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تأثير بعض محسنات التربة على خصوبة التربة وإنتاجية الطماطم تحت ظروف الاراضى الملحية

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الملخص العربي

أجريت تجربة حقلية لموسمين صيفين ٢٠١٠ – ٢٠١١ م في مزرعة خاصة بمنطقة جلبانة قرية ٧ شرق قناة السويس شمال سيناء– مصر والتي تروى بمياه ترعة السلام المخلوطة بنسبة ١ : ١ مياه نيل ومياه صرف زراعي . الهدف من البحث هو تقيم أفضل نوع من المحسنات المضافة (الجبس الزراعي – الكبريت الزراعي – الكمبوست) وأفضل معدلات الإضافة لكل منهم على خصوبة التربة وإنتاجية محصول الطماطم صنف سوبر أسترين بى تحت ظروف الأراضي الملحية حديثة الاستصلاح. وكانت معدلات الإضافة (٢.٥ – ٥) و(٠.٢ – ٠.٤) و (٥ – ١٠) ميجا جرام للفدان من الجبس والكبريت و الكمبوست على الترتيب وكانت النتائج كالتالي :

وجد أن إضافة الجبس والكمبوست والكبريت أدت إلى انخفاض الملوحة وكذلك رقم حموضة التربة . زاد إنتاج الطماطم للفدان في الموسم الثاني عن الموسم الأول حيث تراوح إنتاجية الفدان من للكنترول٤.٩٨٦ إلى ٢٤.٨١٩ ميجا جرام للفدان للمعاملة بالجبس و ٤.٩٨٨ للكنترول إلى ٢٧.٤٣٠ للمعاملة الكبريت وكذلك ٤.٩٨٩ للكنترول إلى ٢٧.٦٩٤ ميجا جرام للفدان للمعاملة بالكمبوست .زاد المحتوى من العناصر الكبرى والصغرى في ثمار الطماطم وخاصة في المعاملات ذات المعدلات العالية من الإضافة وخاصة الكمبوست .

نتيجة استخدام جميع المحسنات التي تم استخدامها في تلك الدراسة زاد محتوى التربة من العناصر الكبرى والصغرى الميسرة (نتروجين ، فوسفور ، بوتاسيوم ، حديد ، منجنيز و زنك).

ومن خلال الدراسة نستطيع أن نوصى باستخدام الكمبوست بمعدل ٥ طن للفدان لإعطاء محصول اقتصادي والحصول على تربة ذات درجة خصوبة جيدة صالحة لإنتاج الطماطم تحت ظروف الاراضى الملحية حديثة الاستصلاح.

EFFECT OF SOME SOIL AMENDMENTS ON SOIL FERTILITY AND TOMATO PRODUCTIVITY UNDER SALINE SOIL CONDITION

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ABSTRACT: *Field experiment was conducted in two summer growing seasons; of 2010 and 2011 in a private Farm, Gelbana Village 7. This area locate at east of the Suez Canal, at North Sinai Governorate, Egypt. The irrigation source is from, El - Salam Canal (1: 1 Nile water mixed with agricultural daring water). The objective of this work is to evaluate the best one of three soil amendments added (gypsum, sulfur and compost) and the best rate of application on soil fertility and yield of tomato (Super Strain B) variety under saline conditions of newly reclaimed soil. The results were as follows: the addition of gypsum, compost and sulfur led to reduce soil salinity and soil pH and increase production of tomatoes per feddan in the second season than first season. The productivity ranged from 4.986 to 24.819 Mega grams per feddan for the gypsum treatment and 4.988 to 27.430 for the sulfur treatment, as well as 4.989 to 27.694 Mega grams per feddan of the compost treatment. On the other hand the soil treated with all soil amendments led to increasing the content of the macro and microelements in the fruits of tomato. The soil treated with all soil amendments led to increasing the content of the macro and microelements available in soil .From the results of the study it can be recommend using the compost at a rate of 5 tons per fed to give an economic crop and get on the fertility of the soil suitable for the production of a good tomato yield.*

Key words: *Gypsum, Sulphur, Compost – Soil fertility- Tomato production - Soil salinity.*

INTRODUCTION

Total salt affected area in the world about 955 Mg ha out of which 0.9 Mg ha in Egypt. The majority of salt-affected soils in Egypt are located in the northern-central part of the Nile Delta and on its eastern and western sides. However, fifty five percent of the cultivated lands of northern Delta region are salt-affected, twenty percent of the southern Delta and middle Egypt region and twenty five percent of the Upper Egypt region are salt-affected soils, FAO (1995).

