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Effect of Nutrient Management on Morpho-physiological Growth and Quality of Garlic (*Allium sativum* L.) cv. G-50

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ABSTRACT: Alliums are among the oldest cultivated plant species. The most widely cultivated garlic belongs to the genus Allium which is used as a common spice and condiment crop. With continuous production, soil fertility may be depleted as a result of intensive cropping, improper fertilization, and the absence of micronutrient applications, as well as the use of less or no organic manures. To sustain a higher level of soil fertility and crop productivity, complementary use of chemical fertilizers with organic manures has assumed great importance nowadays. The present experiment was conducted at Vegetable Research Centre, Maharajpur, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M. P.) during *Rabi season* of 2020-21 for evaluating the effect of nutrient management on growth and quality of garlic (*Allium sativum* L.) cv. G-50". The experiment was carried out in Randomized Block Design (RBD) with three replications in10 treatment combinations. The maximum plant height (38.35cm, 56.27cm and 69.08) at 30,60 and 90 days after sowing, highest number of leaves per plant was found with T7 (50:25:25 kg NPK+ Vermicompost 3.75 t/ha).length of leaves (35.22 cm, 48.24 cm, 63.80 at 30, 60, 90 days after sowing respectively), leaf width (0.88 cm, 1.17 cm, 1.51 cm at 30, 60, 90 days after sowing), other parameters like length of pseudostem, width of pseudostem. Highest TSS (36.62 ^{o}Brix and maximum bulb dry matter content (40.44 per cent) was found under treatment T_7 (50:25:25 kg NPK+ vermicompost 3.75 t/ha). However, the minimum value for above parameters were absorbed under treatment(T_1)-Control and ($T_{4)}$ Poultry Manure 7.5 t/ha.

Keywords: Garlic, Vermicompost, Quality, RDF, NPK, Manureand G-50.

INTRODUCTION

Garlic is classified as an annual herbaceous plant that comes from the taxonomic family Amaryllidaceae (Alliaceae). After the onion, this bulb crop has the second most significant position in terms of importance. The bulb, which represents the most advanced portion of the plant, is responsible for generating the economic output. In the Indian system of remedies, this substance is included as a carminative and stomach stimulant, aiding in the processes of digestion and food absorption. In ash content of the garlic is found to have various elements per 100g of raw matter i.e., potassium (260 mg), phosphorus (140 mg), sodium (120 mg), calcium (90 mg), and iron (1.5 mg). Garlic bulbs are found to include around 0.1% essential oils, including organic sulphur compounds such as allyl propyl disulfide and Allyn, among others (Mardomi, 2017). India has the distinction of being the second-largest global producer of garlic, as measured by both cultivated land area and overall production. The plant has the characteristic of producing hermaphrodite blooms. Garlic generates a cluster of little bulbs referred to as cloves, which are enveloped by a delicate outer layer. Garlic is often used as a culinary ingredient and for its medical properties due to its possession of Allicin, a compound known for its antibacterial qualities (Bhatwalkar *et al.*, 2021). Additionally, garlic has been recognized as a potent therapeutic agent against amoebic dysentery. The uninjured bulb of garlic contains water-soluble amino acids called Allin, which are devoid of color and odor. When the garlic bulb is crushed, the enzyme alliinase acts on Allin, resulting in the production of allicin. The primary ingredient of allicin is the pungent compound known as diallyl disulfide, which is widely recognized as a significant flavoring component in garlic.

Garlic has a diverse array of essential minerals, vitamins, and other bioactive compounds that have beneficial effects on human health. According to Azene and Mengesha (2015), the substance under consideration exhibits a high content of sugar, protein, fat, calcium, potassium, phosphorus, sulphur, iodine, fiber, and silicon, as well as many vitamins. The overutilization of chemical fertilizers has led to a deficit of nutrients beyond those that were directly supplied, thus leading to a reduction in the organic carbon content within the soil (Singh *et al.*, 2001). Organic fertilizers are often recommended as a viable alternative to mineral fertilizers. Currently, the use of both organic and inorganic fertilisers is widely adopted as a conventional method in agriculture, proving to be efficacious in enhancing the productivity and overall quality of crops (Sharma and Chetani 2017). Fertilization has a crucial role in influencing the chemical composition, bioactivity potency, and overall quality of garlic. Nevertheless, the utilization of organic inputs, agricultural wastes, and animal manure is constrained in meeting the nutritional requirements of crops on a broad scale owing to their restricted availability (Diriba, 2016). Hence, the implementation of a proper fertilization regimen is crucial in order to achieve optimal garlic production and quality (Martins *et al*., 2016).

