Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.7988

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2020) *8*(3), 123-129

Research Article

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Effect of Drip Irrigation and Nitrogen Fertigation on Growth Characters of Garlic

Harshita Singh[1*], V. K. Batra[1], Suryapal Singh[2] and A. K. Bhatia[1]

[1]Department of Vegetable Science

[2]Department of Seed Science and Technology

Chaudhary Charan Singh Haryana Agricultural University, Hisar-125004, Haryana, India

*Corresponding Author E-mail: harshitamor.1106@gmail.com

Received: 1.02.2020 | Revised: 5.03.2020 | Accepted: 13.03.2020

ABSTRACT

The experiment was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during Rabi season for the two consecutive years (2017-18 and 2018-19) to study the effect of drip irrigation and nitrogen fertigation levels on growth characters of garlic. The observations were recorded on growth parameters, i.e., plant height at 60, 90, 120 DAP and at harvest (cm), number of leaves per plant at 60, 90, 120 DAP and at harvest, leaf length at harvest (cm) and days to maturity. All these growth parameters were recorded maximum with drip irrigation at IW/CPE 1.2 as compared to other levels of drip irrigation and among the nitrogen fertigation treatments, the growth parameters were observed maximum where 90 kg/ha nitrogen was applied through drip system. The interaction between drip irrigation and nitrogen fertigation was found significant for all these characters except for plant height at 120 DAP and days to maturity.

Keywords: *Garlic, Drip irrigation, Nitrogen fertigation, Growth*

INTRODUCTION

Garlic (*Allium sativum* L.), a member of Alliaceae family, is the second important bulb crop after onion and extensively grown throughout the country. It is the oldest cultivated herb being widely recorded in ancient Indian, Chinese, Egyptian and Sumerian cultures. Sanskrit writings document the use of garlic remedies about 5000 years ago. It is cultivated as a *Rabi* season crop in the Indian plains for its bulbs. Garlic is known for its high commercial value of bulbs, which is the most commonly used plant part and is an important and remunerative crop, used both as a spice as well as condiment. Despite its importance, the productivity of garlic in India continues to be low. Among the various factors, irrigation especially at critical growth stages is an important factor influencing the yield, as water is a solvent of nutrients and a pre-requisite to successful garlic production (Michael, 1999).

Cite this article: Singh, H., Batra, V.K., Singh, S., & Bhatia, A.K. (2020). Effect of Drip Irrigation and Nitrogen Fertigation on Growth Characters of Garlic, *Ind. J. Pure App. Biosci. 8*(3), 123-129. doi: http://dx.doi.org/10.18782/2582-2845.7988

Also, adequate and balanced nutrition occupies an important role in increasing plant height and leaves per plant of garlic (Singh & Singh, 2004; Sardi & Timar, 2005 and Ahmed et al., 2006). Therefore, the production technology of garlic on scientific basis is need of the day. Considering the above facts, the experiment was conducted to access the effect of drip irrigation and nitrogen fertigation on growth characters of garlic.

MATERIALS AND METHODS

The field experiment was carried out at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana during *Rabi* (2017-18 and 2018-19). This tract is characterized by semiarid climate. The soil of experimental field was sandy loam in texture, low in organic carbon, medium in available N and P with slightly alkaline reaction. During crop growth period, the cumulative pan evaporation was recorded. The experiment laid out in split plot design consisted of the main plot treatments comprising of four drip irrigation levels *viz*., drip irrigation at IW/CPE 0.6, 0.8, 1.0 and 1.2 based on crop evapo-transpiration and surface irrigation besides sub plots treatments comprising four nitrogen fertigation levels, *viz*., 60, 70, 80 and 90 kg/ha and a control with three replications. The recommended dose of phosphorus (50 kg/ha in the form of SSP), potassium (25 kg/ha in the form of MOP) and half dose of nitrogen in the form of urea from each treatment were applied uniformly as basal dose to all plots before planting garlic. The rest of nitrogen was applied in five split doses after 15 days of planting between the each treatment, *i.e*., 18.75% nitrogen applied at 0-15 DAP, 31.25% in two equal splits at 15 days interval from 16 to 45 DAP, 25% at 60 DAP and rest 25% applied at 75 DAP through drip irrigation. First irrigation was applied immediately after planting of garlic cloves for their better germination. The subsequent irrigations were given as per the treatments when the evaporation was reached up to 10 mm. The quantity of irrigation water applied to each treatment was calculated by multiplying the depth of water with area of plot.

