were insignificantly affected by boric acid foliar application. The interaction between S*A*F recorded the lowest values of EC, dSm^{-1} and ESP, while they weren't affected by the interaction between A*F and S*F. The highest mean relative reduction of EC, dSm^{-1} and ESP for both seasons (42.7 and 27.6%, respectively) were achieved with S*A (Fig.1).Table 3 revealed that the ECe and ESP in root zone (0-60 cm depth) recorded the lowest values and highest relative reduction (38.5% and 25.1%)with gypsum and mole spacing (S_1) .Also the data showed that application of compost had a positive effect on decreasing ECe and ESP relative reduction (32.4 and 21.9%) by application of gypsum under mole spacing (3 m) as compared with before treatment (Fig.1).The reduction in ECe and ESP due to application of compost may be related to release of Ca^{2+} from soil $CaCO_3$ or leaching of Na+ from soil (Sarwar *et al.,* 2008). It may due to gum compounds, polysaccharides and organic acids produced from compost decomposition improving soil structure and help in leaching of soluble salts, where the ECe and ESP were recorded the lowest values due to application of (G+C) with mole spacing (3 m). These results were supported with those obtained by Amer and Hashem (2018). Also, data showed that the ECe and ESP recorded the lowest values for over mean of all both the two seasons (4.3dSm^{-1} and 12.98%) with reduction of 42.7 % and 27.6 %, by application of (G+C). However, ECe was not affected by foliar application of boric acid. These results may be due to that gypsum plays a significant role in the providing with Ca^{2+} to replace the exchangeable Na^{+} on the exchange positions and leaching it out into the ground water (Sharma and Minhas, 2005). And also to the decomposition byproducts and increasing exchangeable calcium which enhance aggregation process and consequently increase apparent soil volume and decrease soil bulk density which increased the efficiency of leaching processes (Abd El-Hamid *et al,* 2011)

Table 3. Mean values of EC, dSm^{-1} and exchangeable sodium percentage (ESP) as affected by treatments after harvesting of sugar beet crop.

Treatments	1st season		2nd season		Mean	
	EC, dSm^{-1}	ESP	EC, dSm^{-1}	ESP	EC, dSm^{-1}	ESP
			Mole spacing (S)			
S_1	5.16c	14.13c	4.16c	12.79c	4.66c	13.46c
S_2	5.51b	14.64b	4.48b	13.24b	5.00b	13.94b
S_3	6.16a	15.46a	5.10a	14.06a	5.63a	14.76a
F_{test}	**	**	**	**	**	**
			Amendments (A)			
G	5.48b	14.66b	4.56b	13.34b	5.02b	14.00b
C	6.13a	15.35a	4.87a	13.76a	5.50a	14.55a
G+C	5.23c	14.22c	4.32c	13.00c	4.77c	13.61c
F_{test}	**	**	**	**	**	**
			Boric acid foliar (F)			
B_1	5.6	14.73	4.57	13.36	5.1	14.04
B_2	5.61	14.74	4.58	13.37	5.1	14.05
B_3	5.61	14.74	4.58	13.37	5.1	14.05
F_{test}	ns	ns	ns	ns	ns	ns
			Interaction			
S*A	**	**	**	**	**	**
A*F	ns	ns	ns	ns	ns	ns
S*F	ns	ns	ns	ns	ns	ns
S*A*F	**	**	**	**	**	**

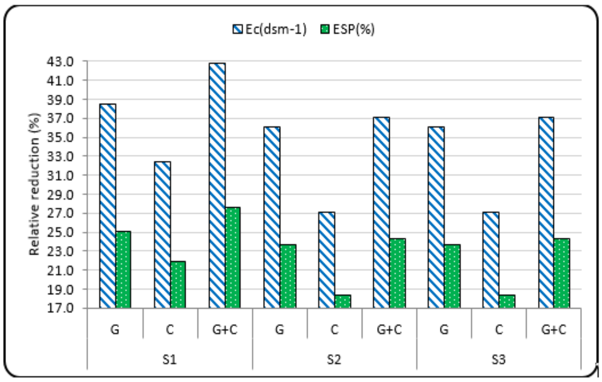

Figure 1. Relative reduction (%) of EC, dSm^{-1} and exchangeable sodium percentage (ESP) as affected by treatments after harvesting of sugar beet crop (over mean both of two seasons)

