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RESPONSE OF TOMATO ROOTS GROWTH TO SOME SALINE IRRIGATION WATER MANAGEMENT PRACTICES

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The present work intends to evaluate the influence of salinity, manner and application system of irrigation water on soil salinity and root growth of Super Marmande tomato cultivar. The experiment was carried out in the Agricultural Experimental Station of the Desert Research Center in Ras Sudr city located in South Sinai Governorate. The soil of such area is loamy sand, saline – non alkali. Water management practices include continuous application of water having either high (14.64dS/m) or low (7.16 dS/m) concentration, as well alternating or blending both types. Also, three systems of irrigation water viz; drip, subsurface drip and furrow were studied with influence on root length and tips. The results showed the following:

1) Drip irrigation was superior than other irrigation systems in alleviating salinity build up in the two soil layers under study. Higher salinity built up under furrow irrigation compared to the other systems. However, the practices of half amount of high salinity water followed by similar amount of low salinity water in each irrigation as well as the cyclic application resulted in the lowest salinity build up in the two studied layers of the soil profile. On the contrary, continuous application of irrigation water, resulted in relatively high salt accumulation in soil profile compared with the cyclic application.
2) Subsurface drip caused greater root length and proliferation as compared to other application systems. The cycling application of different water qualities attenuated the build up of high soil salinity and thus enhanced the root growth and proliferation.

Keywords: irrigation system, application of water salinity, root length, root tips.

In Egypt and many other parts of the world, water is the ultimate limiting factor for the agricultural expansion. Under such condition, i.e. limited supply of good-quality water and increasing demand by the overwhelming population, agriculture is forced to use more and more marginal quality water, either brackish or treated sewage effluent. Egypt has already in use about 5 billion m^3 of drainage and under ground water (Abu-Zeid, 1988). In the costal zones of Egypt aquifer is often subject to sea water intrusion, which affects the quality of water in the wells. Another risky condition, can be found in these cases that wells are located close enough to saline water underlying fresh water thereby over pumping can make such water intrude on the fresh one (Saad, 1982).In this context, many recommendations, and management practices were activated to facilitate the successful use of different water qualities. Among these are the sequential application of good and poor water quality (Rhoades, 1989), selection of the appropriate irrigation frequency and irrigation system (Meiri, 1989) and the selection of crops according with their tolerance to water quality, soil condition and the prevailing climate (Hamdy, 1990). The previous studies on the crop-salinity relationships have been based exclusively on the above ground or marketable crop yield (Maas 1990). Nevertheless, it may be important to evaluate the relationship between salinity and root growth. Therefore, the current work intends to evaluate the influence of water salinity management and application system on soil salinity and root growth of tomato "Super Marmande cultivar".

MATERIALS AND METHODS

This study was performed in the Agricultural Experiment Station of the Desert Research Center (DRC) in Ras Sudr City located on the Eastern Coast of Suez Gulf, South Sinai Governorate. The soil has a loamy sand texture throughout the 0 – 60 cm depth, with 87.8% sand, 7.7% silt and 4.5% clay. In such experiment, two water wells were drilled; water electrical conductivity in the first is 7.16 dS/m and the second is 14.64 dS/m. To minimize the amount of water extracted from the low salinity well and to maximize the utilization of high salinity water, the experiment was designed to include the following treatments;

Five strategies of water applications namely : 1) Irrigation with water having 14.64 dS/m (T_1) , 2) Irrigation with water having 7.16 dS/m (T_2), 3) Alternative in the coarse of each irrigation high salinity water and low salinity water in the rate of 1:1 (T_3) , 4) Cyclic application of T_1 and T_2 (T_4) and 5) Applying mixed water from the (T_1 & T_2) at a ratio of 1 : 2.

