**EFFECT OF DIFFERENT ORGANIC MANURES AND INORGANIC NUTRIENT SOURCES ON GROWTH, YIELD, AND QUALITY OF GARLIC (*Allium sativum* L.*)***

**Abstract**

**The present investigation entitled “Effect of different organic manures and inorganic nutrient sources on growth, yield and quality of garlic (*Allium sativum* L.)” was conducted in year 2021–22 at experimental farm of Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab, India. The sowing was done on second fortnight of October 2021 with a 15 × 7.5 cm2 spacing, followed a Randomized Block Design (RBD) with three replications and 12 treatments, including a control. Results showed that the treatment combining 50 % recommended dose of fertilizer (RDF) and 50% poultry manure (T8) yielded the highest plant height (54.57 cm), leaves number (6.07), Bulb weight (23.73 g), yield (12.46 t/ha), and quality attributes like total soluble solids (35. 40 ˚Brix) and ascorbic acid (12.32 mg/100g), recorded at 90 days after sowing and harvesting. These findings highlight the efficacy of integrated nutrient management for optimizing garlic production.**

**Key words**: *Garlic, Farmyard manure, Poultry manure, Vermicompost, NPK.*

**Introduction**

Garlic (*Allium sativum* L.) belongs to the family Alliaceae and is the second most widely used bulb crop next to onion (Yadav *et al.,* 2017). It is one of the most important bulb crops and commercially cultivated for both local consumption and export. It is native of the Central Asia and Southern Europe especially Mediterranean region (Thompson and Kelly, 1957). Its medical usefulness is recognized in the prevention, treatment, and management of worms, and bacteria, and hypertension, diabetes, cancer, ulcers, and rheumatism, as well as bacterial and fungal infections. Its allicin content is responsible for its cholesterol and blood sugar-lowering activities. It has insecticidal and repellant qualities as well (Farooqui *et al.,* 2005). A fresh bulb contains about 62.8 % moisture, 0.1 % fat, 0.8 % fiber, and is a good source of carbohydrates, vitamin- C, calcium (Ca), selenium (Se), phosphorous (P) and manganese (Mn). Garlic is used in flavoring foods, preparing chutneys, pickles, curry powder, tomato ketchup, etc. Besides the nutritive value of garlic and its use in various forms, include its use in Indian system of medicines (Ayurveda, Unani and Siddha) as carminative and gastric stimulant to help in digestion and absorption of food (Sankaracharya, 1974). Leaves of garlic are rich in protein, vitamin A and C. Organic manure is an environmentally beneficial, economically feasible, and ecologically sound product that also contributes to soil biology, chemistry, and physics. Vermicompost (VC) and Farm yard manure (FYM) acts as a store house of several macro and micro nutrients as well as plant growth regulators which are released during the process of mineralization to release nutrients in the soil and increases its fertility. Organic manure helps in reducing soil C: N ratio, increases humic acid content and provide the nutrients in the readily available form to the plants such as nitrate (NO3), exchangeable P, soluble K, Ca and magnesium (Mg) (Talashilkar *et* *al.,* 1999). Poultry manure is an excellent organic fertilizer, concentrated source of nitrogen and other essential nutrients. It has direct effect on plant growth with increased nutrient uptake (Abusaleha, 1992). Farmyard manure is easily available and widely used by farmers in North India. The decomposing mixture of urine, excrement of animals and kitchen wastages are used in Farmyard manure, which have micro and macro nutrients which enhance the soil productivity. This study’s significance lies in identifying sustainable nutrient combinations that enhance garlic productivity while reducing reliance on chemical inputs, offering practical insights for farmers in semi-arid regions.

