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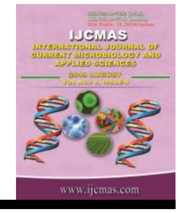

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Influence of Different Irrigation Methods and Water Salinity Levels on Tomato (*Solanum lycopersicum*) Growth under Vertisols of Tungabhadra Project Command

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A B S T R A C T

The field experiment was carried out at Agricultural Research station, Gangavathi (Karnataka), during 2018-19 and 2019-20 to study the influence of M_0–furrow, M_1–surface drip and M_2–subsurface drip irrigation techniques and irrigation salinity levels of S_0–0.65 dS m^{-1} (normal water), S_1–2 dS m^{-1}, S_2–3 dS m^{-1}, S_3–4 dS m^{-1} and S_4–5 dS m^{-1} on tomato (*Solanum lycopersicum*) growth parameters under Vertisols of Tungabhadra Project Command. During two years, the growth attributes such as plants per treatments, plant height during 30, 60, 90 and 120 days after transplanting (DAT), number of branches per plant during 30, 60, 90 and 120 DAT, number of fruits were significantly influenced by the different irrigation techniques and different irrigation saline water levels. The maximum number of plants per treatments, plant height and number of branches per plant during 30, 60, 90 and 120 DAT were recorded higher under subsurface and surface drip as compared to furrow irrigation except plant height during 30 DAT. Similarly, under different irrigation saline water levels, maximum number of plants, plant height and branches were recorded under 0.65 dS m^{-1} and 2 dS m^{-1} treatment and least was recorded in 5 dS m^{-1} treatment. From the study it was concluded that the growth of tomato was good under subsurface drip and surface drip as compared to furrow irrigation under main treatments and under sub treatments, 0.65 and 2 dS m^{-1} treatments performed better as compared to higher salinity levels. Whenever there is shortage of fresh water, saline water upto 2 dS m^{-1} can be used to grow tomato without much effect on the crop growth.

Introduction

The world's oceans may seem unbounded, the amount of fresh water virtually available to the mankind is the most finite. The fresh water is about 2.5 per cent (3.5 crore km^3) of the total global waters which is distributed in glaciers and snow lakes (69%), lake and rivers (0.3%). The salt water is about 97.5 per cent (136.5 crore km^3) of which 0.7% in the form of soil moisture and 30% as ground water. Human use of fresh water has increased more than 35 fold over the past three centuries. The inland saline water has now great potential for the use in irrigation which the application of the adaptable water use technologies as a non conventional water resource (Gleick, 1993). Saline water irrigation is practiced in several regions of the world (Rhoades *et al*, 1992), where water scarcity prevents the use of freshwater for irrigation. Poor quality water constitutes 32-84% of ground water surveyed in different parts of India is related either saline or alkali (Minhas, 1996).

If saline water is skillfully used for irrigation, it can be beneficial for agricultural production, particularly in fruits and vegetables. The successful use of low quality water requires the selection of salt tolerant crops, and the application of a suitable water management strategy. There is a necessity of development of proper irrigation management practices like drip irrigation techniques, so that poor quality saline water can be used with minimum adverse effect on crop yield.

Surface drip irrigation (SD) and subsurface drip irrigation (SDI) methods can be very effective in applying irrigation without leaf wetting.

Of course, more advanced irrigation technologies such as SDI can offer greater achievable irrigation application efficiency and distribution uniformity. In SDI, small amount of water is applied to the soil through the drippers placed below the soil surface with discharge rates same as surface drip irrigation. Subsurface drip irrigation helps in reducing the evaporation loss, very little interference with cultivation or cultural practices, possible increase in longevity of laterals and drippers, increases water use efficiency, saves labour and water saving of up to 30-70%. It can also be used in hilly regions and on saline or alkali soils (Mane *et al.*, 2008).

During the last few years, irrigated tomato has been expanding rapidly in the semi-arid part of Karnataka around shallow to deep wells having a salinity of more than 2 dS m^{-1} with normal irrigation methods. This leading to land becomes more prone to the salt affected. Tomato is considered moderately sensitive to salt stress, since it can tolerate an ECe (EC of the saturated soil extract) of about 2.5 dS m^{-1} and fruit yield decrease by 10% with each unit of ECe increasing above the threshold value (Maas, 1986; FAO, 2005). Campos *et al.*, (2006) stated that the maximum soil salinity level tolerated by tomato is 2.5 dS m^{-1}, without reduction in the growth. However, there is no much information available on the effect of different irrigation techniques under saline water growth of tomato crop in Vertisols under TBP command area. Therefore to see the influence of different irrigation methods and use of different saline water levels on growth of tomato, a study has been conducted.