Three types of irrigation methods, viz., drip (D) ,subsurface drip (SD) and furrow (F). In all cases, the amount of irrigation water was controlled by

the consumptive use of tomato plant which was calculated from the meteorological variables and crop coefficient (Kc) using the modified Blaney-Criddle formula as recommended by Dorenboss and Pruitt (1997).In case of SD irrigation, the main, submain lateral and emitters were placed at a depth of 20cm from the soil surface. Meanwhile, in SD irrigation the laterals and emitters are placed on soil surface. In both methods, the distances between laterals and drippers are 1 and 0.5 m, respectively. The drippers are of in-line internal type with a discharge of 2.5 L/S at 0.5 atm.The interval between two consecutive irrigations was three and six days in the drip and F systems, respectively. Need to mention that in F irrigation an additional 30% of the total amount of irrigation water was applied to satisfy irrigation efficiency and leaching requirements. Seedlings of tomato "Supper Marmande" cultivar were transplanted in March 2001. At the fruiting stage, the root system of three selected plants from each treatment was collected, following the wet excavation method described by Bohm (1979). Thereafter, length and size- distribution as well as number of tips were determined using Rizo instrument Inc (Delta T image Analysis system Type DIAS). During the growing season, soil salinity of active root zone layer (0 – 40 cm) and the layer underneath (40 – 60 cm) were determined at May, June and August according to Richard' s (1954).

RESULTS AND DISCUSSION

Soil Salinity

Data illustrated in figs (1 and 2) show that, irrespective of the applied treatments, salt accumulation, except few cases exhibit the two studied layers of the soil profile. On the contrary, it is clear that continuous application of irrigation water, even upon using relatively low salinity water has resulted in relatively high salt accumulation in soil profile as compared to the cyclic application strategy. These findings are in agreement with Rhoades (1990). As for the irrigation system, the data point out-except few cases-that normal drip irrigation (D) is generally superior than other irrigation systems in alleviating salinity build up in the two soil layers under study, most probably due to downward water and salt transport . Meanwhile, in case of SD irrigation system there are upward movements of water and salts which may contribute to the relative increase in salt accumulation in the soil. However, higher salinity build up under F irrigation compared to the other systems could be explained on the basis that the applied amount saline water using such method was higher than those applied by other systems.

