Growth and Yield attributes of Garlic as influenced by application of organic manure, synthetic fertilizers and liquid manure in Bundelkhand region of India

ABSTRACT

A field experiment was conducted during 2022-23 at the Rajola Farm of the faculty of Agricultural Science, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.) to study the Effect of Organic, Inorganic and Liquid Manure Sources of Nutrient on Growth Attributes and Yield Attributes of Garlic (*Allium sativum* L.). The experiment was laid out in Randomized complete Block Design (RCBD)with twelve treatments comprising different source of organic, Inorganic and Liquid manure which were replicated thrice. Among the different manures, application T_{12} 50% FYM + 50% Vermicompostproduced highest plant height (90DAT) (59.15 cm) with comparatively good number of leaves plant^{-1} (20.33), average length of leaf (40.75 cm), neck thickness of bulb (9.88 mm), polar diameter (5.64 mm), equatorial diameter (5.78 mm), average weight of bulb (30.63 g), number of cloves bulb^{-1} (38.66), clove length (29.52 mm) and average weight of cloves (0.98 g). Maximum total yield of bulbs (131.15 q ha^{-1}) was observed when T_{12}50% FYM + 50% Vermicompost Whereas, the minimum Growth Attributes and Yield Attributes of Garlic were recorded with T_1 Control (Farmers Practices). The results showed that application of T_{12} 50% FYM + 50% Vermicompost,proved to be a promising practice for yield enhancement of garlic in the Bundelkhand Region.

Key words–Garlic Growth, Inorganic fertilizer, Liquid manure, Organic manure andYield

Introduction

"Garlic (Allium sativum L.) belonging to Alliaceae family is an aromatic herbaceous annual spice having 2n =2X=16 with umbellate inflorescence". [7]"Garlic has been used in China and India for more than 5000 years, and Egypt since 2000 B.C". (Kamenetsky and Rabinowitch, 2001) [1]. "Garlic is the most important Allium crop and ranks second next to onion in the world" (Voigt, 2004) [2]. "It is popular all over the world as a valuable spice and a popular remedy for various diseases. The important garlic growing countries in the world are China, Turkey, Spain, India, Thailand, Korea Republic, Egypt etc. In India and other Asian and Middle–

East countries, it is already being used in several food preparation like making of chutneys, pickles, curry powders, curried vegetables, meat preparation and tomato ketchup etc. It is rich in proteins, phosphorus, calcium, magnesium and carbohydrates. According to Unani and Ayurvedic medicines, in the treatment of diseases like chronic infection of stomach and intestine, dysentery, typhoid, cholera and diseases of lungs, garlic is successfully used" (Chopra et al., 1958) [3]. "At present time garlic tablets are being used worldwide for its hypocholesterolemic action for reducing the cholesterol level in human blood" (Augusti, 1977) [4]. "Garlic possesses insecticidal action with toxicity of garlic oil to different types of insects. Extract of garlic along with chilli and ginger has beneficial action against many fungi and bacteria. India has 2918.95 thousant tonnes production from 353.50 thousant ha area with average productivity of 2918.95 kg/ha. Among the different states of India, Madhya Pradesh is the leading one accounting for 178.16 thousant ha area and 1807.95 thousant tonnes production (NHRDF,Nashik 2018 – 19s). The other major garlic growing states are Gujarat (35 m ha area and 250 m t production) followed by Rajasthan, Uttar Pradesh, Maharashtra and Tamil Nadu. Punjab has highest per hectare yield (12.16 t/ha) followed by West Bengal and Maharashtra" [5]. "A desire and deserving need of concentrating the sound research work for this crop is required with a complete package of practices i.e. optimum doses of manures and fertilizers to supply major and micro nutrients, proper irrigation techniques, cultural practices and control of various pests and diseases etc. Out of these factors associated with increasing the production of garlic, a sound fertilizer management plays an important role for its good growth, yield and quality. The main way of increasing production of any crop depends on soil conditions and improved production technology. Indiscriminate use of inorganic fertilizers is believed to cause deterioration of soil texture, structure, hindrance of microbial activities, ground water pollution and finally decreased soil fertility and production. On the other hand, the use of organic manures improve soil texture, structure, humus, colour, aeration, water holding capacity, microbial activities, nutrient use efficiency and thereby increase production and reduce environmental hazards" [6]. "Therefore, Integration of organic, inorganic fertilizers and liquid manure can be advocated as one of the strategic solutions to maintain soil fertility and to increase production. Also, it becomes essential to find out the optimum dose of organic manures for proper growth and development of crop". [15] Keeping in view the above facts and for enhancing the growth and yield of garlic in Chitrakoot region.

