Environment and Ecology 37 (1B) : 410—414, January—March 2019
Website: environmentandecology.com ISSN 0970-0420

Effect of Fertigation and Different Drip Irrigation Levels on Growth and Yield of Chilli (*Capsicum annuum* L.)

Vinayak S.T., B. Maheshwara Babu, U. Satishkumar, V. Srinivasa Reddy, Ramesh G.

Received 17 October 2018 ; Accepted 20 November 2018 ; Published on 10 December 2018

Abstract A field experiment was carried out during 2017-2018 to study the effect of fertigation at different drip irrigation levels on growth and yield of chilli crop. The experiments were laid out in split plot design with 10 treatment combinations. The 2 main plots treatment were 75% of RDF (F_1) and 100% of RDF (F_2). The subplot treatment had 5 drip irrigation levels viz., at 60% ET (I_1), 70% ET (I_2), 80% ET (I_3), 90% ET (I_4) and 100% ET (I_5). The results revealed that treatment 80% ET with 100% RDF enhanced the plant height (74.27), number of primary branches (10.73), number of secondary branches (43.27), fruit length (8.48), fruit diameter (1.19) and crop yield (16.31 t/ha).

Keywords Chilli, Drip irrigation, Evapotranspiration, Fertigation.

Introduction

India contributes one fourth of world's production of chilli with an average annual production of 12.89 lakh tons in an area of 7.59 lakh ha (Alam et al. 2014). In India, chilli is mainly grown in Andhra Pradesh, Karnataka, Tamil Nadu and Orissa. In Karnataka, chilli is cultivated in an area of 1.72 lakh ha and its production is 1.32 lakh tons.

Vinayak S.T.*, B. Maheshwara Babu, U. Satishkumar, V. Srinivasa Reddy, Ramesh G.
Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Raichur 584104, Karnataka, India
e-mail: vinaythumbagi@gmail.com
*Corresponding author

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae and is native to Tropical America. Chilli is an important spice crop as well as vegetable crop and is cultivated extensively in India. The demand for chilli is increasing, world wide due to pungency of fruits. Chilli is rich in vitamins A, C, iron and calcium. Chillies are used in making chilli vinegar, hot oil, tomato sauces, rice dishes, soups, hot condiments such as sambar, corn and curry powders. Chilli is compatible with several other spices including basil, ginger, oregano, cilantro, cinnamon, black pepper, fennel and cumin. It is used in the preparation of salads, sauce, pickles and is a main ingredient of Indian diet in each house hold.

Drip irrigation is a hi-tech method of irrigation which has been receiving better acceptance and adoption particularly in areas of water scarcity. Micro irrigation is an effective tool for conserving water resource and studies have revealed that there is significant saving in water ranging between 40 and 70% by adopting drip irrigation when compared to surface irrigation. Therefore, efforts are now concentrated towards utilizing the available quantity of water and putting it to efficient use so as to realize higher productivity with each drop of water.

Fertigation is a recent innovative cultural method, by which fertilizers are applied along with irrigation water through drip system to achieve higher fertilizer use efficiency besides increasing the crop yields. The simultaneous application of water and fertilizer through micro irrigation opens new possibilities for regulating water and nutrient supply's

Table 1. Effect of irrigation and fertilizer levels on plant height, primary branches and secondary branches for 150 DAT of chilli during *rabi* 2017-18. Main treatments: F_1 : 75% of recommended dose for fertilizer, F_2 : 100% of recommended dose for fertilizer. Sub treatments: I_1 : Irrigation at 60% ET, I_2 : Irrigation at 70% ET, I_3 : Irrigation at 80% ET, I_4 : Irrigation at 90% ET, I_5 : Irrigation at 100% ET.

