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Improvement of Growth and Chemical Composition of Tomato Plants under Saline Environmental Conditions.

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Castel Rock cv. tomato plants were grown under saline calcareous soil conditions (Ras Sudr region) during 1995-1996 and 1996-1997 growing seasons .

The treatments were : soil amendments : town refuse (T R) at 20 ton/fed. , sulphur (S) at 500 kg / fed. and a mixture between them . in addition to control treatment : foliar spray with Zn as $ZnSO_4$ and K as K_2O at conc. of 0.0 , 0.2 and 0.4 % for each and the interaction between all previous treatments .

Growth characters of tomato plants significantly increased with application of town refuse , as well as , 0.4 % Zn or 0.4 % K_2O foliar spray and town refuse + 0.4 % Zn treatments . Minerals content (N,P,K and Zn) in shoots of tomato plants was increased with T R application , 0.4 % Zn and 0.4% K_2O foliar spray treatments . The interaction between T R in combination with S and 0.4 % Zn foliar spray gave the highest concentration of Zn in tomato shoots. On the contrary, all treatments under study decreased Na content . Sulphur treatment exhibited the lowest Na content in plants .

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

Tomato (*lycopersicon esculentum*, Mill) is the most important vegetable crop grown in Egypt. In 1997, the area cultivated with tomato in the open field was 401329 feddans and its productivity was 5873441 tons .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 quality water such as underground and drainage water.

The use of such water in addition to the soil properties has led to a decrease in tomato productivity .

Generally , organic manures contain microorganisms which decompose the complex compounds in soil to available macro and micronutrients for plants . Therefore, town refuse is expected improve the chemical and physical properties of soil, as well as reducing the soil reaction (Khalil *et al.*, 1991) and improve growth and yield of plants (Duch, 1979-b and Khalil *et al.*, 1991). In Egypt , Atef (1992) , noticed that application of soil organic amendments decreased soil pH, and combination of organic and inorganic amendments led to further lowering of soil pH and increased plant growth, dry weight and N content of plants as compared to control . Cerda *et al.*, (1984 -b) found that , top growth of tomato plants was affected more than root growth by changes in the amount of S supplied .

Niazi and Tahira (1987) showed that Zn had negligible effects on plant growth and morphology of tomato when plants received 5 kg Zn as Zn Cl_2 and treated with Na Cl at 0 , 5 , 10 , 25 and 50 meq / liter in medium which contained clay/organic matter/sand (2:1:1) . In another study Agwah and Mahmoud (1994) mentioned that , 3 foliar sprays of 0.25% Zn sulphate , increased leaf dry matter percentage of tomato plants .

Behboudian and Anderson (1990) reported that sufficient potassium in plants showed larger leaf area and increased growth of plants ,while plant growth was significantly reduced in case of potassium deficiency . Lopez and Satti (1996) found that the addition of potassium to the saline nutrient solution increased leaf number and leaf fresh weight of tomato per plant .

Duch, (1979-a) mentioned that the highest Zn levels were found in soils treated with town refuse compost (T RC.) and the uptake of these micronutrients by tomato plants was also highest in plants receiving town refuse compost (T RC.) which also improved physical properties of soil . Further more, Sotomayor (1979) reported that the content of P and K increased in plants received town refuse compost than plants which not treated with town refuse. Kampfer and Zehler (1967) found that the uptake of N and P by fodder beet was enhanced by sulphur application .

EL-Sherif *et al.* (1994) found that under saline conditions, Zn applications (5 or 10 kg / fed.) resulted in an increase in Ca and K

uptake , but a decrease in Na and Mg uptake . Satti *et al.*(1994 -a) found that stem and leaf growth were significantly reduced by salinity but growth was enhanced following irrigation when K was added to the nutrient solution .The addition of potassium to tomato plants under saline soil conditions is very important, as the addition of KCl in the medium reduced Na^+ accumulation in plants (Guerrier , 1995) .