Tomato (*Lycopersicon esculentum,* Mill.) is the most popular vegetable with great nutritive value and good source of potassium and vitamin A & C. It is moderately sensitive to salinity and few cultivars are salt tolerant up to some extent, (Rafat and Rafiq, 2009).

Sulphur is a good efficient amendment for improving the physical, chemical and nutritional properties of the soil and in increasing crops yield production especially when it is followed by organic manure application. Sulphur addition decreased soil pH values and increased the nutrients uptake by many plants especially with organic manures (Kandil and Gad, 2010). Mostafa *et al*. (1990) stated that sulphur addition enhances plant growth parameters, reducing soil pH, soil solution and consequently increase the solubility of the un available minerals and hence its concentration in the root zone .Farmyard manure significantly increased both fresh and dry weights of tomato shoots and roots. On the other hand, the application of farmyard manure contains microorganisms has the ability to supply plants with un available N, P and release phytohormones which could increase N, P and K content in tissues of tomatoes. (Gad, 2007). Mohsen , (2006) reported that application of farmyard manure combined with the recommended dose was the most favorable interaction treatment for N, P, K content in different parts of tomato plants. The organic matter in both chicken and farmyard manure improves soil physical properties, such as aggregation, soil aeration and bulk density, insisting surface crust, water retention and supply plant nutrients, (Yafan and Allen, 2004).

Gypsum application improved the soil chemical properties by reducing the SAR and pH. FYM, should be applied before the crop sowing and mixed thoroughly with soil that may help in improving infiltration thereby increasing salts removal and thus increasing yield, Mohamad *et al* (2010) . Rafat and Rafiq (2009) found that the application of gypsum has own advantages due to operating antagonistic effects of calcium against sodium and sulphate ions help in lowering pH of rhizosphere which improves growth conditions. Joachim and Hubert (2010) reported that gypsum incorporating 20 cm depth, ECe was lowered by 43.6% (8.90 $dS.m^{-1}$ to 5.02 $dS.m^{-1}$). However, gypsum incorporated 20 cm soil depth and weekly ploughing reduced ECe by 52.5% (i.e. from 8.90 $dS.m^{-1}$ to 4.23 $dS.m^{-1}$). Stamford *et al* (2002) reported that addition of sulphur to soil could reduced soil pH from (8·2 to 7.4) and electrical conductivity of the soil saturation extract from (15·3 to 7.10 mS/cm).

This study aimed to evaluate the impact of application of different rates of gypsum, compost and sulphur for improving saline soil; soil fertility and increasing yield of tomato plant.

MATERIALS and METHODS

The present study was carried out during two summer growing seasons of 2010 and 2011, at the private farm at Gilbana Village of of North Sinai Governorate, Egypt. This area located at the semi arid region and lies in the north-western Mediterranean coast of Sinai, between 32^o_ 350 and 32^o_ 450 E and 31^o_ 000 and 31^o_ 250 N, (Kaiser, 2009). The soil studied was sandy clay in texture. This area is irrigated with El-Salam canal water (Nile water mixed with agriculture drainage water by 1:1).

Treatments:-

The main plots devoted for the three different amendments (gypsum, sulphur and compost) and sub –plot was the amendments of application rates were (0 – 2.5 and 5 Mg fed^{-1}) for gypsum; (0 – 0.2 and 0.4 Mg fed^{-1}) for sulphur and (0 – 5 and 10 Mg fed^{-1}) for compost, where the mega gram (Mg) = ton = 1000 kg and the feddan (fed) =2.38 hectare (ha) .The transplanting spacing was 25 cm between plants. The plot area was 5 X 10 m^2 included 7 ridges, each with about 4.0 m long and 60 cm width.

The soils of all the experimental pilot units were subjected to some pretreatments processes: - a) leveling the soil surface by using laiser technique. b) Deep sub-soiling plough. c) Establishment of filed drains at a distance of 10 m between each of two drains and a deep of 90 cm at drain beginning , their drainage water flow towards the main collectors of 2 m in depth and d) establishment of an irrigation canal in the middle part of the experimental pilot unit, Shaban (2005).

Preparation of Gypsum and Compost:-

Gypsum, of 87% purity, was sieved through sieve having opening of 0.149 mm to enhance its solubility. Compost was prepared by mixing straw of manure rice; maze; sesame and faba bean straw with farm yard manure. The mature compost was obtained after 3 months of composting, and was passed through a sieve of 10-mm in diameter prior to use in this study.

