Original Research Article

Effect of inorganic, organic and biofertilizers on growth and yield of garlic (*Allium sativum* L.)

ABSTRACT

A study on the research entitled "Effect of inorganic, organic and biofertilizers on growth and yield of garlic (*Allium sativum* L.) cv. Yamuna Safed - 4 (G-323)" was conducted at the Horticultural Research Farm of Doon (P.G.) College of Agriculture Science and Technology, Dehradun, Uttarakhand during 2023-2024. The growth and yield parameters of garlic were significantly influenced by different treatments of inorganic, organic and biofertilizers. The maximum growth in terms of plant height (72.46 cm), number of leaves per plant (6.73), length of leaves (43.80 cm), stem girth (10.89 mm), chlorophyll content of leaves (79.88 mg/g) and yield per hectare (108.00 q/ha) were observed in the treatment T_3 [NPK (100%)].

Keywords: Inorganic, Organic, Biofertilizers, Growth, Yield, Garlic

1. INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most widely grown *Allium* species after onion belonging to the family Alliaceae. It has been an important vegetable crop in India since ancient times. It originated in Central Asia and is used as a vegetable as well asnd for medicinal purposes (Bauer *et al*., 2010). It is the most nutritious crop among the bulbous vegetables. It is also used as a spice and condiment with high nutritional and medicinal value. It contains high amounts of carbohydrates (29%), proteins (6.3%), minerals (0.3%), essential oils (0.1-0.4%) and appreciable quantities of fat, vitamin C and sulphur (Memane *et al.*, 2008).

Garlic greens have a much higher ascorbic content than dried cloves. It has antiviral, antibacterial, antifungal and anti-protozoal properties (El-Saber Batiha *et al.*, 2020). It is beneficial to the cardiovascular and immune systems due to its antioxidant and anti-cancerous properties. It is described as a heat stimulant, carminative & anti-rheumatic and its oil is a powerful antiseptic mainly due to the presence of allicin; an important organosulfur compound (Shang *et al.*, 2019). It is used as a vermifuge for expelling roundworms and has been

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recommended for the cure of several ailments viz., wounds, ulcers, pneumonia, bronchitis and gastro-intestinal disorders (Hazra *et al.*, 2011). The applications of synthetic chemical fertilizers alone can have deleterious effects on the soil health, water resources and ecosystem (Phad, 2023). Plant nutrition is one of the important factors in increasing the growth and yield of crop plants. Nutrients are important for regulating internal metabolic activities in the plant body. It is a well-known fact that long-time inorganic fertilizer application leads to harmful effects on soil fertility, resulting in poor yield and quality of crops. Therefore, integration of inorganic fertilizers, organic manures and biofertilizers can maintain good soil health, productivity and fertility status of soil (Priyanshu *et al.*, 2020).

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Keeping in view the above literature, the present investigation was undertaken to find out the effect of individual application of inorganic, organic and bio-fertilizers for the growth and yield of garlic in the Dehradun region of Uttarakhand.

2. MATERIALS AND METHODS

The experiment was conducted at the Horticultural Research Farm, Department of Horticulture, Doon (P.G) College of Agriculture Science and Technology, Selaqui, Dehradun (UK), India from 2023-2024. The experimental field is located at an altitude of 515 m above mean sea level between 30.35°N latitudes and 77.84°W longitudes. The average annual rainfall is 2073.3 mm; average temperature (15.5°C) and average humidity (75.21%) are recorded during the garlic growth period. The soil of the experimental field was sandy loam with pH ranging from 6.5 to 7.5. The soil was very low in available nitrogen (0.02%), medium in available phosphorus (48.9%) and high in available potassium (2.9%). Electrical conductivity of soil ranged between 0.30-0.73 dS/m indicating the nature of soil is normal. Moreover, the soil contains organic carbon ranging from 0.31% to 0.80%. Garlic cultivar 'Yamuna Safed – 4 (G-323)' was used as planting material for the present investigation. The experiment was laid out in a simple Randomized Block Design (RBD) with three replications and seven treatment plots. The treatment consisted of seven different treatments of inorganic, organic and biofertilizers *viz.*, T_1 [Control], T_2 [FYM (100%)], T_3 [NPK (100%)], T_4 [*Azotobacter* (100%)], T_5 [Vermicompost (100%)], T_6 [Wood ash (100%)] and T_7 [Arbuscular Mycorrhiza (100%)]. Required quantity (considered as 100%) of Farm Yard Manure @ 20 tonnes/ha, NPK @ 100:50:50 kg/ha, *Azotobacter* @ 8 kg/ha, vermicompost @ 10 tonnes/ha, wood ash @ 5 tonnes/ha and Arbuscular

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Mycorrhiza @ 6 kg/ha were applied before planting of garlic cloves in the respective plots as per scheduled treatments.

