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Research Article

RESPONSE OF SOWING DATE AND SULPHUR LEVELS ON GROWTH AND YIELD OF GARLIC (*Allium sativum* L.)

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Abstract- A field experiment was conducted to find out the suitable sowing date and optimum dose of sulphur to obtain good quality yield in garlic (*Allium sativum* L.). Sixteen treatment combinations with four dates of sowing *viz*., 10th October (D_1), 25th October (D_2), 10th November (D_3) and 25th November (D_4) and four levels of sulphur (control, 30, 60 and 90 kg/ ha) were taken. Sowing of garlic crop on 25th October along with application of sulphur @ 60 kg/ ha significantly increased polar diameter of bulb, average weight of bulb and yield. It may be concluded that most suitable time for sowing of garlic crop is 25th October and a dose of 60 kg/ ha sulphur found better to harvest a good crop with good yield and net returns under semi-arid region of Rajasthan.

Keywords- Garlic, sowing dates, sulphur content, bulb yield, cloves

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Introduction

Garlic (*Allium sativum* L), a member of the Alliaceae family, is one of the most aromatic herbaceous annual spices. It is especially rich in protein, carbohydrate and ascorbic acid with a characteristic pungent smell. About 142 calories of energy is obtained from 100 g of garlic. It is widely used in flavouring of food, preparation of chutneys, pickles, curry powder, tomato ketch-up *etc*. Besides the nutritive value of garlic, it is included in Indian system of medicines in the treatments of disease like chronic infection of the stomach and intestine, dysentery, typhoid, cholera and disease lungs, garlic is successfully used [3]. India ranked second in area and third in production of garlic in the world. The productivity of this crop is quite low *i.e*., 5 metric ton/ha which is far less than that of China and Egypt. The poor situation of the crop may be due to its unscientific cultivation and lesser care of growers to its nutritional management especially due to deficiency of sulphur. The date of sowing and appropriate dose of sulphur are the crucial factors that can decide establishment, growth and performance of garlic crop through changing morphological system, physiological functioning and time available for the crop to complete its life cycle [12]. Keeping in view the importance of date of sowing and sulphur nutrition for garlic, the experiment was undertaken to study.

Materials and methods

A field experiment on Garlic *cv*. G-282 was conducted during Rabi season 2014-15 at Horticulture farm, S.K.N. College of Agriculture, Jobner, Jaipur. The experimental soil belongs to loamy sand (entisol) with pH 8.2, ECe 1.35 dSm^{-1}, organic carbon 0.15 %, Available nitrogen 135 kg ha^{-1}, available phosphorus 16.25 kg ha^{-1}, available potassium 148.6 kg ha^{-1} and sulphur 8.40 mg kg^{-1}. The experiment was comprised of 16 treatment combinations with four dates of sowing *viz*., 10th October (D_1), 25th October (D_2), 10th November (D_3) and 25th November (D_4) and four levels of sulphur *viz*., control (S0), Sulphur 30 kg ha^{-1} (S30), Sulphur 60 kg ha^{-1} (S60) and Sulphur 90 kg ha^{-1} (S90). It was laid out in randomized block design with three replications. Sulphur was applied as basal dose in its elemental form. Besides it, the recommended dose of NPK for garlic (120: 40: 100 kg ha^{-1}) was also applied. Full dose of phosphorus and potassium and half dose of nitrogen was applied as basal dose just before sowing and rest half dose of nitrogen was applied as top dressing. Sowing was done manually as per dates of sowing at a spacing of 15 cm X 10 cm maintaining a seed rate of 500 kg cloves ha^{-1}. Five plants were selected randomly from each plot for recording plant height, number of leaves per plant, chlorophyll content of leaves, fresh weight of leaves, neck thickness, bulb diameter, weight of bulb and bulb yield. The chlorophyll content of leaves was determined at 50 days after sowing [1].

