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Influence of vermicompost and sulphur on growth and yield of garlic (*Allium sativum* L.) under semi arid climate

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Abstract

A field experiment was conducted during *rabi* season of 2010–2011 to find out the suitable dose of vermicompost (VC) and sulphur (S) to obtain high yield and net returns in garlic (*Allium sativum*). Sixteen treatment combinations with four levels of VC (control, 2.5, 5.0 and 7.5 t ha^{-1}) and four levels of S (control, 30, 60 and 90 kg ha^{-1}) were evaluated. Application of 7.5 t ha^{-1} VC and 90 kg ha^{-1} S individually produced maximum plant height, number of leaves per plant, chlorophyll content in leaves, fresh weight of leaves, neck thickness, number of cloves per bulb, weight of bulb, bulb diameter and bulb yield, whereas, the combined application of 5.0 t ha^{-1} VC along with 60 kg ha^{-1} S was found to be significantly superior with respect to weight of bulb (34.55 g), bulb yield (199.18 q ha^{-1}) and net returns of garlic.

Keywords: *Allium sativum*, bulb, clove, garlic, sulphur, vermicompost

Introduction

Garlic (*Allium sativum* L.) belonging to the family Amaryllidaceae is the second important bulb crop after onion. It is specially rich in protein, carbohydrate and ascorbic acid. 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 (Ayurvedic, Unani and Siddha) as a carminative and gastric stimulant to help in digestion and absorption of food (Sankaracharya 1974). India is ranked second in area and third in production of garlic in the world. The productivity of this crop is quite low *i.e.* 5 t ha^{-1} (Anonymous 2010) which is far less than that of China and Egypt. This may be due to its unscientific cultivation particularly nutrient management. The present experiment is therefore carried out to bridge this knowledge gap.

Materials and methods

The field experiment was carried out on sandy loam soil of horticulture research farm of S.K.N. College of Agriculture, Jobner (Rajasthan) during 2010–2011 The soil had pH 8.2, electrical conductivity 0.92 dSm^{-1} (133.80 kg ha^{-1} available N, 8.14 kg ha^{-1} available P, 148.15 kg ha^{-1} available K, 8.40 mg kg^{-1} available S and 0.27% OC). The experiment comprised of 16 treatment combinations with four levels each

of VC (0, 2.5, 5.0 and 7.5 t ha^{-1}) and S (0, 30, 60 and 90 kg ha^{-1}) applied to garlic cv. G-41. The experiment was laid out in randomized block design with three replications. VC was procured from Department of Soil Science and Chemistry, S.K.N. College of Agriculture, Jobner. It had 1.52%, 1.28% and 1.07% (on dry weight basis) N, P and K, respectively. Sulphur was purchased from market as elemental sulphur. VC and S were applied as basal doses. Besides the treatments, the recommended dose of NPK for garlic (120: 40: 100 kg ha^{-1}) was also applied. Full dose of P and K and half dose of N were applied as basal dose just before sowing and rest half dose of N was applied as top dressing (30 and 50 DAS). Sowing was done manually on 15th November 2010 at a spacing of 15 cm × 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, number of cloves per bulb and bulb yield. The chlorophyll content of leaves was determined at 50 days after sowing as per the method advocated by Arnon (1949).

Results and discussion

Effect of vermicompost

The result of present investigation clearly indicated that plant height, number of leaves per plant, chlorophyll content of leaves, neck thickness and number of cloves per bulb increased significantly due to application of VC @ 5.0 t ha^{-1}. However, the fresh weight of leaves, bulb diameter (polar and equatorial), weight and yield of the bulb increased significantly up to the highest dose (7.5 t ha^{-1}) of VC (Table 1).

These findings clearly indicated that VC played a significant role in enhancing the growth and yield of garlic. Improvement in plant growth and yield parameters due to application of VC can be attributed to improved nutrient availability and improvement in physical condition of the soil which in turn provides a balanced nutritional environment both in the soil rhizosphere and plant system (Reddy *et al.*

Table 1. Effect of vermicompost and sulphur on plant height, number of leaves per plant, fresh weight of leaves, neck thickness, chlorophyll content in leaves, bulb diameter, number of cloves per bulb, weight of bulb and bulb yield

