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EFFECT OF DRIP FERTIGATION ON WATER USE EFFICIENCY AND YIELD OF TOMATO

Ghanshyam Deshmukh*, M. K. Hardaha[1], Kumar Soni[2], S. K. Ahirwar, S. Pannase, S. L. Alawa and S. D. Sawarkar

Krishi Vigyan Kendra, J.N.K.V.V., Chhindwara (Madhya Pradesh), India.
[1]S.W.E., J.N.K.V.V., Chhindwara (Madhya Pradesh), India.
[2]C.A.E., J.N.K.V.V., Jabalpur (Madhya Pradesh), India.

Abstract

A field experiment was conducted to study the effect of moisture regime and levels of fertilizer on response of tomato (*Lycopersicon esculentuam* L.) cv Abhilash Semines Hybride under drip irrigation. The experiment was laid out during October 2012 to March 2013 under drip irrigated condition. I_1-Drip irrigation with IW/ETc (Irrigation water/Crop evapotranspiration) ratio of 0.60. I_2-Drip irrigation with IW/ETc (Irrigation water/ Crop evapotranspiration) ratio of 0.80. I_3-Drip irrigation with IW/ETc (Irrigation water/Crop evapotranspiration) ratio of 1.00. The yield recorded that was 100.40 t/ha, 107.57 t/ha and 116.98 t/ha with treatment I_1, I_2 and I_3 respectively, the yield recorded in control was 78.84 t/ha.

Key wards : Drip Irrigation, tomato irrigation, drip system of tomato.

Introduction

Tomato is an important vegetable crop in the world, though can be growing in a wide range of soils provided the soil is well drained and aerated. A rich well drained sandy loamy soil is the best for tomato cultivation Fertigation is a technology for distributing fertilizers to the crop along with water through drip irrigation on a continual basis in controlled manner so as to allow for steady use of nutrients by plants and to effect inputs of both water and fertilizer. This is relatively new technology and more number of research works hare been carried. Through fertigation uses either granular or liquid fertilizers, which are dissolved in water, and injected into the irrigation system. Nutrients can be applied through drip system and can vary in concentration and composition. Fertigation provides uniform and relative ease of distribution of nutrients and can fine tune to the nutritional requirements of a particular crop. In general, application of fertilizer with irrigation water gives a better crop response than either broadcast or foliar application. Making a right decision about water and nutrient application is the key for high crop yield and its quality.

The design of the drip fertigation system is based on survey of terrain, assessment of water resources, agronomical details, climatological data for consumption of evapotranspiration requirements and analysis of soil and water sample (Chakravarthy and Singh, 1994).

***Author for correspondence:** E-mail: gshyam1234@rediffmail.com

Materials and Methods

A field experiment was conducted to study the effect of moisture regime and levels of fertilizer on response of tomato (*Lycopersicon esculentuam* L.) cv Abhilash Semines Hybride under drip irrigation. The experiment was laid out during October 2012 to March 2013 under drip irrigated condition. The details of materials used, methods and experimental techniques adopted during the course of experimentation are described in this chapter. The experiment was conducted in Anjani village, Umranala, district Chhindwara (MP). The village is located at 21°36'N 78°31'E to 21.6°N 78.52°E, having an average elevation of 474 meters. The soil of experimental site is Loamy Sand. A composite surface soil sample of the experimental site was collected before planting and analyzed for important physical properties. The texture analysis of the soil was carried out by hydrometer method and specific gravity was determined by pycnometer method. Results of the analysis are shown in table 1. Soil of the experimental site is classified as loamy sand.

Table 1 : Soil texture of the experimental area.

Soil depth (cm)	Sand %	Silt %	Clay %	Specific gravity	Texture
0-15	78	13	9	2.4143	Loamy sand
15-30	75	16	9	2.4879	Loamy sand

Drip irrigation in its present form has become compatible with plastics that are durable and easily moulded into a variety and complexity of shapes required for pipe and emitters. In tomato, flood irrigation is widely practiced in India, which results in inefficient use of irrigation water due to losses in deep percolation, distribution and evaporation. Drip irrigation system ensures higher water use efficiency. Antony and Singandhupe (2004) conducted study on impact of drip and surface irrigation on growth, yield and WUE (water use efficiency) of bell pepper (*Capsicum annum* L.). The experiment was laid out in randomized block design (RBD) with three replications. Irrigation treatments included surface IW/CPE (1.2, 1.0, 0.8 and 0.6) and drip (100, 80, 60 and 40). It was observed that 100% drip irrigation gave maximum yield in bell pepper grown in loamy soil of humid subtropical region. At 100% drip treatment plants had more height and more number of branches as compared to surface irrigated plants.

