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Productivity Improvement of Tomato Plants under Saline Environmental Conditions.

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Tomato plants of Castel Rock cultivar were grown under saline calcareous soil conditions at Ras Sudr region during 1995-1996 and 1996-1997 growing seasons. The treatments were as follows: 1- Four soil amendment treatments *i.e.* town refuse at 20 ton/fed., agricultural sulphur at 500 Kg./fed. and a combination between them, and a control treatment. 2- Foliar spray with zinc at concentrations of 0, 0.2 or 0.4% as $ZnSO_4$ and K as K_2O at concentrations of 0, 0.2 or 0.4%.

A spilt plot design was used. Soil amendments, zinc, and potassium treatments were distributed randomly in the main, sub and sub sub plots respectively. Obtained results revealed that tomato fruits productivity increased significantly with town refuse treatment or 0.4% $ZnSO_4$ or 0.4% K_2O concentration, as well as, with town refuse treatment + 0.4% $ZnSO_4$. The highest values of T. S. S. and vitamin C in tomato fruits were obtained with town refuse treatment or 0.4% $ZnSO_4$or 0.4% K_2O treatments, as well as, with town refuse treatment + 0.4% $ZnSO_4$ treatments. While Ca content was increased with town refuse treatment + 500 Kg./fed. sulphur addition and 0.4% K_2O, as well as, with 500 Kg./fed. S + 0.4% K_2O treatments.

Key words: Tomato, Town refuse, Sulphur, Zinc, Potassium, Soil amendments, Foliar spray, Yield.

Tomato (*Lycopersicon esculentum* Mill) is the most important vegetable crop in Egypt. In 1997, the cultivated area with tomato in the open field was 401329 fed. and produced 5873411 tons of tomato fruits. The need to produce more food is pushing agriculture farther on to marginal lands often characterized by soils and water with a high degree of salinity. The soils of South Sinai governorate are highly calcareous and are affected with salinity. These soils are very poor in organic matter and nutrient elements. Moreover, the irrigation in this area depends on the use of low water quality. The use of such water in

addition to the soil properties has led to a decrease in tomato productivity.

Duch (1979) showed that town refuse compost at 20 ton/ha. resulted the best yield of onion and cabbage. Awadalla *et al.* (1990) reported that manure application decreased the harmful effect of salinity and alkalinity of irrigation water and improved yield of wheat plants. Organic manures provide the soil with macro and micro nutrients reqiured for plants, organic manure contain microorganisms which decompose the complex compounds in the soil and make it available to the plants and reduces soil reaction, as well as, improves yield of plants (Khalil *et al.*, 1991).

Sulphur application is very important in calcareous soil, because it is transformed by soil microorganisms to sulphuric acid, which in turn lowers soil pH , improves soil structure and increases the availability of certain plant nutrients (Aulakh and Pasricha, 1986). Stefanov (1980) reported that application of sulphur increased tomato fruit size, yield, dry matter, sugar, acidity and vitamin C content. Candilo *et al.* (1993, 1994) showed that sulphur addition increased fruit yield, soluble solids and produced more uniform ripening fruits.

As regard to the effect of foliar spray with Zn , it increased fruit size of tomato (Malliek and Muthukrishnon, 1980). Also, Shafshak *et.al.* (1984) found that, application of Zn as foliar spray had a beneficial effect on early, commercial and total yield of tomato fruit weight. Sugar content of tomato fruits increased with applying micronutrients (Mawat and Mothpal, 1985). Also, Agwah and Mahmoud (1994) reported that fruit set, dry matter and total yield of tomato increased with application of 0.25 % zinc sulphate.

The addition of potassium to tomato plants improved the percent of fruit set, number of fruits/plant and fruit weight (Agwah and Mahmoud, 1994 and Satti and Lopez, 1994). Moreover, Lopez and Satti (1996) found that the addition of potassium to the saline nutrients solution increased fruit yield/plant. Therefore, the aim of this work was to study the effect of soil amendements (town refuse and sulphur), as well as, zinc and potassium foliar spray on the yield and quality of tomato .

Materials and Methods

The field work was carried out in the experimental farm of the Dessert Research Center at Ras Sudr , South Sinai governorate , during 1995-1996 and 1996-1997 seasons.