Materials and Methods

Description of study area

The experiment was carried out at Agricultural Research Station (A.R.S), Gangavathi. The site is located in Koppal district of Karnataka state of India and falls in the Northern Dry Zone viz., Zone-III of agro ecological region 6 in the state. The field's location corresponds to 15^0 27' 22.15" N latitude and 76^0 31' 54.83" E longitudes with elevation of 423.17 m above mean sea level (msl). According to the data at Meteorological Department of the A.R.S, Gangavathi, the mean annual rainfall based on 38 years record (1979-2015) is 530.9 mm (Anon., 2017). Although, monsoonal climate sets in early June, rains during September-October (North-east) are more assured in this region. Normally dry weather prevails over entire summer months with hottest period observed during April-May. During the first year of study period, the total rainfall was 112.1 mm and out of it, 107.9 mm was in the month of May, 2018 and during second season, the total rainfall was only 13.2 mm (3.6 mm in January and 9.6 mm in February month, 2019). The maximum open pan evaporation of 6.0 mm day^{-1} was recorded in the months of March, 2018 and April, 2018 with the minimum evaporation of 0.9 mm day^{-1} in the month of January, 2018. During second year, the maximum open pan evaporation of 6.0 mm day^{-1} was recorded in the month of April, 2018 and the minimum evaporation of 1.0 mm day^{-1} in the month of December, January, February and March, 2019.

The texture of the soil was determined by international pipette method. The soils texture of the study area is classified as clay with 33.6 per cent sand, 22.6 per cent silt and 43.8 per cent clay at 0-30 cm depths, 25.1 per cent sand, 27.6 per cent silt and 47.3 per cent clay at 30-60 cm depths and 17.5 per cent sand, 27.2 per cent and 55.3 per cent clay at 60-90 cm depths. The density of soil was found to be 1.26, 1.25 and 1.23 g cm^{-3} at 0-30, 30-60 and 60-90 cm depths respectively. The irrigation water used for experiment was from irrigation pond water, where water was stored through the field channels of seventeen distributory, left bank canal of TBP command. This water was analyzed for pH and EC and was found to be 7.10 and 0.65 dS m^{-1} respectively.

The three different irrigation techniques and five different saline levels of irrigation water were kept as main and sub treatments respectively. The main treatments were M_0–Furrow irrigation, M_1–Surface drip irrigation and M_2–Subsurface drip irrigation and sub treatments were S_0–Normal (0.65 dS m^{-1}) water, S_1–2 dS m^{-1}, S_2–3 dS m^{-1}, S_3–4 dS m^{-1} and S_4–5 dS m^{-1}. Four water tanks (2, 3, 4 and 5 dS m^{-1}) of 2000 liter capacity and one tank (normal water i.e. 0.65 dS m^{-1}) with a capacity of 2500 liter were installed on 8.0 (L) x 2.4 (W) m cement concrete platform. The filtered water was connected to five water tanks with separate control valves for filling.

After filling up the tanks, a known quantity of sodium chloride (NaCl) was calculated and added (Soria and Cuartero, 1998) to get desired ECiw of saline water of 2, 3, 4 and 5 dS m^{-1} as per the calculation procedure given by Bibha Rani and Sharma (2015). Every time after adding NaCl to the tanks, the irrigation water was thoroughly mixed. Under subsurface drip treatment, drip laterals were buried at a depth of 20 cm below the ground. The Tomato nursery plants were sown with plant to plant and row to row distance of 0.4 and 1.2 m respectively. To meet the nutrient requirement and as per the recommended dose of fertilizer, the nitrogen, phosphorus and potassium at the rate 250:250:250 kg ha^{-1} were supplied from the different fertilizers through manually for furrow irrigated plots and the water soluble fertilizers like Urea, 19:19:19, KNO_3 and $CaNO_3$ were applied in splits through irrigation using fertilizer injection system (Venturi) for drip irrigated treatments at different growth stages. All agronomic practices except method of irrigation and application of fertilizer were kept same in all treatments. Manual weeding was done two times during the crop cycle.