MATERIALS AND METHODS

The present study was carried out at the Vegetable Research Complex, Department of Horticulture, JNKVV, Jabalpur (Madhya Pradesh). An experiment was conducted during the Rabi season 2020-21. The variety G-50 was used to carry in a Randomized Block Design with three replications under ten treatments containing different combinations of organic and inorganic fertilizer sources. T_1- 100% RDN through Inorganic fertilizer (control), T_2 - 100% RDN through FYM, T_3 - 100% RDN through Vermicompost, T_4 - 100% RDN through Poultry manure, T_5 - 50% RDN through Inorganic fertilizer+50% RDN through FYM, T_6 - 25% RDN through Inorganic fertilizer+75% RDN through FYM, T_7 - 50% RDN through Inorganic fertilizer+50% RDN through Vermicompost, T_8 - 25% RDN through Inorganic fertilizer+75% RDN through Vermicompost, T_9 - 50% RDN through Inorganic fertilizer+50% RDN through Poultry manure and T_{10} - 25% RDN through Inorganic fertilizer+75% RDN through Poultry manure. To control fungal infection, Thiram was applied to the seeds prior to planting at a rate of 3.0 g per kg seed.

The flat beds of 1×1.95 m^2 size were prepared for planting in spacing of 15×10 cm. Five plants were selected at random from each plot and tagged in order to collect the data on various characters. Parameters related to morphological growth viz., plant height, number of leaves per plant, leaf length, leaf width, pseudostem length, diameter of pseudostem; and quality parameters i.e. TSS, dry matter content %, was estimated. The analysis of variance (ANOVA) for randomized block design (RBD) was conducted using the method proposed by Panse and Sukhtame (1954)

RESULT AND DISCUSSION

The outcome of the statistical analysis revealed that the morphological parameters were significantly affected by the application of both organic and inorganic fertilizer. It has been discovered that the effects of different treatments on garlic plant height are statistically significant. However, at 30, 60, and 90 DAS, the treatment T_7 (50:25:25 kg NPK+ Vermicompost 3.75 t/ha) had the highest plant heights (38.35 cm, 56.27 cm, and 69.08 cm) whereas the lowest plant height (29.61, 43.31 and 58.25 cm) was found in T_4 (100% RDN through Poultry manure) Other than fertilizer application, vermicompost was also seen in garlic, which has a comparatively high level of humus-like compounds, active microorganisms, and enzymes and contains a good variety of micronutrients needed for healthy plant growth (Meena *et al.,* 2018).

At 30, 60, and 90 DAS, it was observed that treatment T_7 (50:25:25 kg NPK+ Vermicompost 3.75 t/ha) had the most number of leaves per plant (4.93, 8.85 and 11.04), while treatment T_4 (100% RDN through Poultry manure) had the fewest (3.01, 5.03 and 8.37). The reason for the greatest number of leaves is that the experimental plant had more nitrogen than the control in garlic (Suthar, 2009; Meena *et al.,* 2018). At 30, 60, and 90 DAS, it was found that the treatment T_7 (50:25:25 kg NPK+ Vermicompost @ 3.75 t/ha) only had the longest leaves (35.22, 48.24 and 63.80 cm), whereas the T_4 treatment had the shortest leaves (26.95, 35.32 and 48.54 cm). The number of tillers grew, and the length of the leaves also increased because of the application of vermicompost containing RDF nutrients. (Meena *et al.,* 2018; Kumar *et al.*, 2014).

