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Effect of saline irrigation water on yield and yield attributing characters of tomato (*Solanum lycopersicum* L.) varieties

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Abstract
Salinity is one of the most important factor limiting fruit growth and production of several horticultural crops. A pot experiment was undertaken during *Rabi* 2017-18 at Department of Agricultural Chemistry & Soil Science, JAU, Junagadh in order to investigate the effect of different levels of saline irrigation water on yield and yield attributing characters of tomato (*Solanum lycopersicum* L.) varieties. The experiment consists of four salinity levels *viz.*, < 2.0, 4.0, 6.0 and 8.0 dS m^{-1} with four different varieties *viz.*,V_1: GT-6, V_2: JT-3, V_3: AT-3 and V_4: DVRT-2 of tomato. Results reported that saline water treatments significantly reduced the vegetative growth parameters and hence total yield of tomato. The yield and yield attributing characters were also significantly influenced by different tested varieties of tomato and recorded highest yield with V_1 (GT-6) variety.

Keywords: Salinity levels, varieties, tomato, growth, yield and yield attributes

Introduction
Tomato is one of the most important horticultural crops in the world and in terms of human consumption and health, it is a major component of daily meals and constitutes valuable vitamins (A & C), minerals, organic acid, fibres and considered as protective food due to its high nutritive value. Tomato plants require high temperatures and high photosynthetic active radiation for optimum production. As these conditions are typical of arid and semi-arid regions where irrigation water is usually limited and often saline. According to FAO guideline (Ayers and Westcot, 1989) [2], tomato is moderately salinity tolerant and could act as a model crop for saline water use because it's already grown in large areas with saline conditions, and also there is wealth of important knowledge of the physiology and genetics of this species (Cuartero and Fernandez-Munoz, 1999) [4]. Unfavourable growing conditions and improper selection of varieties are some of the important constraining factors which limits its production. However, under stress conditions by selecting suitable tomato varieties and regulation of growing environment, it could be possible to harvest better crop yield. The objective of present work was to investigate the effect of saline irrigation water on yield and yield attributing characters of tomato varieties.

Materials and Method
A pot experiment conducted in the net house of Department of Agricultural Chemistry and Soil Science, JAU, Junagadh during *Rabi* 2017-18. The soil of experimental area was silty clayey in texture and alkaline in reaction. The experiment undertaken consists of 16 treatments combinations comprising four levels of salinity water *viz.* < 2.0, 4.0, 6.0 and 8.0 dS m^{-1} and four levels of varieties *viz.* V_1: GT-6, V_2: JT-3, V_3: AT-3 and V_4: DVRT-2 laid out in factorial CRD with 3 replications. All forty eight pots were filled with each soil bulk of 15 kg. The required quantity of N @ 37.5 kg ha^{-1} P_2O_5 @ 37.5 kg ha^{-1} and K_2O @ 62.5 kg ha^{-1} applied to all the pots as basal dose in the form of Urea, DAP and MOP, respectively. Remaining quantity of 37.5 kg ha^{-1} applied at 30 DAT in form of urea. Three seedling of tomato were transplanted in each pot and later two healthy seedlings per pot were maintained for recording observations. The pots were uniformly irrigated with saline water as per treatments and with

fresh water as control and as when crop required irrigation throughout the cropping season. While for the preparation of different levels of saline water, sea water of EC 55 dS m^{-1} was diluted with rain water in order to prepare 4.0, 6.0 and 8.0 dS m^{-1} levels of salinity. All collected data of various parameters were statistically analysed using F' test (Panse and Sukhatme, 1985) [7].

Results and Discussion

Yield parameters

Data pertained in table 1 shows significant influence of different levels of saline water among different varieties on fruit and stalk yield which found decreasing with increased level of salinity. Significantly higher fruit and stalk yield recorded under S_1 (< 2.0 dS m^{-1}) salinity level. However, variety V_1 (GT-6) registered highest value of fruit yield (133.16 g $plant^{-1}$), variety V_3 (AT-3) recorded highest stalk yield (176.33 g $plant^{-1}$). The interaction effect on fruit and stalk yield (Table 2 and 3) was also found statistically significant with treatment combinations V_1S_1 (GT-6 X < 2.0 dS m^{-1}) and V_3S_1 (AT-3 X < 2.0 dS m^{-1}), respectively. Yield reductions caused by salinity may be due to both the osmotic stress and specific toxicity which provokes wide range of physiological and biochemical alterations which in turn inhibit plant growth and yield. These results are in conformity with the findings of Mitchel *et al*. (1991) [6], Babu and Thirumurugan, (2001), Yurtseven *et al*. (2005) [11] and Turhan *et al.* (2009) [9].