$$V = N*A*D$$

Where, V = volume of water applied (mm)

N = number of irrigations

A = area of the plot (m^2)

D = depth of irrigation (mm)

Planting of cloves of garlic variety Hisar Garlic17 was done on 9th November and 26th October during 2017-18 and 2018-19, respectively. The planting was done on the raised beds of with three rows planted on each bed with spacing at 30 cm. Other cultural operations and plant protection measures were applied as per package of practices. Observations were recorded on plant height at 60, 90, 120 DAP and at harvest (cm), number of leaves per plant at 60, 90, 120 DAP and at harvest, leaf length at harvest (cm) and days to maturity and were analysed statistically.

RESULTS AND DISCUSSION

Garlic crop responded well to drip irrigation and nitrogen fertigation levels. The growth characters, like plant height and number of leaves per plant at 60, 90, 120 days after planting and at harvest, leaf length and days to maturity was significantly influenced with different levels of drip irrigation and nitrogen fertigation during both years of study. The maximum plant height at 60, 90, 120 days after planting and at harvest (34.78 and 35. 96 cm, 51.64 and 52.74 cm, 68.10 and 70.70, and 55.33 and 57.02 cm, respectively), number of leaves per plant at 60, 90, 120 days after planting and at harvest (5.48 and 6.28, 6.97 and 7.17, 8.94 and 9.38, and 6.24 and 6.40, respectively), leaf length (34.77 and 37.09 cm, respectively) and days taken by the crop to mature (173.00 and 174.08 days, respectively) were observed with the drip irrigation at IW/CPE 1.2, while the lowest was recorded at IW/CPE 0.6 during 2017-18 and 2018-19, respectively. The increase in plant height, number of leaves per plant and leaf length with an increase in drip irrigation level from IW/CPE 0.6 to 1.2 might be due to the advantageous effects of high soil moisture

status on absorption of water in addition to uptake of nutrients, cell turgidity and elongation of the cell, net-assimilation rate and translocation of assimilates to the actively growing parts of plant. Quite the opposite, shortening of plant height under moisture stress conditions could be due to closure of stomata and reduced CO2 and nutrient uptake by plants. These findings are in agreement with the results of Der et al. (2018) who obtained significantly higher values for plant height at harvest under 100 % PE of drip irrigation and the lowest under 60 % PE of drip irrigation in garlic. Similarly, Sankar et al. (2008b) and Sankar et al. (2008a) reported higher plant height in garlic and onion with drip irrigation at 100 % PE, respectively. Whereas, Gyanendra et al. (2016) reported that vegetative growth of garlic was highest under 75% of pan evaporation treatment, and declined with increasing irrigation amount to 100 and 125% of pan evaporation.

Among the nitrogen fertigation treatments, the maximum plant height at 60, 90, 120 days after planting and at harvest (35.08 and 36.38 cm, 51.73 and 51.60 cm, 66.11 and 68.76, and 52.50 and 55.27 cm, respectively), number of leaves per plant at 60, 90, 120 days after planting and at harvest (5.37 and 6.13, 6.77 and 6.89, 9.00 and 9.26, and 5.93 and 6.09, respectively), leaf length (34.26 and 36.28 cm, respectively) and days taken by the crop to mature (170.42 and 172.00 days, respectively) were registered with the application of 90 kg/ha nitrogen through drip irrigation, while the minimum were observed with 60 kg/ha nitrogen fertigation in both years, respectively. This may be due to the fact that nitrogen plays an imperative role in meristematic activity, thereby, improving the leaf area index and chlorophyll content, ensuing in higher photosynthetic rate and vegetative growth of garlic plants (Murata, 1969).