The objective of this work was to study the effect of soil amendments (town refuse and sulphur), as well as, foliar spray with zinc and potassium on growth and minerals content of tomato in Ras Sudr , South Sinai Governorate .

Materials and Methods

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

The physical and chemical properties of the soil at the depth of 30 cm and the chemical analysis of the saline irrigation water were berformed according to the methods described by Richards (1954) and Jackson (1958) (Tables A-C).

The design of experiment was split split plot according to Thomas and Hills (1975) with three replicates . Every replicate included 36 treatments which were combinations of four soil amendments, three zinc concentrations and three potassium concentrations . The area of the experimental unit was 1/400 fed.and consisted of three rows, each row was one meter width .

The treatments, soil amendments assigned to the main plots had four treatments , control (without soil addition) , town refuse (T R) at a rate of 20 ton/fed., agricultural sulphur (S) at a rate of 500 kg/fed. and combination between T R(20 ton/fed.) + S (500 kg/fed.). Zinc was arranged in sub plots and sprayed as zinc sulphate at concentrations of 0.0 % , 0.2 % and 0.4 % and potassium oxide was arranged in sub sub plots and sprayed at concentrations of 0.0 % , 0.2 % and 0.4 % .

Town refuse was applied to the soil at three weeks before transplanting in the bottom of the rows , covered with soil and irrigated three times before transplanting . The chemical composition of town refuse (Table D) was determined according to Jackson (1958).

Agricultural sulphur was added to the soil three weeks before transplanting , mixed with the upper ten centimeters of the soil and irrigated three times before transplanting for oxidation according to Atef (1992) . Zinc and potassium were sprayed on plants as Zn SO_4 and K_2O , three times *i.e.* after 3, 6 and 9 weeks from transplanting .

Seeds of tomato cv. Castle Rock were sown on August 10th and 15th for the seasons 1995 and 1996, respectively in a media mixed of peatmoss + vermiculite + sand (1:1:1) , in seedlings plastic salver .The nutrient solution was sprayed on seedlings in nursery at a rate of 2 % three times , after 10, 20 and 30 days from sowing . Seedling were transplanted 40 days after sowing at a distance of 20 cm and irrigated with saline water from ground well (4198 ppm NaCl) . Calcium superphosphate , ammonium sulphate and potassium sulphate were added to the soil at the rates of 300,300 and 150 kg/fed.respectively . All fertilizers applications were divided into four equal parts and were applied beside the transplants in the front of the irrigation water. Fertilization was carried out 2, 4, 6 and 8 weeks after transplanting. The normal cultural practices of growing the crop were used .

Growth characters :

Five plants were randomly taken from each plot 70 days after transplanting as a representative sample for the following vegetative growth measurements : Plant height (cm) , fresh weight / plant (gm) and dry matter percent of shoots .

Chemical composition :

Dry matter percentage of plant tissues : was estimated by method of (A.O.A.C., 1975) . The mineral content of plant shoots were estimated using the wet ashing procedure for the dry powdered samples according to Johanson and Ulirich (1959) .The total nitrogen and phosphorus contents were determined according to methods described by Huphries (1956) and Frie et al. (1964) respectively . The methods described by Brown and Lilliland (1964) were used for the determination of potassium and sodium and zinc was determined using the Atomic Absorption Spectrometer (Unicum 929).

TABLE (A). physical properties of the experimental soil at 30 cm. depth .

$CaCO_3$ %	(%) of Particle 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	Organic matter	Saturation soluble extract								Nmg\ 100gm	Gypsum (%)	Zn ppm
			Soluble anions (meq / l)				Soluble cations (meq/l)						
	dS m^{-1}	%	$CO_3^=$	HCO_3^-	$SO_4^=$	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+			
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	Anions (me / l)				Cations (me / l)			
	dS m^{-1}	$CO_3^=$	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

TABLE (D). The constituents of applied town refuse .