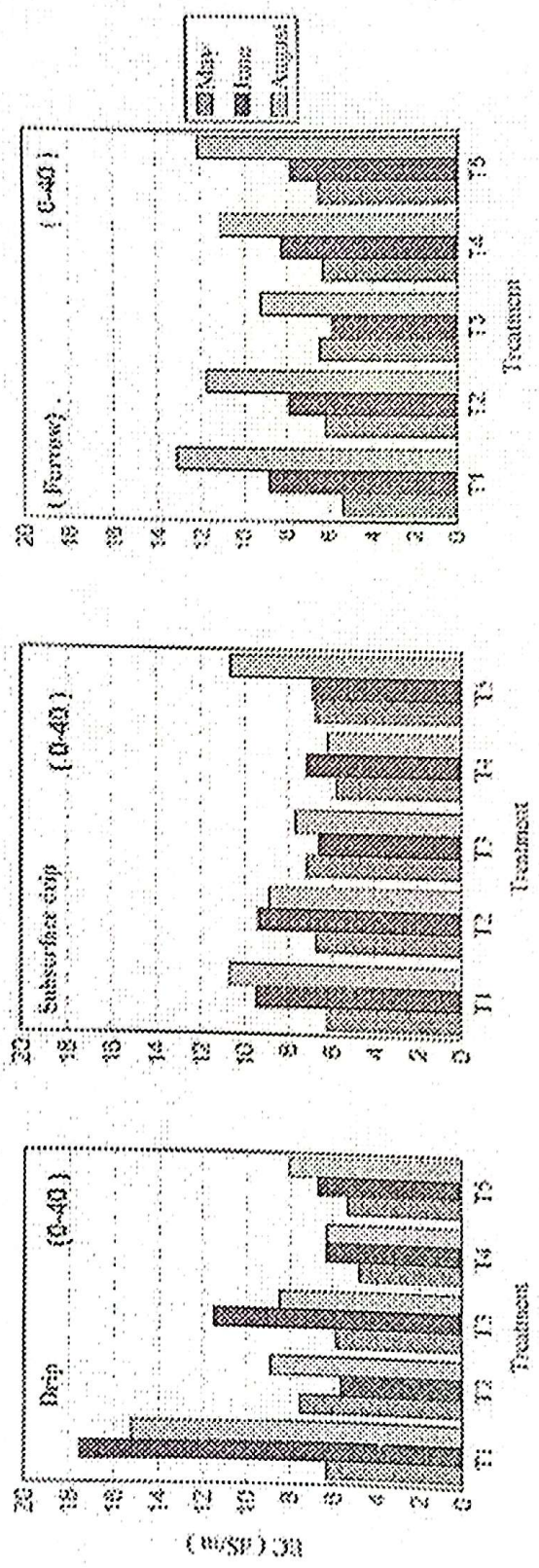


Fig. (1). Soil salinity of the surface soil layer (0-40 cm) at different periods during Tomato growth season under the applied treatment.