	Plant height (cm) 150 DAT			Primary branches 150 DAT			Secondary branches 150 DAT		
Treatments	F_1	F_2	Mean	F_1	F_2	Mean	F_1	F_2	Mean
I_1	64.93	66.33	65.63	9.40	9.67	9.53	32.87	36.13	34.50
I_2	68.00	69.33	68.67	9.40	9.87	9.63	34.33	36.93	35.63
I_3	72.73	74.27	73.50	10.33	10.73	10.53	39.33	43.27	41.30
I_4	71.67	73.80	72.73	9.73	10.07	9.90	34.87	39.20	37.03
I_5	70.27	71.53	70.90	9.53	9.83	9.68	33.33	37.47	35.40
Mean	69.52	71.05		9.68	10.03		34.95	38.60	
	SEm±	CD at 5%		SEm±	CD at 5%		SEm±	CD at 5%	
Main treatment	0.11	0.46		0.04	0.17		0.01	0.06	
Sub treatment	0.87	1.84		0.09	0.19		0.47	1.00	
Main×Sub treatment	1.23	2.61		0.13	0.27		0.67	1.41	

to the crops, besides maintaining and distributing the desired concentration of nutrient in soil. When fertilizer is applied through drip, it is observed that beside the increase in yield 30% of the fertilizer could also be saved. The increase in yield as compared to conventional irrigation method is from 20 to 100%, whereas saving in water ranges from 40 to 70%. In addition to this 50 to 60% there is a saving in labor cost. The main objective of the study was to standardise the level of drip irrigation using both runoff water and groundwater for chilli crop.

Materials and Methods

A field study was conducted on chilli (var Kalasa) at experimental field of Department of Soil and Water Engineering, College of Agricultural Engineering, University of Agricultural Sciences, Raichur during the *rabi* season of 2017-18. The research farm is located at a 16º15´ N latitude and 77º20´E longitude and is at an elevation of 407 m above mean sea level (MSL). The climate is semi-arid and average annual rainfall is 713 mm. The daily climatological data during the study period were recorded from the meteorological observatory at the Main Agricultural Research Station, Raichur. The soil type of the experiment field was clay. The field was ploughed using tractor drawn disc plough and pulverized using rotavator. The raised beds of size 10.8 × 1 m^2 were made and chilli seedlings raised in portrays were transplanted on the raised beds. The experiments were laid out in split plot design with 10 treatments combination. Two fertilizer levels viz., 75% of recommended dose of fertilizer (F_1) and 100% of recommended dose of fertilizer (F_2) were taken as main plot treatments. Five irrigation levels viz., Drip irrigation at 60% ET (I_1), Drip irrigation at 70% ET (I_2), Drip irrigation at 80% ET (I_3), Drip irrigation at 90% ET (I_4) and Drip irrigation at 100% ET (I_5) were taken as sub plot treatments. The plants biometric observation viz., plant height, number of primary branches, number of secondary branches, number of days for 50% flowering, fruit length, fruit diameter and fruit yield were recorded. The data was statistically analyzed and interpreted.

Results and Discussion

Plant height

The data on plant height as influenced by irrigation levels and fertilizer levels and their interactions are presented in Table 1. The variation in plant height differed significantly due to interaction effects. The maximum plant height was recorded at 80% ET with 100% of RDF (74.27) and lowest (64.93) was recorded at 60% ET with 75% of RDF. However, interaction effect of irrigation and fertilizer levels treatments on plant height was significant with 80% ET with 100% RDF. Increased plant height in 80% ET through drip irrigation with 100% RDF was pos-

Table 2. Effect of irrigation and fertilizer levels on plant height, primary branches and secondary branches for 150 DAT of chilli during *rabi* 2017-18. Main treatments: F_1 : 75% of recommended dose for fertilizer, F_2 : 100% of recommended dose for fertilizer. Sub treatments: I_1 : Irrigation at 60% ET, I_2 : Irrigation at 70% ET, I_3 : Irrigation at 80% ET, I_4 : Irrigation at 90% ET, I_5 : Irrigation at 100% ET.