The used amounts (compost; gypsum and sulphur) were individually incorporated in soil and ploughed and followed by irrigation. The treatments were lift for 10 days for drying. This final process was repeated three times. All soil treatments were applied one month earlier to as sure its complete decomposition of the used amendments. The application of irrigation water was higher than F.C to enhance leaching of salts from soil.

The fertilizers requirements were added for all treatments as the following:-

Urea (46 % N) was added for all treatments to overcome a total applied dose of 100 kg fed^{-1}, potassium was added as potassium sulphate (48% K_2O) at rate of 100 kg K_2O fed^{-1} and super phosphate (15 % P_2O_5) was added at the equivalent to the 60 kg P_2O_4 fed^{-1}.

Tomato (Lycopersicon *esculentum* Mill.) Super Strain B, cv. was seedling in 5 April 2010 for first season and 2 April 2011 for second seasons. The raised seedling where seedling height about 20 cm was distributed and transplanted in field where the plant spacing was 25 cm between the two plants in line about 150 m lengths and 50 cm cross in split plots design with three replicates. The yield was harvested in 5th of September 2010 and 2nd of September 2011. Tomato fruits were harvested every week. At harvest 2-3 times per week and at the end of the harvesting season, the fruit yield (kg/ plant), fruit yield (Mg/fed), Number fruit /plant and dray fruit (g/plant), was accounted.

Methods of analysis:-

Surface (0 – 30 cm) soil samples were collected from the study area, before planting and also from each experimental after plant harvesting. The samples were air dried ground, sieved (2 mm mesh) and kept for analysis. The physical and chemical properties were done according to (Piper1954), Black, (1965) and Page *et al* (1982).
The obtained results were presented in Table (1). The compost analyses were done according to the standard methods described by Brunner and Wasmer (1978), and the obtained results were in shown in Table (2).

Plant analysis: Samples fruits were dried at 70ºC for 48 hours. Samples of dry fruit tomato were ground and 0.5 g of their powder was digested by concentrated digestion mixture of H_2SO_4/ $HClO_4$ acids according to Sommers and Nelson (1972). Nitrogen was determined by micro Keldahl, according to Jackson (1976). Phosphorus was determined Spectrophotometrcally using ammonium molybdate/ stannus chloride method according to Chapman and Pratt (1978). Potassium was determined by a flame photometer, according to Page *et al.* (1982). Fe, Mn, and Zn were determined by using Atomic Absorption (model GBC 932).

The obtained data were statistically analyzed according to Snedecore and Cochran (1979).

Table (1): Physical and chemical properties of the soil sample before planting

Course sand (%)	Fin sand (%)	Silt (%)	Clay (%)		Texture	O.M (%)		$CaCO_3$ (%)
4.16	62.84	7.63	25.37		Sandy clay	0.56		10.48
pH* (1:2:5)	EC** (dS/m)	Soluble cations (meL^{-1})				Soluble anions (meL^{-1})		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{--}_4
8.12	15.20	9.47	20.17	121	0.98	8.31	97	46.31
Available nutrients (mgkg^{-1} soil)								
N	P	K	Fe	Mn	Zn	Cu		
53	6.75	189	3.84	2.86	1.03	0.064		

*pH in soil – water suspension.
** EC dsm^{-1} in soil paste extract.

Table (2): Chemical composition of the used compost.

pH*	EC**	O.M	C	C/N	N	P	K	Ca	Mg	Fe	Mn	Zn

	dSm^{-1}	(%)								($mg\ kg^{-1}$)		
6.87	4.67	43.71	25.41	16.72	1.52	0.97	2.86	3.98	0.70	250	175	90

*pH (1:2.5) – water suspension.
** EC dsm^{-1} water suspension by (1: 5).

RESULTS AND DISCUSSION

1-Effect of different soil amendments rate on soil chemical properties:-

The effect of different soil amendments type and its application rates on the soil salinity of the studied soil (EC, dSm^{-1}) are presented in Table (3). These results indicated that the soil salinity (EC) was decreased with increasing rate of amendments application specially compost. The highest reduction in the EC values was in soil treated with compost at the rate of 10 Mg fed^{-1}. According to the found decreases in the soil EC, the treated amendments may be arranged as follows: compost > sulphur > gypsum. The decrease effect of soil amendments on EC were significant in the first season, but it's was non significant in second season. These results are in agreement with Hussain *et al* (2001); they reported that the slight decrease occurred when different amendments were applied in combination or alone except sulphur or its combination with FYM, when it increased a little. Also, this decrease it may be due to the improvement in porosity and hydraulic conductivity, which resulted in enhancing the leaching of salts.

