

Research Article

Effect of nitrogen and sulphur levels on growth and yield of garlic (*Allium sativum* L.)

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Abstract

A study was conducted in the College of Horticulture, Mandsaur during the years 2007- 2008 during the *rabi* season (Winter, Oct.-March). The main aim of this experiment was to enhance the productivity of garlic through assessing the effect of different levels of nitrogen and sulphur. The experiment consisting of 4 levels of nitrogen (50, 100, 150 and 200 kg ha⁻¹) and 4 levels of sulphur (0, 20, 40 and 60 kg ha⁻¹) were applied as basal dose and top dressing. Application of 200 kg nitrogen ha⁻¹ significantly increased the plant height (cm), number of leaves per plant, neck thickness (cm), bulb diameter(cm), number of cloves per bulb, fresh weight of 20 cloves (g), dry weight of 20 cloves (g), fresh weight of bulb (g), dry weight of bulb (g) and bulb yield (q ha⁻¹). Among various levels of sulphur tried (60 kg ha⁻¹) exhibited the best growth and yield attributes. Significantly higher yield of garlic was obtained with the treatment combination (200 kg N ha⁻¹ + 60 kg S ha⁻¹).

Keywords: *Allium sativum* L., growth, nitrogen, sulphur, fertilizer, yield, India.

Introduction

Garlic (*Allium sativum* L.) is sexually sterile and has traditionally been cultivated clonally through cloves. In India, garlic is cultivated over 171.45 thousand hectares, producing 923.25 thousand tonnes with an average yield of 5.23 tonnes ha⁻¹ (NHRDF, 2007-08). India ranks second in area and production in the world. In Madhya Pradesh it is grown over about 67.50 thousand hectares

with total production of 5.43 tonnes ha⁻¹. Madhya Pradesh ranks first in area and production of garlic in India [1].

It is now evident that out of all the major plant nutrients found in various Indian soils, nitrogen and sulphur are the most deficient elements (Arekery *et. al.* 1956). Availability of nitrogen is of prime importance for growing plants as it is a major and indispensable source of protein and nucleic acid molecules. It is also an integral part of chlorophyll molecules, which are responsible for photosynthesis. It is well known that the use of fertilizer helps in production and is a somewhat quick method for achieving maximum yields (Naruka, 2000).

One of the outstanding features in the chemical composition of *Allium* plants is the large amount of organic bound sulphur. These sulphur compounds in onion and garlic have received a lot of attention because of their potential antibiotic (Lehmann, 1930; Cavallito and Baily, 1944; and Seebeck, 1947) and flavour properties.

Sulphur is an essential plant nutrient. Its role in balanced fertilization and consequently in crop production is being increasingly appreciated. It performs many physiological functions like synthesis of sulphur and methionine. (Baird, 1991).

Materials and Methods

The investigation was undertaken at the Research Farm, College of Horticulture, Mandsaur, Madhya Pradesh of JNKVV Agriculture University (23^o45'-24^o13' N latitude, 74^o44'-75^o18' E longitude, 435.02 m above MSL) on garlic cultivar G-282 during the 2007- 2008, *rabi* season. The crop was planted on a ridge at a spacing of 15 cm x 10 cm and recommended horticultural practices were undertaken. The experiment was conducted in a randomized block design with three replications on light black loamy soil with 7.2 pH and (0.7 ds/m) EC low in available nitrogen (26.3 kg ha⁻¹) and medium in available phosphorus (10.0 kg ha⁻¹). The treatment included: 4 levels of nitrogen (50, 100, 150 and 200 kg ha⁻¹) and 4 levels of sulphur (0, 20, 40 and 60 kg ha⁻¹). The crop was sowed on 10 October 2007, fertilized and irrigated as per the recommended practices. The garlic crop was harvested on 25 March 2008 and the yield of various treatments were calculated using the prevailing market prices of the garlic crop.

Results and Discussion

Application of fertilizers (N and S) increased growth and yield parameters over control.

Effect of nitrogen

The application of 200 kg N ha⁻¹ significantly increased the growth attributes like plant height cm. (38.16, 42.35 and 55.12) at 30, 60 and 90 DAP respectively, number of leaves per plant (5.86, 6.22 and 8.83) at 30, 60 and 90 DAP respectively in comparison to 50 kg N ha⁻¹ and 100 kg N ha⁻¹ (Table-1).

Similarly, 200 kg N ha⁻¹ significantly increased the yield parameters like neck thickness (0.7492 cm), bulb diameter 95.03 cm), number of cloves per bulb (23.51), fresh weight of 20 cloves (36.76

Table 1. Effect of nitrogen and sulphur levels on growth and yield of garlic (*Allium sativum* L.).

