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Optimization of Irrigation Scheduling under Different Types of Automated Drip Irrigation System for Tomato

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A B S T R A C T

Water is a vital commodity and it is essentially used for maximizing crop production and productivity. Drip irrigation is gaining popular among the farmers because of its high efficiency and productivity. This study was conducted during the Kharif season of 2018 and 2019 to find the best automated drip irrigation system among the time based, volume based, soil moisture sensor based and tensiometer based drip irrigation in comparison with conventional drip irrigation system. The design adopted was randomized block design with four replications. From the results, it can be concluded that the soil moisture sensor based drip irrigation system was found to be performing better when compared to other types both in terms of yield (99 t ha^{-1}) and water use efficiency (2.52 t ha^{-1} cm^{-1}). Hence, irrigation scheduling based on the soil moisture availability of the soil is the most superior over other methods.

Introduction

Water is a precious commodity and its judicious use is essential for maximizing crop production and productivity. In the changing climatic scenario, water resource has become very scarce and also being unscientifically used in the farming operations.The continuous increasing in population of the world demands massive amount of food which is a major cause of concern in coming future. To meet the need of huge food production there is an urgent need of rapid improvement in food production technology, a system that makes agricultural process easier and burden free from the farmers prospective. In a country like India, where the economy is mainly based on agriculture and the climatic condition are isotropic, still we are not able to make full use of agricultural resources, so we introduce the automated irrigation system (Ravish Chandra and P.K. Singh, 2018).

Modern irrigation methods like drip and sprinkler irrigation are gaining momentum among the farmers due to their easy handling, water saving potential and encouraging yield results in most parts of India, especially in Tamil Nadu. The rate of applying water in a micro irrigation is an important factor which governs moisture distribution in the soil profile. A high rate may cause deep percolation loss in soil whereas, a very low rate may contribute to evaporation loss through micro irrigation (Kakhandaki *et al*., 2013). Presently, farmers manually irrigate their lands at regular intervals through surface irrigation. In spite of its wide use, this method is characterized by low irrigation efficiency resulting in over or under irrigation that leads to reduced crop yields (Jain and Meena, 2015). There is a great need to modernize agricultural practices for better water productivity and resource conservation. Drip irrigation is the most effective way to supply water and nutrients to the plant, which not only saves water but also increases yield of crops. In this technique, most significant advantage is that water is supplied near the root zone drip by drip due to which enormous amount of water is saved (Upadhyaya, 2015). At present, the farmers in India have been using irrigation technique through manual control. This process sometimes consumes more water and sometimes the water reaches late due to which the crops get dried. This problem can be perfectly solved by adopting automated drip irrigation system.

Automation of drip irrigation refers to operation of system with no or minimal manual interventions. Automated irrigation has number of advantages including greater precision, more efficient use of water and reduction in human labour. It also facilitates high frequency and low volume irrigation (Priyan and Panchal, 2017). Automated drip irrigation system uses sensors, which are installed in the root zone at the undisturbed soil. The soil moisture sensor is connected to an irrigation system controller that measures soil moisture content and valves of the system are turned ON and OFF automatically for different interval of time. It also helps in saving time, removal of human error in adjusting soil moisture levels and to maximize the yield coupled with less water consumption (Ramya and Saranya, 2017). Vegetables constitute an important part of daily human diet by providing vital nutritional elements to the food. Water is a most important input in an assured vegetable production system, especially in areas where vegetable production lacks due to scarcity and or irregular distribution of rainfall (Puneet Sharma and Arun Kaushal, 2015). With this background, Tomato was selected to study different types of automated irrigation system. Hence, the present study was proposed to optimize the irrigation scheduling under different automated irrigation systems for Tomato was conducted.

Materials and Methods

The experiment was conducted at the Eastern Block farm of Tamil Nadu Agricultural University, Coimbatore. The soil of experimental field is sandy clay loam in texture soil in texture with a pH of 8.1 and electrical conductivity of 0.95 dSm^{-1}. The irrigation water had a pH of 8.3 and electrical conductivity of 2.85 dSm^{-1}. The nutrient status of the soil is 190, 23 and 360 kg ha^{-1} of NPK respectively. The organic carbon content of soil is 2.6 g kg^{-1}.

