AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **11** | Issue 1 | June, 2016 | 194-198
Visit us -*www.researchjournal.co.in*

RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/11.1/194-198

Article history :
Received : 19.10.2015
Revised : 13.05.2016
Accepted : 20.05.2016

Effect of planting dates, bio-fertilizers and organic manures on qualitative horticultural characteristics of garlic

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ABSTRACT : A field experiment was carried out at the Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* seasons of the years 2004-05 and 2005-06. The experiment was laid out in Split Plot Design with four replications and thirty treatment combinations. An early maturity of garlic crop was noticed with the 30th October planting date and nutrient management treatment of 75 kg nitrogen ha^{-1}+37.5 kg phosphorus ha^{-1} + PSB @ 2.5 g kg ha^{-1} of cloves. The cloves $bulb^{-1}$, size of bulbs and cloves (diameters and length) were found to be the maximum with 15th September planting date and nutrient management treatment of 50 kg ha^{-1}+ 25 kg phosphorus ha^{-1}+ vermicompost @ 5 t ha^{-1}. In the storage study for 90 days the total soluble solids content in the garlic cloves did not show any significant differences.

KEY WORDS : Cloves, Biofertilizers, TSS

HOW TO CITE THIS ARTICLE : Ghawade, S.M. and Gonge, V.S. (2016). Effect of planting dates, bio-fertilizers and organic manures on qualitative horticultural characteristics of garlic. *Asian J. Hort.*, **11**(1) : 194-198, **DOI : 10.15740/HAS/TAJH/11.1/194-198.**

The name garlic is derived from old English word 'gar' which means spear, presumably referring to the clove. The cultivated crops evolved from wild relatives that grow in mountainous regions of Central Asia (Brewster, 2002). In Maharashtra, leading garlic growing districts are Pune, Nashik, Aurangabad, Jalna and Ahmednagar, which, occupies 7952 hectares area with annual production of 59981 tonnes and productivity with 7.57 tonnes per hectare (Anonymous, 2006). The increasing demand both of home usage and industries has resulted in steep rise in garlic prices. As a result, the area under: this crop is increasing very fast in the state in qeneral and akola, washim, amravati and buldhana districts of vidarbaha region in particular. The ideal combination from the proposed treatments of this study would have a good scope for the better yield and quality production of garlic bulbs in the region. The present investigation was, therefore, proposed on effect of planting dates, bio-fertilizers and organic manures on qualitative horticultural characteristics of garlic.

RESEARCH METHODS

An experiment was laid out in Split Plot Design with four replications. The five dates of planting were considered as a main factor and six levels of biofertilizers and manures were considered as a sub-factor. The treatments of main factor are S_1 - 1st September, 2004 and 2005, S_2 - 15th September, 2004 and 2005, S_3 - 30th September, 2004 and 2005, S_4 - 15th October, 2004 and 2005, S_5 - 30th October, 2004 and 2005 and that of sub factor being F_1 - 75 kg nitrogen ha^{-1}+ 37.5 kg phosphorus ha^{-1} + *Azotobacter* @ 2.5 g kg ha^{-1} of cloves, F_2 - 75 kg

nitrogen ha^{-1}+ 37.5 kg phosphorus ha^{-1}+ PSB @ 2.5 g kg ha^{-1} of cloves, F_3 - 50 kg nitrogen ha^{-1}+ 25 kg phosphorus ha^{-1} + vermicompost @ 4 t ha^{-1}, F_4 - 50 kg nitrogen ha^{-1}+ 25 kg phosphorus ha^{-1}+ FYM @ 10 t ha^{-1}, F_5 - 100 kg nitrogen ha^{-1}+ 50 kg phosphorus ha^{-1} and F_6- Control (No fertilizer).

The cloves of 2 to 3 g weight were selected and such cloves were then inoculated with *Azotobacter* and phosphorus solublising bacteria (PSB) at the rate of 2.5 9 kg ha^{-1} of cloves (seed material) by dipping them for 5 minutes in thick paste of carrier based inoculant and jaggary solution. Then, such cloves were dried in shade for half an hour and later on the cloves were used for planting. The pooled analysis of two years data on qualitative charecters like cloves $bulb^{-1}$, size of garlic bulbs and cloves, total soluble solids content in the cloves were carried out as per the methods suggested by Panse and Sukhatme (1967).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Influence of planting dates and nutrient management on size of garlic bulbs and cloves :

Influence of planting dates :

