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Tomato production as influenced by different irrigation regimes and fertigation schedules during *rabi* season

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ABSTRACT
A field investigation was conducted to study the effect of different irrigation regimes and fertigation schedules on growth and yield of tomato during rabi season at Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) during the year 2010-11 and 2011-12. Application of irrigation at 1.2 ETc irrigation regime through drip recorded significantly higher fruit weight plant^{-1} of tomato (3.782, 3.294 and 3.538 kg) and tomato fruit yield (134.56, 114.83 and 124.69 t ha^{-1}) than rest of the irrigation regimes during first, second year and on pooled mean.Application of fertigation schedule as per RD of P_2O_5 up to 60 days after transplanting in equal splits (8 splits) + RD of N and K_2O up to 100 days after transplanting (15 splits) recorded significantly maximum fruit weight plant^{-1} of tomato (3.865, 3.369 and 3.617 kg) and tomato fruit yield (138.24, 117.42 and 127.83 t ha^{-1}) than rest of the treatments combinations during both the year and on pooled mean. Scheduling of irrigation through drip at 1.2 ETc irrigation regime and application of RD of P_2O_5 up to 60 days after transplanting in equal splits (8 splits) + RD of N and K_2O up to 100 days after transplanting (15 splits) through drip obtained maximum gross monetary returns, net monetary returns and B:C ratio.
Key words: *Tomato, irrigation regime, fertigation schedule, water use efficiency, monetary returns, B:C ratio*

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INTRODUCTION

Tomato (*Solanum lycopersicum* L) which belongs to the family *solanaceae*, is one of the most widely used and popular vegetable in the world. It is commercially important vegetable crop and ranks first amongst the processed vegetables. Water is a scarce resource for irrigation; therefore, optimum use of water is of paramount importance. It helps in better utilization of all other production factors and thus leads to increase in yield per unit land and time. This needs an immediate attention towards the judicious application of water. Drip irrigation affords the opportunity to optimal use of critical input water on the basis of evapotranspiration need of crop so as to increase it's productivity, fruit quality and water use efficiency. Besides water, the most critical input which seriously affects the growth and yield of crop, especially vegetable crops like tomato is plant nutrients or fertilizers. Fertigation which combines the application of irrigation water with fertilizers. The technique applies both water and fertilizer at a low rate to the vicinity of plant root zone resulting in higher yields and better quality of crops. There is scope to increase the productivity of tomato by adopting suitable fertigation schedule and irrigation regimes. In view of this, the present investigation was planned and conducted.

MATERIAL AND METHODS

The soil of experimental field was clay loam in texture. A soil was low in available nitrogen (218.47 kg ha^{-1}), medium in phosphorus (17.10 kg ha^{-1}) and high in available potassium (493.55 kg ha^{-1}) content with slightly alkaline in reaction (pH 7.90). The electrical conductivity was 0.25 dSm^{-1} at 25 ^{0}C, organic carbon content in soil was 0.53 per cent.

The present experiment was laid out in split plot design with three replications. There were twenty treatment combinations. The four main plot treatments comprised of four irrigation regimes *viz.,* 0.6 ETc, 0.8 ETc, 1.0 ETc and 1.2 ETc irrigation regimes. Whereas, sub plot treatments comprised of five fertigation schedules *viz.,* F_1= fertigation of RD of N, P_2O_5 and K_2O up to 60 DAT in equal splits (8 splits), F_2= fertigation of RD of P_2O_5 up to 60 DAT in equal splits (8 splits) + RD of N and K_2O up to 80 DAT in equal splits (12 splits), F_3= fertigation of RD of P_2O_5 up to 60 DAT in equal splits (8 splits) + RD of N and K_2O up to 100 DAT in equal splits (15 splits), F_4= fertigation of RD of N and P_2O_5 up to 60 DAT in equal splits (8 splits) + RD of K_2O up to 80 DAT in equal splits (12 splits) and F_5= fertigation of RD of N and P_2O_5 up to 60 DAT in equal splits (8 splits) + RD of K_2O up to 100 DAT in equal splits (15 splits). The control treatment i.e. surface irrigation with recommended dose of fertilizer through conventional fertilizers was considered only for comparison and not included in statistical analysis. Recommended dose of fertilizer i.e. 300:150:150 kg N, P_2O_5 and K_2O ha^{-1} + 20 t FYM ha^{-1} was applied.

The water soluble fertilizers of different grades (12:61:0 and 0:0:50) were used for fertigation. The fertigation was scheduled at every week commencing from seven days after transplanting as per the treatments. In surface irrigation treatment (control), 50 % recommended dose of N and 100 % recommended dose of P_2O_5 and K_2O was applied as basal dose and 50 % recommended dose of nitrogen was applied in three equal splits at 20 days interval through urea, single super phosphate and muriate of potash.