Soil pH directly affects the life and growth of plants because it affects the availability of all nutrients. Data presented in Table (3). show a non significant change in soil pH of the treated soil amendments between all treatments. The pH of the soil was decreased with different amendments and rates of its application this decrease was ranged from 8.09 to 7.89 for gypsum; 8.08 to 7.88 for sulphur and 8.07 to 7.87 for compost during the two grown seasons. This behavior may be due to that, in the organic matter (compost) fraction the negative charge surfaces are a raised from the dissociation of H^+ from certain functional groups particularly from carboxylic (-COOH) and phenolic (-C6H4OH) groups. These results are in agreement with Khan *et al*. (2006); they found that the soil pH was decreased with gypsum application in range from 8.54 to 7.54. On the other hand Mahmoud (2011) reported that the corresponding relative decreases in soil pH were from 8.23 to 7.67 and 8.14 to 7.60 as an average for the two seasons from the control treatments to applied highest rates of gypsum and sulphur respectively.

2- Available macronutrients in soil.

The presented data in Table (3) show the soil contents of available N, P and K (mg kg^{-1}). This content was increased as a result of salt affected soil treated by the soil amendments. This increase may be attributed to the effect of different application rates of sulphure, compost and gypsum caused an increase in the availability of N, P and K in the soil as will as these contents were increased with increasing the added rates of soil amendments. Compost sulphur and gypsum applications resulted in a significantly increase of N with increasing the rates of application. On the other hand, the effect of different soil amendments on available P and K were non significant in the second season even with high rates of application, but this effect was significant of available K in the first season. This finding is in agreement with the results obtained by Voorhees and Uresk (1990) and Mahmoud (2011).

In general, the application of gypsum increased the solubility of N and K, whereas it decreased the solubility of P, where P may be related with soluble Ca^{++} released from added gypsum found lass soluble P compounds namely calcium phosphate. The application of compost increased the solubility of all tested nutrients in the study soil. These results are in agreements with Elrashidi *et al* (2010) they found that the application of peat improved the solubility of most nutrients in the soil. Sulphur element plays a great role in plant metabolism and supplying it to the soil caused reduction in the soil pH, consequently enhances the solubility and availability of many elements, Lai, *et al* (2000).

3- Available micronutrients in soil.

It is evident from data present in Table (3) that pronounced increases in soil available microelement contents (Fe, Mn and Zn) were as a result of high application

Table 3

soil amendments rates. The availability of micronutrients in soil depends on the change of soil pH , resulted from he treatments of the tested soil amendments. Thus it could be concluded that the more pronounced increase in the available Fe, Mn and Zn contents as a result of increasing the applied rates of different soil amendments may be attributed to improve soil pH. This finding is in agreement with results obtained by Mahmoud (2011).

4- Yield and yield compound.

Data presented in Table (4) revealed the effect of amendments (gypsum, compost and sulphur) application rates on yield and yield component of tomato plants. It's obvious from the results that, there is a significant variation in fruit yield (Mg fed^{-1}), and No. fruits /plant in the two seasons. The highest values of fruit yield (27.694 Mg/fed) was recorded with compost at the rate of (10 Mg /fed), which had positive effect higher than the other treatments. The corresponding relative increase (%) in the obtained yield of the soil treated with gypsum at rates of (2 and 4 Mg fed^{-1}) the fruit yield (Mg fed^{-1}) were 139 and 283 % compared with control, respectively. While hese values for the soil treated with sulphur at rates of (0.2 and 0.4 Mg fed^{-1}) were 213 and 300 % respectively. Also the relative increases for soil treated with compost at rates of (5 and 10 Mg fed^{-1}) were 238 and 306 % respectively, compared with untreated soil. It could be noticed that as amendments rates increase the soil productivity was increase, it is mainly due to decreasing of the soil salinity. The compost improves soil physical and chemical properties such as aggregation, soil aeration and lower bulk density which led to easy leaching soluble salt from the soil. Sulphure addition enhances plant growth parameters, reducing pH of soil solution and consequently increases the solubility of the un available nutrients. These data are in harmony with those obtained by Kandil and Gad (2010), and Rafat and rafiq (2009) they reported that application of gypsum has its own advantages due to operating antagonistic effects of calcium against sodium and sulphate ions help in lowering down pH of rhizosphere which improves growth conditions and increase tomato fruit yields.

Table (4): Yield and yield components as affected by different the soil amendments.