**MATERIALS AND METHODS**

The field experiment entitled “Effect of different organic manures and inorganic nutrient sources on growth, yield and quality of garlic (*Allium sativum* L.)” was conducted at the Horticulture farm and quality observations were recorded at the Horticulture Laboratory of Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab, India during the Rabi season, 2021–2022. The location is situated in Punjab at 30.6435 ˚N and 76.3970 ˚E, at a height of 246 meters above mean sea level. The state's agro-climatic zone 3 (Central Plain zone) encompasses this area. The climate of this region is classified as tropical, hot and semi – arid which is mainly dry. Both summer and winter are severe except during monsoon season. The temperature in this zone ranges from 7°C to 32°C. The annual rainfall of the region is 692 mm. Monsoon rainfall contributes 79 % of annual rainfall in the region. The soil is loamy sand in texture, slightly alkaline in reaction, rich in organic carbon with medium available nitrogen, and phosphorus and high potassium status. The planting material was obtained from Punjab Agricultural University, Ludhiana. Experiment consist of 12 treatments comprises chemical fertilizers, FYM, PM, VC & their combinations i.e. T1: Control, T2: 100 % RDF, T3: 100 % FYM, T4: 100 % PM, T5: 100 % VC, T6: 50 % RDF + 50 % VC, T7: 50 % RDF + 50 % FYM, T8: 50 % RDF + 50 % PM, T9: 75 % RDF + 25 % VC, T10: 75 % RDF + 25 % FYM, T11: 75 % RDF + 25 % PM and T12: 25 % RDF + 25 % FYM + 25 % PM + 25 % VC. PG18 garlic variety was selected for the present study planted at spacing of 15 × 7.5 cm. The required quantity of fertilizers or organic manures as per treatment combination were applied at the time of land preparation. The RDF was applied through urea, SSP & MOP. Half of the nitrogen was applied as a basal dose along with full dose of phosphorus and potassium. Remaining half of nitrogen was applied in three equal splits at 90 days after planting following planting of cloves. Other cultural practices like weeding, hoeing and irrigation were done as and when required.