The physical and chemical properties of the soil and chemical analysis of irrigation were performed water are shown in Tables (A, B and C) respectively which were performed according to Jackson (1958) and Richards (1954).

A split plot design with three replicates was used . Every replicate included 36 treatments which were the combinations of four soil amendments , three zinc concentrations and three potassium concentrations. The treatments were randomly arranged inside every replicate.

A- Soil amendments were assigned in the main plots as follows:
1- Control (without soil addition).
2- Town refuse (T. R.) at a rate of 20 ton/fed..
3- Agricultural sulphur (S) at a rate of 500 Kg./fed..
4- Combination between T.R.(20 ton/fed.) + S (500 Kg./fed.).

B- Zinc application was arranged in the sub plots at concentrations of 0, 0.2 or 0.4 % and sprayed as zinc sulphate.

C- Potassium application was arranged in the sub - sub plots at concentrations of 0, 0.2 or 0.4 % and sprayed as K_2O.

TABLE A. Mechanical properties of the experimental soil at 30 cm. depth .

$CaCO_3$ %	(%) of Particale size distribution (mm)					Class texture
	Coarse sand (1 - 0.5)	Fine sand (0.25 - 0.1)	Total sand (1-0.1)	Silt (0.05 - 0.002)	Clay < 0.002)	
56.99	53.68	27.60	81.28	7.95	10.77	Loam sand

TABLE B. Chemical properties of the experimental soil before transplanting.

PH	EC mmhs cm^2	Organic matter	Saturation soluble extract								Nmg 100gm	Gypsum	Zn
			Soluble anions (meq l)				Soluble cations (meq/l)						
		%	$CO_3^=$	HCO_3^-	SO_4^-	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+		(%)	ppm
8.01	4.12	0.65	-	0.69	11.9	27.9	22.3	2.31	13.5	0.61	1.84	0.15	2.17

TABLE C. Chemical analysis of the irrigation water.

pH	EC mmhs cm^2	Anions (me / l)				Cations (me / l)			
		$CO_3^=$	HCO_3^-	$SO_4^=$	Cl^-	Ca^{++}	Mg^{--}	Na^+	K^+
7.87	6.56	-	2.74	20.82	43.84	20.25	13.85	34.78	0.25

The area of each sub-sub plot was 10.5 m^2 (3×3.5) ; *i.e.* 1/400 of fed. and consisted of three rows. Each row was three and half meters long and one meter wide .

Town refuse and agricultural sulphur treatments were applied to the soil three weeks before transplanting at the bottom of the rows , covered with soil and irrigated three times before transplanting. The chemical analysis of town refuse is shown in Table (D). The soil analysis after harvest is recorded in Table (E).

Zinc and potassium were sprayed on plants as $ZnSO_4$ and K_2O three times, *i.e.* 3, 6 and 9 weeks after transplanting.

Tomato seeds of Castle Rocke cv. were sown in plastic trays on August 10 th and 15 th for the first and second seasons , respectively in a mixed media of peatmoss , vermiculite and sand (1:1:1). The nutrient solution was sprayed on seedlings in the nursery three times , at 10, 20 and 30 days after sowing.

Uniform and healthy transplants were obtained from the nursery 40 days after sowing and transplanted at a distance of 20 cm and irrigated with saline water from ground well (4198 ppm NaCl).

Calcium super phosphate (15.5 % P_2O_5) was placed under soil at a rate of 300 Kg./fed. , 15 days before transplanting. 300 Kg./fed. ammonium sulphate (20.5 % N) and 150 Kg./fed. potassium sulphate (48 % K_2O) were side dressed. Nitrogen and potassium fertilizers were divided into four equal doses and applied in the front of irrigation water after 2, 4, 6 and 8 weeks from transplanting.

Data was recorded for the following characters:

I- Yield and its components:

The fruits were collected at 3/4 coloring stage for the following measurements: Number of tomato fruits/plant , fresh weight of fruit (gm.) and total yield (ton/fed.).

II- Fruit quality:

Five tomato fruits were taken from each plot for the following determinations:

Total soluble solids (T.S.S) was determined using Abbe refractometer (A.O.A.C., 1975). Vitamin C (mg. /100 gm.) was determined according to Catherine and Jame method (1975). Calcium content (%) was determined according to the method described by Richards (1954).