RESULT AND DISCUSSION

Fruit yield

Scheduling of irrigation at 1.2 ETc regime produced significantly higher fruit weight $plant^{-1}$ (3.782, 3.294 and 3.538 kg, respectively) and fruit yield (134.56, 114.83 and 124.69 t ha^{-1}, respectively) as compared to rest of the irrigation regimes during first, second year of investigation and on pooled mean. The moisture stress condition i.e. scheduling of irrigation at 0.6 ETc regime produced significantly minimum fruit weight $plant^{-1}$ and fruit yield (Table 1).

Application of irrigation at 1.2 ETc irrigation regime through drip maintained the soil moisture always at field capacity throughout crop growth period resulting maximum absorption of moisture and nutrients which favoured important growth attributes *viz.,* plant height, number of branches, number of leaflets, leaf area, dry matter accumulation per plant as well as fruit weight $plant^{-1}$ also showed significant improvement, which ultimately resulted in significant increase in tomato fruit yield. Similar results were reported by [1], [6]) and [7]

The tomato plant fertigated through drip as per RD of P_2O_5 up to 60 days after transplanting in equal splits (8 splits) + RD of N and K_2O up to 100 days after transplanting (15 splits) recorded significantly higher fruit weight $plant^{-1}$ (3.865, 3.369 and 3.617 kg, respectively) and fruit yield (138.24, 117.42 and 127.83 t ha^{-1}, respectively) than rest of the fertigation schedules during first, second year and pooled mean, respectively. Significantly minimum fruit weight $plant^{-1}$ and fruit yield were observed where combine fertigation of RD of N, P_2O_5 and K_2O up to 60 days after transplanting in equal splits (8 splits) was applied during both the years under study and in pooled results. This might be due to split application of fertilizers to tomato up to effective fruits pickings favoured to increase growth attributes accompanied with higher photosynthetic rate. These photosynthates were effectively translocated towards fruit formation finally reflected in increased maximum number of fruits per plant and resulted in higher fruit weight $plant^{-1}$. Similar results were reported by [2], [9] [5], [7] and [8].

The surface irrigation with recommended dose of fertilizers produced less tomato fruit yield as compared to different irrigation regimes and fertigation schedules through drip irrigation. This might be due to plant experienced the moisture and nutrient stress during fruiting phase of crop growth resulted in decreased formation of photosynthates and affected translocation of photosynthates towards reproductive parts produced minimum fruit weight $plant^{-1}$ of tomato.

Consumptive use

Among the irrigation regimes, scheduling of irrigation at 1.2 ETc irrigation regime recorded maximum consumptive use (542.46 and 598.71 mm) where as the irrigation regime 0.6 ETc recorded minimum consumptive use (271.23 and 299.35 mm) during 2010-11 and 2011-12. The drip irrigation system when compared with surface irrigation method, it could be seen that the surface irrigation registered more consumptive use (848.40 and 874.50 mm) than all the irrigation regimes applied through drip irrigation method during both the years under study (Table 2). These findings are in confirmity with those reported by [3] and [4].

Water use efficiency

The drip irrigation showed its superiority over surface irrigation in respect of water use efficiency. Among the irrigation regimes scheduling of irrigation at 0.6 ETc registered maximum water use efficiency of 321.72 and 247.27 kg ha^{-1}-mm during 2010-11 and 2011-12 and it was 30.13 and 29.45 per cent higher than 1.2 ETc irrigation regime. The higher irrigation regime i.e. 1.2 ETc irrigation regime registered minimum water use efficiency of 247.23 and 191.01 kg ha^{-1}-mm during first and second year of experimentation. The findings are in confirmity with those [1], [6] and [7].

Table 1: Yield attributes and fruit yield of tomato as influenced by different treatments