Treatments	Rate Mg/fed	Fruit yield kg/plant		Fruit yield Mg* / fed		Fruit Number / plant		Dry fruit (g/plant)	
Seasons		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Gypsum	0	2.10	3.96	4.986	6.045	12	15	14.20	15.30
	2.5	5.42	6.58	10.687	15.630	29	35	23.60	24.15
	5.0	6.17	7.21	17.350	24.819	38	46	29.30	30.12
Mean		4.56	5.92	11.010	15.500	26	32	22.37	23.19
Sulphur	0	2.16	3.98	4.988	7.239	14	19	14.41	15.45
	0.2	6.87	7.12	15.482	22.843	38	46	27.52	30.26
	0.4	7.30	8.14	21.390	27.430	43	52	31.0	32.41
Mean		5.44	6.41	13.953	19.171	32	39	24.31	26.04
Compost	0	2.17	3.98	4.989	7.352	15	20	14.70	14.79
	5	6.90	7.58	18.764	22.972	48	54	29.51	32.14
	10	7.68	8.29	22.357	27.694	54	60	33.62	35.71

Mean	5.58	6.62	15.37	19.339	39	45	25.94	27.55
LSD %5 amendment	ns	ns	***	***	***	**	***	ns
Rates	***	ns	***	***	***	***	***	ns
Interaction	ns	ns	***	***	***	*	***	ns

* Mg (mega gram) = ton = 1000 kg

5-Mineral content in tomato fruits:-

Data in Table (5) show that in tomato fruits, contents (%) of N, P and K. These contents were increased by all compost, sulphur and gypsum rates of application, the compared to control. The lowest contents of these nutrients were observed for the control treatments. The N, P and K concentration in tomato fruits (%) in the two seasons were clear decreased with increasing soil salinity, The data of N, P and K content in tomato fruits show relative increase with decreasing soil salinity as a result of adding different amendments. The N, P and K contents in tomato fruits ranged between 109 – 1.49 % in first season and 1.115 – 1.53 % in second season for N; 0.21 – 0.49 % in first season and 0.25 – 0.52 % in second season for P and 1.78 – 2.07 % in first season and 1.80 – 2.10 % in second season for K, respectively. The relative increases of the studied N, P and K in tomato fruits are mainly depend on the type of amendments used, as it could be arranged as follows: compost ≥ sulphur > gypsum in two seasons for N; gypsum > sulphur > compost in first season and compost > sulphur > gypsum in second season for P and gypsum > compost > sulphur in two seasons for K, compared with control,. This finding is in agreement with results obtained Gad, *et al* (2007), Kandil and Gad (2010), and Khan, *et al*., (2002). They reported that the nutrient (N, P and K) uptake by tomato, onion and sunflower were strikingly increased by the application of sulphur compared to gypsum.

On the other hand, the effects of using soil amendments (gypsum, sulphur and compost) under saline soil condition on the concentrations of Fe, Mn and Zn in tomato fruits was presented in Table (5). The change in the Fe, Mn and Zn concentrations in tomato fruits under saline soil condition depended upon the added rates of amendments and its reduction of low soil pH. Sulphur application at rates of 0.2 – 0.4 Mg fed^{-1} to saline soil were associated with clear changes in the accumulation of, Mn, Fe, and Zn in the fruit tissues of tomato plants. The corresponding mean values of relative increase (Fe , Mn and Zn) contents in tomato fruits of two seasons were 9.91 – 22.88 % ; 2.59- 6.65 % and 17.99 – 47.46 % for gypsum at rates of (2.5 – 5.0 Mg fed^{-1}) respectively compared with untreated soil. While, the corresponding highest mean values in the two seasons of tomato fruits the relative increase values were 28.02 – 39.21 %; 7.19 – 9.65 % and 39.62 – 71.47 % for sulphur by rates (0.2 – 0.4 Mg fed^{-1}), respectively compared with untreated soil. Also the relative increases mean values in the two season of fruit tomato contents for Fe, Mn and Zn were 33.89 – 45.35 %; 9.12- 10.72 % and 46.33 – 85.19 % for compost at rates of 5 - 10 Mg fed^{-1}, respectively compared with untreated soil .This finding is in agreement with results obtained by Carter and Cutcliffe (1990). They found that gypsum had little effect on soil porosity and structure indices, but it has a role in changing soil pH and significantly influenced soil microbial biomass. El-rashidi *et al* (2010); found that the application of peat improved the solubility of most nutrients and proved to be useful as an amendment for gypsum-rich soils and increases its productivity. These results are in agreement with the results obtained by Kandil, and Gad (2010).

From the obtained results, it could be concluded that the application sulphur, gypsum and compost at different rates may be used as a soil amendments under salt affected soils condition, where these applications were associated by reducing of soil salinity and pH, and increased in the soil content of available macro- and micronutrients which followed by the increase in soil fertility and positively reflected on tomato yield and yield comonents. Thus it could be recommended using the compost at a rate 5 Mg per fed to give in an economic crop and get on the fertility of the soil suitable for the production of a good tomato yield.