Growth and Yield attributing Characters

The data (Table 1) with regards to the yield attributing characters like plant height, number of branches per plant, number of fruits per plant and average fruit weight were significantly influenced by salinity and varieties and higher value of those parameters noted with S_1 (< 2.0 dS m^{-1}) salinity level, due to the fact that young plants were more sensitive to saline conditions. Here among the four different varieties, V_3 (AT-3) variety reported highest plant height (66.42 cm) and no. of branches per plant (5.92) while highest no. of fruits per plant (6.58) and avg. fruit weight (23.25 g) were observed with variety V_4 (DVRT-2) and V_2 (JT-3) respectively. The reduction in growth could be a result of salinity, which cause water stress due to osmotic effects and disturbs the physiology of plants by changing the metabolism of plants (Garg *et al*., 2002) [5], causing cell injury in transpiring leaves, thus reducing growth of plant (Munns, 2005) [7]. Mitchel *et al*. (1991) [6] revealed the reason for reduction in fruit growth or fruit weight caused by salinity could be due to a lower supply of nutrients and water to the fruit during its development more than to a deficit in the supply of mineral ions, organic acids or starch. Adams and Ho (1989) [1] stated that the effect of salinity in reducing the yield of tomato plant was due to a reduction in both tomato fresh weight and fruit number per plant.

Table 1: Effect of saline irrigation water and varieties on yield, yield attributing characters of tomato

Treatments	Yield attributing characters					
	Fruit yield (g $plant^{-1}$)	Stalk yield (g $plant^{-1}$)	Plant height (cm)	No. of branches/ plant	No. of fruits/ plant	Average fruit weight (g)
Salinity (S)						
S_1:< 2.0 dS m^{-1} (tap water)	153.38	159.42	71.46	6.77	7.04	23.50
S_2: 4.0 dS m^{-1}	134.52	146.00	62.75	5.88	6.54	21.61
S_3: 6.0 dS m^{-1}	101.09	128.33	57.21	5.38	5.63	17.60
S_4: 8.0 dS m^{-1}	84.87	107.92	44.50	4.89	4.58	15.95
S.Em. ±	2.21	1.97	1.15	0.10	0.11	0.36
C.D. (P=0.05)	6.37	5.67	3.30	0.29	0.33	1.04
Variety (V)						
V_1: GT-6	133.16	130.83	53.25	5.47	6.29	21.28
V_2: JT-3	126.87	126.67	55.58	5.73	5.25	23.25
V_3: AT-3	110.03	145.00	66.42	5.92	5.67	19.02
V_4: DVRT-2	103.80	139.17	60.67	5.79	6.58	15.11
S.Em. ±	2.21	1.97	1.15	0.10	0.11	0.36
C.D. (P=0.05)	6.37	5.67	3.30	0.29	0.33	1.04
S x V Interaction						
S.Em. ±	4.42	3.94	2.29	0.20	0.23	0.72
C.D. (P=0.05)	12.73	11.35	6.60	NS	0.65	2.09
C.V. %	6.46	5.04	6.73	6.09	6.59	6.38

Table 2: Interaction effect of salinity and varieties on fruit yield (g $plant^{-1}$) of tomato

	S_1:< 2.0 dS m^{-1}	S_2: 4.0 dS m^{-1}	S_3: 6.0 dS m^{-1}	S_4: 8.0 dS m^{-1}	Mean
V_1: GT-6	165.33	158.15	106.90	102.24	133.16
V_2: JT-3	162.00	146.77	103.13	95.58	126.87
V_3: AT-3	153.17	108.70	102.67	75.58	110.03
V_4: DVRT-2	133.00	124.47	91.67	66.07	103.80
Mean	153.38	134.52	101.09	84.87	
S.Em. ±	4.42		C.D. (P=0.05)	12.73	

Table 3: Interaction effect of salinity and varieties on stalk yield (g plant^{-1}) of tomato

	S_1:< 2.0 dS m^{-1}	S_2: 4.0 dS m^{-1}	S_3: 6.0 dS m^{-1}	S_4: 8.0 dS m^{-1}	Mean
V_1: GT-6	147.33	139.00	129.67	107.33	130.83
V_2: JT-3	146.67	133.33	115.67	111.00	126.67
V_3: AT-3	176.33	160.00	136.00	107.67	145.00
V_4: DVRT-2	167.33	151.67	132.00	105.67	139.17
Mean	159.42	146.00	128.33	107.92	
S.Em. ±	3.94		C.D. (P=0.05)	11.35	

Conclusion

From the above results, it can be concluded that tomato variety V_1 (GT-6) exhibited its superiority for fruit yield. Tested varieties of tomato exhibited significant variation in terms of growth and yield attributes *viz*, stalk yield, plant height, no. of branches per plant, no. of fruits per plant and average fruit weight in an inconsistent manner which might be due to their genetic traits. As a successful salt tolerant cultivar should exhibit salt tolerance without compromising its yield potential, variety V_1 (GT-6) was found quite tolerant to salinity as compared to other tested varieties of tomato. Overall, relative tolerance of tested tomato varieties in sequential order as follows: GT-6 > JT-3 > AT-3 > DVRT-2 against saline irrigations upto EC 8.0 dS m^{-1}. Our results are in concordance with the findings of Vadaliya *et al*. (2019) [10] having similar work with sesame crop.

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