Soil physical properties

Table 4 showed that the effect of mole spacing, soil amendments and boron foliar application and their interactions on soil physical properties. The obtained data clearly revealed that bulk density (Mgm^{3}) was significantly decreased by decreasing the distance of mole spacing treatment (S_1) and both of soil porosity and basic infiltration rate, IR (cmh^{-1}) were increased under the same treatment. bulk density, soil porosity. infiltration rate IR (cmh^{-1}) were affected by mole treatment according the following descending order: $S_1 > S_2 > S_3$.bulk density, soil porosity and basic infiltration rate, IR were significantly affected and recorded most values with application of (G+C), and it could be put in the order (G+C) > C > G. The previous soil physical properties were insignificantly affected by boron foliar application or A*F and S*F. The more significant effects were obtained due to the interaction between S*A*F

The attached improvement in the soil physical properties might be due to that gypsum alone or combined with other used amendments improved the hydro-physical properties (Morsy *et al*. 1982) such as soil bulk density which decreased with gypsum application (Massoud, 2006) through involved Ca^{2+} which improved soil aggregation and permeability (Ahmed, 2009). Also, humical substances stabilize soil aggregates for a long term in which they are mainly involved in the micro-aggregate formation (Chaney and Swift, 1986), or the application of compost improved soil physical properties such as total porosity (Amer *et al*,2019).Finally, the application of soil gypsum and compost on improving soil properties by enhancing soil quality parameters such as bulk density, soil porosity, aggregation, structure and water holding capacity,(Amer and Hashem, 2018,Bayoumy *et al.*, 2019 and Aiad (2019).

Table 4. Soil bulk density, soil porosity and soil basic infiltration rate (IR) as affected by treatments after harvesting of sugar beet crop.

Treatments	1st season			2nd season		
	Bulk density (Mgm^{-1})	Soil Porosity, (%)	BIR ($cnhr^{-1}$)	Bulk density (Mgm^{-1})	Soil Porosity, (%)	BIR ($cnhr^{-1}$)
			Mole spacing (S)			
S_1	1.29c	51.32a	1.19a	1.25c	52.29a	1.25a
S_2	1.35b	49.18b	1.10b	1.31b	50.69b	1.19b
S_3	1.38a	48.05c	0.85c	1.32a	50.06c	1.06c
F_{test}	*	*	*	*	*	*
			Amendments (A)			
G	1.37a	48.30c	0.88c	1.33a	49.94c	1.05c
C	1.34b	49.43b	1.07b	1.29b	51.20b	1.19b
G+C	1.30c	50.82a	1.19a	1.26c	51.91a	1.26a
F_{test}	**	**	*	*	*	*
			Boric acid foliar (F)			
B_1	1.34	49.52	1.05	1.29	51.02	1.17
B_2	1.34	49.52	1.05	1.29	51.02	1.17
B_3	1.34	49.52	1.05	1.29	51.02	1.17
F_{test}	ns	ns	ns	ns	ns	ns
			Interaction			
S*A	*	*	*	*	*	*
A*F	ns	ns	ns	ns	ns	ns
S*F	ns	ns	ns	ns	ns	ns
S*A*F	*	*	*	*	*	*

Availability of some soil nutrients

Data in Figures (2-4) pointed out that soil available content of nitrogen, phosphorus and potassium were increased with decreasing the distance of mole spacing down up 3m (S_1). Application of soil amendments had a positive effect on increasing the availability of N, P and K in soil where it recorded the highest values with application of G+C for both of two growing seasons

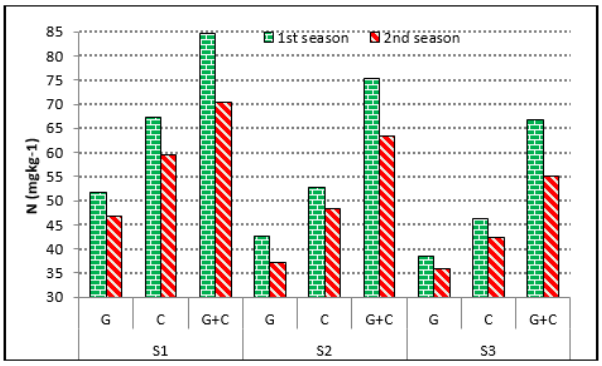

Figure 2. Soil available Nitrogen $mgkg^{-1}$

Finally, application of G+C with mole spacing at 3 m has the highest effect on increasing the availability of nitrogen, phosphor and potassium. These results may be due to the decomposition byproducts and increasing availability of Nitrogen, Phosphorus, Potassium and some other nutrients. (Amer *et al*, 2019)

