

Impact of organic and inorganic fertilizers on growth, yield and economics of garlic (*Allium sativum* L.)

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ABSTRACT

A field experiment was carried out at Research Farm, College of Agriculture, Indore (Madhya Pradesh) during winter season 2020-21 to study the impact of organic and inorganic fertilizers on growth, yield and quality of garlic. The experiment comprising of organic-cum-inorganic sources of nutrients was laid out in randomized block design with three replications. Results revealed that application of 50% RDF along with 2.5 t VC ha⁻¹ + 1.5 t PM ha⁻¹ brought about maximum growth and yield-attributing parameters (plant height 87.4 cm, leaves 10.8 / plant, leaf length 51.3 cm, leaf width 2.10 cm, LAI 2.42, neck thickness 1.55 cm, bulb weight 42.90 g, bulb diameter 5.78 cm and cloves 27.5/ bulb) as well as bulb yield (103.54 q ha⁻¹), net income (Rs. 230630 ha⁻¹) and B: C ratio (3.88). The second best treatment was 50 % RDF + 5 t VC ha⁻¹ with 98.24 q ha⁻¹ yield, and net income of Rs. 214980 ha⁻¹. Similarly, the maximum value of TSS (40.15 °Brix) was recorded under the 50 % RDF + 2.5 t VC + VC + 1.5 t PM ha⁻¹. The overall trend indicated that combined application of VC and PM was found superior than their separate application along with RDF.

Keywords: Organic, inorganic fertilizers, yield, economics, garlic

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important spices and condiments used in daily cooking in India. It is an important crop among all the spice crops due to its medicinal as well as flavour and taste imparting characters. Garlic belongs to the family Alliaceae with genus *Allium* and species *Sativum* having 2=16 chromosome numbers. In Madhya Pradesh, garlic has the highest area of 178 thousand hectares and production 1808 thousand tonnes with the productivity up to 10.15 t ha⁻¹ (National Horticulture Board, 2020). The Mandsaur and Indore districts are the main producer of garlic in Madhya Pradesh. Serious attention is now being paid towards the organic farming having integrated nutrient management because it is economically viable, eco-friendly and ecologically sound practice. The continuous application of inorganic fertilizers has deteriorated the soil. The combined use of inorganic fertilizers and organic manures (FYM, vermicompost, poultry manure with biofertilizers) helps to maintain soil productivity on sustainable basis (Vikas Kumar *et al.*, 2019). Organic manures are well known to improve physico-chemical and biological soil properties to enhance its fertility and productivity (Ali *et al.*, 2018). Incorporation of organic and inorganic

sources of nutrients holds great promise in garlic production (Badal *et al.*, 2019). The information on the conjunctive use of organic manures and inorganic fertilizers on the productivity of garlic is limited in this region. Therefore, the present research work was taken up.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2020-21 at the Research Farm, College of Agriculture, Indore (M.P.). The soil of the experimental field was silty clay-loam having pH 7.8, organic carbon 7.6 g kg⁻¹, available N, P and K 210, 12.6 and 425 kg ha⁻¹, respectively. The experiment was laid out in randomized block design keeping three replications. The 10 treatments having different combinations of organic and inorganic fertilizers were: T₁=100% RDF (N₁₀₀P₅₀K₅₀S₂₅), T₂=25% RDF + 7.5 t VC, T₃=25% RDF + 4.5 t PM, T₄=25% RDF + 3.75 t VC+ 2.25 t PM, T₅=50% RDF + 5.0 t VC, T₆=50% RDF + 3 t PM, T₇=50% RDF + 2.5 t VC + 1.5 t PM, T₈=75% RDF + 2.5 t VC, T₉=75% RDF+ 1.5 t PM, T₁₀= 75% RDF+ 1.25 t VC + 0.75 t ha⁻¹ PM. The N, P and K contents in Vermicompost was 1.44, 1.00 and 1.55 %, and in poultry manure 2.00, 1.10 and 0.92 %, respectively. The garlic var. G-384 (Yamuna Safed-8) was sown on 7 November,

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2020 using 500 kg seed ha⁻¹ and keeping 15 x 10 cm spacing. The crop was grown as per recommended package of practices. The crop was harvested during the first week of April, 2021. The TSS (°Brix) of garlic was recorded under each treatment with the help of Pocket Refractometer. The plant growth parameters, yield and yield attributing parameters were recorded after the harvesting of garlic. The data obtained were statistically analyzed for the various treatments.

RESULTS AND DISCUSSION

Growth parameters

The data (Table 1) revealed that application of 50% RDF + 5 t VC + 1.5 t PM ha⁻¹ resulted in maximum (87.4 cm) plant height, 10.8 leaves/plant, 51.3cm leaf length, 2.10 cm leaf width, 2.42 LAI, 1.55 cm neck thickness. This was followed by the treatments having 5 t VC or

3.0 t ha⁻¹ PM applied separately along with 50% RDF. The highest vegetative growth parameters under the best treatment may be owing to the fact that NPKS alongwith vermicompost and poultry manure provided maximum availability of multinutrients in addition to the improvement of physico-chemical and biological properties of the soil. The superiority of mixed application of vermicompost + poultry manure may be on account of the fact that it has the rich nutrient value with a lot of beneficial soil microorganisms and makes soil porous, friable and improve water infiltration and moisture retention. Moreover vermicompost and poultry manure have got different nutrient contents, variation in decomposition of organic residues, C : N ratio and nutrient release pattern under the existing agro-climatic conditions. These results corroborate with those of Acharya *et al.* (2018), Aditya Kumar *et al.* (2018), Sanjay Kumar *et al.* (2019) and Badal *et al.* (2019).