TABLE D. The constituents of applied town refuse .

Moisture content (%)	Macronutrients (%)								
	Organic C	Total N	C/N ratio	P_2O_5		K_2O		Na^+ (%)	
				Total	Soluble	Total	Soluble	Total	Soluble
27.5	20	1.1	20 : 1	1.3	0.54	3.5	0.97	1.15	0.5

Micronutrients (PPM)							
Fe		Zn		Mn		Cu	
Total	Soluble	Total	Soluble	Total	Soluble	Total	Soluble
1300	740	960	4	316	39	375	84

TABLE E. Chemical properties of the expemimental soil after harvest at 30 cm. depth .

PH	EC Mmhos cm^2	Organic matter (%)	Saturation soluble extract								N mg\ 100gm	Gypsum meq\l	Zn ppm
			Soluble anions (meq / l)				Soluble cations (meq / l)						
			CO_3^{--}	HCO_3^-	SO_4^{--}	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+			
*8.05	3.63	0.54	—	0.58	9.98	25.23	19.08	2.16	12.75	0.58	1.63	2.77	1.93
**7.85	1.82	1.28	—	1.47	11.83	3.1	4.86	2.89	7.04	0.44	2.93	4.81	7.21
***7.68	1.69	0.48	—	0.53	12.16	3.77	6.33	3.21	5.47	0.42	1.03	5.44	9.31
****8.12	1.74	0.96	—	0.86	11.92	3.68	5.08	3.56	5.84	0.42	2.41	4.96	12.07

* Chemical porperties of the control soil .

** Chemical porperties of the soil which was treated with town refuse.

*** Chemical porperties of the soil which was treated with a sulphur.

**** Chemical porperties of the soil which was treated with a mixture of town refuse and sulphur .

Statistical analysis:

Obtained data were statisticaly analysed according to Thomas and Hills (1975).

Results and Discussion

I. Yield and its components :

Yield and its components expressed as fruit No./plant , fruit weight (gm/plant) and total yield (ton/fed.) as affected by soil amendments (town refuse and sulphur) and foliar spray with zinc and potassium are shown in Table (1)

Effect of soil amendments :

Data presented in Table (1) show a positive significant effect of T.R. on fruit No./plant , average of fruit weight and total yield . These results are in the same trend found by Awadalla *et al* .(1990) who reported that T.R. decrease saline harmful effect by supplying the plant with nutrients thus increased fruit set . Hummadi and Chliem (1987) and Rosario *et al.* (1993) reported that town refuse has

a beneficial effect on fruit weight of tomato. The increase in fruit weight was due to the positive response of tomato growth to town refuse addition. Similar results on the effect of town refuse on increasing yield component expressed as fruit No./plant and fruit weight were obtained by Duch (1979) and Nogales *et al*. (1984).

The results in Table (1) show that, agricultural sulphur at a rate of 500 Kg./ Fed. gave a positive effect on fruit No./plant, average fruit weight and total yield of tomato plants. These results are in confirmation with those obtained by Stefanov (1980), Aulakh and Pasricha, (1986) and Candilo *et al.* (1993). The effect of sulphur on increasing total yield may be due to sulphur effect on decreasing soil pH and increasing of certain plants nutrients release in soil solution which in turn improved plant growth and yield.

TABLE 1. Single effect of soil amendments (town refuse and sulphur) and foliar sprays (zinc and potassium) on fruit No. / plant, fruit weight (gm) and total yield (ton / fed.) of tomato plant during 1995-1996 and 1996- 1997 seasons.

Treatments	fruit No. / plant		fruit weight (gm)		total yield (ton / fed.)	
	95/96	96/97	95/96	96/97	95/96	96/97
soil amendments						
Control	9.55	7.98	70.99	58.17	8.17	5.61
Town refuse	12.15	11.29	101.23	111.46	14.74	15.11
Sulphur	10.26	9.15	93.69	90.12	11.54	10.08
TR + S	11.48	9.68	97.85	104.22	13.51	12.14
LSD at 0.05	0.39	0.11	0.66	0.71	0.35	0.19
Zn application						
Zn_0	10.44	8.83	87.74	86.80	11.15	9.69
Zn_1	10.88	9.71	91.19	92.38	12.01	10.98
Zn_2	11.25	10.04	93.90	93.78	12.81	11.53
LSD at 0.05	0.37	0.18	0.68	0.99	0.38	0.22
K application						
K_0	10.03	8.73	90.69	89.81	11.04	9.68
K_1	10.94	9.55	90.80	91.25	12.08	10.81
K_2	11.61	10.31	91.43	91.92	12.84	11.72
LSD at 0.05	0.30	0.18	0.78	1.46	0.32	0.27