The treatment of the experiment comprises of Time based drip irrigation (T_1), Volume based drip irrigation (T_2), Soil moisture sensor based drip irrigation (T_3), Tensiometer based drip irrigation (T_4) and Conventional method of drip irrigation (T_5) with four replications under Randomized Block Design (RBD). In all the treatments, 100 per cent recommended dose of fertilizer (RDF) was used.

The experiment was conducted during 2018 and 2019 at *Kharif* season (July- Nov) and Shivam hybrid was used. Drip irrigation system was installed for each plot. Buffer distances of approximately 60 cm separated the plots to reduce irrigation influences between them. Drip system (DI) was equipped with controllers to control the pressure and flow meter to quantify the water added in each irrigation event.

Initial soil analysis (Available N, P, K, and Organic carbon) and at post-harvest soil analysis (Available N, P, K) were done. Biometric observations like plant height (cm), number of branches plant^{-1} and days to first fruit pick were observed.

The irrigation for different treatments was given based on the selected system. The water requirement of the crop was determined by using the formula,

WRc = CPE * Kp * Kc * Wp * A

Where, WRc = water requirement (litre per plant); CPE = cumulative pan evaporation for three days (mm); Kp = pan factor (0.8); Kc = crop coefficient; Wp wetting percentage in fraction; A=area per plant.

Crop coefficients (Kc) for tomato crop (Allen *et al.*, 1998) were

Initial stage, 0-30 days	0.60
Development stage, 31-70 days	1.15
Mid-stage, 71-110 days	1.15
Final stage, 111-135 days	0.70

Duration of operation of drip system to deliver the required volume of water per plant was calculated as follows:

$$\text{Irrigation duration} = \frac{\text{Volume of water needed}}{\text{Emitter discharge x No of emitters}}$$

Results and Discussion

The pooled data of two years experiment of plant height, number of branches and cholorphyll content were measured at 30, 60, 90 days after sowing (DAS) and at harvest.

The results revealed that even though there was a slight difference among treatments it was not statistically significant. Hence the type of automated irrigation system has no significant impact of the growth parameters like plant height, number of branches and chlorophyll content. Similar results were reported by Kakhandaki *et al.*, 2013 and Bhardwaj *et al.*, 2018.

Highest yield of 99 t ha^{-1} was achieved in the soil moisture sensor based drip irrigation treatment (T_3). All the treatments except, conventional method of drip irrigation resulted in almost equal yield (Chouhan *et al.*, 2015 and Soni, 2019).

Table.1 Plant height (cm) at different growth stages

Treatments	30 DAS	60 DAS	90 DAS	Final stage
Time based drip irrigation (T_1)	37.47	74.24	104.31	130.50
Volume based drip irrigation (T_2)	36.58	80.53	112.95	135.78
Soil moisture sensor based drip irrigation (T_3)	36.92	82.32	121.28	138.27
Tensiometer based drip irrigation (T_4)	36.83	82.03	116.38	129.25
Conventional method of drip irrigation (T_5)	36.27	84.83	126.14	141.25
CD (5%)	0.56	4.93	10.33	6.32

Table.2 Number of branches at different growth stages

Treatments	30 DAS	60 DAS	90 DAS	Final stage
Time based drip irrigation (T_1)	3.65	5.65	6.40	8.25
Volume based drip irrigation (T_2)	3.80	5.70	6.15	8.25
Soil moisture sensor based drip irrigation (T_3)	3.95	6.35	6.50	8.75
Tensiometer based drip irrigation (T_4)	3.65	5.70	6.35	8.50
Conventional method of drip irrigation (T_5)	3.75	6.10	6.55	9.25
CD (5%)	0.15	0.39	0.19	0.52

Table.3 Chlorophyll at different growth stages

Treatments	30 DAS	60 DAS	90 DAS	Final stage
Time based drip irrigation (T_1)	42.02	52.38	50.35	44.25
Volume based drip irrigation (T_2)	40.90	51.50	49.25	41.20
Soil moisture sensor based drip irrigation (T_3)	40.68	50.88	50.86	45.68
Tensiometer based drip irrigation (T_4)	42.10	52.10	51.84	46.24
Conventional method of drip irrigation (T_5)	37.25	48.65	44.36	39.20
CD (5%)	2.45	1.85	3.64	3.75