Table 5

REFERENCES

Black CA. (1965). Methods of Soil Analysis, Part 2, Series 9, Am Soc. Agron. Inst. Publ., Madison, WI,; 894-1372.

Brunner, P. H. and H. R. Wasmer (1978). Methods of analysis of sewage sludge solid wastes and compost. W.H.O. International Reference Center for Wastes Disposal (H-8600), Dulendrof Switzerland.

Carter, M.R. and J.A. Cutcliffe (1990). Effects of gypsum on growth and mineral content of brussels sprouts, and soil properties of Orthic Podzols. Fertilizer Research, (24): 77- 84.

Chapman, H.D. and P.F. Pratt (1961). Methods of Analysis for Soils, plants and Waters . Univ. of California, Division of Agric. Sci.

El-rashidi, M. A., L.T. West, C.A. Seybold, E.C. Benham, P. J. Schoeneberger and R. Ferguson (2010). Effects of gypsum addition on solubility of nutrients in soil amended with peat. Soil Sci., 175 (4): 162- 172.

FAO, (1995). Improvement and Production, Drainage and Salinity. An nternational Source Book. Pari

Gad, A.A., E.A. El- Ghamriny, A. Bardisi and A.A. Shazly (2007). Effect of farmyard manure and mineral nitrogen sources and rates on dry weight, photosynthetic pigments and yield of tomato grown in sandy soil. Zagazig. J. Agric. Res., 34(5): 845- 869.

Hussain, N., G. Hassan, M. Arshadullah and F. Mujeeb (2001). Evaluation of amendments for the improvement of physical properties of sodic soil. Int. J. Agri. Biol., 3 (3) : 319- 322.

Kaiser, M. F. (2009). Environmental changes remote sensing, and infrastructure development: The case of Egypt's East Port Said harbour. J. Applied Geography. (29): 280- 288.

Kandil, H. and N. Gad (2010). Response of tomato plants to sulphur and organic fertilizer . Int .J. of Acad Res. 2 (3): 204 - 210.

Khan, H.R., M.M. Bhuiyan, S.M. Kabir, F. Ahmed, S.A. Syeed and H.P. Blume (2002). The assessment and management of acid sulfate soils in Bangladesh in relation to crop production. In: The restoration and management of derelict land, MH Wong and AD Bradshaw (ed.), World Scientific Publishing Co. Pte. Ltd. UK,; 254-262.

Khan, R., A. Gurmani, M. Sohail and A. Hussain (2006). Effect of gypsum application on rice yield under Wheat & Rice System. Int. J. Agric. Biol. 8 (4) : 536- 538.

Jackson, ML (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi,; 41-330.

Joachim, H.J. and V. Hubert (2010). Effect of gypsum placement on the physical and chemical properties of saline sandy loam soil. Australina Journal of Crop Science . 4 (7) : 556 -563.

Lai- J.K., B. Mishra and A. K. Sarkar (2000). Effect of sulphur on availability of some plant nutrients. Indian J. Society of Soil Science. 48(1): 67-71.

Mahmoud, A. Awatef (2011). Impact of some sulphure sources on ameliorating soil characteristics, wheat yield and grain quality under newly reclaimed saline soil conditions Fayoum, J. Agric. Res. &Dev., 25 (1) : 36 – 48.

Manjunatha, B. (2006). Impact of farmers organic farming practices on soil properties in Northern dry zone of Karnataka. *M.Sc.(Agri.) Thesis,* Univ. Agric. Sci., Dharwad (India).

Mohsen, A.A. (2006). Studies on the effect of bio organic and chemical fertilizers on growth, yield and quality of tomato under sandy soil conditions. M.Sc. Thesis, Fac. Agric., Zagazig Univ. Egypt.

Mostafa, M.A., A.M. El-Gala, M.M. Wassif and M. El-Maghraby (1990). Distribution of some micronutrients through a calcareous soil column under sulphure and saline water application. Middle East Sulphure symposium. Cairo, 12- 16- Feb. 263- 276.

Mohammad, J. Kh., T. J. Mohammad, U. Kh Amin, A. Mohammad and S. Mohammad (2010). Management of saline sodic soils through cultural practices and gypsum. Pak. J. Bot., 42 (6): 4143- 4155.

Page, A.L., R.H. Miller and D.R. Keeney (1982). "Methods of Chemical Analysis". Part 2: Chemical and microbiological properties (Second Edition). American Society of Agronomy, Inc. and Sci. Soc. of America, Inc. Publishers, Madison, Wisconsin U.S.A.