Tomato growth attributes

The different observations were recorded during growth period of tomato crop for two years (Two seasons). After one month, a well established tomato plants were counted and noted for all the treatments to know the influence of different treatments on plant population. Plant height was recorded at intervals of 30, 60, 90 and 120 days after transplanting (DAT). Height was measured from the base of the plant to the top of the plant with the help of meter scale. Five plants were tagged at random in each treatment for recording the number of branches at an interval of 30 days from the date of transplanting. Number of branches per plant was counted at 30, 60, 90 and 120 DAT. Average number of branches was calculated. Total number of fruits per plant was recorded from each tagged plants during every picking. After the final harvest, the numbers of fruit picked from individual plots were totaled.

Results and Discussion

Every time after filling up of the water tanks, a known quantity of salt (NaCl) were added to obtain desire level of salinity and different saline water was applied through furrow, surface drip and subsurface drip irrigation methods to different treatments. The results of growth parameters of tomato which are influenced by different irrigation techniques and saline water levels were discussed below

Number of established plants

During first season, among different irrigation techniques, significantly higher established plants were observed in M_2 (36.6) treatment followed by M_1 (36.47) and least in M_0 (35.33). In different irrigation water salinity levels, significantly higher plants were observed in S_0 (37.11) followed by S_1 (36.89) and least in case of S_4 (34.33).

Interaction effect showed no significant effect. During second season of the crop, significantly higher established plants were observed in M_2 (36.53) treatment followed by M_1 (36.40) and least in M_0 (35.33). In different irrigation water salinity levels, significantly higher plants were observed in S_0 (37.33) followed by S_1 (37.22) and least in case of S_4 (34.0). Interaction effect found to be non significant (Table 1).

Plant height

In general, height of the plants across the growth stages showed increasing trend irrespective of irrigation technique and irrigation saline water levels (Table 2 and 3) in both the season. The pooled data of two season shows that at 30, 60, 90 and 120 DAT, M_2 (55.45, 84.42, 106.94 and 111.03 cm respectively) recorded significantly higher plant height followed by M_1 (54.37, 82.71, 105.97 and 110.51 cm respectively) and least in case of M_0 (50.41, 75.50, 98.94 and 100.29 cm respectively). Among irrigation salinity levels, height of the plant varied significantly at all four stages of the crop. The treatment S_0 recorded significantly higher plant height (58.31, 85.66, 112.25 and 116.13 cm respectively) followed by S_1 (56.78, 83.73, 111.61 and 115.5 cm respectively) and least in case of S_4 (47.62, 74.28, 88.81 and 95.45 cm, respectively). The highest salinity levels of irrigation reduced the plant height as compared to normal water. The above findings were in proximity with Malash *et al.*, 2005. The interaction effect found to be non significant (Table 2 and 3).

Number of branches per plant

The pooled data of two season indicates that at 30, 60, 90 and 120 DAT, M_2 recorded significantly higher branches (7.2, 11.71, 15.53 and 17.47 per plant, respectively) followed by M_1 (7.16, 11.57, 14.98 and 17.25 per plant respectively) and least in case of M_0 (6.62, 10.41, 12.76 and 14.54 per plant respectively). Among irrigation salinity levels, yield levels, number of branches varied significantly at all four stages of the crop. The treatment S_0 recorded significantly higher branches (7.94, 12.64, 15.97 and 18.23 respectively) followed by S_1 (7.71, 12.18, 15.86 and 18.1 respectively) and least in case of S_4 (5.96, 9.99, 12.78 and 14.57 per plant, respectively). The interaction effect found to be non significant (Table 4 and 5).