The use of 50:25:25 kg NPK + Vermicompost 3.75 t/ha, in treatment T_7 (0.88, 1.17, and 1.51 cm), resulted in the widest leaf at 30, 60, and 90 DAP while in treatment T_4 (poultry manure 7.5 t/ha) minimum leaf width (0.60, 0.82 and 1.27 cm) was found. These conclusions closely resemble those of Badal *et al.* (2019). The length of the pseudostem was dramatically increased by the addition of vermicompost to the integrated nutrition management system. Treatment T_7 (50:25:25 kg NPK+ Vermicompost @ 3.75 t/ha) had the longest pseudostem length (2.51, 4.34 and 5.92 cm) at 30, 60, and 90 DAS, whereas the control had the lowest. The maximum pseudostem length was caused by higher N levels in the experimental plant than the control plant (Meena *et al.,* 2018). The diameter of the pseudostem was significantly larger after the application of both organic and inorganic fertilizers in treatment T_7 (50:25:25 kg NPK+ Vermicompost @ 3.75 t/ha) at 30, 60, and 90 DAS. The pseudostem diameter was significantly smaller in treatment T_4 (poultry manure 7.5 t/ha). The largest diameter of the pseudostem was caused by a larger concentration of soil enzymes, organic matter, and soil for rapid mineralization and transformation of soil, application of vermicompost, and NPK nutrients, which increased to the diameter of the pseudostem (Meena *et al.,* 2018; Mandloi *et al.,* 2008).

The treatment T_7 (50:25:25 kg NPK+ Vermicompost @ 3.75 t/ha) had the greatest TSS and dry matter content percentage, while treatment T_4 (poultry manure 7.5 t/ha) had the lowest TSS and dry matter content clearly. For quick mineralization and transformation of plant nutrients in soil, higher concentrations of soil enzymes, soil organic matter, and soil, application of vermicompost, and NPK nutrition result in an increase to the TSS and dry matter content percent (Meena *et al.*, 2018; Umaretiya *et al.*, 2019; Kumar *et al.,* 2019).

The T_4 treatment provided the lowest net profit, 333690 ha^{-1}, while the T_7 treatment (50:25:25 kg NPK + Vermicompost 3.75 t/ha) produced the highest net profit, 433037.25 ha^{-1}. The T_7 treatment had highest benefit-cost ratio is 3.73:1. Suthar (2009); Kumar *et al*. (2019) claim that vermicompost manure can be a source of plant nutrients for long-term agricultural development.

Table 1 : Effect of organic and inorganic fertilizer on plant height, number of leaves at 30, 60 and 90 days after planting in Garlic cv. G-50.

Treatment	Plant height (cm)			Number of leaves		
	(30 DAP)	(60 DAP)	(90 DAP)	(30 DAP)	(60 DAP)	(90 DAP)
T_1- 100:50:50 kg/ha N:P:K (Control)	29.85	45.22	59.58	3.05	6.02	8.76
T_2- FYM 15 t/ha	32.03	46.51	60.21	3.14	6.98	8.96
T_3- Vermicompost7.5 t/ha	32.89	48.04	61.10	3.73	7.01	9.09
T_4- Poultry Manure 7.5 t/ha	29.61	43.31	58.25	3.01	5.03	8.37
T_5- 50:25:25 kg NPK+FYM 7.5 t/ha	35.30	51.12	65.14	4.21	7.41	9.66
T_6- 25:12.5:12.5 kg NPK + FYM 11.25 t/ha	33.40	48.75	62.10	3.68	7.09	9.34
T_7- 50:25:25 kg NPK + Vermicompost 3.75 t/ha	38.35	56.27	69.08	4.93	8.85	11.04
T_8- 25:12.5:12.5 kg NPK + Vermicompost 5.6 t/ha	34.37	50.01	64.15	4.10	7.35	9.44
T_9-50:25:25 kg NPK + Poultry Manure 3.75 t/ha	35.76	52.70	66.09	4.31	7.54	10.05
T_{10}- 25:12.5:12.5 kg NPK + Poultry Manure 5.6 t/ha	33.58	49.83	63.08	3.82	7.12	9.38
SE(m)±	1.47	1.81	1.92	0.25	0.28	0.39
C.D. @ 5%	4.41	5.43	5.75	0.77	0.85	1.174

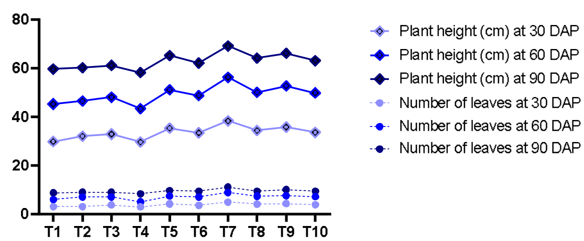

Fig. 1. Plant height (cm) and number of leaves at 30, 60 and 90 days after planting in Garlic cv. G-50.

