

Original Research Article

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Response of Garlic (*Allium sativum* L.) to Organic Manures and Fertilizers

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ABSTRACT

The investigation was undertaken with a view to determine the “Response of Garlic (*Allium sativum* L.) to Organic Manures and Fertilizers” The results were revealed that the application of different treatments influenced the growth, yield and quality attributes of garlic. Among the different treatments, application of RDF 50% + FYM (120 q ha⁻¹) (T₇) recorded maximum plant height at 90 DAP (65.52 cm), number of leaves per plant at 90 DAP (8.06), harvest index (86.88%), bulb weight (30.93 g), bulb diameter (4.82 cm), yield per plot (10.45 kg), clove weight (1.81 g), clove diameter (12.29 mm), clove length (3.24 cm), TSS (43.13 °Brix), chlorophyll content of leaves (0.76 mg/gm/fresh wt.), sulphur content (1.36%), dry matter content (46.34%), ascorbic acid (13.88 mg/100gm) and crude protein content (18.95%) then rest of the treatments. Similarly, the neck thickness at 90 DAP (0.79 cm), the number of cloves per bulb (17.06) and number of bulb per kg (32.33) were also reduced with the application 50 per cent recommended dose of NPK + FYM 120 q ha⁻¹ as compared to other treatments. As far as economics is concerned, maximum net return of 362625 ` ha⁻¹ and benefit cost ratio 4.97 was also recorded by the application of RDF 50% + FYM (120 q ha⁻¹) (T₇).

Keywords

RDF, FYM, DAP,
Crude protein,
Yield.

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Introduction

Garlic (*Allium sativum* L.) belongs to family Alliaceae and having chromosome 2n=16. Garlic is the second most widely cultivated bulb crop after onion. Garlic has originated from Central Asia and spread to other parts of the world. Vegetables are naturally available and cheapest source of nutrients. A fresh bulb contains about (62.8%) moisture, (0.1%) fat, (0.8%) fiber and good source of carbohydrates, vitamin- C, Selenium, Phosphorous and Manganese (Pamplona-Roger, 6). Garlic is used in flavouring foods, preparing chutneys, pickles, curry powder, tomato ketchup, etc. Besides the nutritive value of garlic and its use in various forms, it is included in Indian system of medicines

(Ayurvedic, Unani and Siddha) as carminative and gastric stimulant to help in digestion and absorption of food. The successful commercial cultivation of this crop depends on many factors such as climate, soil fertility, irrigation, fertilizer, spacing and season of growing, etc. Among the different management practices nutrient management plays an important role for good growth, yield and quality. Garlic, being a nutrient loving crop, responds well to added fertilizers in the soil. The uses of inorganic fertilizers help in achieving maximum yield of garlic. Among the major nutrients nitrogen, phosphorus and potash play an important role in nutrition of garlic plants in relation to growth, yield and

quality of bulb. The organic manure is an eco-friendly, economically viable and ecologically sound that also played a significant role in soil biology, chemistry and physics. In recent years, vermicompost and FYM are advocated in integrated nutrient management. Vermicompost and FYM acts as a store house of several macro, micro and plant growth regulators which are released during the process of mineralization to release plant nutrients present in the soil it increases the fertilizer use efficiency. Organic manure helps in reducing C: N ratio, increases humic acid content and provide the nutrients in the readily available form to the plants such as nitrate, exchangeable phosphorus, soluble potassium, calcium and magnesium (Talashilkar *et al.*, 13).

Application of all needed nutrients through chemical fertilizers is known to have deleterious effect on soil fertility leading to unsustainable yields, while integration of chemical fertilizers with organic manures are able to maintain the soil health, productivity and fertility. Integrated nutrient supply approach for the crop by judicious use of organic manure along with the inorganic fertilizers has a number of agronomical and environmental benefits. Integrated nutrient management is the only liable way for obtaining fairly high productivity with substantial fertilizers leading to sustainable agriculture (Swaminathan, 12).

Although, the crop is commercially important and export oriented, its yield is very low in India and Rajasthan. The poor situation of the crop may be due to its unscientific cultivation, use of local cultivars with unpredictable potential and lesser care of growers to its nutritional management. Hence keeping in view the above mentioned facts, an investigation entitled "Response of Garlic (*Allium sativum* L.) to Organic Manures and Fertilizers" was conducted at Horticulture

Farm, RCA, Maharana Pratap University of Agriculture and Technology, Udaipur during the year 2013-14.