The effect of town refuse combined with sulphur on fruit No./plant, average fruit weight and total yield of tomato plants showed a significant increase when compared with control treatment. The increase was higher than individual sulphur application but lower

than town refuse application . Similar findings were obtained by Stefanov (1980).

Effect of foliar spray:

Increasing $ZnSO_4$ up to 0.4 % significantly increased fruit No./plant, fruit weight and total yield in both the growing seasons (Table 1). The increase may be due to improving of fruit set (Mallick and Muthukrishnon ,1980 and Agwah and Mahmoud , 1994).The increment of total yield may be attributed to the increase of fruit No. and fruit weight . These results agree with those obtained by Arora *et.al.* (1983) and Gezerel (1988) using tomato plants.

Potassium application up to 0.4% concentration led to an increase in fruit No. , fruit weight and total yield . This increase may be due to the potassium role in improving fruit set of tomato plants and the reduction of harmful effect of salinity which causes fruit drop before ripening .These results agree with those reported by Niedziela *et al.* (1994) and Satti and Lopez (1994). Also the highest total yield obtained at concentration of 0.4% may be due to the fact that potassium ion is considered one of the essential nutrients which affects the growth of tomato plants . (Condilo *et al.*, 1993 and Lopez and Satti , 1996).

Effect of interaction:

Obtained data revealed no significant effect for the interaction between zinc and potassium, as well as, the interaction between zinc , potassium and soil amendment treatment on yield and its component .

Data in Table (2) revealed the interaction effect between soil amendments and zinc gave a positive significant effect on tomato yield and its components . The highest value obtained with town refuse at 20 ton/fed. combined with zinc at 0.4 % followed by sulphur and zinc , followed by T.R.+S combined with zinc application. This increase may be due to improving the chemical and physical properties of soil , as well as, reducing soil reaction . This therefore improved growth medium quality and improved plants growth . The nutrients were translocated to the fruits and increased its weight (Khalil *et al.*, 1991). Zn has a role in improving fruit size and weight (Zerbi *et al.*, 1995). Town refuse and Zn application increased plant growth and consequently increased yield . These results are in accordance with those obtained by Khalil *et al* .(1991) .

The effect of interaction between soil amendments and potassium treatments on fruit No./plant , fruit weight and total yield of tomato , showed a significant increase in total yield as shown in Table (3). The best results were obtaind with T.R. at 20 ton/fed. combined with 0.4% K_2O treatment . The increment may be were due to the beneficial effect of soil amendment and its contribution with the amount of nutrients available in the soil through decreasing soil pH , and consequently increased growth and yield of plants (Kropisz and Wajciechowski, 1978) .

TABLE 2. Effect of interaction between soil amendments (town refuse and sulphur) and zinc on fruit No. /plant , fruit weight (gm) and total yield (ton / fed.) of tomato plant during 1995 - 1996 and 1996 - 1997 seasons .

Treatment	1995 \ 1996								
	fruit No. /plant			fruit weight (gm)			total yield (ton / fed.)		
	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2
Control	8.9	10.0	9.8	66.9	72.6	73.5	7.1	8.7	8.7
Town refuse	11.9	12.1	12.6	98.7	100.6	104.4	14.0	14.2	15.7
Sulphur	10.3	9.8	10.7	91.1	93.9	96.2	11.3	11.0	12.3
TR + S	10.8	11.7	12.0	94.3	97.8	101.5	12.2	13.7	14.6
LSD at 0.05		NS			1.4			0.8	
	1996 \ 1997								
Control	7.3	8.1	8.5	49.7	62.5	62.4	4.4	6.0	6.4
Town refuse	10.5	11.5	11.8	109.6	111.7	113.1	13.9	15.4	16.0
Sulphur	8.6	9.3	9.6	88.1	90.6	91.7	10.0	9.9	10.4
TR + S	8.8	10.0	10.3	99.9	104.8	108.0	10.5	12.6	13.3
LSD at 0.05		NS			2.0			0.4	

II. Fruit quality :

Results of fruit quality expressed as T.S.S. vit.C. and calcium content (%) as affected by soil amendments and zinc and potassium foliar spray are shown in Table (4).