Table 2 : Effect of organic and inorganic fertilizer on leaf length, leaf width, pseudostem length and pseudostem diameter at 30, 60 and 90 days after planting in Garlic cv. G-50.

Treatment	Leaf length (cm)			Leaf width (cm)			Pseudostem length (cm)			Pseudostem diameter (cm)		
	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
T_1- 100:50:50 kg/ha N:P:K (Control)	27.73	38.99	51.51	0.65	0.84	1.35	2.07	3.05	4.33	0.58	0.73	0.88
T_2- FYM 15 t/ha	28.71	40.28	52.91	0.67	0.88	1.36	2.14	3.75	4.57	0.59	0.75	0.90
T_3- Vermicompost7.5 t/ha	30.49	41.29	53.76	0.68	0.91	1.39	2.16	3.76	4.80	0.61	0.76	0.92
T_4- Poultry Manure 7.5 t/ha	26.95	35.32	48.54	0.60	0.82	1.27	2.06	2.88	4.18	0.57	0.72	0.85
T_5- 50:25:25 kg NPK+FYM 7.5 t/ha	33.74	46.64	61.24	0.79	1.03	1.45	2.3	4.20	5.63	0.67	0.81	0.96
T_6- 25:12.5:12.5 kg NPK + FYM 11.25 t/ha	29.28	42.09	57.76	0.73	0.92	1.40	2.18	3.78	4.90	0.62	0.77	0.91
T_7- 50:25:25 kg NPK + Vermicompost 3.75 t/ha	35.22	48.24	63.80	0.88	1.17	1.51	2.51	4.34	5.92	0.73	0.87	1.04
T_8- 25:12.5:12.5 kg NPK + Vermicompost 5.6 t/ha	32.11	45.20	59.11	0.78	0.96	1.42	2.25	4.04	5.22	0.65	0.79	0.94
T_9-50:25:25 kg NPK + Poultry Manure 3.75 t/ha	34.43	47.05	62.69	0.86	1.06	1.49	2.42	4.29	5.72	0.68	0.83	1.02
T_{10}- 25:12.5:12.5 kg NPK + Poultry Manure 5.6 t/ha	30.75	43.62	58.46	0.74	0.93	1.43	2.23	3.82	5.11	0.64	0.78	0.93
SE(m)±	1.59	2.57	2.54	0.03	0.03	0.03	0.07	0.17	0.20	0.02	0.02	0.03
C.D. @ 5%	4.78	7.71	7.62	0.10	0.09	0.10	0.23	0.52	0.60	0.07	0.06	0.09

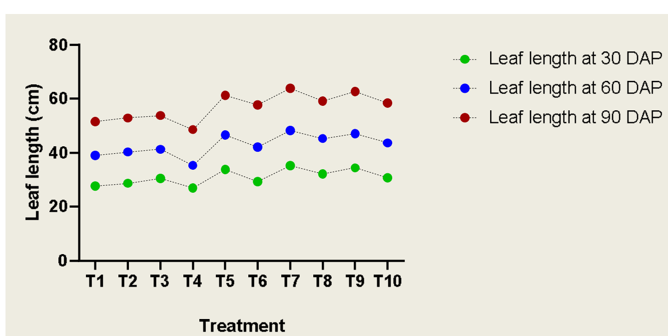

Fig. 2. Leaf length (cm) at 30, 60 and 90 days after planting in Garlic cv. G-50.

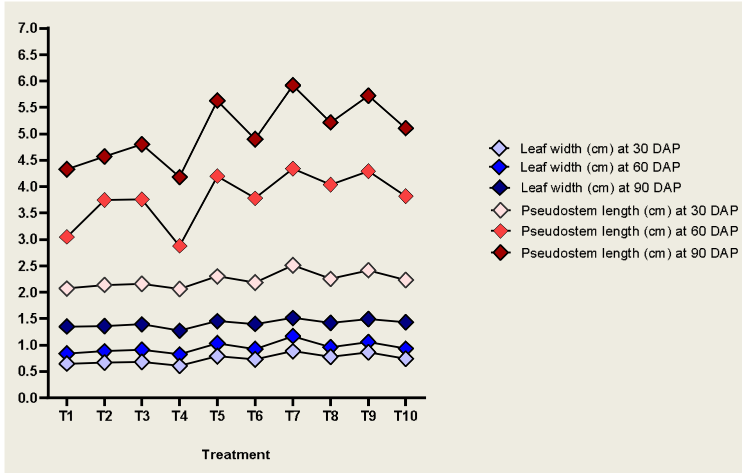

Fig. 3. Leaf width and pseudostem length (cm) at 30, 60 and 90 days after planting in Garlic cv. G-50.