Treatment	Plant height (cm)	Number of leaves per plant	Fresh weight of leaves (g)	Neck thickness (cm)	Chlorophyll content (mg g^{-1})	Bulb diameter (cm)		Number of cloves per bulb	Weight of bulb (g)	Bulb yield (q ha^{-1})
						Polar	Equatorial			
VC (t ha^{-1})										
VC 0 (control)	30.90	5.20	13.00	0.58	0.63	2.19	3.12	18.18	19.34	140.74
VC 2.5	33.20	7.40	18.16	0.62	1.05	2.80	3.70	23.57	21.90	153.29
VC 5.0	35.49	9.00	22.08	0.67	1.18	3.56	4.12	26.35	28.89	191.15
VC 7.5	37.81	9.40	23.30	0.72	1.21	3.90	4.53	27.59	30.90	197.53
SEm±	0.87	0.15	0.37	0.02	0.02	0.06	0.07	0.43	0.18	1.25
CD at 5%	2.53	0.43	1.08	0.05	0.05	0.18	0.20	1.24	0.52	3.61
Sulphur (kg ha^{-1})										
S 0 (control)	31.30	5.60	13.60	0.60	0.72	2.20	3.30	19.25	20.04	142.39
S 30	33.00	7.49	18.21	0.62	1.04	2.92	3.77	23.20	22.50	162.14
S 60	35.50	8.61	21.53	0.65	1.15	3.50	4.10	26.00	28.63	185.19
S 90	37.60	9.30	23.20	0.70	1.16	3.83	4.30	27.24	29.86	193.00
SEm±	0.87	0.15	0.37	0.02	0.02	0.06	0.07	0.43	0.18	1.25
CD at 5%	2.53	0.43	1.08	0.05	0.05	0.18	0.20	1.24	0.52	3.61

1998). These results are in close proximity with earlier reports of Arancon *et al.* (2003) and Choudhary *et al.* (2003).

Effect of sulphur

Plant height, number of leaves per plant, chlorophyll content of leaves, neck thickness, number of cloves per bulb, bulb diameter, weight of the bulb and yield of garlic were significantly affected by application of varying levels of S (Table 1). Application of 90 kg S ha^{-1} resulted in significantly higher growth and yield attributes. S deficiency prevents utilization of N and also brings about an accumulation of soluble N within the plant (Charities & Carpentiers 1956). Thus, increasing level of S in turn improved plant growth by meeting higher nutritional demand for plant growth. Further, S is the constituent of several enzymes and amino acids which are required for chlorophyll synthesis. Besides it increases the uptake of N which is a chief constituent of chlorophyll. Due to these reasons, a significant increase in chlorophyll content and other growth and yield attributes was observed due to S fertilization. These results are in conformity with the findings of Kumar & Singh (1997) and Channagoudra (2004).

Interactive effect of vermicompost and sulphur levels on yield attributes and yield (VC × S)

The combined effect of VC and S was found to be significant for weight of bulb and yield. The maximum weight of bulb and yield were recorded with application of VC 7.5 t ha^{-1} + S 90 kg ha^{-1} which was found to be statistically at par to application of VC 5.0 t ha^{-1} + S 60 kg ha^{-1} (Table 2). VC helps in reducing C: N ratio, increases humic acid content and provides nutrients in readily available form to plants (Talashilkar *et al.* 1999). It also contains biologically active substances such as plant growth regulators (Krishnamoorthy & Vajranabhaiah 1986). On the other hand, S being an important constituent of certain amino acids (cystine, cysteine and methionine), it significantly affected the yield attributing characters and yield (Losak & Wisniowska-Kieliam 2006). Thus, the combined application of VC and S provided all the essential nutrients, required by plants for its growth and

Table 2. Combined effect of vermicompost and sulphur levels on weight of bulb and bulb yield

Treatments	Weight of bulb (g)				Bulb yield (q ha^{-1})			
	V_0	$V_{2.5}$	$V_{5.0}$	$V_{7.5}$	V_0	$V_{2.5}$	$V_{5.0}$	$V_{7.5}$
S_0	16.16	17.68	21.8	24.53	93.83	120.16	173.66	181.89
S_{30}	18.17	20.23	24.13	27.47	125.10	142.39	189.30	191.77
S_{60}	20.41	24.4	34.55	35.17	170.37	163.79	199.18	207.41
S_{90}	22.63	25.3	35.09	36.41	173.66	186.83	202.47	209.05
		SEm±	CD at 5%			SEm±	CD at 5%	
	V × S	0.72	2.08		V × S	5.02	14.44	

Table 3. Combined effect of vermicompost and sulphur on net returns and B: C ratio

Treatments	Net returns (Rs ha^{-1})				B: C ratio			
	V_0	$V_{2.5}$	$V_{5.0}$	$V_{7.5}$	V_0	$V_{2.5}$	$V_{5.0}$	$V_{7.5}$
S_0	191389	265379	420879	440569	2.12	2.79	4.20	4.19
S_{30}	284449	331319	467049	469459	3.13	3.46	4.63	4.44
S_{60}	419509	394769	495939	515629	4.58	4.09	4.88	4.84
S_{90}	428629	463139	505059	519799	4.64	4.76	4.93	4.84
		SEm±	CD at 5%			SEm±	CD at 5%	
	V × S	9706	28029		V × S	0.10	0.29	

development. The combined application of 5.0 t VC ha^{-1} + 60 kg S ha^{-1} was found to be the best treatment as it produced significantly more net returns and B: C ratio (Table 3). These findings are in conformity with the earlier reports of Manohar (2011).

On the basis of this study, it could be inferred that combined application of 5.0 t VC ha^{-1} and 60 kg S ha^{-1} will provide better yield, net return and B: C ratio.

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