Method and material

Description of the experimental site

Description of the experimentalsite The experiment was conducted at the Rajola Farm of the Faculty of Agricultural Science, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.). Chitrakoot is situated at an altitude of 306 mMSL at 240 31'^{0} N longitude and 810 E 15'^{0} E latitude. The climate of the region is semi – arid and sub – tropical having extreme winter and summer. During the winter months, the temperature drops down tolow as 20^o C while in the summer the temperature reaches above 470 C. Hot desiccating winds (Loo) are regular feature during summer whereas there may be occasional spell of frost during the winters. The meteorological data during the investigation period (2022-23) were obtained from the meteorological observatory located at MGCGVV Chitrakoot, Satna. The soil of experimental plot was sandy loam in texture with low organic matter content, slightly saline in nature and well drained.

ExperimentalMaterials

Healthy Improved White Local genotype having uniform size of cloves were collected from regional market and cloves were planted with spacing of 15 × 15 cm on 16th October 2022. The organic manures, inorganic fertilizers and Liquid organic manure i.e. FYM and Vermicompost, Urea, DAP, MOP, Jivamrut, Beejaamrut and Panchgavyawere collected from the local market for the experimentation.

Experimental Design and Treatments

The experiment was laid out in a Randomized complete Block Design comprising twelve treatments viz. T_1- Control (Farmers Practices),T_2 - RDF (150:50:50 kg ha^{-1}) NPK,T_3 - FYM 25 t ha^{-1}, T_4 -Vermicompost 10 t ha^{-1}, T_5 -SPNF (Bijamrit + Jivamrit + Mulching), T_6 -50% FYM + 50% RDF, T_7 -50% Vermicompost + 50% RDF, T_8 -SPNF +Panchgavya, T_9 -50% FYM+ Panchgavya, T_{10} -50% Vermicopost + Panchgavya, T_{11} -50% RDF + Panchgavya, T_{12} -50% and were replicated thrice.

Cultural operations

"Pre-planting irrigation was done manually with the help of tube well. The experimental field was ploughed and well harrowed by means of tractor operated harrow and cultivator. After land preparation, the experimental field was laid out manually as per the experimental plan with the help of rope and measuring tape keeping a plot size of 1m × 1m. Manures, fertilizers and liquid manure were applied as per the treatments. Cloves were planted on 16th October, 2022at a spacing of 15 cm apart in each row and a distance of 15 cm was maintained between the rows. Weed control was done manually by hoeing and shallow earthing up. Top dressing of rest dose

of nitrogen was done at 30 DAP. Other crop management practices were done as per the requirements after plant emergence. Tagging and measurement of observations was done manually starting from 15th November, 2022 onwards. Harvesting of mature bulbs was done manually on 25th March, 2023 when the top leaves turned yellow and brownish, showing signs of drying up and bending". [15]

Data collection and measurement:

Five randomly selected competitive plants from each plot were tagged for recording of the various observations on growth parameters viz. plant height (90 DAT), number of leaves plant^{-1}and average length of leaf., yield and yield attributing characters of garlic viz. neck thickness of bulb, polar diameter of bulb, equatorial diameter of bulb, average weight of bulb, number of cloves bulb^{-1}, length of clove, weight of clove, and bulb yield per ha were recorded after the harvesting of garlic. The data obtained were processed statististically to determine the effect of various treatments. Similarly, yield and its attributing parameters