Piper, C.S. (1950). “Soil and Plants analysis.” A monograph from the water. Agric. Res. Inst., Univ. of Alediade, Australia.

Rafat, S. and A. Rafiq (2009). Vegetative growth and yield of tomato as affected by the application of organic mulch and gypsum under saline rhizosphere. Pak. J. Bot. , 41 (6): 3093- 3105.

Shaban, KH. A. H. (2005). "Effect of different irrigation water resources on properties and productivity of salt affected soils." Ph.D. Thesis, Fac .of. Agric., Monufiya University. Egypt.

Snedecor , G. W. and W.G. Corharn (1979). Statistical Methods. Iowa State University Press. pp . 593, Ames, Iowa, U.S.A.

Sommers, L.E. and D.W. Nelson (1972). Determination of total phophorus in soil. Arapid Perchloric acid digestion Procedure . Soil Sci. Soc . Amer. Proc. 36: 902- 904 .

Stamford, N. P., A. D. Freitas, D. S. Ferraz and C. E. Santos (2002). Effect of sulphur inoculated with *Thiobacillus* on saline soils amendment and growth of cowpea and yam bean legumes. Journal of Agricultural Science . 139:3:275-281.

Voorhees, M. E. and D. W. Uresk (1990). Effect of Amendments on Chemical Properties of Bentonite Mine Spoil. Soil Sci. 150 (4): 663- 775.

Yafan, H. and V. B. Allen (2004). Effect of composts and their combinations with other materials and their combinations with other materials on nutrient accumulation in tomato leaves. Communications in Soil Science and Plant Analysis, 35(19&20): 2809- 2823.

تأثير بعض محسنات التربة على خصوبة التربة وإنتاجية الطماطم تحت ظروف الاراضى الملحية

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الملخص العربي

أجريت تجربة حقلية لموسمين صيفين ٢٠١٠ – ٢٠١١ م في مزرعة خاصة بمنطقة جلبانة قرية ٧ شرق قناة السويس شمال سيناء– مصر والتي تروى بمياه ترعة السلام المخلوطة بنسبة ١ : ١ مياه نيل ومياه صرف زراعي . الهدف من البحث هو تقيم أفضل نوع من المحسنات المضافة (الجبس الزراعي – الكبريت الزراعي – الكمبوست) وأفضل معدلات الإضافة لكل منهم على خصوبة التربة وإنتاجية محصول الطماطم صنف سوبر أسترين بى تحت ظروف الأراضي الملحية حديثة الاستصلاح. وكانت معدلات الإضافة (٢.٥ – ٥) و(٠.٢ – ٠.٤) و (٥ – ١٠) ميجا جرام للفدان من الجبس والكبريت و الكمبوست على الترتيب وكانت النتائج كالتالي :

وجد أن إضافة الجبس والكمبوست والكبريت أدت إلى انخفاض الملوحة وكذلك رقم حموضة التربة . زاد إنتاج الطماطم للفدان في الموسم الثاني عن الموسم الأول حيث تراوح إنتاجية الفدان من للكنترول٤.٩٨٦ إلى ٢٤.٨١٩ ميجا جرام للفدان للمعاملة بالجبس و ٤.٩٨٨ للكنترول إلى ٢٧.٤٣٠ للمعاملة الكبريت وكذلك ٤.٩٨٩ للكنترول إلى ٢٧.٦٩٤ ميجا جرام للفدان للمعاملة بالكمبوست .زاد المحتوى من العناصر الكبرى والصغرى في ثمار الطماطم وخاصة في المعاملات ذات المعدلات العالية من الإضافة وخاصة الكمبوست .

نتيجة استخدام جميع المحسنات التي تم استخدامها في تلك الدراسة زاد محتوى التربة من العناصر الكبرى والصغرى الميسرة (نتروجين ، فوسفور ، بوتاسيوم ، حديد ، منجنيز و زنك).

ومن خلال الدراسة نستطيع أن نوصى باستخدام الكمبوست بمعدل ٥ طن للفدان لإعطاء محصول اقتصادي والحصول على تربة ذات درجة خصوبة جيدة صالحة لإنتاج الطماطم تحت ظروف الاراضى الملحية حديثة الاستصلاح.

Table (3): PH , EC soil and its content available macro and micro nutrients in the studied soil after plant harvesting.