The interaction between drip irrigation and nitrogen fertigation also had a significant effect on growth parameters in both years of investigation. The maximum plant height at 60, 90 days after planting and at harvest, number of leaves per plant at 60, 90, 120 DAP and at harvest along with leaf length at harvest was recorded under drip irrigation at IW/CPE 1.2 and 90 kg/ha nitrogen fertigation in 2017-18 and 2018-19, respectively. This may be due to the fact that an adequate quantity of nutrients coupled with adequate moisture might have resulted in higher growth. However, the number of leaves per plant at harvest was found non-significant in first year but was recorded maximum with drip irrigation at IW/CPE 1.2 and 90 kg/ha nitrogen fertigation in second year. Also, the interaction effect of drip irrigation and nitrogen fertigation on plant height at 120 days after planting and days taken to maturity were found to be non-significant in garlic during both years of study.

Table 1a: Effect of irrigation and nitrogen levels on plant height (cm) of garlic at 60 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	28.23	31.02	32.33	33.53	31.28	28.97	31.76	33.88	35.49	32.53
0.8	28.58	30.40	33.00	34.01	31.50	29.98	31.27	33.36	34.36	32.37
1.0	31.98	32.91	34.96	35.65	33.87	33.21	34.01	35.72	36.52	34.86
1.2	32.48	33.75	35.75	37.14	34.78	33.52	34.90	36.78	38.63	35.96
Mean	30.32	32.02	34.01	35.08		31.42	32.98	34.94	36.38	
Control (Furrow irrigation)	33.09					35.20				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.07	0.08	0.13	0.16		0.08	0.08	0.16	0.16	
CD at 5%	0.24	0.25	0.51	0.48		0.27	0.24	0.51	0.50	

Table 1b: Effect of irrigation and nitrogen levels on plant height (cm) of garlic at 90 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	44.25	46.50	47.61	49.40	46.94	45.05	48.03	46.89	47.39	46.84
0.8	44.62	46.58	48.69	50.74	47.66	46.07	48.13	50.24	51.15	48.90
1.0	47.86	48.78	51.27	52.67	50.15	48.82	50.31	51.67	52.78	50.90
1.2	49.18	50.89	52.39	54.10	51.64	50.06	52.15	53.65	55.08	52.74
Mean	46.48	48.19	49.99	51.73		47.50	49.65	50.61	51.60	
Control (Furrow irrigation)	48.30					51.01				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.09	0.08	0.18	0.17		0.31	0.17	0.63	0.43	
CD at 5%	0.31	0.25	0.53	0.54		1.10	0.51	1.13	1.41	

Table 1c: Effect of irrigation and nitrogen levels on plant height (cm) of garlic at 120 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	60.56	60.87	61.89	62.54	61.47	62.26	62.21	64.60	65.11	63.54
0.8	61.12	62.92	63.18	64.00	62.80	61.89	63.69	65.34	66.70	64.40
1.0	64.89	64.28	65.51	67.10	65.44	65.26	67.08	69.08	70.33	67.95
1.2	65.35	67.07	69.20	70.79	68.10	68.22	70.20	71.47	72.92	70.70
Mean	62.98	63.79	64.95	66.11		64.41	65.79	67.62	68.76	
Control (Furrow irrigation)	63.56					65.87				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.38	0.43	0.77	0.84		0.35	0.28	0.70	0.60	
CD at 5%	1.35	1.27	NS	NS		1.24	0.81	NS	NS	

Table 1d: Effect of irrigation and nitrogen levels on plant height (cm) of garlic at harvest

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	41.38	43.96	44.73	46.35	44.11	42.87	45.43	47.97	49.25	46.38
0.8	44.55	47.41	49.21	50.65	47.96	46.15	49.12	51.05	53.16	49.87
1.0	48.33	49.89	51.22	54.26	50.92	49.43	52.12	53.25	56.42	52.80
1.2	50.98	53.88	57.71	58.76	55.33	51.50	55.22	59.00	62.26	57.02
Mean	46.31	48.79	50.72	52.50		47.52	50.47	52.82	55.27	
Control (Furrow irrigation)	45.22					47.70				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.42	0.22	0.84	0.57		0.20	0.18	0.39	0.37	
CD at 5%	1.48	0.65	1.44	1.85		0.69	0.52	1.11	1.14	