Data about growth components were collected from 10 plants in each replication of the 7 treatments. A random sampling was done from each plot to determine plant height, number of leaves per plant, length of leaves, stem girth and chlorophyll content of leaves. Plant height and length of leaves were measured with the help of measuring tape and expressed in centimeters. Number of leaves was counted from randomly selected plants of different treatment. Stem girth was taken in the east-west and north-south directions with the help of digital vernier calipers (Corceptive Pvt. Ltd.) and averaged. Stem girth was expressed in mm. The chlorophyll content is analyzed by extraction of chlorophyll in a solvent followed by in vitro measurements in a spectrophotometer (Parry *et al.*, 2014). Yield per hectare was calculated by weighing all bulbs from each treatment, replication-wise at the time of harvesting.

$$Yield\ per\ hectare\ (kg) = \frac{Garlic\ weight\ (kg)}{Plot\ area\ (m^2)} \times 10{,}000$$

The obtained data was subjected to statistical analysis using the F test according to the procedure of Gomez and Gomez (1984). The critical difference at 5% was calculated to compare the mean value of the determined criteria of different treatments.

3. RESULTS AND DISCUSSION

The effect of different inorganic, organic and biofertilizers on growth and yield attributes has been presented in Table 1. Plant height is an important factor in the growth of crops. Data recorded for plant height revealed that the maximum plant height (72.46 cm) was recorded in treatment T_3 [NPK (100%)] and was significantly different from treatment T_5 [Vermicompost (100%)] (69.66 cm) and T_2 [FYM (100%)] (63.20 cm). The minimum plant height (50.03 cm) was recorded in treatment T_1 [Control] which was significantly lower than treatment T_7 [Arbuscular Mycorrhiza (100%)] which is 53.40 cm. Kumar *et al.* (2019) reported that the plant height of garlic was significantly increased with the combined application of organic and inorganic fertilizers maintaining long-term soil fertility and sustaining a high level of productivity due to increased availability of nutrients to the plant initially through organic and inorganic fertilizers in the cropping season.

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The maximum number of leaves per plant (6.73) was reported in treatment T_3 [NPK (100%)] followed by T_5 [Vermicompost (100%)] and a minimum number of leaves per plant (5.13) were found in Control which was statistically at par with treatments T_2 [FYM (100%)]. The maximum number of leaves observed in treatment T_3 [NPK (100%)] might be attributed to the immediate availability and high nutrient concentration of fertilizer (Eragegowda *et al.*, 2018). Integrated nutrition management may have promoted vegetative growth, which in turn increased the number of leaves and increased photosynthetic activity (Dhaker *et al.*, 2017). The maximum length of leaves per plant (43.80 cm) was reported in treatment T_3 [NPK (100%)] followed by T_5 [Vermicompost (100%)] and a minimum length of leaves per plant (32.36 cm) was found in control which was significantly different with all other treatments. Results are also similar to the findings of Naidu *et al.* (2000) who reported that the application of nitrogen 150 kg N/ha caused a significant improvement in all growth parameters. Dawar *et al.* (2005) reported about the N levels, the highest leaf length (61.06 cm) was recorded for 120 kg N per ha.

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The maximum stem girth (10.89 mm) was reported in treatment T_3 [NPK (100%)] followed by T_5 [Vermicompost (100%)] and minimum stem girth (6.55 mm) were found in the control which was significantly different among other treatments. The maximum chlorophyll content of leaves (79.88 mg/g) was reported in treatment T_3 [NPK (100%)] followed by T_5 [Vermicompost (100%)] and minimum chlorophyll content of leaves (67.95 mg/g) was found in control which was significantly different among all other treatments. This result conforms with the findings of Sharangi *et al.* (2003), Abd-El-Moneem *et al.* (2005) and Rohidas *et al.* (2010) on garlic. The maximum yield per hectare (108 q/ha) was reported in treatment T_3 [NPK (100%)] followed by T_5 [Vermicompost (100%)] and the minimum yield (63.00 q/ha) was found in the control which was significantly different from other treatments. Similar results are reported by Bagali *et al.* (2012) on onion, Bhandari *et al.* (2012) and Damse *et al.* (2014) on garlic.