The data recorded in Table 1 in respect of the pooled results of two years indicated that, the treatment S_2 had recorded significantly the maximum (4.21 cm and 2.98 cm) length and diameter (3.34 cm and 0.89 cm) of garlic bulb and cloves, respectively. Significantly minimum length (3.67 cm and 2.65 cm) and diameter (2.60 cm and 0.81 cm) of garlic bulb and clove, respectively were observed with the treatment S_5. This might be due to the fact that, the better vegetative growth might have been exhibited in the earlier planted crop as the crop got sufficient time for it's growth under favourable climatic conditions and ultimately it might have resulted into the production of bulbs with the better size of cloves. The results obtained in this investigation are in close agreement with the findings of am and Shrivastava (1974) and Singh *et al.* (1984) in garlic crop.

Influence of nutrient management :

The pooled mean indicated that, the length and diameter of garlic bulb were significantly influenced due to the nutrient management treatments. The significantly maximum length and diameter of garlic bulb (4.39 and 3.12 cm, respectively) and garlic cloves (3.07 cm and 0.93 cm, respectively) were noted with the treatment F_3. The treatment F_6 had noted significantly minimum length and diameter (3.31 cm and 2.87cm) of garlic bulb and that of garlic cloves (2.49 cm and 0.74 cm, respectively) (Table 1). This might be due to the fact that, the vermicompost containing higher quantum of available N, P_2O_5 and K_2O and rich population of microbes which might have mobilized the nutrients to an available form. The exudates of earthworm would have also supported the growth of micro-organism which would have secreted the plant growth hormones and which might have resulted into the better size of garlic bulbs.

The results are found in close conformity with the findings of Patil *et al.* (2005) in garlic.

Interaction effect :

However, the data presented in Table 1 had shown non-significant differences regarding length and diameter of garlic bulb during both the years of experimentation due to an interaction of planting dates and nutrient management treatments.

Influence of planting dates and nutrient management on cloves $bulb^{-1}$ of garlic :

Influence of planting dates :

It is evident from the looked data presented in Table 1 the treatment S_2 had produced significantly the maximum cloves $bulb^{-1}$ of garlic (21.89) and found to be at par with the treatment S_3 (21.72). The treatments S_4 (20.03) and S_1 (19.78) were found to be at par with each other. However, significantly minimum cloves $bulb^{-1}$ of garlic (18.00) were recorded with the treatment S_5. This might be attributed due to more reserve food material present in the cloves and supplied to the plants during initial growing period thereby the better growth and vigour might have been produced due to the plants of earlier planting dates. Similar results were obtained by Gupta *et al.* (2003) in garlic.

Influence of nutrient management :

The significant differences among the nutrient management treatments for cloves $bulb^{-1}$ of garlic were observed. The significantly maximum cloves $bulb^{-1}$ of garlic (22.61) were produced with the treatment F_3 than rest of the treatments. However, the control treatment F_6 had produced significantly minimum cloves $bulb^{-1}$ of garlic (17.31). The other remaining treatments had

recorded the values in the range of 19.87 (F_4) to 21.82 (F_5) for cloves bulb^{-1} of garlic (Table 1). Improvement in clove number bulb^{-1} of garlic might be due to the fact that, the nutrient supply of inorganic and organic material get available through bio-fertilizers, mostly nitrogen might have increased the concentration of carbohydrates and as the cloves could be served as a reservoir for the carbohydrates their number might have been increased. These findings are in line with the results obtained by Wange (1995) in garlic crop.

Interaction effect :

However, the data regarding an interaction effect for cloves bulb^{-1} of garlic due to the planting dates and nutrient management treatments was found to be non-significant during both the years of experimentation.

Influence of planting dates and nutrient management on yield of cured garlic bulbs (plot^{-1} and hectare^{-1}) :

Influence of planting dates :

The yield of cured garlic bulbs (plot^{-1} and hectare^{-1}) was influenced significantly due to the planting dates in both the years of experimentation as well as in the pooled result and depicted in Table 2.

The pooled result indicated that, the yield of cured garlic bulbs was significantly the maximum with the treatment S_2 (3.03 kg plot^{-1} and 101.22 q ha^{-1}) than all the treatments of planting dates and it was followed by the treatments S_3 (2.93 kg plot^{-1} and 97.53 q ha^{-1}) and S_4 (2.90 kg plot^{-1} and 96.74 q ha^{-1}). However, significantly minimum yield of cured garlic bulbs (2.82 kg plot^{-1} and 94.02 q ha^{-1}) was harvested from the treatment S_5. This might be due to the fact that, the earlier planting date might have produced more fresh yield of garlic bulbs which would have resulted into the maximum cured yield of garlic bulbs. These results are in close conformity with the findings of Pereira *et al.* (1987) in garlic.