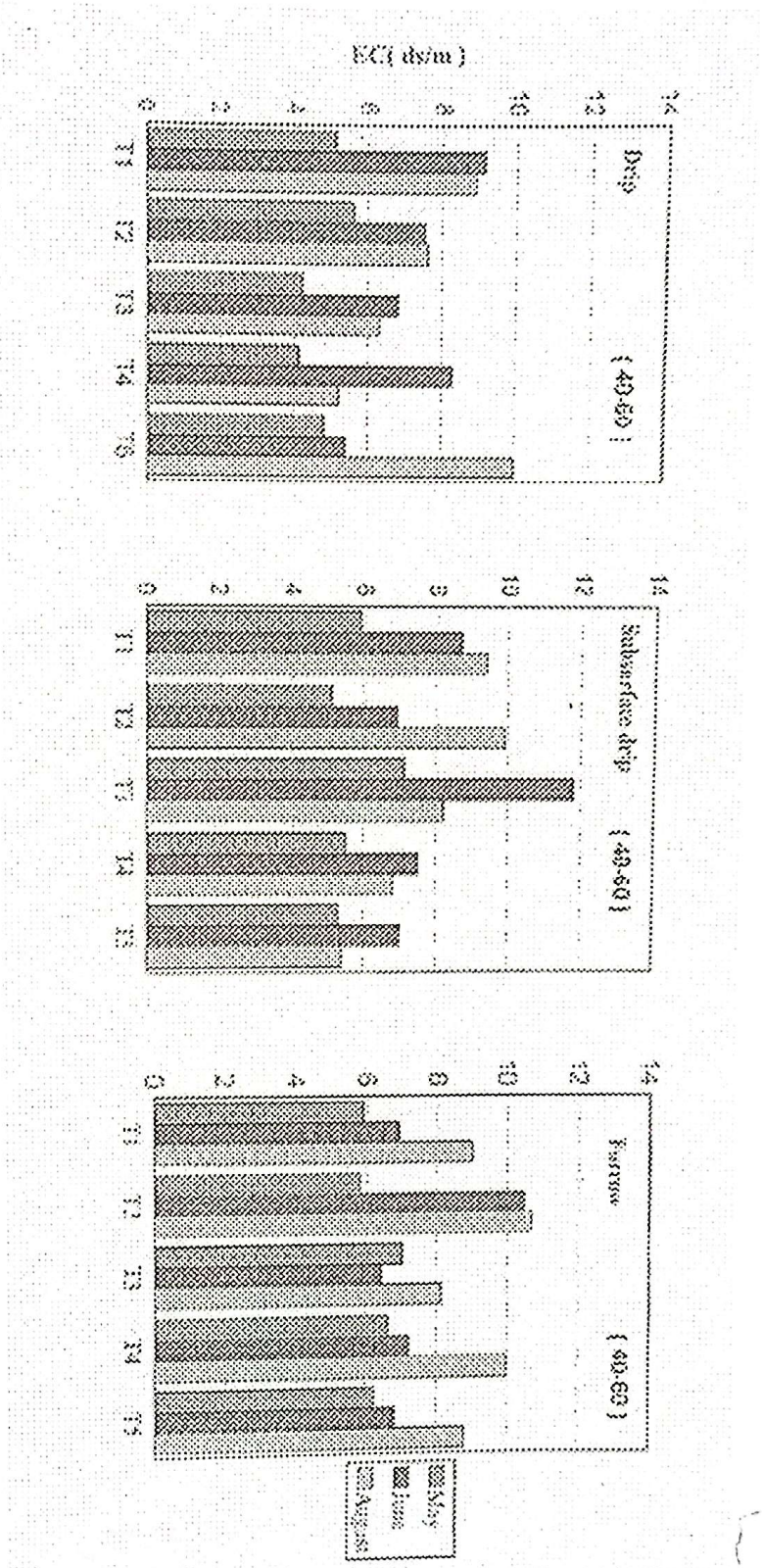


Fig. (2). Soil salinity of the subsurface soil layer (40-60 cm) at different periods during Tomato growth season under the applied treatment.

Root Growth

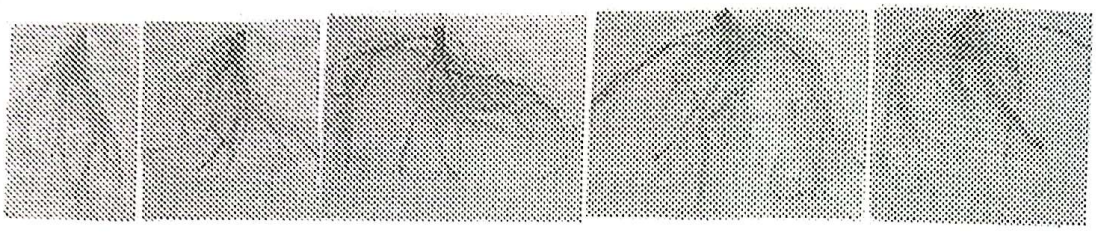
Table (1) plate (1) and figs. (3 and 4) display the influence of the applied treatments on the most important root growth parameters, i.e., length, size-distribution and proliferation. The data indicate that under any irrigation system the increase in salt concentration of irrigation water has resulted in pronounced decrease in the total root length, and the number of root- tips (branching). As for the management, it is evident that under any irrigation system alternating the use of high salinity water and low salinity water i.e., T_3 and T_4, the dilution occurring in the root has resulted in the best root length and branching. This behavior can be attributed to the fact that changing high salinity water to low salinity water causes significant salt leaching and attenuates salt build up in the root zone thereby increasing the root growth and branching. Such effect is less pronounced upon blending the two water sources in the water supply before application. For the irrigation system, it is evident that except very few cases subsurface drip caused greater root length and proliferation as compared to the other systems. In such case, the drippers were placed at a depth of 20 cm from the soil surface, i.e., within the root zone.

In conclusion the cycling application of different water qualities attenuates the build up of high soil salinity and thus enhances the root growth and proliferation. This encourages the use of saline water, particularly in those areas suffering from water shortage, such as Ras Sudr, South Sinai Governorate, Egypt.

TABLE (1). Length and number of tips of tomato cultivar and their several size distribution under the studied treatments of saline water.