Treatment	Weight of fruits plant^{-1} (kg)			Fruit yield t ha^{-1}		
	2010-11	**2011-12**	**Pooled mean**	**2010-11**	**2011-12**	**Pooled mean**
A. Irrigation regimes :						
I_1 : 0.6 ETc	2.468	2.149	2.309	87.26	74.02	80.64
I_2 : 0.8 ETc	2.795	2.434	2.614	98.95	84.01	91.48
I_3 : 1.0 ETc	3.317	2.891	3.104	117.73	100.01	108.87
I_4 : 1.2 ETc	3.782	3.294	3.538	134.56	114.83	124.69
S.E.m. ±	0.044	0.041	0.054	1.81	1.76	2.15
C.D. @ 5 %	0.136	0.123	0.167	5.46	5.31	6.49
B. Fertigation schedules :						
F_1: RD of NPK up to 60 DAT (8 splits)	2.446	2.132	2.289	85.98	72.76	79.37
F_2: RD of P up to 60 DAT (8 splits) + RD of N and K up to 80 DAT (12 splits)	3.403	2.961	3.182	120.91	103.04	111.98
F_3: RD of P up to 60 DAT (8 splits) + RD of N and K up to 100 DAT (15 splits)	3.865	3.369	3.617	138.24	117.42	127.83
F_4: RD of N and P up to 60 DAT (8 splits) + RD of K up to 80 DAT (12 splits)	2.721	2.366	2.543	96.19	81.74	88.96
F_5: RD of N and P up to 60 DAT (8 splits) + RD of K up to 100 DAT (15 splits)	3.018	2.631	2.825	106.81	91.13	98.97
S.E.m. ±	0.052	0.036	0.019	1.86	1.35	0.80
C.D. @ 5 %	0.150	0.104	0.057	5.54	4.02	2.39
Control : Surface irrigation + RDF	1.389	1.216	1.302	46.69	41.27	43.98

The higher water use efficiency (339.77 and 261.43 kg ha^{-1}-mm) was recorded due to fertigation schedules of RD of P_2O_5 up to 60 days after transplanting in equal splits (8 splits) + RD of N and K_2O up to 100 days after transplanting (15 splits) than rest of the fertigation schedules applied to tomato during both the years. This higher WUE may be due to higher tomato fruit yield in the aforesaid fertigation schedule with the same quantity of moisture. These results are in accordance with those reported by [10] and [7].

Among the fertigation schedules, fertigation of RD of N, P_2O_5 and K_2O up to 60 days after transplanting in equal splits (8 splits) registered lowest water use efficiency (211.34 and 162.04 kg ha^{-1}-mm) during both the years under study.

Economics

Scheduling of irrigation through drip at 1.2 ETc irrigation regime through drip and application of RD of P_2O_5 up to 60 days after transplanting in equal splits (8 splits) + RD of N and K_2O up to 100 days after transplanting (15 splits) through drip obtained maximum gross monetary returns, net monetary returns and B:C ratio (Table 3).

Table 2: Consumptive use and water use efficiency in tomato as influenced by different treatments

Treatment	Consumptive use* (mm)		Yield (kg ha^{-1})		WUE (kg ha^{-1} -mm)		Water saving over surface irrigation (%)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
A. Irrigation regimes :								
I$_1$: 0.6 ETc	271.23	299.35	87260	74020	321.72	247.27	71.30	70.43
I$_2$: 0.8 ETc	361.64	399.14	98950	84010	273.61	210.48	61.73	60.58
I$_3$: 1.0 ETc	452.05	498.92	118170	100440	261.41	201.31	52.16	50.72
I$_4$: 1.2 ETc	542.46	598.71	134110	114360	247.23	191.01	42.60	40.87
B. Fertigation schedules :								
F$_1$: RD of NPK up to 60 DAT (8 splits)	406.84	449.03	85980	72760	211.34	162.04	56.95	55.65
F$_2$: RD of P up to 60 DAT (8 splits) + RD of N and K up to 80 DAT (12 splits)	406.84	449.03	120910	103040	297.19	229.47	56.95	55.65
F$_3$: RD of P up to 60 DAT (8 splits) + RD of N and K up to 100 DAT (15 splits)	406.84	449.03	138230	117390	339.77	261.43	56.95	55.65
F$_4$: RD of N and P up to 60 DAT (8 splits) + RD of K up to 80 DAT (12 splits)	406.84	449.03	96210	81740	236.48	182.04	56.95	55.65
F$_5$: RD of N and P up to 60 DAT (8 splits) + RD of K up to 100 DAT (15 splits)	406.84	449.03	106810	91130	262.54	202.95	56.95	55.65
Control : Surface irrigation + RDF	848.40	874.50	46690	41270	55.03	47.19	-	-