**RESULTS AND DISCUSSION**

The height of plant was varied in all treatments, as evident from the data (Table 1). Organic manures likely enhanced soil texture, boosting root proliferation and plant height (Acharya and Kumar, 2018). The maximum plant height was recorded with 50% RDF + 50% PM (T8) (54.57cm), which was at par with 75% RDF + 25% VC (T9) (52.34 cm). However, the minimum was recorded in T1 (46.98 cm). Similar results have been reported by Suem *et al.,* (2013), who have achieved a maximum plant height 50.32 cm with PM @ 1.92 kg plot-1 and the minimum plant height 42.77 cm was recorded in the control plot. The maximum number of leaves were recorded with 50% RDF + 50% PM (T8) (6.07), which were statistically at par with T9, T7, and T10. Whereas, the minimum number of leaves were recorded in control (T1). Results obtained in the present investigation are in agreement with those of Adamu and Fagam (2012) who reported the maximum number of garlic leaves as 6.75 in treatment 5.0 t ha-1 PM and minimum number of leaves per plant 5.75 in control. The results are also in agreement with those of Prajapati *et al.,* (2019). In treatment 50% RDF + 50% PM (T8) achieved the maximum leaf length (51.37 cm), which was significantly higher than the other treatments. Whereas, the minimum leaf length (43.71 cm) was observed in control (T1). Result achieved with 50% PM with 50% RDF in the present study are in agreement with the results obtained by Sharma *et al.,* (2021) who achieved leaf length of 51.4 cm with combination of 50% RDF + 2.5 t VC + 1.5 t PM. Khatri *et al.,* (2019) also noted that the addition of organic manures resulted in improved leaf development. The length of the leaves and other vegetative parameters were significantly impacted by organic sources. The data presented in Table 1 reveals that maximum leaf width (1.94 cm) was recorded with 50% RDF + 50% PM (T8), which were statistically at par with T6, T7, T9 and T11, respectively. In control (T1), a minimum leaf width of 1.68 cm was noted. These results are in agreement with study of Sharma *et al.,* (2021) who found that the maximum garlic leaf width of 2.10 cm in treatment 50% RDF + 2.5 t VC + 1.5 t PM and the minimum leaf width of 1.70 cm in treatment 100% RDF. One of the explanations might be enhancement of soil texture by organic manures thereby assisted plants in developing strong roots which might have increased the leaf width (Acharya and Kumar, 2018). Abou-Elmagd *et al.,* (2006) reported that poultry manure is rich in nitrogen and other plant nutrients and as a result it favors the growth and development of root system which reflects better growth, photosynthetic activity and dry matters accumulation. The perusal of the data presented in Table 1, 50% RDF + 50% PM (T8) produced the highest amount of fresh weight (30.42 g), which was statistically equal to (29.61 g) achieved in T9 and both the observations were significantly higher than other treatments and control (T1) that revealed the lowest amount of fresh weight (19.44 g). Similar to this, using organic manures leads to better yields of garlic crops because they serve as a storehouse for a variety of macro, micro and slow release of these nutrients and plant growth regulators that are released during the process of mineralization to release plant nutrients already present in the soil. This improves the fertilizer use efficiency (Yadav *et al.,* 2017). The findings of our study revealed that the amount of dry weight differed considerably amongst the various treatments. According to the data, 50% RDF + 50% PM (T8) produced the highest dry weight (11.10 g). The least quantity of dry weight (4.21 g) was obtained in control (T1). Combining inorganic chemical fertilizers with organic nutrition sources had a substantial impact on biometric observations, bulb characteristics, and garlic output. This could result from the continuous and progressive release of nutrients during the growth phase, from increased biological activity, and from providing the crop with the right nutrition (Patil *et al.,* 2007). Bulb weight is a crucial component of the garlic produce. The data presented in Table 2, reveals how various organic manures in conjunction with inorganic fertilizer affected garlic bulb weight. Data revealed that the 50% RDF + 50% PM (T8) had the highest bulb weight of 23.73 g which was significantly higher than rest of the other treatments. The lowest bulb weight of 16.90 g was noted in control (T1). Similar trend has also been reported by Nasreen *et al.,* (2009), who obtained the maximum bulb weight of 21 g that was significantly greater in inorganic fertilizers + 5 t ha-1 poultry manure compared to control. Following this treatment garlic bulb produced in T9, T7, T10, T11 had a diameter of 4.03, 3.97, 3.94 and 3.90 cm, respectively. Smallest bulb diameter of 3.16 cm was recorded in control (T1). Increased bulb diameter may stem from greater glucose accumulation. Similar results have been Singh *et al.,* (1997) reported in onion. It is evident from the data presented in Table 2 that the maximum yield per hectare of 12.46 t was recorded with 50% RDF + 50% PM (T8) which was significantly higher than rest of the all treatments. The minimum value of yield per hectare (8.87 t) was recorded in control (T1). The application of plant nutrients directly through organic manures and indirectly through the solubilization of unavailable nutrients of intermediate organic molecules produced during the decomposition of additional manures resulted in an increase in yield with the application of inorganic nutrients (Mitra *et al.,* 2010). The analysis of variance pertaining to the ascorbic acid showed that the effect of treatments on ascorbic acid content was significant. Higher ascorbic acid content of 12.32 mg/100g was ascertained with 50% RDF + 50% PM (T8) which was statistically at par with T7 (12.05 mg/100g) and T9 (11.85 mg/100g). The lowest amount (9.16 mg/100g) of ascorbic acid was found in control (T1). This might be due to increased activity of nitrate reductase enzyme, which helped in synthesis of certain amino acids and protein as reported by Yadav and Vijayakumari (2004). An improvement in the rhizosphere’s nutrient environment and its use by the plant system, which would increase the translocation of minerals, vitamins, and proteins needed for the production of ascorbic acid in the bulb (Ramesh *et al.,* 2006). These results are in close agreement with those of Kalirawna *et al.,* (2022) who observed the treatment75% of RDF + 25% organic manure exhibited significantly higher ascorbic acid (13.34 mg/100g). Minimum ascorbic acid (9.84 mg/100g) assessed in control treatment. As per Table 2, 50% RDF + 50% PM (T8) had the highest TSS of 35.40 ˚Brix, which was significantly higher than rest of the all treatments. In control (T1) garlic, TSS of 28.50 ˚Brix was recorded as the lowest value. In order to increase quality through desired enzymatic changes occurring during growth, organic manures are able to provide necessary macro and micro plant nutrients (Singh and Attrey, 2002). Dhakad *et al.,* (2019) studied and impact of different organic fertilizer on quality of onion (*Allium cepa* L.) under North Gujarat condition and results revealed that the highest TSS (12.86 ˚Brix) was recorded with the treatment 125 kg ha-1 N through poultry manure, while minimum TSS (10.77 ˚Brix) was recorded with the treatment 50 kg VC and 50 kg RDF. It is evident from the Table 2 that the maximum chlorophyll content 0.82 m/g was recorded with 50% RDF + 50% PM (T8). The minimum value of chlorophyll content of 0.69 mg/g was recorded in garlic of control (T1). It could be attributed due to improved nutrient uptake by plant roots and increased plant growth due to adequate nutrient availability and subsequently have increased photosynthesis and improved carbohydrates and sugar through increased photosynthesis (Parisi *et al.,* 2004). This study demonstrates that integrating 50% recommended fertilizer dose with 50% poultry manure optimizes garlic growth, yield (12.46 t/ha), and quality parameters like ascorbic acid and TSS, outperforming other treatments. These findings advocate for balanced nutrient management as a sustainable strategy for garlic cultivation in similar agro-climatic zones.