Moistur Content (%)	Organic C	Total N	C/N ratio	Macronutrients (%) 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	Organic matter	Saturation soluble extract								N mg\ 100gm	Gypsum meq\l	Zn ppm
				Soluble anions (meq / l)				Soluble cations (meq / l)						
		dS m^{-1}	(%)	$CO_3^=$	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 mixtur of town refuse and sulphur .

Results and Discusion

Growth characters :

Growth characters of plants as expressed by plant height, plant weight and dry matter (%) are presented in Table (1) .

Soil amendments :

Soil amendments significantly increased growth characters of tomato plants as compared to control treatment in both the growing seasons . Town refuse addition at a rate of 20 ton/fed. , exerted significant increase in plant height, fresh weight and dry matter (%) of tomato plants as compared to control . Similar results were reported by Atef (1992) and Said (1997) . The positive response of plant height and fresh weight may be due to release of mineral nutrients from town refuse , which decreased the harmful effects of salinity on plant growth (Khalil *et al.*, 1991 and EL-Sersawy *et al.*, 1992) . The increase in dry matter percent of tomato plants treated with town refuse may be explained by the observation mode by Sotomayor (1979) and Anid *et al.*, (1983) that town refuse decreased osomotic pressure in solution and improved the uptake of nutrients required by plants .

Sulphur application had a beneficial effect on growth parameters of tomato plants in both growing seasons. Similar finding was reported by Tandon (1984) and Said (1997). The beneficial effect of sulphur addition to the soil may be due to microbial oxidation process in soil and decrease of soil pH, and increased availability of plant nutrients (Stromberg and Tisdale, 1979) . Sulphur application also led to an increase in fresh weight of shoot and dry matter (%) which was probably a result of improving biological processes and accumulation of organic components in the cells of plants (Stefanov, 1980).

The combination of T R + S increased plant height, fresh weight and dry matter (%) of tomato plants significantly as compared to control .

TABLE 1. Effect of soil amendments, zinc and potassium application on growth characters of tomato plants during 1995-1996 and 1996-1997 seasons.

Seasons / Charct. / Treat.	1995-1996			1996-1997		
	Plant height (cm)	Fresh weight (gm)	Dry matter (%)	Plant height (cm)	Fresh Weight (gm)	Dry matter (%)
Cont.	29.20	73.63	15.38	32.33	89.16	17.24
T R	60.21	234.99	19.99	67.18	259.41	21.05
S	37.42	116.85	17.25	34.18	138.09	19.03
T R + S	49.48	158.68	17.63	57.17	187.58	18.86
L.S.D. at 0.05	0.71	0.35	1.94	2.26	0.08	0.07
Zn_0	41.24	129.24	16.82	47.55	152.05	18.45
Zn_1	45.05	147.83	17.46	50.53	169.71	18.93
Zn_2	45.97	161.04	18.36	52.23	183.93	19.75
L.S.D. at 0.05	0.36	0.19	2.33	1.69	0.06	0.06
K_0	39.68	139.37	17.[illegible]	45.83	160.53	18.69
K_1	44.65	147.06	17.47	51.05	169.61	19.00
K_2	44.93	151.68	17.99	54.17	175.54	19.44
L.S.D. at 0.05	0.40	0.28	2.30	1.12	0.08	0.07

Foliar spray :

Data illustrated in Table (1) shows that , zinc sulphate application as foliar spray on tomato plants significantly increased plant height, fresh weight and dry matter (%) of tomato plants as compared to control . The growth characters gradually increased with increasing Zn concentration up to 0.4 % . These results agree with those obtained by Kalloo (1986) . This may be due to the effect of zinc sulphate in increasing protein production and increase photosynthetic rate (Chaplin and Westwood, 1980) . Also zinc may be able to improve the microorganisms content in cells which contribute to bioprocessing and accumulating of different components in the cell (Agwah and Mahmoud, 1994) .