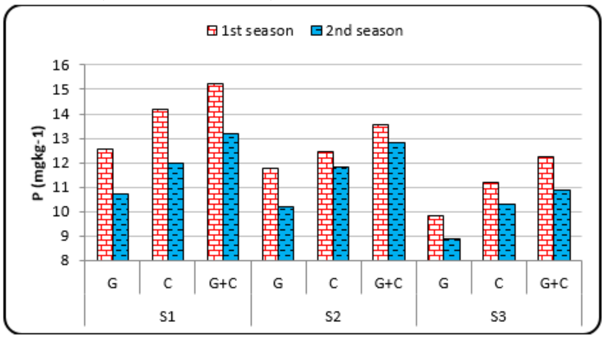

Figure 3. Soil available Phosphorus, $mgkg^{-1}$

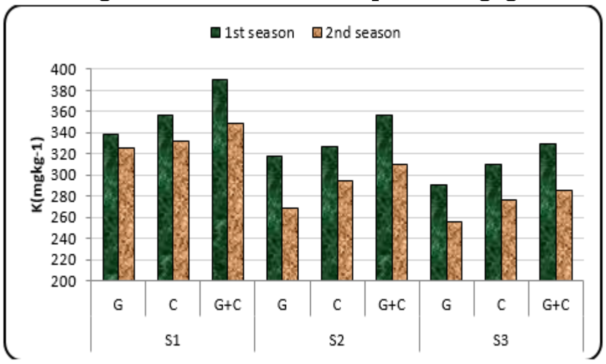

Figure 4. Soil available Potassium,$mgkg^{-1}$

Yield of sugar beet

Data in Table (5) showed that root and top yields of sugar beet were significantly increased due to mole spacing treatment and recorded the highest values with the lowest distance 3 m (S_1), where the previous characters were positively responded as S_1> S_2>S_3 during both of two seasons. Application of soil amendments had significant effect on increasing root and top yield of sugar beet and recorded the highest values (20.43, 21.18) and (11.18,12.36) $tonfed^{-1}$ with application of (G+C). The results may be due to that gypsum alleviated the hazardous effects of salinity stress on yield (Wallace and Carter, 2007), Amer and Hashem, 2018 and HeshamAboelsoud *et al.* , 2020) and supported by that root of sugar beet yield was increased by 7% due to improvement of the soil fertility with application of compost.

Also the same data revealed that root and top yields of sugar beet were significantly increased by foliar application of boric acid and recorded the highest values with B_2 treatment as compared with other treatments. Thesis results superseded by Armin and Asgharipour (2011)

Root and top yields were significantly increased due to interaction of the treatments: S*A, A*F, S*F and S*A*F during both of the two growing seasons

Sugar percentage and sugar yield ($tonFed.^{-1}$) were significantly affected by mole treatment and recorded the highest values (18.89, 19.38) % and (3.47, 3.81) ton $/fed.^{-1}$ with (S_1), during both of the two growing seasons. With regarding to effect of application of soil amendments on sugar percentage and sugar yield application of (G+C) is the best treatment on increasing the previous studied characters .

Results in Table (5) showed that application of boric acid (B_2) is highly significantly affected increasing sugar percentage and sugar yield. Also, Sugar percentage and sugar yield were significantly increased due to the interaction effect between: S*A, A*F, S*F and S*A*F during both of the two growing seasons

Finally Root, top yields, sugar percentage and sugar yield were significantly increased due to the interaction effect between all studied treatments and recorded the highest values with S*A*F during both of the two growing seasons

Table 5. Yield and their component of sugar beet crop as affected by studied treatments after harvesting of sugar beet plants.