Sezen *et al*. (2006) studied the effect of drip irrigation regimes on yield and quality of field grown bell pepper. Irrigation regimes consisted of three irrigation intervals based on three levels of cumulative pan evaporation (E_{pan}) values (I_1, 18-22 mm; I_2, 38-42 mm and I_3, 58-62 mm) were used. The maximum yield of 33.14 t/ha in the year 2002 and 35.3 t/ha in the year 2003 growing season was obtained from irrigation interval of 3-6 days and plant-pan coefficient of 1.0.

Gadissa and Chemeda (2009) studied the effects of drip irrigation levels and planting methods on yield and yield components of green pepper in Bako, Ethiopia. Three irrigation levels (50, 75, 100% of ETc) and two planting methods (normal and paired row 7 planting) were applied. It was found that effect of both treatments on yield, number of fruits per plant and plant heights of green pepper were highly significant ($p < 0.01$) whereas the number of primary and secondary branches per plant was affected significantly ($p < 0.05$). A 50% reduction in irrigation level caused a reduction in yield of about 48.3% and 74.4% under the normal and paired row methods.

Drip irrigation is not a substitute for other proven methods of irrigation. It is just another way of applying water. It is best suited to areas, where water quality is marginal, land is steeply sloping or undulating and of poor quality, where water or labour are expensive, or where high value crop require frequent water applications. Therefore a study is proposed to assess the effect of drip irrigation system on yield of tomato at Chhindwara district of M.P. with to assess the effect of drip irrigation depth on yield of Tomato.

The experiment was laid out with nine treatment combinations consisting of three irrigation levels and three fertilizer levels and one control plot treatment of furrow irrigation.

Irrigation treatments

The following three irrigation treatments were taken for the experiment.

1. **I_1**-Drip irrigation with IW/ETc (Irrigation water/ Crop evapotranspiration) ratio of 0.60
2. **I_2**-Drip irrigation with IW/ETc (Irrigation water/ Crop evapotranspiration) ratio of 0.80
3. **I_3**-Drip irrigation with IW/ETc (Irrigation water/ Crop evapotranspiration) ratio of 1.0

Results and Discussion

Crop yield

The crop yield (t/ha) of tomato recorded for different treatments of the experiment is depicted in fig. 1. It can be observed from fig. 1 that the yield of tomato in control (78.84 t/ha) is quite low as compared to treatment of various level of irrigation with drip and fertigation. In the all three levels of irrigation the tomato yield was higher in fertigation with 100 % RDF. It can also be observed that in all three level of fertilizer the tomato yield was higher in 100% IW/Etc *i.e*. I_3. Table 2 reveals that effect of irrigation levels is significant between all three levels as well as three levels of fertilizer. However, interaction effect of irrigation and fertilizer on tomato yield is non-significant at 5% level of significance.

The yield recorded that was 100.40 t/ha, 107.57 t/ha and 116.98 t/ha with treatment I_1, I_2 and I_3 respectively,

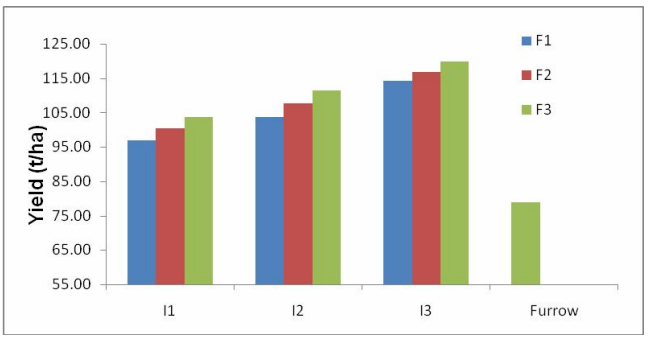

Fig. 1 : Variation in tomato yield with different irrigation and fertigation levels.

Table 2 : Effect of irrigation and fertigation levels on yield of tomato crop.