The effcet of potassium on tomato plants showed a positive and significant response on growth characters which increased with increasing concentration up to 0.4 % , except on dry matter during the first season which was similar to control . These results are in agreement with those obtained by Mengel and Viro (1974) who found that tomato plants supplied with higher K rates grow better . This may be due to the role of potassium in increasing photosynthetic processes which in turn increases growth and dry matter accumulation (Agwah and Mahmoud, 1994 and Said, 1997) .

The effect of interaction :

The effect of soil amendments and zinc application on growth characters of tomato plants is shown in Table (2) . The highest values of plant height, fresh weight and dry matter (%) was obtained with town refuse at 20 ton/fed. + 0.4 % $ZnSO_4$, followed by T R at 20 ton/fed. + S 500 kg/fed. + 0.4% $ZnSO_4$, followed by sulphur 500 kg/fed. +0.4 % $ZnSO_4$. The observed increase in growth may have been due to indirect effect of soil amendments on plants nutrients and the effect of zinc in decreasing the harmful effects of salinity (Kalloo, 1986 and Khalil *et al.*, 1991).

TABLE 2. Effect of soil amendments and zinc foliar spray on growth characters of tomato plants during 1995-1996 and 1996-1997 seasons.

Characters / Treatment	1995 \ 1996								
	plant height (cm)			fresh weight (gm)			dry matter (%)		
	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2
Contorl	27.8	29.6	30.4	62.1	75.1	83.7	14.7	15.2	16.3
Town refuse (TR)	56.3	61.7	62.5	212.4	236.9	255.6	19.2	19.7	20.9
Sulphur	34.3	38.8	39.2	101.2	122.5	126.8	16.6	17.3	17.8
T R + S.	46.6	50.1	51.7	141.2	158.8	178.0	16.8	17.7	18.3
LSD at 0.05		0.7			4.7			0.1	
	1996 \ 1997								
Contorl	30.2	32.9	33.9	78.3	90.4	98.9	16.8	16.9	18.0
Town refuse (TR)	63.8	68.2	69.5	240.7	258.5	279.0	20.4	20.8	21.9
Sulphur	41.6	44.0	45.6	122.0	143.7	148.5	18.6	18.9	19.5
T R + S.	54.5	57.0	60.0	167.2	186.3	209.3	18.1	18.9	19.6
LSD at 0.05		0.4			3.4			0.1	

The results in Table (3) show the effect of interaction between soil amendments and potassium concentrations on growth parameters of tomato plants . The promising treatment was obtained with town refuse 20 ton/fed. + 0.4% K_2O conc. . Similar results were obtained by Atef (1992) and Said (1997) . This may be attributed to the beneficial effects of organic matter and potassiun in decreasing of the salinity effects and its role on soil pH and EC values (Khalil, *et al.*, 1991 and Atef, 1992).

TABLE 3. Effect of soil amendments and K_2O foliar spray on growth characters of tomato plants during 1995-1996 and 1996-1997 seasons.

Characters / Treatment	plant height (cm)			fresh weight (gm)			dry matter (%)		
	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2
1995 \ 1996									
Contorl	26.8	29.4	31.5	63.0	76.8	81.1	15.1	15.3	15.8
T R	53.2	61.6	56.9	230.8	233.2	256.0	19.5	19.9	20.5
Sulphur	33.5	37.9	40.9	110.6	118.0	121.3	16.9	17.2	17.7
T R + S.	45.3	49.7	53.5	153.1	159.6	163.3	17.4	17.6	17.9
LSD at 0.05		0.8			4.6			0.2	
1996 \ 1997									
Contorl	29.3	33.0	34.7	79.0	91.6	96.9	16.9	17.2	17.6
T R	59.9	68.8	72.8	252.6	256.8	268.8	20.6	21.0	21.6
Sulphur	38.9	44.4	47.9	131.8	139.6	143.0	18.6	19.0	19.4
T R + S.	52.2	58.0	61.3	178.8	190.4	193.5	18.6	18.8	19.2
LSD at 0.05		0.6			2.3			0.1	