Materials and Methods

The field experiment was conducted at Instructional-Cum-Research Farm, Department of Horticulture, Rajasthan College of Agriculture, Udaipur, in *Rabi* season November 2013 and completed in April 2014. The soil of the experimental field was clay loam in texture, slightly alkaline in reaction, medium in organic carbon, low in available nitrogen and medium in available phosphorus and potassium. The experiment consisted of eleven treatments with RDF 100% (NPK120: 50:100 kg ha⁻¹) (T₁), Neem cake 100% (40 q ha⁻¹) (T₂), RDF 75% + Neem cake (10 q ha⁻¹) (T₃), RDF 50% + Neem cake (20 q ha⁻¹) (T₄), FYM 100% (240 q ha⁻¹) (T₅), RDF 75% + FYM (60 q ha⁻¹) (T₆), RDF 50% + FYM (120 q ha⁻¹) (T₇), Vermicompost 100% (160 q ha⁻¹) (T₈), RDF 75% + Vermicompost (40 q ha⁻¹) (T₉), RDF 50% + Vermicompost (80 q ha⁻¹) (T₁₀) and Neem cake (13 q ha⁻¹) + FYM (80 q ha⁻¹) + Vermicompost (53 q ha⁻¹) (T₁₁) were tested in Randomized Block Design with three replications.

Observation pertaining to the growth and yield attributes such as number of days taken to sprouting, number of leaves per plant at 90 DAP, plant height at 90 DAP and neck thickness at 90 DAP, crop maturity, bulb weight, bulb diameter, number of bulbs kg⁻¹, yield plot⁻¹, yield ha⁻¹, number of cloves per bulb, clove weight, clove diameter, clove length and harvest index were recorded on random sample basis from each treatment and replication are sum up for calculating average to reduce the statistically error. All quality characters of garlic such as TSS, total chlorophyll content at 90 DAP, sulphur content, dry matter content, drying ratio,

ascorbic acid and protein content were analyzed as per standards methods given in (A.O.A.C., 1). Data were analyzed as per standard statistical methodology.

Results and Discussion

The effect of different organic manures and fertilizers on vegetative growth parameters of garlic (Table-1) showed that application of 50 per cent recommended dose of NPK + FYM 120 q ha⁻¹ recorded significantly highest plant height (65.52 cm), number of leaves (8.06 plant⁻¹) at 90 DAP, Similarly, neck thickness (0.79 cm) at 90 DAP was also significantly reduced which were followed by 50 per cent recommended dose of NPK + Vermicompost 80 q ha⁻¹ and 50 per cent recommended dose of NPK + neem cake 20 q ha⁻¹ respectively, as compared to other treatments.

The significant effect on these parameters, as consequence of organic manures and chemical fertilization are attributed to the increased nutritional status of soil resulting into increased growth of the crop. This may be attributed to favorable effect of organic sources on microbial activity and root proliferation in soil which caused solubilizing effect on native nitrogen, phosphorus, potassium and other nutrients. The reduced dose of chemical fertilizers supplemented with organic manures also decreases exploitation of micronutrients.

The result of combined use of fertilizers and organic manures are in close agreement with the findings of Patil *et al.*, (8) and Jawagadi *et al.*, (3) reported that combined application of organic manures and inorganic fertilizers increased organic carbon, available N, S, Mn and Fe thus, improved soil fertility.

The application of organic manure and fertilizers significantly increased the yield parameters (Table -2). The maximum values

of yield attributes i.e. bulb weight (30.93 g), bulb diameter (4.82 cm), yield per plot (10.45 kg), yield per hectare (174.22 q), clove weight (1.81 g), clove diameter (12.29 mm), clove length (3.24 cm), harvest index (86.88%) and yield 5.99 per cent were achieved by combined application of 50 per cent recommended dose of NPK + FYM 120 q ha⁻¹ as compared to other treatments. Similarly, the number of cloves per bulb (17.06) and number of bulb per kg (32.33) were also reduced with the application 50 per cent recommended dose of NPK + FYM 120 q ha⁻¹.

This might be due the facts that increase in fertility levels, helped in the expansion of leaf area and chlorophyll content which together might be have accelerated the photosynthetic rate and in turn increased the supply of carbohydrates to the plants. The application of 50% recommended dose of NPK favored the metabolic and auxin activities in plant and ultimately resulted in increased bulb weight, bulb diameter, yield plot⁻¹ (kg), clove weight, clove diameter, clove length, harvest index and finally the total yield. Similarly, FYM improved physical, chemical and biological properties of soil which consequently increased the value of growth parameters, yields attributes and finally yield. Further, it is relevant to note that, farm yard manure seems to be directly responsible in increasing crop yields either by accelerating the respiratory process by increasing cell permeability by hormone growth action or by combination of all these processes. It supplies nitrogen, phosphorus, potassium of which phosphorus involved in cell division, photosynthesis and metabolism of carbohydrates where potash regulated proper translocation of photosynthesis and stimulated enzyme activity which in turn might have increased the rate of growth and positive development in yield characters which was resulted in high bulb yield of garlic.