Treatments	Growth and yield parameters												
	Plant height (cm)			Number of leaves/plant			Fresh weight (g)		Dry weight (g)		Neck thickness (cm)	Bulb diameter (cm)	Bulb yield q ha ⁻¹
	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	20 cloves	bulb	20 cloves	bulb			
Nitrogen (N kg ha⁻¹)													
50	30.26	34.68	44.54	5.07	5.55	7.90	26.33	38.79	10.69	16.42	0.4942	3.32	112.13
100	35.64	40.02	49.23	5.47	5.92	8.33	30.83	43.62	12.59	20.64	0.6358	4.27	141.70
150	37.72	42.27	54.71	5.84	6.19	8.75	35.83	48.15	13.71	23.40	0.7325	4.92	160.75
200	38.16	42.35	55.12	5.86	6.22	8.83	36.76	48.67	13.78	24.09	0.7492	5.03	165.18
SEm±	0.51	0.63	0.79	0.08	0.09	0.12	0.37	0.70	0.19	0.31	0.0121	0.08	2.10
CD at 5%	1.48	1.81	2.28	0.24	0.25	0.36	1.07	2.03	0.54	0.88	0.0349	0.23	6.06
Sulphur (S kg ha⁻¹)													
0	32.84	36.80	46.26	5.19	5.54	7.87	26.69	41.40	11.08	18.47	0.5858	3.94	126.87
20	34.73	38.71	49.91	5.44	5.83	8.24	31.37	43.80	12.60	20.60	0.6242	4.19	141.50
40	36.32	40.94	52.50	5.68	6.11	8.67	35.02	45.98	13.23	22.07	0.6767	4.55	157.60
60	37.89	42.87	54.94	5.93	6.41	9.03	36.67	48.06	13.85	23.42	0.7250	4.87	160.54
SEm±	0.51	0.63	0.79	0.08	0.09	0.12	0.37	0.70	0.19	0.31	0.0121	0.08	2.10
CD at 5%	1.48	1.81	2.28	0.24	0.25	0.36	1.07	2.03	0.54	0.88	0.349	0.23	6.06

g), dry weight of 20 cloves (13.78g), fresh weight of bulb (48.67 g), dry weight of bulb (24.09 g) and bulb yield $q\ ha^{-1}$ (165.18) in comparison to 50 $kg\ N\ ha^{-1}$ and 100 $kg\ N\ ha^{-1}$. However, non significant difference was recorded between 200 $kg\ N\ ha^{-1}$ and 150 $kg\ N\ ha^{-1}$ (Table -2).

Availability of nitrogen is of prime importance for growing plants as it is major and indispensable constituent of protein and nucleic acid molecules. It is an integral part of chlorophyll molecules, which are responsible for photosynthesis. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs finally leading to higher productivity. The findings of this investigation are in close conformity with those of Naruka [3], Naruka and Dhaka (2001), Yadav (2003), Banafar *et. al.* (2005), Sharma *et. al.* (2008) and Naruka *et. al.* (2005)

Table 2. Total cost of cultivation ha^{-1} (including cost of individual treatment combination).

S. No.	Treatment combinations	Cost of nitrogen (Rs ha^{-1})	Cost of sulphur (Rs ha^{-1})	Total cost under treatments (Rs ha^{-1})	Total cost of cultivation (Rs ha^{-1})
1	N ₁ S ₀	299	000	299	42781
2	N ₁ S ₁	299	888	1187	43669
3	N ₁ S ₂	299	1777	2076	44558
4	N ₁ S ₃	299	2666	2965	45447
5	N ₂ S ₀	843	000	843	43624
6	N ₂ S ₁	843	888	1731	44512
7	N ₂ S ₂	843	1777	2620	45400
8	N ₂ S ₃	843	2666	3509	46290
9	N ₃ S ₀	1386	000	1386	44167
10	N ₃ S ₁	1386	888	2274	45055
11	N ₃ S ₂	1386	1777	3163	45944
12	N ₃ S ₃	1386	2666	4052	46833
13	N ₄ S ₀	1930	000	1930	44711
14	N ₄ S ₁	1930	888	2818	45599
15	N ₄ S ₂	1930	1777	3707	46488
16	N ₄ S ₃	1930	2666	4596	47377

ious levels of sulphur tried, 60 kg S ha⁻¹ exhibited maximum plant height at 30, 60 and 90 DAP (37.89, 42.87 and 54.94 cm respectively), number of leaves per plant (5.93, 6.41 and 9.03) at 30, 60 and 990 DAP respectively (Table-1).

Similarly, application of 60 kg S ha⁻¹ significantly increased yield attributes (Table-2) like neck thickness (0.7250 cm), bulb diameter (4.87 cm), number of cloves per bulb (23.08), fresh weight of 20 cloves (36.67 g), dry weight of 20 cloves (13.85g), fresh weight of bulb (48.06 g), dry weight of bulb (23.42 g) and bulb yield q ha⁻¹ (160.54) in comparison to lower doses of sulphur.

Sulphur is an essential plant nutrient. Its role in balanced fertilization and consequently in crop production is being recently realized. It performs many physiological functions like synthesis of sulphur containing amino acids. Overall increase in growth attributes may be due to sulphur increasing the root system of the plants which might have resulted in an increased uptake of nutrients and were used in photosynthesis. Randle (1992), Randle and Bussard (1993), Sadarea *et. al.* 1997, Alam *et. al.* (1999), Jaggi and Dixit (1999) and Jaggi (2005) also obtained similar results.

The application of nitrogen and sulphur significantly influenced the growth and yield of garlic. The growth and yield potential of garlic can be increased by application of N @ 150 kg ha⁻¹ + S @ 60 kg ha⁻¹ giving a benefit cost ratio of 4.68 : 1.

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