Chemical composition of tomato plants :

Effect of soil amendments :

Results in Table (4) indicate that town refuse was effective in increasing N, P, K and Zn content in tomato plants . The favorable effect of town refuse on N and P may be due to its beneficial effect on soil reaction and the availability of nutrients to plants , in addition to the nutrient supply contained in T R . Similar results were reported by Sotomayor (1979) and Khalil *et al.*, (1991) . Town refuse treatment increased sodium content in shoots of tomato plants during 1995 - 1996 which may have been due to the large amounts of Na contained in T R . The increase in zinc content of tomato plants due to T R may have been due to the large amount of zinc contained in T R. These results agree with those obtained by Duch (1979-a). The stimulative effect of sulphur on N, P and K content of plants may be due to increased availability of nutrients and rapid conversion of N and P into organic sulphur compounds . Similar results were obtained by Martinez *et al.* (1983) .Also sulphur treatment significantly decreased sodium content in tomato shoots .

TABLE 4. Effect of soil amendments, zinc and potassium application on mineral content of tomato plants during 1995-1996 and 1996-1997 seasons .

Characters / Treatments	Total N (%)		P (mg \ 100 gm)		K (%)		Na (%)		Zn (ppm)	
	95 \ 96	96 \ 97	95 \ 96	96 \ 97	95 \ 96	96 \ 97	95 \ 96	96 \ 97	95 \ 96	96 \ 97
Soil amendments										
Control	2.75	2.88	228	242	2.87	3.73	0.52	0.53	0.70	0.61
Town refuse	4.21	4.13	341	343	4.01	4.51	0.60	0.49	0.82	0.87
Sulphur	3.19	3.29	268	274	3.62	3.82	0.43	0.40	0.78	0.77
T R + S	4.03	3.83	304	302	4.25	4.42	0.54	0.41	0.85	1.00
LSD at 0.05	0.13	0.10	4.28	3.55	0.22	0.07	0.02	0.09	0.01	0.01
Zn application										
Zn_0	3.28	3.13	276	285	3.26	3.79	0.57	0.51	0.67	0.74
Zn_1	3.57	3.50	285	289	3.69	4.10	0.51	0.45	0.73	0.80
Zn_2	3.79	3.99	293	297	4.11	4.39	0.48	0.41	0.95	0.89
LSD at 0.05	0.07	0.07	4.40	3.69	0.13	0.08	0.02	0.00	0.01	0.01
K application										
K_0	3.38	3.37	274	280	3.34	3.82	0.57	0.51	0.94	0.91
K_1	3.53	3.55	285	290	3.73	4.18	0.51	0.45	0.76	0.80
K_2	3.72	3.68	2296	300	3.98	4.29	0.48	0.41	0.66	0.72
LSD at 0.05	0.06	0.07	5.50	3.60	0.13	0.15	0.02	0.02	0.01	0.01

Zinc content in tomato plants increased significantly with sulphur tratment ,which agrees with those reported by Aulakh and Pasricha (1986) .

Mixture of T R + S treatment caused a significant increase in total nitrogen , phosphorus and potassuim content in tomato plants . This may be expected because T R contain macro and micronutrients, in addition to the effect of S on decreasing soil pH and enhancing nutrient uptake . These results are in harmony with those obtained by Khalil *et al.* (1991). Morover sodium content significantly decreased with T R and sulphur application. This reduction may have been due to the role of sulphur in decreasing the harmful effect of salinity by increasing the leaching of sodium with irrigation water (Guerrier , 1995). In addition , T R and S significantly increased Zinc content in shoots of tomato plants . S decreased soil pH and make some micronutrients more available to plants , as well as T R . application provided the soil with large amount of zinc . These results are in the same line with those obtained by Duch (1979-a) and Khalil *et al.* (1991).