Table.1 Number of established plants per treatment and number of fruits as influenced by different irrigation techniques and saline water

Treatment details	Number of plants per treatment			Number of fruits per plant		
	2018	2019	Pooled	2018	2019	Pooled
Irrigation techniques (M)						
M_0	35.33	35.33	35.33	47.20	45.73	46.47
M_1	36.47	36.40	36.43	58.47	57.40	57.93
M_2	36.60	36.53	36.57	59.20	58.13	58.67
SE m ±	**0.04**	**0.05**	**0.04**	**0.32**	**0.37**	**0.26**
C.D (p=0.05)	**0.11**	**0.15**	**0.11**	**0.94**	**1.07**	**0.75**
Irrigation saline water levels (S)						
S_0	37.11	37.33	37.22	62.11	61.11	61.61
S_1	36.89	37.22	37.06	60.89	59.78	60.33
S_2	36.44	36.22	36.33	54.44	53.67	54.06
S_3	35.89	35.67	35.78	52.56	51.22	51.89
S_4	34.33	34.00	34.17	44.78	43.00	43.89
SE m ±	**0.07**	**0.09**	**0.08**	**0.47**	**0.71**	**0.52**
C.D (p=0.05)	**0.21**	**0.26**	**0.23**	**1.35**	**2.04**	**1.49**
Interaction (MxS)						
$M_0 S_0$	36.67	36.67	36.67	53.00	52.00	52.50
$M_0 S_1$	35.67	36.00	35.83	51.67	50.33	51.00
$M_0 S_2$	35.67	35.67	35.67	49.33	47.67	48.50
$M_0 S_3$	35.00	35.00	35.00	45.33	44.00	44.67
$M_0 S_4$	33.67	33.33	33.50	36.67	34.67	35.67
$M_1 S_0$	37.00	37.33	37.17	66.33	65.33	65.83
$M_1 S_1$	37.33	37.67	37.50	65.33	64.33	64.83
$M_1 S_2$	36.67	36.33	36.50	56.33	56.33	56.33
$M_1 S_3$	36.67	36.33	36.50	56.00	54.33	55.17
$M_1 S_4$	34.67	34.33	34.50	48.33	46.67	47.50
$M_2 S_0$	37.67	38.00	37.83	67.00	66.00	66.50
$M_2 S_1$	37.67	38.00	37.83	65.67	64.67	65.17
$M_2 S_2$	37.00	36.67	36.83	57.67	57.00	57.33
$M_2 S_3$	36.00	35.67	35.83	56.33	55.33	55.83
$M_2 S_4$	34.67	34.33	34.50	49.33	47.67	48.50
SE m ±	**0.22**	**0.27**	**0.24**	**1.41**	**2.12**	**1.55**
C.D (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Note: M_0: Furrow Irrigation; M_1: Surface drip; M_2: Subsurface drip
S_0: Normal water (ECiw=0.65 dS m^{-1}); S_1: ECiw=2.0 dS m^{-1}; S_2: ECiw=3.0 dS m^{-1}
S_3: ECiw=4.0 dS m^{-1}; S_4: ECiw=5.0 dS m^{-1}

Table.2 Average plant height of tomato as influenced by different irrigation techniques and saline water during 30 and 60 DAT