Table 2a: Effect of irrigation and nitrogen levels on number of leaves per plant of garlic at 60 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	4.62	4.96	5.07	5.15	4.95	5.14	5.35	5.43	5.55	5.37
0.8	4.81	5.06	5.16	5.22	5.06	5.50	5.73	5.91	6.10	5.81
1.0	5.09	5.13	5.41	5.35	5.25	5.75	6.04	6.30	6.27	6.09
1.2	5.15	5.41	5.61	5.75	5.48	5.98	6.17	6.40	6.58	6.28
Mean	4.92	5.14	5.31	5.37		5.59	5.82	6.01	6.13	
Control (Furrow irrigation)	4.56					5.29				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.02	0.02	0.05	0.05		0.01	0.01	0.02	0.02	
CD at 5%	0.09	0.07	0.14	0.14		0.04	0.03	0.06	0.06	

Table 2b: Effect of irrigation and nitrogen levels on number of leaves per plant of garlic at 90 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	5.81	5.96	6.22	6.36	6.09	5.96	6.14	6.33	6.45	6.22
0.8	5.99	6.22	6.41	6.53	6.29	6.12	6.30	6.44	6.63	6.37
1.0	6.21	6.44	6.61	6.76	6.51	6.37	6.51	6.70	6.86	6.61
1.2	6.52	6.78	7.14	7.43	6.97	6.70	7.04	7.31	7.61	7.17
Mean	6.13	6.35	6.60	6.77		6.29	6.50	6.70	6.89	
Control (Furrow irrigation)	5.83					6.90				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.02	0.01	0.04	0.02		0.03	0.01	0.05	0.04	
CD at 5%	0.07	0.03	0.06	0.08		0.09	0.04	0.09	0.12	

Table 2c: Effect of irrigation and nitrogen levels on number of leaves per plant of garlic at 120 DAP

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	7.84	8.15	8.30	8.54	8.21	8.03	8.25	8.49	8.74	8.38
0.8	8.06	8.43	8.70	8.89	8.52	8.21	8.72	8.95	9.13	8.75
1.0	8.43	8.60	8.92	9.15	8.78	8.87	9.03	9.29	9.52	9.18
1.2	8.63	8.73	9.09	9.43	8.97	9.07	9.29	9.50	9.66	9.38
Mean	8.24	8.48	8.75	9.00		8.54	8.82	9.06	9.26	
Control (Furrow irrigation)	7.82					8.66				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.03	0.03	0.09	0.06		0.02	0.02	0.04	0.04	
CD at 5%	0.10	0.08	0.18	0.18		0.07	0.06	0.13	0.12	

Table 2d: Effect of irrigation and nitrogen levels on number of leaves per plant of garlic at harvest

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	4.79	4.93	5.14	5.27	5.03	4.98	5.25	5.42	5.50	5.29
0.8	5.21	5.37	5.48	5.73	5.45	5.33	5.47	5.67	5.84	5.58
1.0	5.34	5.55	5.79	6.09	5.69	5.62	5.89	6.00	6.18	5.92
1.2	5.85	6.11	6.36	6.62	6.24	5.99	6.26	6.53	6.82	6.40
Mean	5.30	5.49	5.69	5.93		5.48	5.72	5.91	6.09	
Control (Furrow irrigation)	4.80					5.21				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.03	0.03	0.06	0.06		0.04	0.02	0.08	0.06	
CD at 5%	0.11	0.08	NS	NS		0.14	0.07	0.15	0.18	

Table 3: Effect of irrigation and nitrogen levels on leaf length (cm) of garlic at harvest