Effect of foliar spray :

As shown in Table (4) zinc sulphate significantly increased NPK content in shoots of tomato plants. The NPK content increased with increasing Zn concentration up to 0.4 %. These results are in line with those reported by EL-Sherif *et al.* (1994). Also, Zn apllication significantly increased zinc content of tomato plants . These results agree with those obtained by Barsoum *et al.* (1990) on cowpea . Zinc

application also significantly decreased sodium content of tomato plants. The highest decrease was more pronounced with 0.4 % zinc conc.

NPK content significantly increased in tomato plants with potassium application . The highest increases were obtained with 0.4 % K_2O concentration . These results may be due to the role of potassium in, photosynthetic process and carbohydrates status which is considered to be the base of building other components like protein and nucleic acids (Kastori *et al.*, 1987).

However, sodium and zinc contents of tomato plants significantly decreased with increasing potassium conc. up to 0.4 % . The decrement may be due to the role of potassium in decreasing the harmful effect of salinity and regulate the osmoticum of cells . These results are in agreement with those found by Guerrier (1995) .

Effect of interaction :

The effect of soil amendments and zinc application show that soil amendments + zinc treatment led to a significant increase in N,K and Zn content in tomato plants , while P content showed insignificant increase (Table 5) . During the first season, the highest increase of N,K and Zn was obtained with town refuse + 0.4 % Zn and T R + S + 0.4% Zn treatments , respectively . On the other hand, Na contents was significantly decreased in all treatments . The highest decrease was related to sulphur + 0.4 % Zn treatment . These results may be due to the beneficial effect of the soil amendments and zinc treatment which enhanced the nutrients in soil solution and decreased the harmful effect of salinity and enhanced the growth. Similar findings were reported by Atef (1992) and Salem *et al.*, (1988).

As show in Table (6) soil amendment and K_2O had no significant effect on N, P, K and Na contents in tomato plants, while zinc content increased significantly with T R + 0.4 % K_2O application.

The highest values of growth parameters were obtained with T R + 0.4 % Zn treatment . While the highest values of N,P,K and Zn content in shoots attributed with T R +S + 0.4 % Zn q\1n treatment

TABLE 5. Effect of soil amendments and zinc foliar spray on meniral content of tomato plants during 1995-1996 and 1996-1997 seasons .

Characters / Treatments	1995 1996														
	Total N (%)			P (mg 100gm)			K (%)			Na (%)			Zn (ppm)		
	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2	Zn_0	Zn_1	Zn_2
Contorl	2.54	2.81	2.90	221	227	237	2.63	2.78	3.17	0.57	0.52	0.49	0.54	0.70	0.86
Town refuse	3.92	4.14	4.57	329	343	352	3.64	4.03	4.28	0.67	0.58	0.54	0.77	0.76	0.93
Sulphur	2.88	2.28	3.42	261	270	271	3.21	3.61	4.02	0.45	0.43	0.41	0.66	0.73	0.94
T R + S	2.78	4.04	4.26	295	301	315	3.60	4.29	4.92	0.61	0.52	0.48	0.73	0.75	1.08
LSD at 0.05	0.15			NS			0.25			0.03			0.01		
	1996 1997														
Contorl	2.53	2.85	3.27	236	242	246	3.41	3.68	3.81	0.58	0.53	0.47	0.52	0.60	0.71
Town refuse	3.68	2.09	4.61	340	340	348	4.11	4.46	4.91	0.55	0.47	0.44	0.86	0.87	0.88
Sulphur	2.92	3.25	3.71	269	273	280	3.57	3.73	4.09	0.44	0.40	0.36	0.71	0.77	0.85
T R + S	3.38	3.80	4.31	294	300	313	4.09	4.51	4.74	0.49	0.39	0.35	0.90	0.96	1.13
LSD at 0.05	NS			NS			0.15			NS			0.02		

TABLE 6. Effect of soil amendments and K_2O foliar spray on meniral content of tomato plants during 1995-1996 and 1996-1997 seasons.