Treatment	Rate Mg* fed^{-1}	pH (1:2.5)		EC (dSm^{-1})		Available macronutrients (mg kg^{-1})						Available micronutrients (mg kg^{-1})					
						N		P		K		Fe		Mn		Zn	
season		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Gypsum	0	8.09	8.05	13.47	11.20	62	65	6.78	6.81	196	200	3.86	3.88	2.90	2.94	1.04	1.07
	2.5	8.00	7.98	8.39	7.38	78	79	7.24	7.32	201	205	4.27	4.32	3.04	3.07	1.16	1.19
	5.0	7.97	7.89	6.58	5.41	81	83	7.43	7.46	214	218	4.29	4.35	3.09	3.14	1.18	1.23
	Mean			9.48	7.99	74	76	7.15	7.20	204	208	4.14	4.18	3.01	3.05	1.13	1.16
Sulphur	0	8.08	8.03	13.45	11.18	63	65	6.77	6.84	195	199	3.88	3.91	2.89	2.90	1.05	1.08
	0.2	7.98	7.90	8.14	7.10	81	83	7.33	7.36	214	218	4.30	4.45	3.16	3.20	1.18	1.23
	0.4	7.93	7.88	6.41	5.31	86	88	7.46	7.52	219	223	4.41	4.49	3.19	3.24	1.23	1.27
	Mean			9.33	7.86	77	79	7.19	7.21	209	213	4.20	4.28	3.08	3.11	1.15	1.19
Compost	0	8.07	8.01	13.44	11.12	63	66	6.78	6.86	197	201	3.96	3.98	2.92	2.95	1.05	1.09
	5	7.96	7.92	7.86	6.20	84	87	7.34	7.45	215	220	4.55	4.53	3.28	3.31	1.22	1.27
	10	7.90	7.87	5.31	4.14	92	94	7.48	7.62	219	228	4.76	4.80	3.33	3.35	1.31	1.33
	Mean			8.87	7.15	80	82	7.20	7.31	210	216	4.42	4.44	3.18	3.20	1.19	1.23
LSD 5% amendment				**	ns	**	***	*	ns	***	ns	ns	ns	***	ns	ns	ns
LSD 5 % Rates				ns	***	***	***	ns	ns	***	ns	ns	**	ns	ns	*	ns
LSD 5 % interaction				**	ns	***	***	ns	ns	***	ns	ns	ns	ns	ns	ns	ns

* Mg (mega gram) = ton = 1000 kg

Table (5): Dray fruit of tomato plans content of macro- and micronutrients as affected by the studied treatments.

Treatments	Rate Mg/fed*	Macronutrients (%)						Micronutrients (mgkg^{-1})					
		N		P		K		Fe		Mn		Zn	
Season		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Gypsum	0	1.09	1.13	0.21	0.25	1.78	1.80	60.42	61.23	87.36	87.45	19.25	19.78
	2.5	1.23	1.34	0.29	0.34	1.98	2.02	66.59	67.12	89.65	89.69	22.63	23.41
	5.0	1.36	1.42	0.34	0.38	2.01	2.05	74.25	75.24	93.18	93.25	28.41	29.13
Mean		1.23	1.30	0.28	0.32	1.92	1.96	67.10	67.86	90.06	90.13	23.43	24.11
Sulphur	0	1.08	1.16	0.25	0.28	1.80	1.82	60.45	61.26	88.00	88.10	21.30	21.46
	0.2	1.32	1.39	0.36	0.40	1.99	2.01	77.58	78.22	94.37	94.45	29.45	30.25
	0.4	1.44	1.48	0.39	0.45	2.03	2.05	84.29	85.14	96.52	96.58	36.14	37.19
Mean		1.28	1.34	0.33	0.38	1.94	1.96	74.11	74.87	92.96	93.04	28.96	29.63
Compost	0	1.13	1.18	0.28	0.30	1.83	1.85	61.00	61.32	88.01	88.12	21.33	21.49
	5	1.42	1.47	0.44	0.49	2.02	2.04	81.47	82.31	96.10	96.21	30.56	32.10
	10	1.49	1.53	0.49	0.52	2.07	2.10	88.39	89.41	97.20	97.45	39.14	40.17
Mean		1.35	1.39	0.40	0.44	1.97	2.00	76.95	77.68	93.77	93.93	30.34	31.25
LSD 5% amendment		0.21	0.05	0.03	0.04	0.03	0.056	7.43	1.81	3.97	0.30	3.08	0.48
LSD 5 % Rates		0.23	0.06	0.08	0.07	0.08	0.007	7.93	1.09	7.16	0.39	7.82	0.82
LSD 5 % interaction		ns	ns	ns	ns	ns	ns	ns	***	ns	**	ns	***

* Mg (mega gram) = ton = 1000 kg