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	18.69	23.17	24.89	26.78	23.38	19.69	24.12	27.25	29.26	25.08
0.8	20.88	24.13	27.28	30.19	25.62	22.39	24.50	28.09	31.52	26.62
1.0	24.38	28.35	32.90	36.34	30.50	24.30	29.07	34.89	38.26	31.63
1.2	26.25	31.50	37.58	43.74	34.77	28.61	34.40	39.28	46.07	37.09
Mean	22.55	26.79	30.66	34.26		23.75	28.02	32.38	36.28	
Control (Furrow irrigation)	22.87					26.21				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.10	0.10	0.20	0.20		0.05	0.08	0.09	0.14	
CD at 5%	0.34	0.28	0.60	0.60		0.17	0.22	0.46	0.42	

Table 4: Effect of irrigation and nitrogen levels on days to maturity of garlic

Irrigation (IW/CPE)	2017-18					2018-19				
	Nitrogen (kg/ha)				Mean	Nitrogen (kg/ha)				Mean
	60	70	80	90		60	70	80	90	
0.6	154.67	158.33	163.33	165.00	160.33	156.67	160.00	164.00	166.00	161.67
0.8	159.00	161.67	164.00	168.00	163.17	161.33	164.00	167.00	170.00	165.58
1.0	162.67	165.67	168.67	171.00	167.00	163.67	167.33	171.00	173.33	168.83
1.2	167.00	172.33	175.00	177.67	173.00	169.33	173.33	171.00	173.33	174.08
Mean	160.83	164.50	167.73	170.42		162.75	166.08	169.33	172.00	
Control (Furrow irrigation)	169.00					170.33				
Factors	**I**	**N**	**N x I**	**I x N**		**I**	**N**	**N x I**	**I x N**	
SE (m) ±	0.25	0.34	0.50	0.64		0.44	0.24	0.87	0.60	
CD at 5%	0.87	1.00	NS	NS		1.54	0.70	NS	NS	

CONCLUSION

Based on two years study, it can be concluded that maximum growth garlic crop can be obtained with the application of drip irrigation at IW/CPE 1.2 in combination with 90 kg/ha nitrogen.

REFERENCES

Ahmed, A., Muhammad, S., Muhammad, B., Akhtak, N., & Khan, H. (2006). Effect of various level of nitrogen, phosphorous, potash on yield of garlic. *Sarhad Journal of Agriculture*, 22: 81-89.

Der, H.N., Dabhi, A.B., Barad, B.B., & Gohil, P.J., 2018. Scheduling of drip irrigation and fertigation in rabi garlic (*Allium sativum* L.). *International Journal of Chemical Studies*, *6*(3), 1002-1005.

Gyanendra, P.M.S., Imtiyaz, M., & Dennis, M.D. (2016). Garlic (*Allium sativum* L.) yield as influenced by different levels of irrigation water by drip irrigation system. *International Journal of Innovation in Engineering Research and Management*, *3*(1), 2348-4918.

Michael, A.M., (1999). *Irrigation: Theory and Practice*. Vikas Publishing House Pvt. Ltd. New Delhi, 801p.

Murata, H.J., (1969). Physiological response to nitrogen in plant. In: Physiological Aspects of Crop Yields.

Sankar, V., Lawande, K. E., & Tripathi, P. C. (2008a). Effect of micro irrigation on growth, yield and water use efficiency of onion (*Allium cepa*) under western Maharashtra conditions. *Indian Journal of Agricultural Sciences*. *78*(7), 584-588.

Sankar, V., Lawande, K. E., & Tripathi, P. C. (2008b). Effect of micro irrigation practices on growth and yield of garlic (*Allium sativum* L.) var. G. 41. *Journal of Spices and Aromatic Crops*, 17(3): 230-234.

Sardi, K., & Timar, E. (2005). Response of garlic (*Allium sativum* L.) to varying fertilization level and nutrient ratio. *Communication of Soil Science and Plant Analysis*, *36*, 373-379.

Singh, S.K., & Singh, R.H. (2004). Interaction effect of nitrogen, planting time, and spacing on the performance of garlic (*Allium sativum* L.) cv. Yamuna Safed (G-1). *Biochemical and Cellular Archives*, *4*, 123-128.