Treat.	Root yield (tonFed.$^{-1}$)		Top yield (tonFed.$^{-1}$)		Sugar percentage (%)		Sugar yield (tonFed.$^{-1}$)	
	1st season	2ndseason	1stseason	2ndseason	1st season	2nd season	1st season	2ndseason
				Mole spacing (S)				
S_1	18.38a	19.68a	10.28a	11.15a	18.89a	19.38a	3.47a	3.81a
S_2	16.97b	17.36b	9.31b	10.38b	17.92b	18.33b	3.04b	3.18b
S_3	15.36c	16.25c	8.12c	9.45c	17.12c	17.56c	2.63c	2.85c
F_{test}	**	**	**	**	**	**	**	**
				Amendments (A)				
Gypsum(G)	16.23c	17.96c	8.96c	9.83c	18.15c	18.788c	2.95c	3.37c
Compost(C)	18.75b	19.58b	9.12b	10.94b	18.95b	19.40b	3.55b	3.79b
G+C	20.43a	21.18a	11.18a	12.36a	19.63a	20.15a	4.01a	4.28a
F_{test}	**		**		**	**	**	**
				Boric acid foliar (F)				
B_1	16.89c	17.75	8.58c	9.11c	17.35c	17.85c	2.93	3.17c
B_2	17.78b	18.54	9.83b	10.35b	19.38b	20.28b	3.45	3.76b
B_3	19.34a	20.62	10.75a	11.18a	20.85a	21.10a	4.03	4.35a
F_{test}	**	**	**	**	**	**	**	**
				Interaction				
S*A	**	**	**	**	**	**	**	**
A*F	*	*	*	*	*	*	*	*
S*F	*	*	*	*	*	*	*	*
S*A*F	**	**	**	**	**	**	**	**

CONCLUSION

This study was done to evaluate the effect of mole spacing, gypsum, compost as amendments and foliar application of boric acid on some soil properties and productivity of sugar beet grown in salt affected soil. It could be concluded that the combination of mole spacing (3m), GR with compost and foliar boric acid application with B_3 was more effective treatment on plant growth and soil properties and alleviated the harmful effects of salinity stress on crop yield and quality of sugar beet.

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تأثير أبعاد أنفاق المول وبعض محسنات التربة، والبورون على تحسين بعض خواص التربة وانتاجية بنجر السكر في الاراضى المتأثرة بالأملاح

سحر حسن راشد*

قسم بحوث تحسين وصيانة الأراضى، معهد بحوث الأراضى والمياه والبيئة، مركز البحوث الزراعية

تعد الملوحة وسوء الصرف من أهم العوامل التي تحد من إنتاجية المحاصيل ، ويتسبب انخفاض انتاجية الأراضي مع الزيادة المضطردة في أعداد السكان في وجود فجوة غذائية ، لذا فإن زيادة إنتاجية الأراضى المتأثرة بالأملاح أمر مهم لسد الفجوة الغذائية. أجريت تجربتان حقليتان في منطقة الرياض بمحافظة كفر الشيخ في مصر خلال موسمين زراعيين متتاليين. كان الهدف من هذه الدراسة هو دراسة أثر أبعاد المول وبعض محسنات التربة مع رش عنصر البورون على الخصائص الفيزيائية والكيميائية للتربة وخصوبتها وكذلك إنتاجية بنجر السكر. تم تصميم التجربة فى قطع منشقة مرتين ، حيث كانت القطع الرئيسية معاملات المول: على ابعاد 3 ، 6 ، 9 متر. وكان القطع الشقية الاولى :إضافة الاحتياجات الجبسية، والسمادالعضوى (5 طن / فدان)،[الاحتياجات الجبسية + السمادالعضوى (5 طن / فدان)]. وكانت القطعة الشقية الثانية :الرش الورقي بحمض البوريك:ب1: بدون رش بالبورون، ب2:200 جزء في المليون، ب3 :400 جزء في المليون بورون أوضحت النتائج أن قيم التوصيل الكهربائى للتربة (ECe) ، ونسبة الصوديوم المتبادل (ESP) ، وكثافة التربة (BD) ، والمسامية الكلية ، ومعدل الرشح الأساسي للتربة ،خصوبة ومحتوى التربة من العناصر قد تأثرت بمحسنات التربة وسجلت أعلى القيم بسبب التفاعل بين المعاملات المدروسة . أوضحت النتائج أن الجبس والتسميد بالبورون مع المسافة بين المول (3 م) خففا من التأثيرات الخطرة لإجهاد الملوحة على محصول بنجر السكر. تمت زيادة محصول جذور بنجر السكر ووزن السكر بشكل ملحوظ وسجل أعلى القيم نتيجةالتفاعل بين المعاملات(B_3 * (G+C) *(S1) لذلك يمكن إعتبار إدارة التربة من خلال أنفاق الصرف وإضافة المحسنات نهجًا مناسبًا لتحسين خواص التربة وزيادة انتاجيتها وزيادة محصول بنجر السكر خاصة في المناطق الجافة وشبه الجافة.