Table 1: Effect of organic and inorganic fertilizers on growth parameters of garlic

Treatments	Plant height (cm)	Leaves per plant	Length of leaf (cm)	Width of leaf (cm) at 90 DAS	Leaf area index at 90 DAS	Neck thickness (cm)
T ₁	79.3	8.4	42.3	1.70	1.41	0.95
T ₂	84.7	10.0	46.2	1.97	1.96	1.32
T ₃	84.6	9.6	45.3	1.91	1.85	1.30
T ₄	84.9	9.7	48.1	1.95	2.11	1.37
T ₅	86.2	10.6	49.7	2.00	2.20	1.46
T ₆	85.5	10.2	48.1	1.97	2.07	1.40
T ₇	87.4	10.9	51.4	2.10	2.42	1.55
T ₈	82.6	9.8	44.9	1.88	1.75	1.20
T ₉	81.4	9.5	44.1	1.76	1.57	1.14
T ₁₀	83.8	9.8	45.4	1.92	1.90	1.28
CD (P=0.05)	0.021	0.006	0.004	0.005	0.0007	0.006

T₁=100% RDF (N₁₀₀P₅₀K₅₀S₂₅), T₂=25% RDF + 7.5 t VC, T₃=25% RDF + 4.5 t PM, T₄=25% RDF + 3.75 t VC+ 2.25 t PM, T₅=50% RDF + 5.0 t VC, T₆=50% RDF + 3 t PM, T₇=50% RDF + 2.5 t VC + 1.5 t PM, T₈=75% RDF + 2.5 t VC, T₉=75% RDF+ 1.5 t PM, T₁₀= 75% RDF+ 1.25 t VC + 0.75 t ha⁻¹ PM.

Yield-attributes and yield

The best treatment having the combined use of both the organics (2.5 t VC + 1.5t PM ha⁻¹) along with 50% RDF (NPKS) recorded significantly higher yield attributes (viz. 42.90 g bulb weight, 5.78 cm bulb diameter, 27.5 cloves/bulb) and bulb yield of 103.54 q ha⁻¹. This was followed by T₅ and T₆ having 5 t ha⁻¹ VC or 3 t ha⁻¹ PM with 50% RDF. The higher yield and yield attributes may be owing to maximum

growth parameters including length and width of leaves (photosynthetic surface area) associated with higher rate of photosynthesis consequently higher productivity. The higher yield response due to combined use of vermicompost and poultrymanure may be due to improvement in the physical and biological properties of soil which resulted in better supply of plant nutrients and led to good crop growth and yield. According to Jatoliya *et al* (2019), the improvement in bulb yield might be ascribed to better vegetative

growth which has resulted in better interception, absorption and utilization of radiation energy, leaving to greater photosynthetic rate and translocation of photosynthates towards the reproductive organs (sink). These results are in accordance with the findings of Yadav *et al.* (2018), Vikas Kumar *et al.* (2019), Sanjay Kumar *et al.* (2019) and Sitaula *et al.* (2020). The

increased supply of NPKS with dual organics might have increased multiple activities in plant and soil which in turn resulted in greater accumulation of carbohydrates, protein and their translocation to the reproductive organ. The TSS was found highest (40.15 °Brix) under 50 % RDF + 2.5 t ha⁻¹ VC + 1.5 t ha⁻¹ PM and lowest (33.50 °Brix) under 100 % RDF.

Table 2: Effect of organic and inorganic fertilizers on yield attributes, yield, economics and TSS of garlic

Treatments	Weight per bulb (g)	Diameter of bulb (cm)	Cloves per bulb	Bulb yield (q ha ⁻¹)	Net income (Rs ha ⁻¹)	B:C Ratio	TSS (°Brix)
T ₁	38.40	4.87	24.6	75.60	150590	2.97	33.50
T ₂	41.50	5.46	26.3	91.74	192980	3.35	37.12
T ₃	40.75	5.37	25.9	88.48	183670	3.25	36.43
T ₄	41.82	5.58	26.9	93.67	199740	3.46	37.62
T ₅	42.16	5.66	27.2	98.24	214980	3.70	39.85
T ₆	41.57	5.62	26.8	94.37	202870	3.53	38.54
T ₇	42.90	5.78	27.5	103.54	230630	3.88	40.15
T ₈	39.25	4.95	25.2	82.45	165550	3.02	35.82
T ₉	39.00	4.90	25.0	78.58	152440	2.83	34.88
T ₁₀	40.35	4.25	25.8	87.82	180910	3.19	36.23
CD (P=0.05)	0.011	0.003	0.018	0.003	-	-	0.009

Economics

The increased monetary gain is the prime objective of any garlic grower. In this experiment, the application of both the organics (2.5 t ha⁻¹ VC + 1.5 t ha⁻¹ PM) with 50% RDF gave the maximum income (Rs.23630 ha⁻¹ with 3.88 B:C ratio). This was followed by 50 % RDF + 5.0 t ha⁻¹ vermicompost (Rs.214980 ha⁻¹) and 50 % RDF + 3.0 t ha⁻¹ poultry manure (202870 ha⁻¹) with B: C ratio 3.70 and 3.53. The lowest net income

(Rs.140490 ha⁻¹ with 2.97 B: C ratio) was obtained from T₁ having only 100% RDF (N₁₀₀P₅₀K₅₀S₂₅). The higher net income from these treatments was as a result of similar increases in bulb yield which fetched higher market value in terms of gross income.

It may be concluded from the results that 50% RDF with 2.5 t ha⁻¹ Vermicompost + 1.5 t ha⁻¹ Poultry manure recorded maximum growth yield, net income and TSS from garlic var. G-384 under Malwa region of Madhya Pradesh.

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