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Research Article

RESPONSE OF GARLIC (*Allium sativum* L.) TO ORGANIC AND INORGANIC FERTILIZERS

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Abstract: A field experiment was conducted during the *rabi* season of 2016-17 to study the effect of organic and inorganic fertilizer on growth, yield attributes, yield, quality and economics of garlic (*Allium sativum* L.). The eight treatment combinations of different fertilizers doses, FYM and biofertilizers (PSB and *Azotobacter*) were tested in randomized block design with three replications. Organic and inorganic fertilizer significantly influenced growth, yield attributes, yield, quality and economics of garlic. Application of 75% RDF + FYM (20 tones/ha) + PSB (5 kg /ha) + Azotobacter (3 kg/ha) treatment significantly increased the bulb yield by 90.37 and 24.47 percent over control (83.11 q/ha) and 100% RDF (100:60:60 kg/ha) (127.11 q/ha) treatments, respectively.

Keywords: *Garlic, FYM, NPK, PSB, Azotobacter*

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Introduction

Garlic (*Allium sativum* L.) belongs to the family Alliaceae. It is the second most important bulb crop after onion. The economic yield is obtained from its underground developed part known as bulb. Garlic is one of the important bulb crops for its nutritive value as a spice. It is widely used in flavoring of food, preparation of chutneys, pickles, curry powder, tomato ketchup etc. It is included in Indian system of medicines as a carminative and gastric stimulant to help in digestion and absorption of food [1]. India ranks second in area and production of garlic in the world. In India, garlic was cultivated in 261 thousand ha producing 1428 thousand tones with productivity 5.1 tones/ha. In Madhya Pradesh, it is grown in about 6,000 thousand hectares area and total production of 27 thousand tones giving an average production of 4.5 tones/ ha. Madhya Pradesh ranks first in area and second in production in India [2]. The productivity of garlic is very low due to imbalanced nutrient management. Among the bulky organic manures, the farm yard manure (FYM) is the extensively used organic source of plant nutrients. It is also helpful in maintaining the organic carbon content in soil. Majority of the nitrogen is lost in soil through leaching or to the atmosphere as a result of denitrification. Therefore, it becomes imperative to tap new methods of enriching soil with N and thus the possibility of using bio-fertilizers in crop production has attained a special significance. Bio-fertilizers also known as micro-bio-inoculants are the preparations containing live or latent cells of efficient strains of microorganisms, which may be the biological nitrogen fixers or p-mobilizers [1]. The interactive advantage of inorganic and organic sources of nutrients generally proved superior to the use of each component applied separately. The role of farm yard manure (FYM) in enhancing efficient use of chemical fertilizers is well documented [3]. Keeping the above facts in view, the present investigation was conducted entitled effect of organic and inorganic fertilizer on growth, yield and quality of Garlic (*Allium sativum* L.).

Materials and Methods

The field experiment was carried out at the Horticultural Research Farm, College of Horticulture, Mandsaur, MP, during 2016-17. The soil of the experimental field was light black loamy in texture with 243.2 kg/ha of available nitrogen, 19.75 kg/ha of available phosphorus and 448 kg/ha of available potassium and neutral in reaction (pH 6.5). There were 8 treatments in the experiment *viz*., T_1–Control,T_2 - 100% RDF (100:60:60 kg/ha), T_3 - 50% RDF + FYM (20 t/ha),T_4 - 50% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha), T_5 - 50% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha) + FYM (20 t/ha), T_6 - 75% RDF + FYM (20 t/ha),T_7 - 75% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha), T_8 - 75% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha) + FYM (20 t/ha). The garlic cv. G-282 was sown at the spacing 10 x 7.5 cm and at depth of 5 cm in open furrows. First weeding was done 30 days after germination and second weeding was done after 60 days of germination. All the other recommended package of practices was adopted for raising the crop.

Result and Discussion

Effect on growth attributes

The data showed that application of organic and inorganic fertilizer significantly affected different growth attributes of garlic *viz*., plant height at 120 DAS, number of leaves/plant at 120 DAS, length of leaves at 90 DAS, stem girth (mm), chlorophyll content of leaf (SPAD value). The significant maximum plant height (79.17cm), number of leaves /plant (14.97), length of leaves (64.23 cm), stem girth (10.97 mm) and chlorophyll content of leaf (78.86 SPAD value) was recording with treatment75% RDF + FYM (20 t/ha). + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha). The difference in plant height of garlic may be due to the treatment combination of organic and inorganic fertilizers maintain long term soil fertility and sustain high level of productivity and also due to increased availability of nutrients to the plant initially through organic and inorganic fertilizers in the cropping season. Application of inorganic and organic sources might possibly have enhanced meristem activity leading to increased plant height and dry matter accumulation. The increase in growth attributes might be due to the production of more chlorophyll content with the application of balanced nutrition in the form of organic