Soil amendments :

As shown in Table (4), data reflected that addition of town refuse (T.R.) significantly increased vitamin C content of tomato fruit . The increase may be due to improvments in plant growth characteristics. On the other hand , calcium content in tomato fruit was not affected by town refuse addition .These results agree with those obtained by Duch (1979).

Sulphur application at a rate of 500 Kg./fed. significantly increased T.S.S. and vitamin C of tomato in both growing seasons. The increase may be due to lowering of soil pH (Table E) and improving uptake of needed nutrients by plants. These results agree with those obtained by Stefanov (1980) and Candilo *et al*.(1994 and 1995) . But calcium content of tomato fruit was not affected by sulphur application . Similar observation was made by Anonymous (1986).

TABLE 3. Effect of interaction between soil amendments (town refuse and sulphur) and potassuim foliar spray on fruit No. /plant , fruit weight (gm) and total yield (ton / fed.) of tomato plant during 1995 - 1996 and 1996 - 1997 seasons .

Treatment	1995 \ 1996								
	fruit No. /plant			fruit weight (gm)			total yield (ton / fed.)		
	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2
Control	8.8	9.4	10.3	70.7	71.2	71.1	7.6	8.1	8.8
Town refuse	11.2	12.4	12.8	100.9	101.2	101.6	13.6	15.1	15.5
Sulphur	9.4	10.3	11.0	93.4	93.6	94.1	10.6	11.6	12.4
TR + S	10.6	11.6	12.3	97.7	97.1	98.7	12.4	13.5	14.6
LSD at 0.05		NS			NS			NS	
	1996 \ 1997								
Control	7.4	7.9	8.6	57.2	58.6	58.8	5.2	5.6	6.1
Town refuse	10.4	11.4	12.0	110.0	111.4	112.9	13.8	15.3	16.3
Sulphur	8.3	9.2	9.9	89.2	90.4	90.8	9.0	10.2	11.0
TR + S	9.2	9.7	10.7	102.9	104.5	105.3	10.8	12.1	13.5
LSD at 0.05		NS			NS			0.5	

TABLE 4. Single effect of soil amendments (town refuse and sulphur) and foliar spray (zinc and potassium) on TSS, vitamin C. (mg / 100 gm) and calcium (%) / fruit of tomato during 1995-1996 and 1996-1997 seasons.

Treatments	TSS %		Vitamin C. (mg/ 100 gm)		Calcium (%) / fruits	
	95/96	96/97	95/96	96/97	95/96	96/97
soil amendments						
Control	7.67	8.99	23.81	22.11	0.35	0.34
Town refuse	10.19	12.71	26.76	25.93	0.32	0.35
Sulphur	7.78	9.11	25.63	24.90	0.36	0.37
TR +S	8.37	9.89	25.96	24.86	0.43	0.42
LSD at 0.05	0.66	0.18	0.04	0.03	0.11	0.12
Zn application						
Zn_0	8.04	9.65	25.07	23.93	0.45	0.47
Zn_1	8.59	10.14	25.52	24.34	0.34	0.35
Zn_2	8.89	10.74	26.03	25.08	0.30	0.30
LSD at 0.05	0.14	0.17	0.03	0.02	0.10	0.01
K application						
K_0	7.90	9.48	25.40	24.31	0.29	0.29
K_1	8.52	10.17	25.57	24.40	0.37	0.38
K_2	9.09	10.88	25.64	24.64	0.43	0.45
LSD at 0.05	0.24	0.13	0.03	0.03	0.02	0.02

The addition of town refuse (20 ton/fed.) combined with sulphur (500 Kg./fed.) led to an increase in T.S.S. of tomato fruits . Sulphur enhanced soil structure , decreased pH and enhanced nutrients availability . While organic manure provides the soil with nutrients and microorganisms which breakdown the complex compounds in the soil.