Characters / Treatments	1995 1996														
	Total N (%)			P (mg 100gm)			K (%)			Na (%)			Zn (ppm)		
	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2	K_0	K_1	K_2
Contorl	2.61	2.74	2.90	219	228	238	2.54	2.90	3.11	0.57	0.52	0.49	0.78	0.78	0.64
Town refuse	3.98	4.20	4.45	327	341	356	3.71	4.08	4.27	0.65	0.59	0.55	1.00	0.76	0.70
Sulphur	3.00	3.19	3.38	258	267	277	3.31	3.71	3.92	0.48	0.42	0.39	0.92	0.77	0.64
T R + S	3.90	4.00	4.17	293	300	316	3.82	4.29	4.62	0.58	0.53	0.50	1.05	0.83	0.69
LSD at 0.05	NS			NS			NS			NS			0.021		
	1996 1997														
Contorl	2.81	2.85	2.98	233	242	250	3.31	3.69	3.90	0.57	0.52	0.49	0.69	0.60	0.54
Town refuse	3.96	4.16	4.26	332	343	353	4.23	4.46	4.83	0.56	0.47	0.43	0.98	0.85	0.79
Sulphur	3.12	3.29	3.47	267	274	282	3.45	4.02	4.02	0.45	0.39	0.36	0.88	0.77	0.67
T R + S	3.59	3.89	4.01	289	302	315	4.21	4.54	4.64	0.46	0.41	0.36	1.11	0.99	0.89
LSD at 0.05	NS			NS			NS			NS			0.015		

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تحسين النمو والتركيب الكيماوى لنباتات الطماطم تحت الظروف البيئية الملحية.

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أجريت التجربة بزراعة نباتات الطماطم صنف كاسل روك تحت ظروف الأرض الكلسية الملحية بمنطقة راس سدر خلال موسمى النمو ١٩٩٥/١٩٩٦ و ١٩٩٦/١٩٩٧ . وكانت المعاملات كالآتى:

١. أربعة معاملات مصلحات تربة (مخلفات مدن بمعدل ٢٠ طن/ فدان ، كبريت زراعى بمعدل ٥٠٠ كجم/ فدان ، خلط بينهما بالإضافة إلى معاملة المقارنة).

٢. رش ورقى بإستعمال ثلاثة تركيزات للزنك (٠ ، ٠,٢ ، ٠,٤ %) فى صورة كبريتات زنك وثلاثة تركيزات للبوتاسيوم (٠ ، ٠,٢ ، ٠,٤ %) فى صورة أكسيد بوتاسيوم.

٣. التفاعل بين جميع المعاملات السابقة.

وقد أوضحت النتائج المتحصل عليها أنه:

- بالنسبة لصفات النمو لنباتات الطماطم فقد زادت معنويًا بإضافة مخلفات المدن أو الرش بالزنك بتركيز ٠,٤% أو أكسيد البوتاسيوم بتركيز ٠,٤% أو معاملة مخلفات المدن + ٠,٤% رش بالزنك .
- بالنسبة لمحتوى العناصر (نيتروجين ، فوسفور ، بوتاسيوم ، زنك) فى المجموع الخضرى لنباتات الطماطم فقد زادت معنويًا مع إضافة مخلفات المدن أو الرش بالزنك ٠,٤% أو أكسيد البوتاسيوم ٠,٤%.
- أعطت معاملة التفاعل بين مخلفات المدن + الكبريت الزراعى + ٠,٤% زنك أعلى تركيز لمحتوى الزنك فى نباتات الطماطم
- وقد لوحظ أن جميع المعاملات المستخدمة فى البحث أدت إلى نقص محتوى الصوديوم فى النباتات. وقد حققت المعاملة بالكبريت الزراعى أقصى إنخفاض لمحتوى الصوديوم فى النباتات عن باقى المعاملات.