Table 1 : Effect of planting dates and organic manures on horticultural characteristics of garlic

	Length of bulb			Diameter of bulb			Length of clove			Diameter of clove			Clove per bulb		
	2004-05	2005-06	Pooled mean	2004-05	2005-06	Pooled mean	2004-05	2005-06	Pooled mean	2004-05	2005-06	Pooled mean	2004-05	2005-06	Pooled mean
Main factor - Planting dates (S)															
S_1 – 1st September	4.07	4.13	4.11	2.97	2.99	2.98	2.78	2.81	2.80	0.84	0.85	0.85	19.04	20.51	19.78
S_2 – 15th September	4.16	4.25	4.21	3.31	3.37	3.34	2.96	3.00	2.98	0.88	0.89	0.89	20.67	23.10	21.89
S_3 – 30th September	4.08	4.15	4.09	3.17	3.23	3.20	2.88	2.93	2.91	0.87	0.88	0.88	20.55	22.89	21.72
S_4 – 15th October	3.86	3.93	3.90	2.74	2.87	2.81	2.81	2.86	2.84	0.84	0.85	0.85	19.53	20.53	20.03
S_5 – 30th October	3.65	3.69	3.67	2.62	2.58	2.60	2.62	2.67	2.65	0.79	0.82	0.81	17.03	18.97	18.00
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. ±	0.06	0.06	0.09	0.04	0.04	0.03	0.03	0.03	0.04	0.01	0.006	0.01	0.17	0.65	0.28
C.D. (P=0.05)	0.19	0.19	0.26	0.12	0.13	0.10	0.09	0.09	0.11	0.04	0.02	0.03	0.51	1.98	0.81
Sub-factor - Nutrient management (F)															
F_1	4.17	4.14	4.13	2.92	2.95	2.94	2.78	2.82	2.80	0.80	0.82	0.81	19.98	21.41	20.70
F_2	4.14	4.10	4.12	2.96	2.97	2.97	2.89	2.93	2.91	0.84	0.85	0.85	20.55	21.92	21.24
F_3	4.37	4.44	4.39	3.14	3.11	3.12	3.05	3.09	3.07	0.92	0.93	0.93	22.19	23.03	22.61
F_4	4.02	3.99	4.00	2.96	3.01	2.99	2.77	2.79	2.78	0.88	0.87	0.88	19.12	20.61	19.87
F_5	4.11	4.26	4.19	2.99	3.08	3.03	2.71	2.74	2.73	0.91	0 .93	0.92	21.18	22.45	21.82
F_6 - Control (No fertilization)	3.23	3.35	3.31	2.81	2.93	2.87	2.46	2.51	2.49	0.73	0.75	0.74	16.75	17.87	17.31
'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. ±	0.05	0.07	0.09	0.04	0.03	0.02	0.04	0.04	0.05	0.01	0.007	0.008	0.21	0.37	0.25
C.D. (P=0.05)	0.17	0.22	0.28	0.11	0.13	0.07	0.11	0.11	0.14	0.03	0.02	0.02	0.66	1.04	0.73
Interaction - S x F															
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.E. ±	0.06	0.16	0.21	0.09	0.07	0.06	0.12	0.09	0.10	0.02	0.01	0.02	0.48	1.16	1.17
C.D. (P=0.05)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NS=Non-significant

Influence of nutrient management :

The data regarding pooled result presented in Table 2 indicated that, the significantly maximum yield of cured garlic bulbs (3.13 kg plot^{-1} and 104.27 q ha^{-1}) was produced by the treatment F_3 than all the treatments and it was followed by the treatments F_5 (3.06 kg plot^{-1} and 101.88 q ha^{-1}) and F_2 (3.01 kg plot^{-1} and 100.34 q ha^{-1}), The control treatment F_6 had recorded significantly minimum yield of cured garlic bulbs (1.96 kg plot^{-1} and 65.03 q ha^{-1}), Whereas, the treatments F_1 (2.94 kg plot^{-1} and 97.96 q ha^{-1}) and F_4 (2.91 kg plot^{-1} and 96.77 q ha^{-1}) had registered the medium ranged values for the yield of cured garlic bulbs. This might be due to the fact that, due to an application of inorganic fertilizers supplemented with vermicompost might have produced more fresh yield of garlic bulbs which would have resulted into the maximum cured yield of garlic bulbs.