Town refuse and sulphur showed a significant increase in vitamin C content of tomato fruits . This may be due to increasing absorption of nutrients by plants and improved photosynthesis. These results agree with those obtained by Stefanov (1980) . Ca content of tomato fruits increased with town refuse and sulphur treatment. These results may be attributed to the role of microorganisms in breaking down the complex compounds and the release of nitrogen which thiobacter need to transform sulphur to sulphuric acid , lowering pH and improving the elements content of soil including calcium.

Foliar spray .

Spraying zinc at various concentrations showed an increase in T.S.S. and vitamin C content of tomato fruits, Table (4) . The values increased with increasing zinc concentrations and the highest values were contributed by 0.4% Zn. This increase may be due to the increase in sugar accumulation in plant and consequently increased T.S.S. Also enhanced growth characters may have increased vitamin C translocated to the fruits. Similar results were reported by Mawat and Mothpal (1985) .

According to the results in Table (4), potassium showed significant effect on TSS and vitamin C of tomato fruits . The highest reading were obtained by 0.4% K_2O application . This may be due to the role of potassium in photosynthesis and carbohydrate accumulation . Similar findings were found by Mengel and Viro (1974) and Said (1997).

The highest value of Ca content in fruits was found with 0.4 % K_2O as shown in Table (4). This result may be due to decreasing the harmful effect of salinity on plants with using potassium or foliar spray and this enhanced Ca uptake from soil solution .Similar results were reported by Satti *et al* .(1994) .

Effect of interaction:

Obtained data reveled no significant effect for the interaction between soil amendment , zinc and potassium on fruit quality . Tables (5-7) show the effect of interaction between soil amendments and zinc application , soil amendments and potassium and between zinc and potassium foliar spray on fruit quality of tomato

T.S.S. and vitamin C. significantly increased with T.R. and 0.4% Zn treatment . The highest Ca content was achieved with the combination of T.R. and sulphur and the lower Ca percent was related to using TR and 0.4% Zn.

Town refuse at 20 ton/fed. and 0.4% K_2O treatment achieved the highest value of T.S.S. in tomato fruits followed by T.R. + S and 0.4 %K_2O treatment . The interaction between soil amendments and K conc. had no effect on vitamin C content of tomato fruit . On the other hand, T.R. and S. + 0.4% K_2O and S. + 0.4% K_2O followed by

T.R.+0.4 % K_2O had a positive effect on Ca content in tomato fruits. The interaction between Zn and K concentrations had a significant effect on T.S.S. vitamin C and Ca content the values increased with increasing Zn and K concentrations up to 0.4% for each.

TABLE 5. Effect of interaction between soil amendments (town refuse and sulphur) and zinc on T.S.S. ,V. C (mg /100 gm) and calcium (% / fruit) of tomato fruit during 1995 - 1996 and 1996 - 1997 seasons .

Treatment	T.S.S. %			V. C (mg /100 gm)			Ca (% / fruit)		
	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2
1995 \ 1996									
Control	7.38	8.05	7.58	23.33	23.83	24.27	0.42	0.33	0.31
Town refuse	9.18	10.55	10.83	26.31	26.77	27.2	0.43	0.28	0.25
Sulphur	7.57	7.81	7.96	25.23	25.71	26.13	0.42	0.34	0.33
TR + S	8.03	7.94	9.15	25.41	25.96	26.51	0.54	0.34	0.31
LSD at 0.05		0.29			0.05			0.02	
1996 \ 1997									
Control	8.39	9.29	9.30	21.49	22.04	22.98	0.43	0.31	0.29
Town refuse	11.69	12.79	13.47	25.59	26.04	26.49	0.47	0.30	0.27
Sulphur	8.96	9.07	9.29	24.27	24.84	25.40	0.43	0.35	0.33
TR + S	9.53	9.38	10.63	24.14	24.80	25.64	0.53	0.42	0.32
LSD at 0.05		0.35			0.03			0.02	

TABLE 6. Effect of interaction between soil amendments (town refuse and sulphur) and potassium foliar spray on T.S.S. , V. C (mg /100 gm) and calcium (% / fruit) of tomato fruit during 1995 - 1996 and 1996 - 1997 seasons .