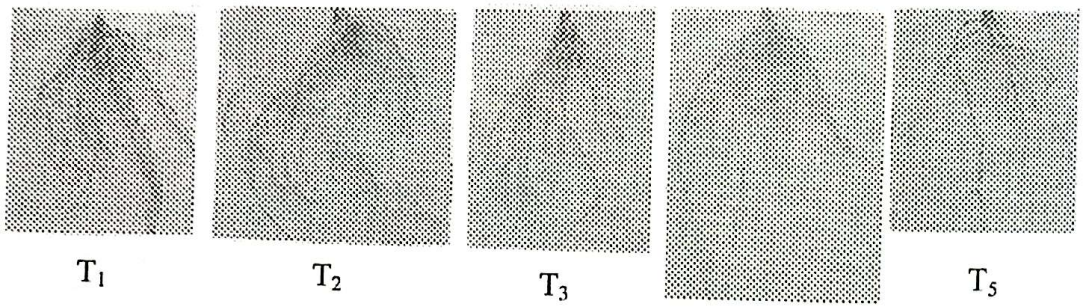
Treatments	Studied Parameter	Drip				Subsurface Drip				Furrow			
		(0-2) mm	(2-3.5) mm	(3.5-5) mm	Total	(0-2) mm	(2-3.5) mm	(3.5-5) mm	Total	(0-2) mm	(2-3.5) mm	(3.5-5) mm	Total
T1	Length No. of Tips	402.92 3545	56.31 13	64.38 16	636.8 3819	137.11 3227	60 7	60 16	137.11 3860	257.25 1279	22.24 3	30.68 06	334.57 1282
T2	Length No. of Tips	386 2424	34.6 3	21.32 7	422.91 2433	431.34 3872	20.68 11	78.67 5	548.73 3828	186.36 1339	29.40 8	41.51 3	258.38 1431
T3	Length No. of Tips	583.53 4880	36.91 19	75.86 2	852.73 4502	484.3 5818	28.5 15	48.32 13	572.93 5244	311.38 3646	36.93 2	42.58 10	387.02 2095
T4	Length No. of Tips	708.84 4423	87.58 25	130 10	903.9 4068	1010.24 4475	65.83 4474	78.18 13	758.22 8	154.41 4439	8.35 1543	34.85 8	237.81 1542
T5	Length No. of Tips	386 4225	30.39 7	22.84 7	426.51 1838	470 3583	68.82 13	70.21 12	638.53 3558	178 1330	34.11 8	34.72 8	250.48 1383

Drip Irrigation System



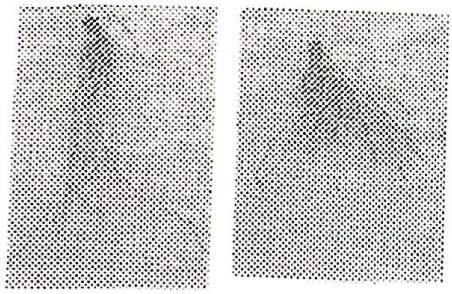
T_1 T_2 T_3 T_4 T_5

Sub-surface Drip Irrigation System



T_1 T_2 T_3 T_4 T_5

Furrow Irrigation System



T_1 T_2 T_3 T_4

Plate (1). Influence of different irrigation systems on root growth.