Interaction effect :

The data presented in Table 2 exhibited that, an interaction effect of the planting dates and nutrient management treatments was found to be non-significant in respect of yield of cured garlic bulbs during both the years of experimentation.

Influence of planting dates and nutrient management on total soluble solids :

Influence of planting dates :

The data presented in Table 2 clearly indicated that, during the year 2004-05, the content of total soluble solids after 90 days of storage was the maximum (40.29 %) under the treatment S_2 of 15th September planting. However, it was found to be minimum (39.55 %) for the same storage period with the treatment S_5 of 30th October planting.

Similarly, during the year 2005-06, the maximum total soluble solids were registered at 30 (39.81 %), 60 (40.54 %) and 90 days (40.68 %) of storage with the treatment S_2. However, minimum values for total soluble solids (40.53) were recorded with the treatment S_5 of

Table 2 : Effect of planting dates and organic manures on horticultural characteristics of garlic

Treatments	Yield of cured garlic bulbs (kg plot^{-1})			Yield of cured garlic bulbs (q ha^{-1})			Total soluble solids at 90 days of storaqe	
	2004-05	2005-06	Pooled mean	2004-05	2005-06	Pooled mean	2004-05	Pooled mean
Main factor =planting dates (s)s								
S_1 - 1st September	2.86	2.90	2.88	99.25	96.59	95.92	40.20	40.63
S_2 -15th September	2.97	3.10	3.03	99.06	103.37	101.22	40.29	40.68
S_3 - 30th September	2.90	2.96	2.93	96.52	98.54	97.53	40.13	40.62
S_4 - 15th October	2.88	2.92	2.90	96.16	97.32	96.74	40.07	40.58
S_5 - 30th October	2.82	2.81	2.82	94.09	93.95	94.02	39.55	40.53
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS	NS
S.E. $\pm$	0.01	0.02	0.01	0.47	0.45	0.32	0.19	0.14
C.D. (P=0.05)	0.04	0.06	0.03	1.42	1.34	0.96		
Sub-factor - nutrient management (F)								
F_1	2.93	2.95	2.94	97.70	98.22	97.96	39.97	40.54
F_2	2.95	3.07	3.01	98.39	102.29	100.34	40.08	40.66
F_3	3.04	3.21	3.13	101.37	107.16	104.27	40.42	40.85
F_4	2.88	2.93	2.91	96.00	97.54	96.77	39.88	40.76
F_5	3.00	3.12	3.06	99.84	103.92	101.88	40.13	40.85
F_6	2.02	1.89	1.96	67.19	62.87	65.03	39.85	40.24
'f' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS	NS
S.E. $\pm$	0.01	0.04	0.02	0.65	0.66	0.41	0.14	0.12
C.D. (P=0.05)	0.03	0.12	0.06	1.97	1.95	1.25	-	-
Interaction - S x F								
'F' test	NS	NS	NS	NS	NS	NS	NS	NS
S.E. $\pm$	0.03	0.03	0.03	1.33	1.15	1.18	0.32	0.26
C.D. (P=0.05)	-	-	-	-	-	-	-	-

NS=Non-significant

planting date. This might be due to the fact that, an early planting date might have produced the quality cloves of garlic due to availment of congenial temperature through out the crop period and which would have recorded more content of total soluble solids. On advancement of storage period, an increasing trend of total soluble solid content has been reported by Warade (2004) in onion.

Influence of nutrient management :

Among the different nutrient management treatments in the year 2004-05, the content of total soluble solids of garlic cloves were observed to be the maximum at 90 days after storage (40.42 %) with the treatment F_3. However, minimum values were registered for content of total soluble solids of garlic cloves at 90 days (39.85 %) of storage period with the treatment F_6.

During the year 2005-06, the maximum content of total soluble solids were noticed at 90 days (40.85 %) period in garlic cloves with the treatment F_3. However, minimum values pertaining to the total soluble solids at each stage of storage were recorded with the control treatment F_6 (40.24 %) Table 2. This might be due to an application of chemical fertilizer supplemented with vermicompost might have produced the quality cloves of garlic which would have resulted into more content of total soluble solids. These results are in line with the findings of Warade (2004) in onion.

Interaction effect :

However, the data presented in Table 2 revealed that, an interaction effect of the planting dates and nutrient management treatments on content of total soluble solids was found to be non-significant at 90 days of storage of garlic bulbs during both the years of experimentation.

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