Treatment details	Average plant height (cm) -30 DAT			Average plant height (cm)-60 DAT		
	2018	2019	Pooled	2018	2019	Pooled
Irrigation techniques (M)						
M_0	51.20	49.61	50.41	79.33	71.67	75.50
M_1	55.40	53.33	54.37	84.36	81.06	82.71
M_2	56.17	54.73	55.45	85.61	83.23	84.42
SE m $\pm$	**0.38**	**0.38**	**0.36**	**0.31**	**0.59**	**0.43**
C.D (p=0.05)	**NS**	**NS**	**NS**	**0.90**	**1.69**	**1.23**
Irrigation saline water levels (S)						
S_0	58.82	57.80	58.31	87.53	83.78	85.66
S_1	57.26	56.31	56.78	85.49	81.98	83.73
S_2	54.59	52.51	53.55	84.72	78.53	81.63
S_3	51.67	49.88	50.77	80.93	77.23	79.08
S_4	48.94	46.30	47.62	76.83	71.73	74.28
SE m $\pm$	**0.62**	**0.75**	**0.68**	**0.62**	**0.93**	**0.72**
C.D (p=0.05)	**1.79**	**2.17**	**1.96**	**1.79**	**2.68**	**2.07**
Interaction (MxS)						
$M_0 S_0$	58.93	57.00	57.97	84.93	77.00	80.97
$M_0 S_1$	56.47	55.67	56.07	82.07	76.67	79.37
$M_0 S_2$	48.27	47.07	47.67	81.63	69.77	75.70
$M_0 S_3$	47.20	45.87	46.53	78.00	72.37	75.18
$M_0 S_4$	45.13	42.47	43.80	70.03	62.53	66.28
$M_1 S_0$	58.03	57.23	57.63	88.67	86.67	87.67
$M_1 S_1$	57.00	56.40	56.70	87.00	83.43	85.22
$M_1 S_2$	58.87	55.17	57.02	85.40	82.40	83.90
$M_1 S_3$	53.10	50.80	51.95	81.27	78.47	79.87
$M_1 S_4$	50.00	47.07	48.53	79.47	74.33	76.90
$M_2 S_0$	59.50	59.17	59.33	89.00	87.67	88.33
$M_2 S_1$	58.30	56.87	57.58	87.40	85.83	86.62
$M_2 S_2$	56.63	55.30	55.97	87.13	83.43	85.28
$M_2 S_3$	54.70	52.97	53.83	83.53	80.87	82.20
$M_2 S_4$	51.70	49.37	50.53	81.00	78.33	79.67
SE m $\pm$	**1.87**	**2.26**	**2.04**	**1.87**	**2.79**	**2.15**
C.D (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Note: **M_0:** Furrow Irrigation; **M_1:** Surface drip; **M_2:** Subsurface drip
S_0: Normal water (ECiw=0.65 dS m^{-1}); **S_1:** ECiw=2.0 dS m^{-1}; **S_2:** ECiw=3.0 dS m^{-1}
S_3: ECiw=4.0 dS m^{-1}; **S_4:** ECiw=5.0 dS m^{-1}

Table.3 Average plant height of tomato as influenced by different irrigation techniques and saline water during 90 and 120 DAT

Treatment details	Average plant height (cm)- 90 DAT			Average plant height (cm) - 120 DAT		
	2018	2019	Pooled	2018	2019	Pooled
Irrigation techniques (M)						
M_0	98.87	99.01	98.94	99.77	100.81	100.29
M_1	105.71	106.22	105.97	109.17	111.85	110.51
M_2	106.66	107.21	106.94	109.99	112.07	111.03
SE m ±	**0.40**	**0.42**	**0.37**	**0.32**	**0.51**	**0.32**
C.D (p=0.05)	**1.15**	**1.22**	**1.06**	**0.91**	**1.48**	**0.93**
Irrigation saline water levels (S)						
S_0	112.15	112.34	112.25	115.64	116.61	116.13
S_1	111.22	112.00	111.61	114.78	116.23	115.51
S_2	106.51	107.07	106.79	107.19	109.80	108.49
S_3	99.80	100.77	100.28	100.27	101.34	100.81
S_4	89.06	88.56	88.81	93.68	97.22	95.45
SE m ±	**0.39**	**1.25**	**0.76**	**0.48**	**1.25**	**0.78**
C.D (p=0.05)	**1.14**	**3.59**	**2.19**	**1.38**	**3.59**	**2.26**
Interaction (MxS)						
$M_0 S_0$	109.57	108.33	108.95	110.30	111.33	110.82
$M_0 S_1$	108.97	109.33	109.15	110.17	111.37	110.77
$M_0 S_2$	101.23	102.17	101.70	102.50	103.07	102.78
$M_0 S_3$	92.57	93.67	93.12	92.93	94.60	93.77
$M_0 S_4$	82.03	81.53	81.78	82.97	83.67	83.32
$M_1 S_0$	112.97	114.70	113.83	117.83	118.33	118.08
$M_1 S_1$	112.07	114.00	113.03	116.83	118.33	117.58
$M_1 S_2$	108.27	108.33	108.30	109.03	112.33	110.68
$M_1 S_3$	102.93	103.73	103.33	103.47	103.93	103.70
$M_1 S_4$	92.33	90.33	91.33	98.67	106.33	102.50
$M_2 S_0$	113.93	114.00	113.97	118.80	120.17	119.48
$M_2 S_1$	112.63	112.67	112.65	117.33	119.00	118.17
$M_2 S_2$	110.03	110.70	110.37	110.03	114.00	112.02
$M_2 S_3$	103.90	104.90	104.40	104.40	105.50	104.95
$M_2 S_4$	92.80	93.80	93.30	99.40	101.67	100.53
SE m ±	**1.18**	**3.74**	**2.28**	**1.44**	**3.74**	**2.35**
C.D (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Note: **M_0:** Furrow Irrigation; **M_1:** Surface drip; **M_2:** Subsurface drip
S_0: Normal water (ECiw=0.65 dS m^{-1}); **S_1:** ECiw=2.0 dS m^{-1}; **S_2:** ECiw=3.0 dS m^{-1}
S_3: ECiw=4.0 dS m^{-1}; **S_4:** ECiw=5.0 dS m^{-1}