Treatment	T.S.S. %			V. C (mg /100 gm)			Ca (% / fruit)		
	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2
1995 \ 1996									
Control	7.58	7.61	7.82	23.65	23.83	23.94	0.30	0.36	0.40
Town refuse	9.48	10.18	11.07	26.62	26.77	26.88	0.21	0.35	0.39
Sulphur	6.98	7.94	8.52	25.54	25.7	25.82	0.30	0.34	0.44
TR + S	7.55	8.35	9.22	25.78	25.99	26.10	0.35	0.43	0.42
LSD at 0.05		0.47			NS			0.04	
1996 \ 1997									
Control	8.35	8.77	9.52	21.94	22.11	22.28	0.28	0.34	0.40
Town refuse	11.98	12.46	13.67	25.89	25.69	26.22	0.24	0.38	0.43
Sulphur	8.44	9.13	9.76	24.76	24.92	25.03	0.30	0.36	0.45
TR + S	9.15	9.85	10.55	24.67	24.86	25.04	0.33	0.43	0.52
LSD at 0.05		0.25			NS			0.03	

TABLE 7. Effect of interaction between soil zinc and potassium foliar spray on T.S.S.% , V. C (mg/100 gm) and calcium (% / fruit) of tomato fruit during 1995 - 1996 and 1996 - 1997 seasons .

Treatment	1995 \ 1996								
	T.S.S. %			V. C (mg /100 gm)			Ca (% / fruit)		
	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2
Zn_0	7.46	8.02	8.66	24.92	25.09	25.19	0.34	0.46	0.57
Zn_1	7.98	8.73	9.05	25.42	25.48	25.57	0.29	0.35	0.40
Zn_2	8.25	8.82	9.69	25.87	26.05	26.16	0.25	0.31	0.34
LSD at 0.05		NS			NS			0.03	
	1996 \ 1997								
Zn_0	9.07	9.62	10.25	23.76	23.93	24.09	0.34	0.48	0.57
Zn_1	9.47	10.05	10.89	24.29	24.19	24.55	0.29	0.35	0.41
Zn_2	9.90	10.74	11.50	24.89	25.08	25.28	0.24	0.30	0.37
LSD at 0.05		0.22			0.047			0.03	

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تحسين إنتاجية نباتات الطماطم تحت الظـــروف البيئيـــة الملحية .

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أجريت التجربة بزراعة نباتات الطماطم صنف كاسل روك تحت ظروف الارض الكلسية الملحية (بمنطقة رأس ســـدر) خـــلال موســـمى النمـــو ١٩٩٥-١٩٩٦ , ١٩٩٦-١٩٩٧. و كـــــانت المعاملات كالاتى :

١. أربعة معاملات مصلحات تربة (مخلفات مدن بمعدل ٢٠ طـــن / فدان , كبريت زراعى بمعدل ٥٠٠ كجم/فـــدان , مخلـــوط مـــن مخلفات المدن و الكبريت الزراعـــى بنفـــس المعـــدلات الســـابقة بالاضافة الىمعاملة المقارنة)

٢. رش ورقى بأستعمال ثلاثـــة تركـــيزات للزنـــك (صفـــر , ٠,٢ و ٠,٤ %) فى صورة كبريتات زنك , ثلاثة تركيزات للبوتاســـيوم (صفر , ٠,٢ و ٠,٤ %) فى صورة اكسيد البوتاسيوم .

٣. التفاعلات بين جميع المعاملات السابقة .

وقد اوضحت النتائج المتحصل عليها , انه قد زاد إنتاج محصـــول الطماطم معنويا بالمعاملة ٢٠ طن مخلفات مدن / فـــدان , ٠,٤ % رش بالزنك , ٠,٤% رش بأكسيد البوتاسيوم , مخلفات المـــدن + ٠,٤% زنك . و لقد تم الحصول على اعلى نسب للمواد الصلبـــة الذائبة , فيتامين ج بالثمار بالمعاملة بمخلفـــات المـــدن ٢٠ طـــن /فدان , ٠,٤% رش بالزنك , ٠,٤% رش بأكسيد البوتاســـيوم او معاملة مخلفات المدن + ٠,٤% زنك . بينما زاد محتـــوى الثمـــار من الكالسيوم بكل مـــن المعـــاملات ٢٠ طـــن مخلفـــات المـــدن +٥٠٠كجم كبريت , ٠,٤% رش بأكسيد البوتاسيوم أو ٥٠٠كجـــم كبريت +٠,٤% رش بأكسيد البوتاسيوم .