Table 3: Economics of tomato as influenced by different treatments

Treatment	Gross monetary returns (Rs. ha^{-1})			Cost of cultivation (Rs. ha^{-1})		Net monetary returns (Rs. ha^{-1})			B : C ratio		
	2010-11	2011-12	Pooled mean	2010-11	2011-12	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean
A. Irrigation regimes											
I$_1$: 0.6 ETc	523580	407135	465358	169779	169290	353801	237845	295823	3.08	2.40	2.74
I$_2$: 0.8 ETc	593716	462059	527888	170549	170061	423167	291998	357582	3.48	2.72	3.10
I$_3$: 1.0 ETc	706393	550031	628212	171319	170831	535074	379200	457137	4.12	3.22	3.67
I$_4$: 1.2 ETc	807359	631547	719453	172090	171602	635269	459945	547607	4.69	3.68	4.19
S.Em ±	10849	8879	19582	-	-	10849	8879	19582	0.06	0.05	0.11
C.D. (P = 0.05)	32764	29208	59138	-	-	32764	29208	59139	0.19	0.16	0.33
B. Fertigation schedules											
F$_1$: RD of NPK up to 60 DAT (8 splits)	515863	400171	458017	170723	170235	345140	229936	287538	3.02	2.35	2.68
F$_2$: RD of P up to 60 DAT (8 splits) + RD of N and K up to 80 DAT(12 splits)	725489	566706	646098	170944	170456	554545	396250	475398	4.24	3.32	3.78
F$_3$: RD of P up to 60 DAT (8 splits) + RD of N and K up to 100 DAT (15 splits)	829463	645819	737641	171030	170542	658433	475277	566855	4.85	3.78	4.31

F_4: RD of N and P up to 60 DAT(8 splits) + RD of K up to 80 DAT (12 splits)	577153	449557	513355	170944	170456	406209	279101	342655	3.37	2.64	3.00
F_5: RD of N and P up to 60 DAT(8 splits) + RD of K up to 100 DAT (15 splits)	640842	501212	571027	171030	170542	469812	330670	400241	3.74	2.94	3.34
S.Em ±	11543	7681	7030	-	-	11543	7681	7030	0.07	0.04	0.04
C.D. (P = 0.05)	33251	22127	21075	-	-	33251	22127	21075	0.19	0.13	0.12
Control : Surface irrigation + RDF	280144	227003	253574	128674	129260	151470	97743	124606	2.18	1.76	1.97

CONCLUSION

The surface irrigation with recommended dose of fertilizers obtained lowest economic returns than mean economic returns obtained under different treatments during both years under study.Based on two years of experimentation it could be concluded that application of irrigation through drip at 1.2 ETc irrigation regime (at alternate day) alongwith fertigation (at every week) of recommended dose of P_2O_5 (150 kg ha^{-1}) up to 60 days after transplanting in equal splits (8 splits) + recommended dose of N and K_2O (300 and 150 kg ha^{-1}) up to 100 days after transplanting (15 splits) registered maximum yield attributes and fruit yield of tomato crop during *rabi* season.

REFERENCES

1. Kahlon, M.S., Josan, A.S, Khera, K.L and Choudhary, O.P. (2007). Effect of drip and furrow methods of irrigation on tomato under two irrigation levels. *Indian Journal of Agricultural Research* **41** (4): 282 -286.
2. Kavitha, M., Natarajan, S., Sasikala, S.and Tamilselvi, C. (2007). Influence of shade and fertigation on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.). *International Journal of Agricultural Science* **3** (1): 99-101.
3. Mahajan, Gulshan and Singh, K.G. (2006). Response of greenhouse tomato to irrigation and fertigation. *Agricultural Water Management* **84**: 202-206.
4. Panigrahi, B., Roy, D.P. and. Panda, S. N.(2010). Water use and yield response of tomato as influenced by drip and furrow irrigation. *International Agricultural Engineering Journal.* **19** (1) :19 -30.
5. Sanchita, Brahma, Phookan, Deepa Borbora, Barua, Pankaj and Saikia, Luchon. (2010). Effect of drip-fertigation on performance of tomato under Assam conditions. *Indian Journal of Horticulture* **67**(1): 56-60.
6. Sezen, Metin S., Celikel, Gülendam, Yazar, Attila, Tekin, Servet and Kapur, Burcak. (2010). Effect of irrigation management on yield and quality of tomatoes grown in different soilless media in a glasshouse. Scientific Research Essay **5** (1): 041-048.
7. Sharda, Rakesh, Kaushal, M.P., Siag, Mukesh and Biwalkar, Nilesh. (2011). Economic evaluation of subsurface drip irrigation system in tomato. *Progressive Horticulture* **43** (1): 66-71.
8. Sharma, Uday. 2011. Response of tomato to irrigation and fertilizer management practices. *Journal of Hill Agriculture* **2** (1): 122-125.
9. Shedeed, Shaymaa I., Zaghloul, Sahar M., Yassen, A. A. (2009). Effect of method and rate of fertilizer application under drip irrigation on yield and nutrient uptake by tomato. Ozean Journal of Applied Science **2** (2): 139-147.
10. Singh, Rajbir and Kumar Satyendra. (2007). Effect of drip irrigation and black polyethylene mulch on growth, yield, water use efficiency and economics of tomato (*Solanum lycopercicum*).*Vegetable Science* **34** (2): 177-180.

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