Table.4 Number of branches of tomato as influenced by different irrigation techniques and saline water during 30 and 60 DAT

Treatment details	Number of branches-30 DAT			Number of branches-60 DAT		
	2018	2019	Pooled	2018	2019	Pooled
Irrigation techniques (M)						
M_0	6.54	6.70	6.62	10.47	10.35	10.41
M_1	7.09	7.22	7.16	11.58	11.55	11.57
M_2	7.13	7.28	7.20	11.91	11.63	11.77
SE m ±	**0.03**	**0.03**	**0.03**	**0.06**	**0.07**	**0.06**
C.D (p=0.05)	**0.09**	**0.09**	**0.08**	**0.18**	**0.19**	**0.19**
Irrigation saline water levels (S)						
S_0	7.87	8.01	7.94	12.62	12.67	12.64
S_1	7.64	7.78	7.71	12.33	12.02	12.18
S_2	6.93	7.04	6.98	11.33	11.19	11.26
S_3	6.26	6.47	6.37	10.26	10.08	10.17
S_4	5.90	6.03	5.96	10.06	9.92	9.99
SE m ±	**0.08**	**0.08**	**0.08**	**0.10**	**0.09**	**0.10**
C.D (p=0.05)	**0.23**	**0.23**	**0.22**	**0.30**	**0.25**	**0.27**
Interaction (MxS)						
$M_0 S_0$	7.52	7.68	7.60	11.67	11.83	11.75
$M_0 S_1$	7.31	7.44	7.37	11.20	11.00	11.10
$M_0 S_2$	6.69	6.75	6.72	10.93	10.80	10.87
$M_0 S_3$	5.60	5.91	5.76	9.43	9.17	9.30
$M_0 S_4$	5.57	5.70	5.63	9.10	8.97	9.03
$M_1 S_0$	8.03	8.13	8.08	12.97	13.10	13.03
$M_1 S_1$	7.75	7.88	7.82	12.70	12.80	12.75
$M_1 S_2$	7.05	7.20	7.12	11.27	11.10	11.18
$M_1 S_3$	6.60	6.76	6.68	10.57	10.48	10.53
$M_1 S_4$	6.03	6.11	6.07	10.40	10.27	10.33
$M_2 S_0$	8.05	8.20	8.13	13.23	13.07	13.15
$M_2 S_1$	7.87	8.01	7.94	13.10	12.27	12.68
$M_2 S_2$	7.05	7.16	7.11	11.80	11.68	11.74
$M_2 S_3$	6.57	6.75	6.66	10.77	10.60	10.69
$M_2 S_4$	6.10	6.27	6.18	10.67	10.53	10.60
SE m ±	**0.24**	**0.24**	**0.23**	**0.31**	**0.26**	**0.29**
C.D (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Note: **M_0:** Furrow Irrigation; **M_1:** Surface drip; **M_2:** Subsurface drip
S_0: Normal water (ECiw=0.65 dS m^{-1}); **S_1:** ECiw=2.0 dS m^{-1}; **S_2:** ECiw=3.0 dS m^{-1}
S_3: ECiw=4.0 dS m^{-1}; **S_4:** ECiw=5.0 dS m^{-1}

Table.5 Number of branches of tomato as influenced by different irrigation techniques and saline water during 90 and 120 DAT