Treatments	50% Flowering			Fruit length (cm)		
	F_1	F_2	Mean	F_1	F_2	Mean
I_1	52.00	51.33	51.67	5.54	6.19	5.87
I_2	51.33	51.00	51.17	6.23	7.36	6.79
I_3	49.00	45.00	47.00	8.11	8.48	8.30
I_4	49.67	50.00	49.83	7.98	8.21	8.09
I_5	51.33	50.67	51.00	7.54	8.18	7.86
Mean	50.67	49.60		7.08	7.68	
	SEm ±	CD at 5%		SEm±	CD at 5%	
Main treatment	0.23	1.04		0.01	0.04	
Sub treatment	1.42	3.02		0.05	0.12	
Main × Sub treatment	2.01	4.27		0.08	0.16	

Table 2. Continued.

Treatments	Fruit diameter (cm)			Yield (t/ha)		
	F_1	F_2	Mean	F_1	F_2	Mean
I_1	1.00	1.09	1.04	10.45	11.17	10.81
I_2	1.06	1.11	1.09	13.27	13.30	13.29
I_3	1.17	1.19	1.18	15.23	16.31	15.77
I_4	1.15	1.16	1.15	13.64	14.29	13.96
I_5	1.10	1.12	1.11	13.20	13.78	13.49
Mean	1.09	1.14		13.16	13.77	
	SEm ±	CD at 5%		SEm±	CD at 5%	
Main treatment	0.01	0.01		0.03	0.14	
Sub treatment	0.02	0.04		0.34	0.73	
Main × Sub treatment	0.03	0.06		0.48	1.03	

sibly due to better availability of soil moisture. The application of fertilizers especially nitrogen enhances vegetative growth, which further could have contributed to carbohydrate synthesis. These results are in the agreement with Ughade and Mahadkar (2015).

Number of primary branches

The data on total number of primary branches per plant at different stages of crop growth as influenced by irrigation levels and fertilizers levels are presented in Table 1. The maximum number of primary branches was found at 80% ET with 100% of RDF (10.73) and lowest (9.40) was recorded in 75% RDF with 60% ET. However, interaction effect of irrigation and fertilizer levels treatments on number of primary branches was significant was 80% ET with 100% of RDF. Favorable microclimate and efficient availability of soil moisture and nutrient could have increased the number of primary branches. These results are agreement with the finding of Ughade and Mahadkar (2015).

Number of secondary branches

The irrigation and fertilizer levels significantly affected the secondary branches of chilli crop. The data on total number of secondary branches per plant as influenced by irrigation levels and fertilizers levels are presented in Table 1 levels. The maximum number of secondary branches was found at 80% ET with 100% of RDF (43.27) and lowest (32.87) was recorded in 75% RDF with 60% ET. However, interaction effect of irrigation and fertilizer levels treatments on number

of secondary branches was 80% ET with 100% of RDF. The increase in number of primary branches and increased availability of moisture and nutrient might have contributed for the increase in secondary branches. These results are agreement with the finding of Ughade and Mahadkar (2015).

Number of days required to 50% flowering

Irrigation and fertigation had marked influence on number of days required to 50% flowering as shown in Table 2. Drip irrigation at 80% ET was more effective in inducing early flowering as compared to drip irrigation at 60% ET. The minimum days required for 50% flowering was observed in treatment receiving 75% RDF (45 days) while maximum days required for 50% flowering was observed in treatment receiving 100% RDF (52 days). However, interaction effect of irrigation and fertilizer levels treatments on number of secondary branches was 80% ET with 100% of RDF. Drip irrigation affected the temperature and micro climate conditions around the plants, further influencing the photosynthetic efficiency of the plant this might have contributed to early flowering. The results were in agreement with the finding of Sharma et al. (2016).

Fruit length

The data on fruit length, showed marked variations due to different levels of irrigation and fertilizer application and the same is presented in Table 2. The length of fruit in chilli varied from 5.87 to 8.30 cm depending upon the irrigation levels and amount of fertilizers supplied through different treatments. The maximum length of fruit was found in treatment with 80% ET and 100% of RDF (8.48 cm). Minimum length of fruit (5.54) cm was recorded in 60% ET with 75% of RDF. However, interaction effect of irrigation levels and fertilizer levels on fruit length was 80% ET and 100% of RDF. The highest fruit length under 80% ET with 100% fertilizer could be due to congenial soil moisture conditions which further could have contributed for higher uptake of nutrition for better growth of fruit.

