Plant Archives Vol. 18 No. 1, 2018 pp. 893-896 *ISSN 0972-5210*

EFFECT OF DIFFERENT FERTIGATION LEVELS ON GROWTH AND YIELD OF GARLIC (*ALLIUM SATIVUM* L.) cv. G-282

Rajesh Gupta*, M. K. Hardaha[1] and K.P. Mishra[2]

*Scientist, KVK, College of Horticulture, Mandsaur – 458001 (M.P.) India
[1]Professor, Department of Soil & Water Engineering, College of Agricultural Engineering, JNKVV, Jabalpur – 482004, (M.P.) India
[2]Associate Professor, Soil & Water Engineering, Faculty of Agricultural Engineering, MGCGVV, Chitrakoot, Satna – 485334 (M.P.) India

Abstract

Field experiments were carried out during the two consecutive *rabi* seasons 2014-15 and 2015-16 with three fertigation levels *viz.*, 60%, 80%, 100% recommended dose of fertilizer (RDF) (100:50:50:50 Kg/ha of N:P:K:S) and 100% RDF with flood irrigation as control to determine the suitable fertigation level for Garlic (*Allium sativum* L.) cv. G-282 in agro-climatic conditions of Malwa plateau of Madhya Pradesh. The experiment was laid out in a factorial randomized block design with three replications. Fertigation levels significantly affected ($P<0.05$) the plant height, marketable bulb yield and gross bulb yield of garlic. However, the neck thickness was unaffected by fertigation levels. Among different fertigation levels tested, fertigation level of 100% RDF recorded highest plant height (73.48 cm), neck thickness (0.87 cm), marketable bulb yield (138.91 q/ha) and gross bulb yield (153.25 q/ha). Therefore, it can be inferred that application of 100% RDF (N:P:K:S) under drip fertigation in garlic crop is the best fertigation dose in order to get higher marketable and gross bulb yield for agro-climatic conditions of Malwa plateau of Madhya Pradesh.

Keywords- Fertigation, Plant height, Neck thickness, Marketable bulb yield, Gross bulb yield

Introduction

Garlic (*Allium sativum* L.) belongs to the family Alliaceae. It is the second important bulb crop grown after onion and world area coverage by garlic was increased from 1142.22 thousand ha in 2003 to 1422.41 thousand ha in 2011 with an average productivity of 12 and 16.71 t/ha, respectively (FAOSTAT, 2011). In India, garlic is cultivated in 280.95 thousand ha with a production of 1617.34 thousand MT an average yield of 5.76 t/ha (NHRDF, 2016). India has become one of the biggest exporters of garlic worldwide. It is grown in large quantities in the states of Madhya Pradesh, Gujarat, Orissa, Rajasthan, Karnataka, Tamil Nadu, Maharashtra and Bihar. Madhya Pradesh is leader state in the production of seed spices and the largest producer of garlic in India and occupies the area of over 81.17 thousand ha with a production of 424.50 thousand MT (NHRDF, 2016). Garlic is a very shallow-rooted bulb crops and very sensitive to moisture stress conditions particularly during bulb initiation and development. Frequent irrigation is, therefore, necessary for better bulb development. In garlic, flood irrigation is widely practiced in India, which results in inefficient use of irrigation water due to losses in deep percolation, distribution and evaporation. The drip fertigation technology is the key intervention in water and fertilizer saving which enhanced the crop productivity.

Fertigation is the most efficient method of fertilizer application, as it ensures application of the fertilizers directly to the plant roots (Patel and Rajput, 2003). In fertigation, fertilizer application is made in small and frequent doses that fit within scheduled irrigation intervals matching the plant water use to avoid leaching. Drip irrigation enables, the application of water-soluble fertilizers and other chemicals along with irrigation water uniformly and more efficiently in the root zone of crop. However, as against approximately 80 percent of the

***Author for correspondence :** E-mail : rajgupta171@gmail.com

irrigated land in Israel under fertigation, there is negligible share of fertigation in India. Therefore, this research was carried out to optimize the fertigation scheduling for agro-climatic conditions of Malwa region of Madhya Pradesh.

Materials and methods

The field experiments were conducted during the two consecutive *rabi* seasons 2014-15 and 2015-16 at farmer's field in Dhariyakhedi village of Mandsaur district of Madhya Pradesh. The area is situated in western part of Madhya Pradesh which falls under agro-climatic zone of Malwa plateau. It lies between the parallels of $23^0$45'50'' and $25^0$2'55" north latitudes and between the meridians of $74^0$42'30" and $75^0$50'20" east longitudes with an average elevation of 436 meters. Mandsaur belongs to sub-tropical climate having a mean temperature range of minimum 5^0C and maximum 44^0C in winter and summer, respectively. The average annual rainfall in the district is 786.6 mm. The topography of the experimental site was uniform and leveled and the soil is clayey in texture with 45 cm depth. A composite soil sample from 15 cm soil layer was collected before the start of experiment for analyzing the various physico-chemical properties of soil.