Table-1 *Effect of nutrient management on growth of garlic*

Treatment	Plant height (cm)	Number of leaves	Length of leaf (cm)	Stem girth (mm)	Chlorophyll content (SPAD value)
Control	67.33	12.00	43.29	6.71	67.82
100% RDF (100:60:60 kg/ha)	74.33	13.87	56.88	8.83	73.00
50% RDF + FYM (20 tones/ha)	72.67	13.20	56.20	8.05	71.88
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	71.33	12.60	46.40	7.37	69.63
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	75.00	14.20	60.92	9.51	74.55
75%RDF + FYM (20 tones /ha)	74.33	13.47	54.67	8.43	72.60
75%RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	72.00	12.73	53.40	7.87	71.42
75% RDF + PSB (5kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	79.17	14.87	64.23	10.97	78.86
S.Em. ±	0.79	0.13	0.91	0.38	1.23
CD at 5%	2.42	0.41	2.77	1.16	3.75

Table-2 *Effect of nutrient management on quality of garlic*

Treatment	Sulphur content of bulb (%)	TSS content of bulb (o Brix)	Volatile oil content of bulb (%)	Fresh weight of bulb / plant (g)	Dry matter content in bulb (%)	Moisture content in bulb (%)
Control	1.04	33.63	0.39	25.16	36.57	63.43
100% RDF (100:60:60 kg/ha)	1.27	37.01	0.51	29.35	31.62	68.38
50% RDF + FYM (20 tones/ha)	1.25	36.27	0.48	28.69	32.32	67.68
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	1.15	34.38	0.43	27.76	35.04	64.93
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	1.34	37.94	0.53	30.85	31.35	68.68
75%RDF + FYM (20 tones /ha)	1.26	36.43	0.49	28.88	31.64	68.36
75%RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	1.19	35.60	0.46	28.35	32.62	67.38
75% RDF + PSB (5kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	1.38	40.30	0.59	33.27	30.96	68.74
S.Em. ±	0.02	0.56	0.02	0.86	0.45	0.56
CD at 5%	0.08	1.71	0.06	2.63	1.37	1.70

Table-3 *Effect of nutrient management on yield attributes, yield and economics of garlic*

Treatment	Length of bulb (cm)	Diameter of bulb (cm)	Cloves / bulb	Weight of 20 cloves (g)	Bulb yield (q ha^{-1})	Net return (Rs/ha)	B:C ratio
Control	3.69	3.79	14.20	23.01	83.11	192730	3.41
100% RDF (100:60:60 kg/ha)	4.24	4.88	18.83	32.14	127.11	318730	5.09
50% RDF + FYM (20 tones/ha)	3.89	4.28	17.43	30.98	113.33	270390	3.88
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	3.74	4.05	15.13	27.04	101.33	239690	3.73
50% RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	4.43	5.01	20.23	33.67	146.66	365680	4.92
75%RDF + FYM (20 tones /ha)	4.01	4.39	18.10	31.54	120.00	288900	4.06
75%RDF + PSB (5 kg/ha) + Azotobacter (3 kg/ha)	3.74	4.18	16.60	29.31	104.89	248600	3.78
75% RDF + PSB (5kg/ha) + Azotobacter (3 kg/ha) + FYM(20 tones/ha)	4.93	5.70	22.53	38.14	158.22	398860	5.26
S.Em. ±	0.10	0.16	0.44	1.55	3.52	14349.4	0.20
CD at 5%	0.30	0.50	1.34	4.72	10.68	43524.4	0.61

and inorganic and also due to production of plant growth regulators by bacteria in rhizosphere, where it is absorbed by roots. These results are in close conformity with the findings of [3], [1], [4] and [5] in garlic.