Result and Discussion

The application of different doses of organic manures, fertilizers and liquid manures significantly influenced the vegetative growth parameters of garlic. The maximum plant height (59.15 cm) at 90 DAP was recorded with the application of 50 % FYM + 50% Vermicompost (Table- 1). In contrast, significantly lowest plant height (24.65 cm) was observed under control. The improvement in growth of the plant resulting from application of nutrient sources allowing efficient nutrient uptake is well documented. The similar results were also reported earlier by Talware et al. (2010); Ranjan et al. (2010); Singh et al. (2017), Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The highest number of leaves per plant (Table 1) was obtained when the plants were supplied with 50% FYM + 50% Vermicompost i.e., 20.33 at 90 DAT. While, the control shows the minimum number of leaves per plant at all the successive stage of growth 8.22 at 90 DAT. Similar findings were also reported earlier by Yadav et al. (2017), Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The average length of leaves (Table 1) was recorded at the successive stage of growth i.e., 90 DAT is (40.75 cm) cm recorded in the plot which was treated with 50% FYM + 50% Vermicompost. However, lowest length was recorded in control (T1) i.e., 20.52 cm at 90 DAT.

Results of experiment can be explained by correlating the observations with the work done by in garlic, Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The treatment 50 % FYM + 50 % Vermicompost recorded the earliness in maturity (Table-1) 148.77 days under study. However, the treatment control (T1) took maximum days for maturity (196.11 days). "The early maturity of bulb might be due to the hormones and organic acid secreted by organic manures during decomposition might have led to early maturity. The maximum number of days to be taken for maturity under control may be due to inadequate availability of nutrients resulting into more time to complete the vegetative growth" (Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The maximum polar diameter and equatorial (Table 2) was observed with the treatment 50 % FYM + 50 % Vermicompost i.e., 5.64 cm and 5.78 cm, respectively. However, the minimum value was observed with the treatment T1 (control) 3.20 cm and 3.15 cm respectively. Maximum polar and diameter in this treatment may be the result of high nitrogen supply resulting in increased growth and succulency. These results are in close agreement with those of Singh et al. (2002); (2007); Priyanshu et al. (2020), Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

Neck thickness of bulb result shows (Table 1) that 50% FYM in treatment T12 and using of 50 % vermicompost gave significant results as compare to control (Farmer practices). Treatment T12- 50 % FYM + 50 % Vermicompost shows profound increase in the neck thickness of bulb, highest value recorded is 9.88 mm. While, the lowest value is observed in control 6.62 mm. The results supported by the finding reported by Singh et al. (2002); Islam et al. (2007), Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The effect of nutrient management was found significant in the average weight of bulbs. The treatment 50 % FYM + 50 % Vermicompost recorded average weight of bulb (30.63), number of cloves per bulb (38.66) and clove length bulb (29.52 mm). The least value of average weight, number of cloves per and clove length were recorded with the control (T1) i.e., 21.63., 25.15 and 18.25 mm respectively. Similar, results were reported earlier by Gowda et al. (2007); Banjare et al. (2015), Serap Dogan et al. (2023), Kavad M.H. et al. (2023).

The productivity parameters (Table 3) like average weight of clove and total yield of bulbs were significantly affected by various doses of nutrients during the trialing. The productivity parameters improve with using 50 % FYM + 50% Vermicompost then declined the productivity parameters when sole application of Farmer practices. The Maximum value of average weight of clove and total yield of bulb (0.98 g and 137.15 q ha^{-1}) was observed in the treatment receiving 50 % FYM + 50 % Vermicompost. However, minimum average weight of clove and total yield of bulb (0.61 g and 95.23 q ha^{-1}) was recorded in control (T1). The results supported by the finding reported by Serap Dogan et al. (2023); Patidar et al. (2017), Kavad M.H. et al. (2023).

Table 1: Effect of organic, inorganic and liquid manure sources of nutrient on growth attributes of garlic (*allium sativum* L.).