The total plot size of experimental site was 35 m × 25 m with individual plot area of 15 m × 1.2 m. The garlic cloves (cv. G-282) were dibbled at 15 cm × 10 cm spacing on broad bed furrow (BBF) of 120 cm top width with 45 cm furrow maintaining 15 cm height. Each BBF having two drip laterals with in-built emitters with 50 cm spacing between two consecutive emitters at a discharge rate of 4.1 lph. The uniformity coefficient was calculated as 96.80% at pressure of 1.0 kg/cm^2. Irrigation water was applied according to daily crop evapotranspiration. In this study, a fixed irrigation interval of three days was adopted and amount of water applied was estimated based on previous two days evapotranspiration. The irrigation was stopped 15 days before harvesting in all treatments. The experiment consists of three levels of recommended doses of fertilizer (RDF) *i.e.*, 60% (F_1), 80% (F_2), and 100% (F_3) for garlic crop. The recommended dose of fertilizer (RDF) for garlic was given @100:50:50:50 Kg/ha of N:P:K:S (Nitrogen : Phosphorous : Potassium : Sulphur) respectively. The half dose of N, P, K and S was applied as basal dose and remaining half dose was applied through fertigation in fifteen split at six days interval after planting of cloves and continued up to 90 days after planting as per different treatments. A basal dose of well decomposed farmyard manure @ 20 t ha^{-1} was incorporated in the soil before one month of sowing. The control plot was irrigated in border strip by flood method and fertilizers were applied manually at 100% as recommended doses. Water soluble fertilizers Urea, Urea Phosphate Sulphate of Potash (SOP) and Sulphur WDG 90 were used in fertigation process. The observation on plant height, neck thickness, gross bulb yield and marketable bulb yield of garlic were recorded using standard procedures. The individual year data recorded were subjected to statistical analysis using FRBD (Factorial Randomized Block Design) with three replications as suggested by Gomez and Gomez (1984). Pooled analysis of data over years was also performed to identify the average effect of fertigation over years. The pooled analysis of data was also performed to draw interference of fertigation effect over both the years.

Results and discussion

The plant height was measured in centimetres from ground level to the tip of the longest leaf with the help of metre scale and an average value was worked out for each treatment. The result showed that the plant height was significantly affected by different fertigation treatments (table 1). Highest plant height (73.48 cm) was found in 100% RDF followed by 80% RDF (72.42 cm), control (70.50 cm) and least in 60% RDF (67.87 cm) as depicted in fig 1. The increased plant height in drip fertigated treatments might be due to better availability of moisture and nutrients during entire crop growth period which favoured the growth attributes. Similar results were obtained by Sankar *et al*. (2008) and Mahadeen (2011). The neck thickness was unaffected by fertigation levels (table 1), however drip fertigated treatments gave higher neck thickness as compared to control. The highest neck thickness was recorded in 100% RDF (0.87 cm) followed by 80% RDF (0.74 cm) and least in control (0.65 cm) as depicted in fig 2.

The garlic bulbs were graded in different categories according to their bulb size *viz.*, A-Grade (>25 mm), B-Grade (15-25 mm), C-Grade 10-15 mm), D-Grade (<10 mm). The A, B and C grade bulbs were considered under

Table 1: Plant height and neck thickness of garlic as influenced by different fertigation levels.

Parameter	Year	60% RDF	80% RDF	100% RDF	Control	CD (0.05)
Plant height (cm)	2014-15	67.71	72.25	73.36	70.35	4.75
	2015-16	68.04	72.59	73.60	70.65	4.56
	Pooled	67.87	72.42	73.48	70.50	S
Neck thickness (cm)	2014-15	0.65	0.73	0.86	0.64	0.01
	2015-16	0.66	0.74	0.88	0.66	0.02
	Pooled	0.65	0.74	0.87	0.65	NS

S - Significant, NS - Non Significant

Table 2: Grade wise bulb yield of garlic as influenced by different fertigation levels.