Effect on yield attributes and yield

The data showed that organic and inorganic fertilizers significantly affected different yield attributes and yield of garlic. The significant maximum length of bulb (4.93 cm), diameter of bulb (5.70 cm), fresh weight of bulb/plant (33.27g), number of cloves/bulb (22.53), clove length (2.42 cm), weight of 20 cloves (38.14 g), moisture content (68.74%) and bulb yield (158.22 q ha^{-1}) were observed with treatment 75% RDF + FYM (20 tones/ha) + PSB (5 kg /ha) + *Azotobacter* (3 kg/ha),while minimum was recorded with the control. Application of 75% RDF + FYM (20 tones/ha) + PSB (5 kg /ha) + *Azotobacter* (3 kg/ha) significantly increased the bulb yield by 90.37 and 24.47 percent over control (83.11 q/ha) and 100% RDF (100:60:60 kg/ha) (127.11 q/ha) treatments, respectively. The overall increment in yield attributes and yield of garlic may be due to the beneficial effects of higher growth parameters with this treatment. Continuous mineralization and availability of nutrients as per the requirement during later stage of the crop growth might be the reason for higher value of yield attributes with the combined use of inorganic, organic and biofertilizers [1]. Efficient translocation of photosynthates to bulbs thereby increasing bulb size and hence increases in dry matter accumulation of bulbs. The increase in yield with application of integrated nutrient approach might be attributed to increased growth of plant in respect of height of plant and number of leaves. The healthy top growth might be responsible for higher rate of photosynthesis and accumulated carbohydrates which result increased size of bulbs as indicated by diameter and average bulb weight and ultimate resulted in higher yield. These results are in close conformity with the finding of [6], [7], [8] and [5].

Effect on quality attributes

All the treatments significantly increased the quality attributes in garlic. The maximum TSS content of bulb (40.30 oBrix), sulphur content of bulb (1.38) and volatile oil content in bulb (0.59) were recorded with the treatment 75% RDF + PSB (5 kg /ha) + *Azotobacter* (3 kg/ha) + FYM (20tones/ha). The improvement in TSS, sulphur might be due to the known fact that organic manure is capable of supplying adequate macro and micro plant nutrient which play a major role in improvement of quality through desirable enzymatic changes during growth. Similar result was also reported by [9] in onion, [3], [7], [10],[11]and [12] in garlic.

Economics attributes

Data of B:C ratio and net return of different organic and inorganic fertilizer treatments are presented in table 3 clearly showed that treatment 75% RDF + FYM (20 tones/ha) + PSB (5 kg /ha) + *Azotobacter* (3 kg/ha) resulted in maximum B:C ratio (5.26:1) and net return of Rs. 398860 ha^{-1}. While, minimum net return was recorded under the treatment control which was Rs. 192730 with the B:C ratio (3.41:1). Similar result was also reported by [1] in garlic.

Application of research: Application of organic and inorganic fertilizers improved the yield and quality of garlic.

Research Category: Integrated nutrient management

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Study area / Sample Collection: Horticultural Research Farm, College of Horticulture, Mandsaur, MP

Cultivar / Variety name: Garlic (*Allium sativum* L.) - G-282

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Talware P., Gupta N.K. and Dubey S.D. (2012) *Crop Research*, 43(1, 2& 3), 89-97.
[2] National Horticulture Board (2016) *National Horticulture Board-Database. Govt. of India, Gurgaon, India. http://www.nhb.gov.in*.
[3] Mohd T.A., Desai J.D., Parmar S.B. and Parmar B.R. (2011) *The Asian Journal of Horticulture*, 6(1), 52-55.
[4] Sharma K.C., Sharma L.K., Sharma A.K. and Sharma V. (2013) *Journal of Hill Agriculture*, 4(1), 56-59.
[5] Sachin A.J., Bhalerao P.P. and Patil S.J. (2017) *International Journal of Chemical Studies*, 5(4), 559-562.
[6] Kore M.S., Shembekar R.Z., Chopde N.K., Kuchanwar O.D., Pilanwan S.S. and Godse S.B. (2006) *Journal of Soils and Crops*,16, 465-68.
[7] Bhandari S.A., Patel K.S. and Nehete D.S. (2012) *The Asian Journal of Horticulture*, 7(1), 48-51.
[8] Choudhary K.M., Kavita A., Maurya I.B., Singh B., Sharma M.K. and Hatwal P.K. (2014) *Progressive Horticulture*, 46(2), 367-371.
[9] Kaswan P.K., Yadav P.K., Jakhar R.K., Kumawat A. and Kumar H. (2017) *International Journal of Current microbiology and Applied Sciences*, 6(6), 497-503.
[10] Sevak Kuldeep, Patel M.N., Bhadhauria H.S. and Wankhade V.R. (2012) *International Journal of Forestry and Crop Improvement*, 3(2), 147-148.
[11] Kumara B.R. and Patil Shankargouda (2014) *Trends in Biosciences*, 7(12), 1331-1336.
[12] Patidar Manish,Shaktawat R.P.S. and Naruka I.S. (2017) *Journal of Krishi Vigyan*, 5(2), 54-56.