Results and discussion

Effect of sowing time

The results given in [Table-1] clearly indicate that plant height, number of leaves per plant, chlorophyll content of leaves and fresh weight of leaves increased significantly when crop sown on 25th October over rest of sowing dates. These findings clearly indicated that 25th October sowing date played a significant role on enhancing the growth of garlic. Improvement in plant growth on 25th October sowing date might be due to fact that variation in maximum and minimum temperature at this stage was favourable. Further, the favourable agro climatic conditions prevailed with sowing on 25th October have improved in germination and seedling emergence than 10th October, 10th November and 25th November sowing. These findings are in close confirmative with the results of Hornok [8] and Jat [10]. Further, sowing of crop on various date significantly increased the neck thickness, bulb diameter (polar), weight of bulb and bulb yield per hectare [Table-1] to [Table-3]. The improvement in yield attributes and yield was observed maximum when crop sown on 25th October which might be due to favourable environment condition prevailed during germination and initial growth. Although, early and delay in sowing adversely affected plant yield due to reason that plants are exposed to high as well as low temperature during the period of growth and development of plant and bulb. These findings are in close confirmative with the results of Baswana, *et al*. [2] and Faruq [5].

Effect of sulphur

The [Table-1] indicates that plant height, number of leaves per plant, chlorophyll content of leaves and neck thickness increased significantly upto application of

sulphur @ 60 kg ha^{-1}. This is supported by the fact that sulphur deficiency prevents utilization of nitrogen and brings about accumulation of soluble nitrogen in the plant leaves. Thus, increasing level of sulphur in turn improved plant growth by meeting higher nutritional demand for plant growth. These results are also in close conformity with the findings of Hariyappa [6], Dabhi and Patel [4] and Jaggi [9]. The results predicted in [Table-1] to [Table-3] indicate that yield attributing characters namely bulb diameter and bulb yield increased significantly with the increasing level of sulphur fertilization upto 60 kg ha^{-1}. Although, the highest values for these parameters were recorded with the application of highest dose (90 kg ha^{-1}) of sulphur being statistically at par with each other. Sulphur being an integral constituent of certain amino acids of which nitrogen is also essential constituent, might have helped in increasing net assimilation rate of nitrogen along with other nutrients. Thus, it might have resulted in increased projected yield. The results are in supported with the findings of Hore, *et al*. [7]; Verma, *et al*. [13] and Jyotimala and Thakur [11].

Interactive effect of different date of sowing and sulphur levels (D x S)

The results presented in [Table-2 & 3] shows that the sowing dates of garlic crop along with different levels of sulphur increased the yield significantly. Maximum diameter, weight of bulb and per hectare were obtained when crop sown on 25th October and fed with 90 kg S ha^{-1} (D_2S_{90}). However, this combination was found statistically at par with treatment D_2S_{90} where crop sown on 25th October and fed with 60 kg S ha^{-1}. The combined effect of sowing dates and sulphur levels significantly increased the yield attributes and yield which might be due to the fact that appropriate sowing date along with optimum dose of sulphur helped to absorb most of the essential nutrients in proper amount and increased microbial population in the rhizosphere, required by plants for better growth and development and such favourable environment conditions were provided under the 25th October sown crop. The results are in close confirmative with Faruq (5) and Hore, *et al*. [7]. The data in [Table-3] also shows that the net returns has been increased when crop sown on 25th October along with increasing level of sulphur upto 60 kg ha^{-1}. These results can be directly correlated with corresponding increase the yield of garlic due to different sowing dates and sulphur as a direct effect on net returns [10].

Conclusion

On the basis of results, it can be concluded that sowing of garlic on 25th October along with application of Sulphur @ 60 kg ha^{-1} (D_2S_{90}) under semi-arid region of Rajasthan was found better to harvest a good crop with yield of 226.66 q ha^{-1} and net returns of Rs. 326587 ha^{-1}.