Table.1 Response of organic manures and fertilizers on vegetative growth parameters of garlic

Treatment	Number of days taken to sprouting	Number of leaves per plant at 90 DAP	Plant height at 90 DAP (cm)	Neck thickness at 90 DAP (cm)
T ₁	6.00	7.60	65.28	0.84
T ₂	6.66	7.13	63.51	0.99
T ₃	6.33	7.33	64.78	0.87
T ₄	5.66	7.80	65.36	0.83
T ₅	6.33	7.26	63.61	0.96
T ₆	6.00	7.33	64.88	0.88
T ₇	5.33	8.06	65.52	0.79
T ₈	6.33	7.26	63.62	0.97
T ₉	5.66	7.40	64.62	0.86
T ₁₀	5.33	7.93	65.42	0.80
T ₁₁	6.67	7.20	63.68	0.94
SEm±	0.39	0.19	0.25	0.02
CD at 5%	NS	0.56	0.75	0.06

Note: DAP = Days after planting

Treatment Details

RDF 100% (NPK120: 50:100 kg ha.⁻¹) (T₁), Neem cake 100% (40 q ha.⁻¹) (T₂), RDF 75% + Neem cake (10 q ha.⁻¹) (T₃), RDF 50% + Neem cake (20 q ha.⁻¹) (T₄), FYM 100% (240 q ha.⁻¹) (T₅), RDF 75% + FYM (60 q ha.⁻¹) (T₆), RDF 50% + FYM (120 q ha.⁻¹) (T₇), Vermicompost 100% (160 q ha.⁻¹) (T₈), RDF 75% + Vermicompost (40 q ha.⁻¹) (T₉), RDF 50% + Vermicompost (80 q ha.⁻¹) (T₁₀) and Neem cake (13 q ha.⁻¹) + FYM (80 q ha.⁻¹) + Vermicompost (53 q ha.⁻¹) (T₁₁)

Table.2 Response of organic manures and fertilizers on yield attributes of garlic

Treatment	Crop maturity (days)	Bulb weight (g)	Bulb diameter (cm)	Number of bulbs per kg	Yield per plot (kg)	Yield per hectare (q)	Number of cloves per bulb	Clove weight (g)	Clove diameter (mm)	Clove length (cm)	Harvest index (%)
T ₁	133.90	28.80	4.50	34.72	9.86	164.37	19.02	1.51	12.08	3.04	86.36
T ₂	137.20	23.06	3.62	46.36	7.02	117.02	24.06	0.96	9.90	2.23	79.03
T ₃	135.60	27.60	4.06	36.23	9.26	154.39	21.13	1.30	10.81	2.64	82.37
T ₄	133.40	29.46	4.64	33.94	10.02	167.03	18.40	1.60	12.14	3.08	86.43
T ₅	136.80	23.26	3.72	43.00	7.18	119.69	23.20	1.00	10.12	2.36	80.24
T ₆	135.10	28.02	4.32	35.68	9.38	156.40	20.76	1.34	10.96	2.90	83.15
T ₇	133.10	30.93	4.82	32.33	10.45	174.22	17.06	1.81	12.29	3.24	86.88
T ₈	137.40	23.21	3.70	43.08	7.13	118.86	23.93	0.97	10.00	2.30	79.54
T ₉	135.80	27.00	4.22	37.03	9.15	152.53	22.26	1.21	10.93	2.72	82.07
T ₁₀	133.60	30.20	4.72	33.11	10.28	171.37	17.86	1.68	12.18	3.16	86.60
T ₁₁	137.20	23.32	3.75	42.88	7.22	120.37	23.80	0.98	10.02	2.38	80.12
SEm±	3.50	0.67	0.09	1.00	0.40	6.76	0.32	0.02	0.14	0.04	1.50
CD at 5%	NS	2.00	0.27	2.97	1.19	19.96	0.97	0.05	0.43	0.12	4.44