Fruit diameter

The data on the effect of different levels of irrigation and fertilizer on fruit diameter is presented in Table 2. The diameter of chilli fruits ranged from 1.04 to 1.18 cm based on the levels of irrigation. The maximum fruit diameter (1.19) cm was found in treatment of 80% ET with 100% RDF and minimum fruit diameter (1 cm) was found in treatment of 60% ET with 75% RDF. However, interaction effect of irrigation levels and fertilizer levels on fruit diameter was 80% ET with 100% RDF. The increase in fruit diameter of chilli with increase in nutrient level is mainly attributed to increased availability of nutrients essential for the growth and development of crop. These results are in the agreement with Gireesh (2017).

Crop yield per hectare

The results of crop yield per hectare due to effect of irrigation and fertigation levels are presented in Table 2. The maximum yield per hectare (16.31 t) was recorded in 80% ET with 100% RDF. Similarly lowest yield (10.45 t) was recorded in 60% ET with 75% RDF. However, interaction effect of irrigation levels and fertilizer levels on crop yield was 80% ET with 100% RDF. Drip irrigation provides adequate soil moisture at field capacity. This facilitates better root development in terms of number and spread of roots which further might have contributed for luxuriant growth of plant and in better nutrient uptake resulting better growth and development of plants resulting in higher yield. The above results are in agreement with Vijayakumar et al. (2010), Krishnamoorthy and Noorjehan (2014) and Imamsaheb et al. (2014).

Conclusion

The plant growth parameters like plant height, number of primary and secondary branches per plant and days to 50% flowering were significantly influenced by irrigation levels and fertilizer levels. The maximum yield (16.31 t ha^{-1}) was recorded in the treatment consisting of drip irrigation at 80% with 100% RDF. On the basis of experimental observations and statistical analysis, it is concluded that 80% ET with 100% RDF was considered superior in chilli crop and it was able to maintain optimum growing conditions

that are required for crop to flourish well produce higher yield.

Acknowledgements

The authors are grateful to the All India Coordinate Research Project on Plasticulture Engineering and Technology ICAR - CIPHET, PAU Ludhiana for providing necessary facilities to carry out the research work.

References

Alam MZ, Hamim I, Ali MA, Ashrafuzzaman M (2014) Effect of seed treatment on seedling health of chilli. J Environ Sci & Nat Resources 7 (1) : 177—181.

Gireesh B (2017) Studies on irrigation and fertigation management on chilli (*Capsicum annuum* L.) under drip system. PhD thesis. Indira Gandhi Krishi Vishwavidyalaya, Raipur, pp 30—38.

Imamsaheb SJ, Hanchinmani CN, Ravinaik K (2014) Impact of drip irrigation and fertigation on growth, yield, quality and economic returns in different vegetable crops. Asian J Hort 9 (2) : 484—491.

Krishnamoorthy V, Noorjehan AK (2014) Effect of water soluble and conventional fertilizers on growth and yield of chillies. J Krishi Vigyan 2 (2) : 28—30.

Sharma P, Kaushal A, Singh A, Garg S (2016) Growth and yield attributes of okra under influence of drip irrigation. Int J Engg Res Appl 6 (2) : 85—91.

Ughade SR, Mahadkar UV (2015) Effect of different planting density, irrigation and fertigation levels on growth and yield of brinjal (*Solanum melongena* L.). Int J Life Sci 10 (3) : 1205—1211.

Vijayakumar G, Tamilmani D, Selvaraj KP (2010) Maximizing water and fertilizer use efficiencies under drip irrigation in chilli crop. J Manage Public Policy 2 (1) : 85—95.