Table.4 Chlorophyll at different growth stages

Treatments	Total fruit yield (t/ha)	Water requirement (cm)	WUE (t/ha-cm)	B:C ratio
Time based drip irrigation (T_1)	96.30	41.5	2.32	2.08*
Volume based drip irrigation (T_2)	96.85	52.0	1.86	2.14*
Soil moisture sensor based drip irrigation (T_3)	99.00	39.3	2.52	2.44*
Tensiometer based drip irrigation (T_4)	97.25	39.7	2.45	2.28*
Conventional method of drip irrigation (T_5)	74.07	56.1	1.32	1.98
CD (5%)	12.98	-	-	-

* Working life of the system is assumed as 10 years

In the water use efficiency also soil moisture sensor based drip irrigation treatment (T_3) resulted in higher side (2.52 t ha^{-1} cm^{-1}) (Ashoka, *et al.*, 2015). Water requirement is comparatively less in all the automated drip irrigation systems when compared to the conventional drip irrigation system (Rao *et al.*, 2016 and Jain and Meena, 2015). There was no much difference was observed in the B: C ratio among the treatment since the cost of automation systems are almost same in all the categories.

In conclusion from the study it can be concluded that the soil moisture sensor based drip irrigation system was found to be performing better when compared to other types such as tensiometer based, time based and volume based drip irrigation systems both in terms of yield and water use efficiency.

References

Allen, R. G., L. S. Pereira, Dirk Raes and Martin Smith. 1998. Crop evapotranspiration - Guidelines for computing crop water requirements. - FAO Irrigation and Drainage Paper 56, Water Resources, Development and Management Service, FAO, Rome.

Ashoka, P., Kadasiddappa, M.M. And Sanjay, M.T. 2015. Enhancing water productivity through micro irrigation technologies in Indian agriculture. Annals of plant and soil research 17: 601-605.

Bhardwaj, A.K. Pandiaraj, T., Chaturvedi, S., Singh, T.C., Soman , P., Bhardwaj, R.K., and Labh,B. 2018. Growth, Production Potential and Inputs Use Efficiency of Rice under Different Planting Methods in Drip Irrigation. Current Journal of Applied Science and Technology, 26(6): 1-9.

Chouhan, S.S., Awasthi, M.K. and Nema, R.K. 2015. Studies on Water Productivity and Yields Responses of Wheat Based on Drip Irrigation Systems in Clay Loam Soil. Indian Journal of Science and Technology, 8(7): 650–654.

Jain, N.K. and Meena, H.N. 2015 Improving productivity of groundnut (*Arachis hypogaea*) by using water soluble fertilizer through drip irrigation. Indian Journal of Agronomy, 60 (1): 109 -115.

Kakhandaki, S.H., Padmakumari, O. and Patil, R.H. 2013. Performance of drip and micro sprinkler irrigation systems in tomato crop. Karnataka J. Agric. Sci., 26 (3): 419-420.

Priyan, K and Panchal, R. 2017. Micro-Irrigation: An Efficient Technology for India's Sustainable Agricultural Growth. Kalpa Publications in Civil Engineering, 1: 398-402.

Puneet Sharma and Arun Kaushal. 2015. Economics of Growing Okra under Drip Fertigation. Indian Journal of Science and Technology, Vol 8 (35): 1-5.

Ramya. K. M, M. Saranya. 2017. Experimental Investigation on Drip Irrigation using Moisture Sensor. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 5 (VIII): 1250-1255.

Rao, K. V. R., Bajpai, A., Gangwar, S., Chourasia, L. and Soni, K. 2016. Maximising water productivity of wheat crop by adopting drip Irrigation. Res. on Crops, 17 (1): 163-168.

Ravish Chandra and Singh, P.K. 2018. Evaluation of Drip Irrigation System for Okra Crop under Tarai Condition of Uttarakhand, India. *Int.J.Curr.Microbiol.App.Sci.*, 7 (03): 132-139.

Soni, J.K., Asoka Raja, N. and Vimal Kumar, V. 2019.Improving productivity of groundnut (*Arachis hypogaea* L.) under drip and micro sprinkler fertigation system. Legume Research, 42(1): 90-95.

Upadhyaya, A. 2015. Water Management Technologies in Agriculture: Challenges and Opportunities. Journal of Agri Search 2(1): 7-13.

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