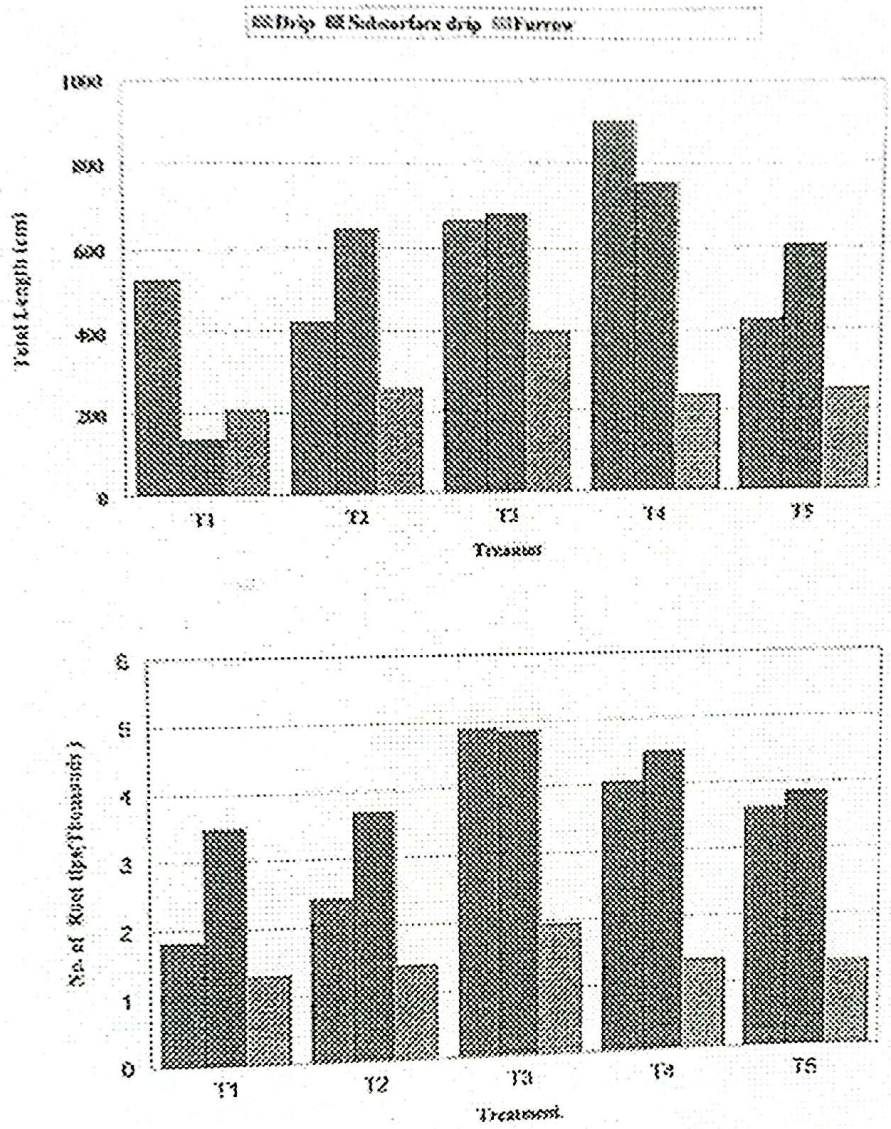


Fig. (3). Total Root Length (cm) and total No. of Root Tips (thousands) of Tomato plants under different irrigation systems.