Treatments	Fruit yield (t/ha)			Mean	Furrow
	Fertilizer level				
Irrigation levels	F_1	F_2	F_3		
I_1	96.86	100.53	103.80	100.40	78.84
I_2	10.62	107.71	111.36	107.57	
I_3	114.21	116.88	119.87	116.98	
Mean	104.90	108.37	111.68		
Irrigation (I)	S				
Fertilizer (F)	S				
I × F	NS				
SEM				CD (5%)	
0.6904				1.6931	

Table 3 : Effect of irrigation and fertigation levels on average 25 fruit weight.

Treatments	Average 25 fruit weight (g)			Mean	Furrow
	Fertilizer Level				
Irrigation levels	F_1	F_2	F_3		
I_1	1308.67	1344.53	1367.60	1340.27	1173.93
I_2	1380.67	1418.13	1434.33	1411.04	
I_3	1466.13	1492.53	1515.20	1491.29	
Mean	1385.16	1418.40	1439.04		
Irrigation (I)	S				
Fertilizer (F)	S				
I × F	NS				
SEM				CD (5%)	
0.1970				0.4830	

whereas, it was 104.90 t/ha, 108.37 t/ha and 111.68 t/ha with treatments F_1, F_2 and F_3 respectively. The yield recorded in control was 78.84 t/ha.

Quality parameters of tomato

The attributes of quality of tomato fruits such as a number of fruit per plant, average 25-fruit weight, fruit weight per plant and per cent of discoloured fruits were studied.

Average 25 fruit weight

After picking the twenty five fully matured fruits were selected from each replicated treatment. Fruit weight was measured, the average 25- fruit weight of tomato recorded for all different treatment of the experiment is presented in fig. 2. It can be observed that average 25 fruit weight

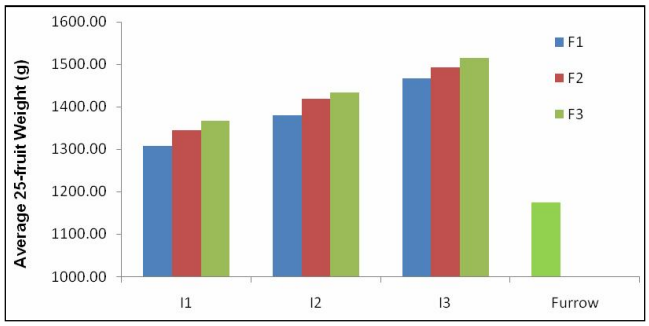

Fig. 2 : Variation in average 25-fruit weight of tomato different irrigation and fertigation levels.

of control was quite low as compared to various level of irrigation with drip and fertigation. In all the three level of irrigation, the average 25 tomato fruit weight was higher in fertigation with 100% RDF. It can also be observed that all three level of fertilizer the average 25 fruit weight was higher in 100% IW/ETc level. Table 3 reveals that effect of irrigation level is significant between all three level and as well as three level of fertilizer. However, interaction effect of irrigation and fertilizer on average 25- fruit weight of tomato is non–significant at 5% level of significance. The average 25- fruit weight recorded that was 1340.27 g, 1411.04 g and 1491.29 g in the treatment I_1, I_2 and I_3 respectively, whereas it was 1385.16 g, 1418.40 g and 1439.04 g with treatment F_1, F_2 and F_3 respectively. The average 25-fruit weight recorded in control was 1173.93 g.

Summary and Conclusion

The following salient points were observed in the study.

1. The maximum yield (119.87 t/ha) and minimum (78.84 t/ha) was found in I_3-F_3 and control treatments, respectively. In irrigation levels, increase in yield from I_1 to I_2 was 7.5 per cent, I_1 to I_3 was 17.0 per cent and from I_2 to I_3 was 8.7 per cent. The effect of irrigation level was significant at 5%.
2. The effect of irrigation level as well as fertigation level was significant on average weight of 25 fruits. The interaction of irrigation and fertigation was non-significant. The maximum increase in average fruit weight was found 29 percent in treatment I_3-F_3 over the control *i.e.* furrow irrigation.
3. The increase in water use efficiency is 254 per cent in I_1 (IW/Etc = 0.60) over the control. It has reduced by 20 per cent in I_2 and 30 per cent in I_3 over I_2, respectively.

4. The increase in water use efficiency in fertigation treatment F_2 and F_3 was 3 per cent and 6 per cent over F_1, respectively.
5. The maximum percentage of water saving over control treatment was observed in I_1 (64%) followed by I_2 (52%) and I_3 (40%) over the control (furrow method).
6. Yield and quality of tomato increases with increasing in depth of water applied by drip irrigation, however water use efficiency decreases.

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