**Table. 1:** Effect of different organic manures and NPK on vegetative parameters of garlic

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Treatments | Plant  Height  (cm) | Leaf number/  plant | Leaf length  (cm) | Leaf  width (cm) | Fresh weight  (g) | Dry weight  (g) |
| T1 | **46.98c** | **5.13d** | **43.71c** | **1.68d** | **19.16e** | **4.21f** |
| T2 | **49.01cde** | **5.40bcd** | **46.54bc** | **1.75bcd** | **23.74bc** | **7.80de** |
| T3 | **49.19cde** | **5.47bcd** | **45.69bc** | **1.71cd** | **21.66d** | **6.96e** |
| T4 | **48.55de** | **5.53bcd** | **46.28bc** | **1.74bcd** | **22.73cd** | **7.14e** |
| T5 | **49.46cde** | **5.40bcd** | **44.78bc** | **1.70d** | **22.50cd** | **7.54de** |
| T6 | **49.89bcd** | **5.67abc** | **47.36b** | **1.82abcd** | **24.99b** | **8.10cd** |
| T7 | **50.92bcd** | **5.73ab** | **47.89b** | **1.86abc** | **25.29b** | **9.29b** |
| T8 | **54.57a** | **6.07a** | **51.37a** | **1.94a** | **30.42a** | **11.10a** |
| T9 | **52.34ab** | **5.80ab** | **47.92b** | **1.88ab** | **29.61a** | **8.96bc** |
| T10 | **51.39bc** | **5.67abc** | **47.39b** | **1.77bcd** | **25.05b** | **8.89bc** |
| T11 | **50.27bcd** | **5.60abcd** | **46.55bc** | **1.79abcd** | **23.89bc** | **7.73de** |
| T12 | **49.84bcd** | **5.20cd** | **46.53bc** | **1.75bcd** | **23.58bcd** | **7.36de** |
| C.D. (5%) | **2.73** | **0.49** | **3.33** | **0.15** | **2.07** | **0.91** |

Note: Values superscript with same letter are not statistically significant.

**Table. 2:** Effect of different organic manures and NPK on vegetative parameters of garlic

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Treatments | Bulb Weight (g) | Yield per Hectare (t) | Ascorbic Acid (mg/g) | TSS (˚Brix) | Chlorophyll (mg/g) |
| T1 | **16.90e** | **8.87e** | **9.16g** | **28.50g** | **0.68g** |
| T2 | **20.13bcd** | **10.57bcd** | **11.01cdef** | **29.57fg** | **0.70efg** |
| T3 | **19.20d** | **10.08d** | **10.51ef** | **29.67fg** | **0.69fg** |
| T4 | **19.27cd** | **10.12cd** | **10.32f** | **28.60g** | **0.73cde** |
| T5 | **19.33bcd** | **10.15bcd** | **10.87def** | **29.77fg** | **0.72defg** |
| T6 | **20.97bcd** | **11.01bcd** | **11.14cdef** | **31.43cde** | **0.74bcd** |
| T7 | **21.40bc** | **11.24bc** | **12.05ab** | **32.37bc** | **0.76bc** |
| T8 | **23.73a** | **12.46a** | **12.32a** | **35.40a** | **0.82a** |
| T9 | **21.47b** | **11.27b** | **11.85abc** | **33.73b** | **0.77b** |
| T10 | **20.93bcd** | **10.99bcd** | **11.41bcd** | **31.60cd** | **0.75bcd** |
| T11 | **20.53bcd** | **10.78bcd** | **11.36bcde** | **30.67def** | **0.74bcd** |
| T12 | **19.73bcd** | **10.36bcd** | **10.78def** | **29.83efg** | **0.73cdef** |
| C.D. (5%) | **2.07** | **1.13** | **0.86** | **1.63** | **0.04** |

Note: Values superscript with same letter are not statistically significant.

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