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Table 1. Effect of inorganic, organic and biofertilizers on plant height, number of leaves, length of leaves, stem girth, chlorophyll content and yield of garlic

Symbols	Treatments Details	Plant Height (cm)	Number of leaves per plant	Length of leaves (cm)	Stem Girth (mm)	Chlorophyll content of leaves (mg/g)	Yield (q/ha)
T_1	Control	50.03	5.13	32.36	6.55	67.95	63.00
T_2	FYM (100%)	63.20	6.26	40.06	8.83	73.22	88.00
T_3	NPK (100%)	72.46	6.73	43.80	10.89	79.88	108.00

T_4	*Azotobacter* (100%)	58.73	6.06	38.46	8.43	72.47	81.00
T_5	Vermicompost (100%)	69.66	6.53	41.65	9.45	75.47	91.66
T_6	Wood ash (100%)	56.20	5.73	37.25	7.82	71.58	74.00
T_7	Arbuscular Mycorrhiza (100%)	53.40	5.40	35.40	7.28	70.36	68.00
C.D. @ 5 %		2.624	0.489	0.914	0.207	0.858	10.015
SE(m)		0.842	0.157	0.293	0.067	0.276	3.215
C.V.		2.410	4.547	1.322	1.362	0.654	6.794

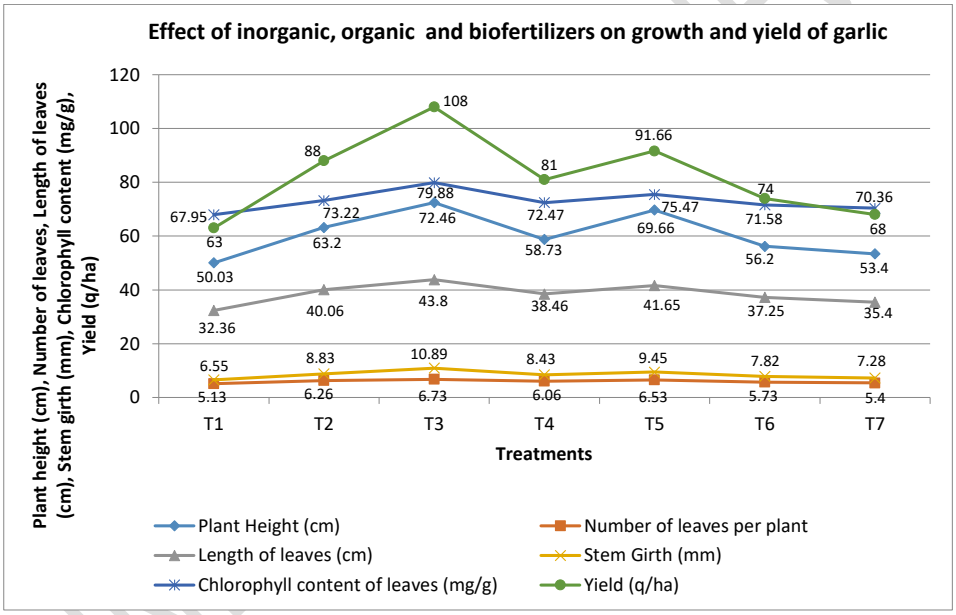

Figure 1. Effect of inorganic, organic and biofertilizers on plant height, number of leaves, length of leaves, stem girth, chlorophyll content and yield of garlic

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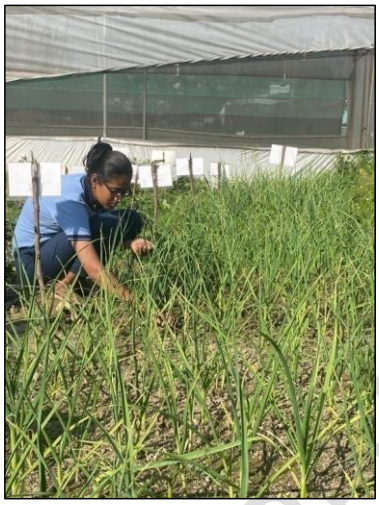

Plate 1. Pictorial view of garlic experimental field

4. CONCLUSION

The present study revealed that the treatment T_3 [NPK (100%)] significantly enhanced the growth and yield parameters of garlic, including plant height, number of leaves, leaf length, stem girth, chlorophyll content and total yield, compared to other treatments. Treatments T_5 [Vermicompost (100%)] and T_2 [FYM (100%)] also showed promising results, emphasizing the importance of organic fertilizers in sustainable farming.

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The findings underscore the potential of integrating inorganic and organic fertilizers to improve garlic production in the Dehradun region while maintaining soil health. Future research could focus on optimizing the ratios of organic and inorganic inputs to achieve maximum yield and environmental benefits.

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