Treatment	Plant height 90 DAT	Number of leaves plant^{-1}	Average length of leaf (cm)	Days to maturity (Days)
Control (Farmers Practices)	31.22	8.22	20.52	196.11
RDF (150:50:50 kg ha^{-1}) NPK	38.67	14.4	28.15	162.28
FYM 25 t ha^{-1}	38.22	16.28	27.66	155.63
Vermicompost 10 t ha^{-1}	41.15	17.44	26.82	161.65
SPNF (Bijamrit + Jivamrit + Mulching)	43.63	15.96	35.28	154.51
50% FYM + 50% RDF	47.56	13.75	33.33	163.70
50% Vermicompost + 50% RDF	55.51	14.98	28.37	166.94
SPNF +Panchgavya	46.15	16.71	29.48	174.10
50% FYM+ Panchgavya	44.52	17.28	30.15	166.62
50% Vermicopost + Panchgavya	42.20	16.49	34.26	168.25
50% RDF + Panchgavya	53.55	18.35	28.86	178.33
50% FYM + 50% Vermicompost	59.15	20.33	40.75	148.77
S. Em±	2.15	1.076	1.833	3.49
C.D. (p = 0.05)	4.459	2.231	3.801	7.24

Table 2: Effect of organic, inorganic and liquid manure sources of nutrient on yield attributes of garlic (*allium sativum* L.).

Treatment	Neck thickness of bulb (mm)	Polar diameter (mm)	Equatorial diameter (mm)	Average weight of bulb	Number of cloves per bulb	Clove length (mm)
Control (Farmers Practices)	6.62	3.20	3.15	21.63	25.15	18.25
RDF (150:50:50 kg ha^{-1}) NPK	8.78	5.24	5.22	30.66	32.89	24.22
FYM 25 t ha^{-1}	9.68	7.71	4.52	29.11	31.10	21.11
Vermicompost 10 t ha^{-1}	9.13	4.23	4.28	25.17	36.46	22.52
SPNF (Bijamrit + Jivamrit + Mulching)	9.63	4.55	4.11	26.18	30.11	23.52
50% FYM + 50% RDF	8.91	4.43	4.63	29.55	36.28	26.22
50% Vermicompost + 50% RDF	8.57	5.52	5.25	22.25	35.63	27.22
SPNF +Panchgavya	9.52	4.13	4.41	28.15	31.55	24.15
50% FYM+ Panchgavya	8.12	4.63	4.55	29.10	33.47	22.13
50% Vermicopost + Panchgavya	9.16	4.28	4.14	23.23	30.82	22.11
50% RDF + Panchgavya	8.58	4.61	4.17	29.51	28.66	21.21
50% FYM + 50% Vermicompost	9.88	5.64	5.78	30.63	38.66	29.52
S. Em±	0.41	0.17	0.17	1.10	1.31	0.57
C.D. (p = 0.05)	0.85	0.36	0.36	2.29	2.72	1.19

Table 3: Effect of organic, inorganic and liquid manure sources of nutrient on yield attributes of garlic (*allium sativum* L.) weight of cloves and yield of bulb.

Treatment	Average weight of cloves	Total yield of bulb (q/ha)
Control (Farmers Practices)	0.61	95.23
RDF (150:50:50 kg ha^{-1}) NPK	0.85	127.33
FYM 25 t ha^{-1}	0.84	110.11
Vermicompost 10 t ha^{-1}	0.78	109.18
SPNF (Bijamrit + Jivamrit + Mulching)	0.82	115.66
50% FYM + 50% RDF	0.86	117.15
50% Vermicompost + 50% RDF	0.81	114.20
SPNF +Panchgavya	0.85	118.77
50% FYM+ Panchgavya	0.94	114.11
50% Vermicopost + Panchgavya	0.87	111.22
50% RDF + Panchgavya	0.82	122.15
50% FYM + 50% Vermicompost	0.98	131.15
S. Em±	0.021	163.99
C.D. (p = 0.05)	0.044	340.11

Conclusion

Findings of the present field experiment revealed that application of 50% FYM + 50% Vermicompost secured enhanced growth, yield attributes and yield of garlic as compared to rest of the treatments. However poor growth and yield was recorded under farmer practice where no nutrient source was applied. Thus, application of T_{12} 50% FYM + 50% Vermicompost, may be recommended for improving yield and production potential of garlic in Bundelkhand regions of India.

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