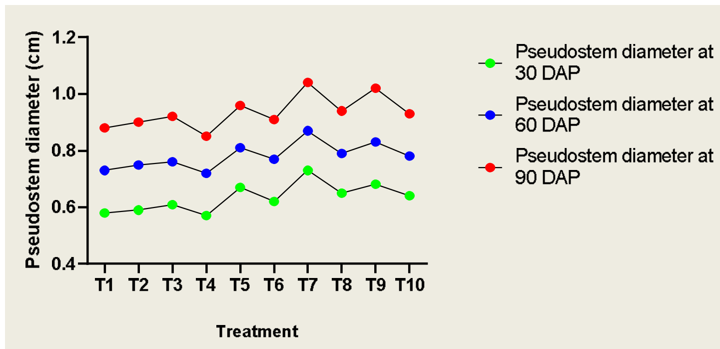

Fig. 4. Pseudostem diameter (cm) at 30, 60 and 90 days after planting in Garlic cv. G-50.

Table 3 : Effect of organic and inorganic fertilizer on TSS °Brix and dry matter content of bulb (%) after harvest in Garlic cv. G-50.

Treatment	TSS (°) brix	Dry matter content of bulb %
T_1- 100:50:50 kg/ha N:P:K (Control)	34.33	35.81
T_2- FYM 15 t/ha	34.57	35.94
T_3- Vermicompost 7.5 t/ha	34.80	36.47
T_4- Poultry Manure 7.5 t/ha	32.83	35.04
T_5- 50:25:25 kg NPK+FYM 7.5 t/ha	35.47	37.09
T_6- 25:12.5:12.5 kg NPK + FYM 11.25 t/ha	36.03	36.32
T_7- 50:25:25 kg NPK + Vermicompost 3.75 t/ha	36.62	40.44
T_8- 25:12.5:12.5 kg NPK + Vermicompost 5.6 t/ha	35.12	37.06
T_9-50:25:25 kg NPK + Poultry Manure 3.75 t/ha	36.42	39.41
T_{10}- 25:12.5:12.5 kg NPK + Poultry Manure 5.6 t/ha	34.59	36.49
SE(m)±	1.31	1.04
C.D. @ 5%	NS	3.13

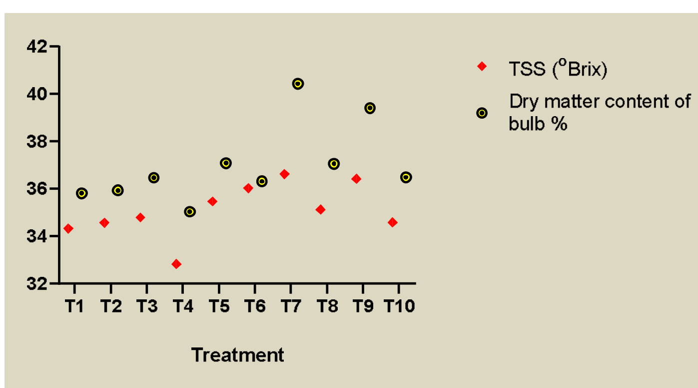

Fig. 5. TSS °Brix and bulb dry matter content (%) at 30, 60 and 90 days after planting in Garlic cv. G-50.

CONCLUSIONS

According to the assessment, the treatment T7, which included the application of a combination of 50:25:25 kg NPK and Vermicompost at a rate of 3.75 t/ha, resulted in a superior response in garlic compared to all other treatment combinations. The integration of both inorganic and organic sources, such as vermicompost, poultry manure, and farmyard manure, had a significant impact on the morphological growth and quality of garlic.

FUTURE SCOPE

In future, this study will be helpful in conducting trials at various locations with various organic manure and bio-fertilizers with different combinations in garlic crops. This study will also give the advantage to performing similar trials with other varieties of garlic for performing qualitative analysis i.e. TSS and dry matter content with local region-specific higher yield.

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Conflict of Interest. None.

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