Treatment	Grade wise bulb yield (q/ha)				Market-able bulb yield (q/ha)	Gross bulb yield (q/ha)	Unmar-ketable Yield (%)
	Grade A	Grade B	Grade C	Grade D			
Year: 2014-15							
60% RDF	19.89	28.28	27.56	7.94	75.73	83.67	9.48
80% RDF	28.57	40.44	39.96	10.86	108.96	119.82	9.07
100% RDF	37.01	51.18	50.10	14.03	138.29	152.32	9.24
Control	17.68	26.03	26.62	10.02	70.33	80.34	12.47
Year: 2015-16							
60% RDF	20.37	28.71	28.12	8.44	77.20	85.63	9.89
80% RDF	28.61	40.63	40.60	11.55	109.84	121.40	9.52
100% RDF	37.31	51.71	50.51	14.65	139.53	154.18	9.51
Control	17.85	26.18	26.98	10.39	71.01	81.40	12.77
Pooled							
60% RDF	20.13	28.50	27.84	8.19	76.46	84.65	9.68
80% RDF	28.59	40.54	40.28	11.21	109.40	120.61	9.30
100% RDF	37.16	51.45	50.31	14.34	138.91	153.25	9.38
Control	17.76	26.11	26.80	10.20	70.67	80.87	12.62

Table 3: Marketable bulb yield and gross bulb yield of garlic as influenced by different fertigation levels.

Parameter	Year	60% RDF	80% RDF	100% RDF	Control	CD (0.05)
Marketable bulb yield (q/ha)	2014-15	75.73	108.96	138.29	70.33	2.61
	2015-16	77.20	109.85	139.53	71.01	2.25
	Pooled	76.46	109.40	138.91	70.67	S
Gross bulb yield (q/ha)	2014-15	83.67	119.82	152.32	80.34	1.94
	2015-16	85.63	121.40	154.18	81.40	1.84
	Pooled	84.65	120.61	153.25	80.87	S

S - Significant

marketable yield and D grade bulbs considered under unmarketable category as presented in Table 2. The result indicated that the different grade bulbs were significantly affected by different fertigation treatments. The A-Grade bulbs yield varied from 17.76 q/ha to 37.16 q/ha, B-Grade bulbs yield varied from 26.11 q/ha to 51.45 q/ha, C-Grade bulbs yield varied from 26.80 q/ha to 50.31 q/ha and D-Grade *i.e.*, unmarketable bulbs yield varied from 8.19 q/ha to 14.34 q/ha under different fertigation treatments. The pooled data clearly indicated that the 80% RDF gave the lowest percentage (9.30%) of unmarketable bulb yield followed by 100% RDF (9.38%) and while control treatment gave the highest percentage (12.62%) of unmarketable bulb yield. This might be due to the fulfilment of crop nutrient and water requirement at various growth stages under different fertigation treatments. It is evident fact that drip irrigation ensures better aeration and moisture in the root zone (Tiwari *et al.*, 2003). These results are in accordance with Sankar

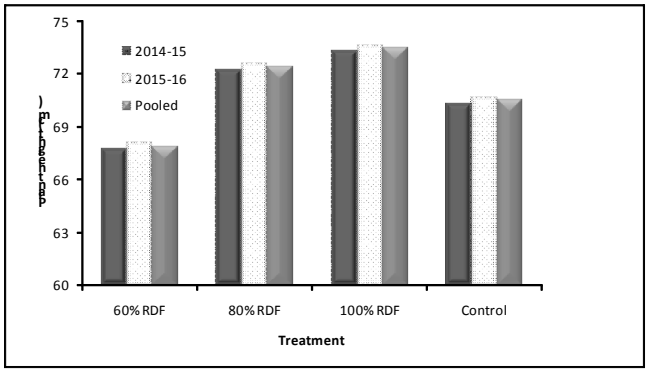

Fig 1: Effect of fertigation levels on plant height of garlic

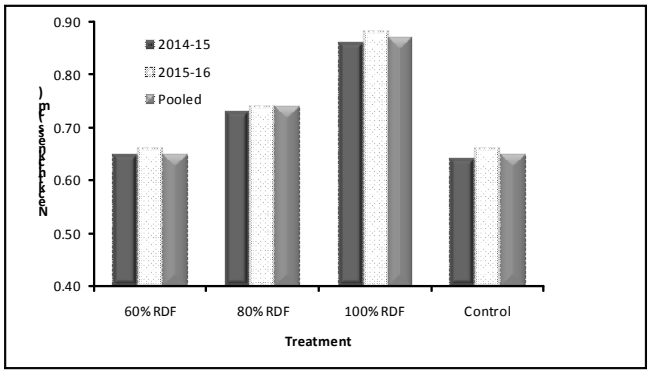

Fig 2: Effect of fertigation levels on neck thickness of garlic

et al. (2008) in garlic and Enchalew *et al.* (2016) in onion.