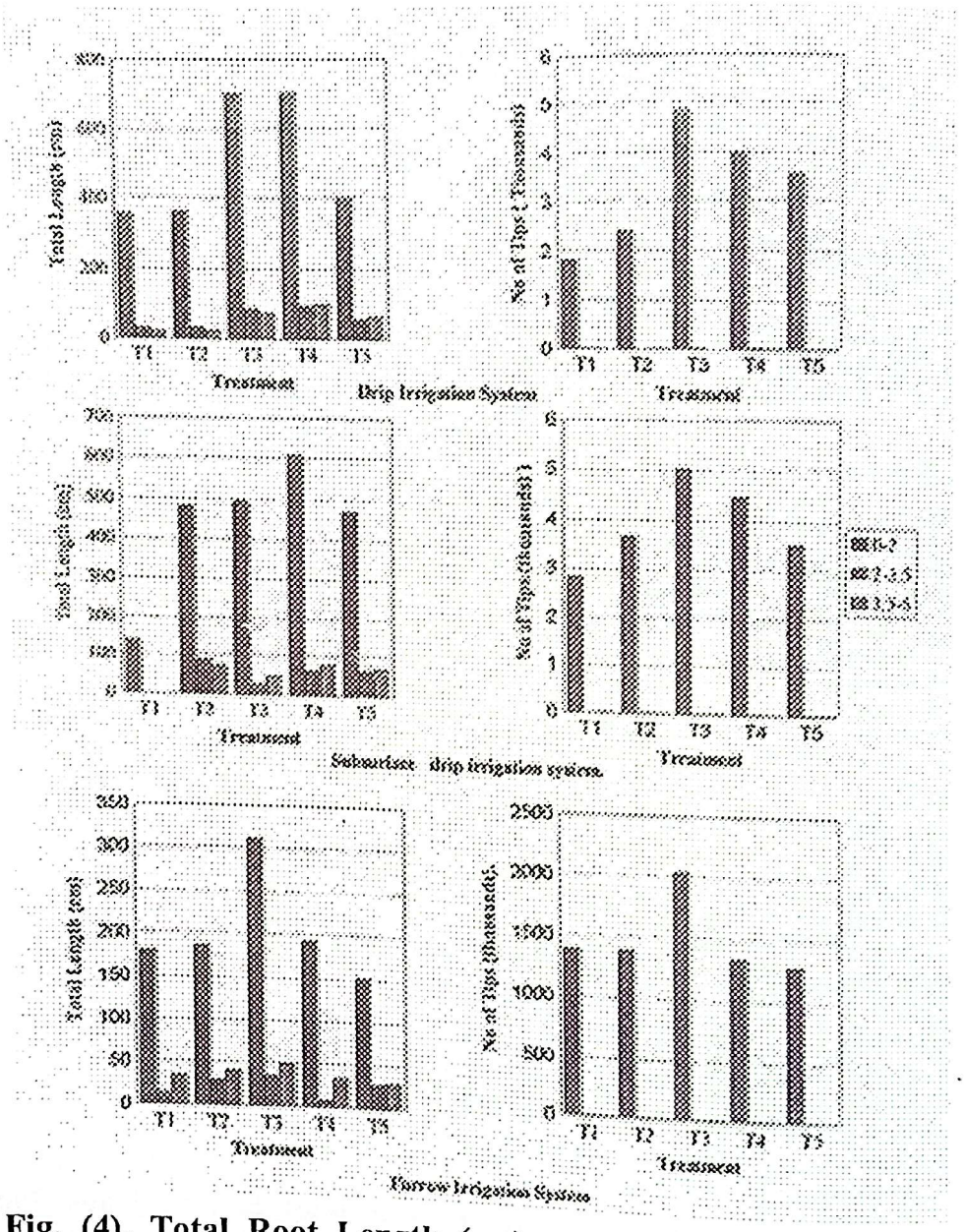


Fig. (4). Total Root Length (cm) and total No. of Root Tips (thousands) of Tomato plants under different irrigation systems.

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استجابة نمو جذور الطماطم لبعض تطبيقات نظم الرى والمعاملات المختلفة بالماء المالح

هدى محمد سعيد
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أستهدفت الدراسة التعرف على اثر تطبيق نظم مختلفة من الرى بالماء المالح على نمو جذور الطماطم صنف "سوبرمرماند" وأجريت التجربة بمحطة التجارب الزراعية التابعة لمركز بحوث الصحراء برأس سدر بجنوب سيناء .
دلت نتائج تحليل التربة التى أجريت بها التجربة على أنها تربة جيرية – ملحية غير قلوية – ذات قوام رملى طفلى .
أستخدمت ثلاثة نظم رى مختلفة وهى الرى بالتنقيط والرى تحت سطحى والرى بالغمر .
طبقت معاملات مختلفة من طرق الأضافة كما يلى:

١. الرى بمياة مرتفعة الملوحة ١٤،٦٤ ديسمز/م
٢. الرى بمياة منخفضة الملوحة ٧،١٦ ديسيمز/م
٣. الرى التتابعى (الرى بمياة عالية الملوحة نصف الكمية ثم الرى بالمياة منخفضة الملوحة بنصف الكمية الباقية)
٤. الرى التبادلى (وفيه يتم بالتبادل مرة بالرى عالى الملوحة والرية التالية بالرى منخفض الملوحة)
٥. الرى المخلوط (حيث يتم خلط المياة عالية الملوحة مع المياة منخفضة الملوحة بنسبة ١:٢

وقد أمكن التوصل الى النتائج التالية :-

- كان الرى بالتنقيط هو أفضل النظم المستخدمة بالمقارنة بالطرق الأخرى حيث أدى الى تقليل تأثير الملوحة المتكونة فى الطبقتين تحت الدراسة فى التربة.
- وجد أن أعلى نسبة ملوحة تكونت تحت نظام الرى بالغمر.
- دلت نتائج طرق الأضافة على أن معاملة الرى التتابعى أو التبادلى تؤدى الى أنخفاض كمية الملوحة المتكونة بقطاع التربة تحت الدراسة.
- أعطى نظام الرى التحت سطحى (المدفون) أعلى قيم لأطوال الجذوروذلك بالمقارنة بالطرق الأخرى.