Table-1 *Effect of sowing date and sulphur levels on plant height, number of leaves, total chlorophyll content, fresh weight of leaves and neck thickness of garlic*

Treatments	Plant height (cm)	No. of leaves per plant	Total chlorophyll content (mg/g)	Fresh weight of leaves (g)	Neck thickness (cm)
Sowing Dates					
10th October (D_1)	36.90	7.78	1.20	20.50	0.699
25th October (D_2)	36.95	8.85	1.24	21.88	0.775
10th November (D_3)	34.25	7.68	1.10	19.91	0.710
25th November (D_4)	31.55	6.05	0.87	18.39	0.680
SEm±	0.84	0.19	0.03	0.47	0.014
CD (P=0.05)	2.43	0.54	0.08	1.36	0.042
Sulphur levels					
Control (S_0)	31.28	5.85	0.87	17.21	0.635
Sulphur 30 kg ha^{-1} (S_{30})	34.24	7.42	1.09	19.90	0.700
Sulphur 60 kg ha^{-1} (S_{60})	36.82	8.39	1.21	21.54	0.754
Sulphur 90 kg ha^{-1} (S_{90})	37.31	8.71	1.24	22.04	0.775
SEm±	0.84	0.19	0.03	0.47	0.014
CD (P=0.05)	2.43	0.54	0.08	1.36	0.042

Table-2 *Effect of sowing date and sulphur levels on diameter and weight of bulb (after curing) of garlic*

Treatments	Polar diameter (cm)					Weight of bulb after curing (g)				
Sowing Dates → / Sulphur ↓	10th Oct (D_1)	25th Oct (D_2)	10thNov (D_3)	25thNov (D_4)	**Mean**	10th Oct (D_1)	25th Oct (D_2)	10thNov (D_3)	25thNov (D_4)	**Mean**
Control (S_0)	2.56	3.12	2.10	1.56	**2.33**	18.52	23.77	17.63	13.99	**18.48**
Sulphur 30 kg ha^{-1} (S_{30})	3.80	4.64	3.12	2.33	**3.47**	26.79	34.38	25.50	20.25	**26.73**
Sulphur 60 kg ha^{-1} (S_{60})	4.55	5.56	3.74	2.78	**4.16**	31.07	39.88	29.58	23.48	**31.00**
Sulphur 90 kg ha^{-1} (S_{90})	4.72	5.76	3.88	2.89	**4.31**	32.23	41.37	30.69	24.36	**32.16**
Mean	**3.91**	**4.77**	**3.21**	**2.39**		**27.15**	**34.85**	**25.85**	**20.52**	
	SEm ±		**CD (P=0.05)**			**SEm ±**		**CD (P=0.05)**		
D	0.08		0.24			0.44		1.26		
S	0.08		0.24			0.44		1.26		
DxS	0.17		0.49			0.87		2.52		

Application of research: Research useful to study the response of sowing date and sulphur levels on growth and yield of Garlic.

Research Category: Crop Science

Abbreviations:
CGR: Crop growth rate
Kg: Kilogram
Ha^{-1}: Per Hectare

Table-3 *Effect of sowing date and sulphur levels on bulb yield and net returns of garlic crop*

Treatments	Bulb yield (q ha^{-1})					Net returns (Rs/ha)				
Sowing Dates → / Sulphur ↓	10th Oct (D_1)	25th Oct (D_2)	10thNov (D_3)	25thNov (D_4)	**Mean**	10th Oct (D_1)	25th Oct (D_2)	10thNov (D_3)	25thNov (D_4)	**Mean**
Control (S_0)	110.47	153.33	105.71	96.19	**116.43**	118945	196093	110377	93241	**129664**
Sulphur 30 kg ha^{-1} (S_{30})	142.85	199.04	124.76	111.42	**144.52**	176479	277621	143917	119905	**179481**
Sulphur 60 kg ha^{-1} (S_{60})	162.85	226.66	142.85	126.66	**164.76**	211729	326587	175729	146587	**215158**
Sulphur 90 kg ha^{-1} (S_{90})	167.61	232.37	146.66	134.28	**170.23**	219547	336115	181837	159553	**224263**
Mean	**145.95**	**202.85**	**130.00**	**117.14**		**181675**	**284104**	**152965**	**129822**	

	SEm ±	CD (P=0.05)	SEm ±	CD (P=0.05)
D	2.26	6.53	2709	7823
S	2.26	6.53	2709	7823
DxS	4.52	13.06	5417	15646

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