Treatment details	Number of branches-90 DAT			Number of branches-120 DAT		
	2018	2019	Pooled	2018	2019	Pooled
Irrigation techniques (M)						
M_0	12.79	12.72	12.76	14.57	14.51	14.54
M_1	15.01	14.95	14.98	17.29	17.22	17.25
M_2	15.55	15.51	15.53	17.50	17.43	17.47
SE m ±	**0.14**	**0.14**	**0.14**	**0.15**	**0.15**	**0.15**
C.D (p=0.05)	**0.41**	**0.42**	**0.41**	**0.43**	**0.43**	**0.43**
Irrigation saline water levels (S)						
S_0	15.88	16.06	15.97	18.07	18.40	18.23
S_1	15.82	15.89	15.86	17.93	18.27	18.10
S_2	14.29	14.11	14.20	16.24	15.91	16.08
S_3	13.34	13.26	13.30	15.29	14.96	15.12
S_4	12.90	12.66	12.78	14.73	14.40	14.57
SE m ±	**0.17**	**0.17**	**0.17**	**0.19**	**0.23**	**0.21**
C.D (p=0.05)	**0.50**	**0.49**	**0.49**	**0.56**	**0.67**	**0.61**
Interaction (MxS)						
$M_0 S_0$	13.58	13.92	13.75	15.67	16.00	15.83
$M_0 S_1$	13.47	13.50	13.48	15.47	15.80	15.63
$M_0 S_2$	13.33	13.13	13.23	14.47	14.13	14.30
$M_0 S_3$	11.97	11.77	11.87	13.97	13.63	13.80
$M_0 S_4$	11.60	11.30	11.45	13.30	12.97	13.13
$M_1 S_0$	16.63	16.80	16.72	19.07	19.40	19.23
$M_1 S_1$	16.60	16.77	16.68	18.93	19.27	19.10
$M_1 S_2$	14.47	14.27	14.37	17.20	16.87	17.03
$M_1 S_3$	13.83	13.73	13.78	15.73	15.40	15.57
$M_1 S_4$	13.50	13.17	13.33	15.50	15.17	15.33
$M_2 S_0$	17.43	17.47	17.45	19.47	19.80	19.63
$M_2 S_1$	17.40	17.40	17.40	19.40	19.73	19.57
$M_2 S_2$	15.07	14.93	15.00	17.07	16.73	16.90
$M_2 S_3$	14.23	14.27	14.25	16.17	15.83	16.00
$M_2 S_4$	13.60	13.50	13.55	15.40	15.07	15.23
SE m ±	**0.52**	**0.51**	**0.51**	**0.58**	**0.70**	**0.64**
C.D (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Note: **M_0:** Furrow Irrigation; **M_1:** Surface drip; **M_2:** Subsurface drip
S_0: Normal water (ECiw=0.65 dS m^{-1}); **S_1:** ECiw=2.0 dS m^{-1}; **S_2:** ECiw=3.0 dS m^{-1}
S_3: ECiw=4.0 dS m^{-1}; **S_4:** ECiw=5.0 dS m^{-1}

Number of fruits per plant

The pooled data of two season indicted that, among irrigation techniques, significantly higher number of fruits were counted in a single plant in M_2 (58.67) during entire harvesting stage followed by M_1 (57.93) but lesser fruits in case of M_0 (46.47). Among irrigation saline water levels, significantly higher fruits were counted in S_0 (61.61) followed by S_1 (60.33) and least in case of S_4 (43.89). No significant effect was found under interaction (Table 1). Similar results were obtained by Takase *et al.*, 2010 and Malash *et al.*, 2005. The reduction of fruit number may be due to reduction in flower number per cluster (Malash *et al*., 2002).

It is concluded that in two seasons the growth attributes such as plants per treatments, plant height during 30, 60, 90 and 120 DAT, number of branches per plant during 30, 60, 90 and 120 DAT, average single fruit and ten fruits weight were significantly influenced by the different irrigation techniques and different irrigation saline water levels. The maximum number of plants per treatments, plant height and number of branches per plant during 30, 60, 90 and 120 DAT were recorded higher under subsurface and surface drip as compared to furrow irrigation except plant height during 30 DAT. Similarly, under different irrigation saline water levels, maximum number of plants, plant height and branches were recorded under 0.65 dS m^{-1} and 2 dS m^{-1} treatment and least was recorded in 5 dS m^{-1} treatment. Hence it is concluded that whenever there is shortage of fresh water, saline water upto 2 dS m^{-1} can be used to grow tomato crop without much effect on the growth parameter.

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