Yield of garlic bulb was greatly affected by different fertigation levels (table 3). Marketable bulb yield of garlic was found maximum in 100% RDF (138.91 q/ha) which was significantly higher over control (70.67 q/ha), 60% RDF (76.46 q/ha) and 80% RDF (109.40 q/ha) as depicted in fig 3. Similarly, gross bulb yield of garlic was found

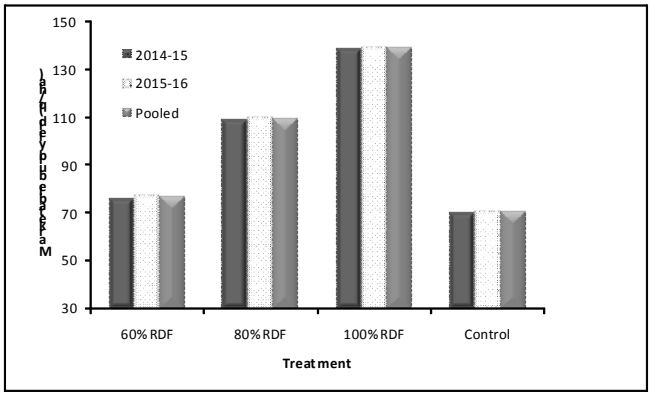

Fig 3: Effect of fertigation levels on marketable bulb yield of garlic

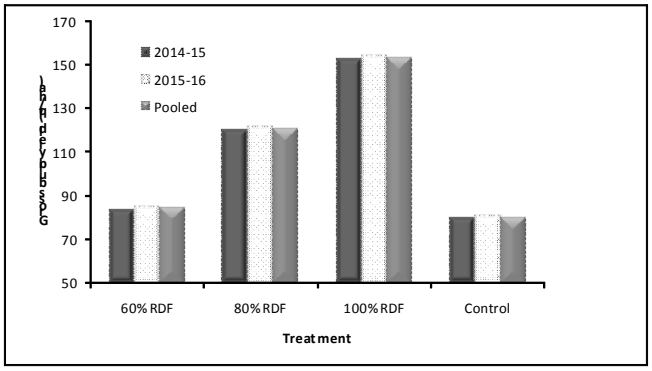

Fig 4: Effect of fertigation levels on gross bulb yield of garlic

maximum in 100% RDF (153.25 q/ha) which was significantly higher over control (80.87 q/ha), 60% RDF (84.65 q/ha) and 80% RDF (120.61 q/ha) as depicted in fig 4. These results are in line with that of Patel *et al*. (1996) and Ayars (2008). The maximum bulb yield was recorded in treatment 100% RDF may be due to optimum availability of NPK and S fertilizers which increases the rate of metabolism and synthesized more carbohydrate thus increases bulb yield. In present study, the increased bulb yield in drip fertigation system was mostly due to the favourable effect of available soil moisture, uniform distribution of irrigation water and fertilizers in split doses during entire growth period of garlic.

Conclusion

Based on the two years *rabi* season experiment, it can be concluded that 100:50:50:50 Kg/ha (100% RDF) application of N:P:K:S under drip fertigation in garlic crop is the best fertigation dose in order to get higher marketable and gross bulb yield for agro-climatic conditions of Malwa plateau of Madhya Pradesh.

Acknowlegment

With sincere respect and gratitude, we would like to thank Director Research Services, MGCGV, Chitrakoot, Satna (M.P.) and Dean, College of Horticulture, Mandsaur (M.P.) for providing facilities and valuable guidance for the research work.

Refrences

Ayars, E.J. (2008). Water requirement of irrigated garlic. *Transactions of the ASABE*, **51(5):** 1683-1688.

Enchalew, B., S.L. Gebre, M. Rabo, B. Hindaye and M. Kedir (2016). Effect of deficit irrigation on water productivity of onion (*Allium cepa* L.) under drip irrigation. *Irrigation Drainage Sys Eng.,* **5:** 172. doi: 10.4172/2168-9768.1000172.

FAOSTAT (2011). Area and production of crops by countries. Food and Agriculture Organization of the United Nations. http://faostat.fao.org

Gomez, K.A. and A.A. Gomez (1984). Statistical procedures for agricultural research, 2nd Ed. New York. John Wiley and Sons.

Mahadeen, A.Y. (2011). Influence of clove weight on vegetative growth and yield of garlic (*Allium sativum* L.) grown under drip irrigation. *Jordan Journal of Agricultural Sciences*, **7(1):** 44-48.

NHRDF (2016). National Horticultural Research and Development Foundation. http://www.nhrdf.com

Patel, B.G., V.D. Khanpara, D.D. Malavia, R.B. Maraviya and B.B. Kaneria (1996). Economic feasibility of drip irrigation in garlic. *Ind. J. Agron.*, **45:** 143-145.

Patel, Neelam and T.B.S. Rajput (2003). Yield response of some vegetable crops to different levels of fertigation. *Annals of Agricultural Research*. **24 (3):** 542-545.

Sankar, V., K.E. Lawande and P.C. Tripathi (2008). 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.

Tiwari, K.N., Ajai Singh and P.K. Mal (2003). Effect of drip irrigation on yield of cabbage *(Brassica oleracea* L. Var. capitata) under mulch and no mulch conditions. *Agricultural Water Management,* **58:** 19-28.