Treatment Details

RDF 100% (NPK120: 50:100 kg ha.⁻¹) (T₁), Neem cake 100% (40 q ha.⁻¹) (T₂), RDF 75% + Neem cake (10 q ha.⁻¹) (T₃), RDF 50% + Neem cake (20 q ha.⁻¹) (T₄), FYM 100% (240 q ha.⁻¹) (T₅), RDF 75% + FYM (60 q ha.⁻¹) (T₆), RDF 50% + FYM (120 q ha.⁻¹) (T₇), Vermicompost 100% (160 q ha.⁻¹) (T₈), RDF 75% + Vermicompost (40 q ha.⁻¹) (T₉), RDF 50% + Vermicompost (80 q ha.⁻¹) (T₁₀) and Neem cake (13 q ha.⁻¹) + FYM (80 q ha.⁻¹) + Vermicompost (53 q ha.⁻¹) (T₁₁)

Table.3 Response of organic manures and fertilizers on quality characters of garlic

Treatment	TSS (°Brix)	Chlorophyll content of leaves at 90 DAP (mg/gm/fresh wt.)	Sulphur content (%)	Dry matter content (%)	Ascorbic acid (mg/100g)	Crude Protein content (%)
T ₁	42.71	0.72	1.34	46.08	13.58	18.54
T ₂	39.85	0.58	1.05	39.17	11.22	14.93
T ₃	41.15	0.66	1.20	43.48	12.18	16.88
T ₄	42.80	0.73	1.32	46.17	13.64	18.70
T ₅	40.34	0.61	1.11	40.57	11.35	15.06
T ₆	41.32	0.69	1.23	44.24	12.63	17.15
T ₇	43.13	0.76	1.36	46.34	13.88	18.95
T ₈	40.68	0.60	1.10	39.96	11.53	15.62
T ₉	41.43	0.68	1.22	43.92	12.55	17.02
T ₁₀	42.92	0.74	1.35	46.29	13.71	18.81
T ₁₁	40.60	0.60	1.08	41.12	11.44	15.93
SEm±	0.75	0.01	0.02	1.10	0.19	0.25
CD at 5%	2.22	0.03	0.06	3.25	0.56	0.76

Treatment Details

RDF 100% (NPK120: 50:100 kg ha.⁻¹) (T₁), Neem cake 100% (40 q ha.⁻¹) (T₂), RDF 75% + Neem cake (10 q ha.⁻¹) (T₃), RDF 50% + Neem cake (20 q ha.⁻¹) (T₄), FYM 100% (240 q ha.⁻¹) (T₅), RDF 75% + FYM (60 q ha.⁻¹) (T₆), RDF 50% + FYM (120 q ha.⁻¹) (T₇), Vermicompost 100% (160 q ha.⁻¹) (T₈), RDF 75% + Vermicompost (40 q ha.⁻¹) (T₉), RDF 50% + Vermicompost (80 q ha.⁻¹) (T₁₀) and Neem cake (13 q ha.⁻¹) + FYM (80 q ha.⁻¹) + Vermicompost (53 q ha.⁻¹) (T₁₁).

These findings are in conformity with those of Patil *et al.*, (8) and Singh *et al.*, (11) in garlic. They found that combined application of organic manure and fertilizers increased the yield attributes and finally the total yield in garlic. Later on it was also supported by the findings of by Shinde *et al.*, (10) in onion and Kumar *et al.*, (4) in garlic.

It is evident from the data presented in the Table-3 that different organic manures and fertilizers had significant effect on physico-chemical characteristics of garlic. The maximum value of TSS (43.13%), chlorophyll content of leaves at 90 DAP (0.76 mg), sulphur content (1.36%), dry matter content (46.34%), ascorbic acid (13.88 mg) and crude protein content (18.95%) was achieved by combined application of 50 per cent recommended dose of NPK + FYM 120 q ha⁻¹. However, treatments T₁, T₄, T₁₀ and T₇ were at par with each other in respect to quality parameters.

The improvement in physico-chemical characters of garlic might be due to fact that organic manures are capable of supply adequate macro and micro plant nutrients which play major role in quality improvement through desirable enzymatic changes taking place during growth. Response of farm yard manure in improving soil nutrition is well established fact. The effects were much more pronounced when inorganic fertilizer use with farm yard manure. Positive influences of NPK fertilization on N content of bulb appear to be due to improved nutritional environment both in root zone and plant system. The increase in N and P might be due to more availability of N, P and K to plants due to application of FYM which might have improved chemical and biological properties of soil and enabled plant roots to proliferate resulting in better utilization of nutrients by crop. The increase in nitrogen content in bulbs resulted in higher protein content in

garlic bulb. These results are in close conformity with the finding of Mohd *et al.*, (5) in garlic and Jamir *et al.*, (2) in onion. The findings of present study are in accordance with Patel *et al.*, (7) in onion and Shiferaw *et al.*, (9) in garlic.

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