Impact of Integrated Nutrient Management on growth, yield and quality of garlic (*Allium sativum L.*) under Lucknow conditions

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Abstract

A field experiment was conducted to study the Impact of Integrated Nutrient Management on growth, yield and quality of garlic (*Allium sativum L.*) under Lucknow conditions during the year 2016-2017. The experiment was laid out in randomized block design with three replications and twelve treatments with combination or individual application of organic manure and bio-fertilizers. After analysis of performance of different treatments the results indicatedthat application of (50% RDF + 50% vermi-compost @ 3 t/ha.), resulted into maximum height of plant (cm), number of leaves per plants, length of leaves (cm), diameter of stem (cm), Pseudo stem length (cm), bulb diameter (cm), neck thickness(cm), number of cloves per bulb, length of cloves (cm), average weight of bulb (g), number of bulb/kg, bulb yield (q/ha) and TSS (^{O} Brix) under the treatment T_6 has obtained better response of garlic over the all other treatment combinations.

Key words: Garlic, INM, growth parameters, bio-fertilizers, yield and quality.

Introduction

All bulb crops belong to monocotyledoneae family Alliaceae and the genus Allium. Among bulb crops garlic are cultivated from ancient time. The genus allium includes more than 500 spp. Out of them garlic are most important. They are grown in rabi season. Garlic (*Allium sativam*L.) is the second important bulb crop after onion. It is very hardy vegetable crop and is grown throughout India. Garlic is used as spice or condiment. It has a higher nutritive value than other bulbs crop. It is used in different preparation to cure against throat and lingering. It reduces the cholesterol in the blood. The garlic extracts also the nematicidal, fungicidal and bacterial properties. The foliage of garlic is flattened rather then hollow like than of the onion. Garlic is easily stored as the bulb keep fairly well in an ordinary well ventilated room for long time and hence this crop is very well suited for growing at places for away from consuming centers. Garlic contains amino acid 'Allion' which is colourless. However when cloves are crushed allicin is formed due to the enzymatic reaction of allinase. The economic yield is obtained from its underground herb, which is considered of bulbets, popularly called as cloves. Garlic is in flavorings food, preparing chutneys, pickels, curry powder, tomato ketchup etc. It is rich in proteins, phosphorus, calcium, magnesium and carbohydrates. The uninjured bulb content a colourless, odorless water soluble amino acid allion by crushing the garlic bulb, the enzyme alliances break down allion to produce allicin of which the principle ingradiant is the odouriferousdiallyl-disulfide (60%), diallyltrisulfied (20%), allyl propyl disulfide (6%) and small quality of diethyl disulfide and

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probably diallyl polysulfide. According to the unani and Ayurvedic system of medicine as practiced in India, garlic is conciderd as carminative and is a garlic stimulate and thus help in digestion and absorption of food. The world production of garlic was 249.82 lakh MT, from 3.81 lakh hectare areas. China, India Republic of Korea, Russian Fed, Myanmar, Ethiopia, USA and Egypt are the major garlic growing countries. China rank 1st in area, production and productivity (8.50 lakh ha, 200 lakh MT, 23.53 ton/ha respectively) and India is the second in area (262.06 T ha) and production (1425.46 TMT). Productivity is quit law (5.44 t/h) in India compared to world average (16.26 t/ha). (FAO, 2014). Among the different state in India Madhya Pradesh is the leading accounting for the 31% of area and 30% of production with average yield of 5.23 t/h. The major garlic growing states are Gujarat, Rajasthan, Orissa, Uttar Pradesh, Maharashtra and Tamilnadu. In India per hectare yield are highest in West Bengal (11.94 t/h) followed by Maharashtra (11.43t/h). (NHRDF, 2015). India exported 4804.47MT garlic with the worth of Rs1651.81 lakh. In the export of dehydrated garlic flakes, powder and dried 1024.06 MT, 973.46 MT, 342.95 MT, respectively with the whole worth of Rs1320.63 lakhs (NHRDF, 2015). Among the many constraints for low productivity in garlic (Allium sativumL.), imbalanced nutrition is the main limiting factor. The continuous and imbalanced use of fertilizers is adversely affecting the sustainability of agricultural production besides causing environmental pollution. Greenland (1975) suggested that for a sustainable crop production system, chemical nutrients removed by the crop must be replenished and physical conditions of the soil maintained. Integrated nutrient management (INM) provides excellent opportunities to overcome all the imbalances besides sustaining soil health and enhancing crop production. This optimizes the benefit from all possible sources of plant nutrients in an integrated manner. Hence, this investigation was planned to identify the ideal integrated nutrient management package.Hence, the present investigation have been planned to study of out the effect of integrated nutrient management on growth and yield attributing traits of garlic under Lucknow conditions.

Materials and Methods

The field experiment was conducted at the Horticultural Research Farm and quality observations were recorded at Laboratory of Department of Applied plant science (Horticulture), School for Bioscience and Biotechnology, Babasaheb Bhimrao Ambedkar University, (A Central University), Vidya-Vihar, Rae Bareli Road, Lucknow (U.P.)-226 025.During the *Rabi* season, 2016-17. The soil of experimental field is sandy loam and slightly alkaline in nature with the soil pH 8.2 A basal dose of well rotten farmyard manure and vermi-compost was incorporated in the soil before one month of sowing. The inorganic fertilizer, applied through SSP, urea and murate of potash. Nitrogen was incorporated in three split, 1/3 part at planting time and remaining dose of 2/3 nitrogen as per treatment was applied in two equal splits at 30 days and 45 days after planting with irrigation through urea. The sowing was done in rows at 15 × 10 cm, cloves of healthy bulbs 8-10 mm in diameter were dibbled 5 - 7.5 cm deep

keeping their growing ends upwards, on 12 October during year 2016. The seed rate was 500 Kg ha^{-1}. After sowing cloves were covered with the thin layer of soil for its proper germination Observations were recorded on the morphological, yield attribution and yield of bulb of garlic. Five plants were randomly selected from each plot and tagged for recording observation on various characters. The observations on height of plant (cm), number of leaves per plants, length of leaves (cm), diameter of stem (cm), Pseudo stem length (cm), bulb diameter (cm), neck thickness(cm), number of cloves per bulb, length of cloves (cm), average weight of bulb (g), number of bulb/kg, bulb yield (q/ha) and TSS (^{O} Brix). On set of the Rabi season these healthy bulb uniform shape and size were selected and transplanted well prepared field Statistical analysis of the data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme (1989).

Result and Discussion

Effect of INM on growth attributes:

Plant height (cm): The effects of different treatments on the plant height of garlic were found significant. However, the maximum plant height at 30 DAS was recorded in T_6 (30.20) followed by T_7 (30.10) and minimum plant height was recorded in T_1 (24.63 cm). At 60 DAS maximum plant height was recorded under the treatment T_6 (38.60 cm) followed by T_7 (38.43cm) and minimum plant height in T_1 (33.83). At 90 DAS maximum plant height was recorded in T_6 (69.40 cm) followed by T_7 (69.36 cm) and minimum plant height was recorded in T_1 (59.93 cm). The integrated nutrient management significantly increased the plant height recorded in the treatment RDF along with the vermi-compost application. The effects of different treatments on the plant height of garlic were found significant. However, the maximum plant height at 30 DAS was recorded in T_6 (30.20) followed by T_7 (30.10) and minimum plant height was recorded in T_1 (24.63 cm). At 60 DAS maximum plant height was recorded under the treatment T_6 (38.60 cm) followed by T_7 (38.43cm) and minimum plant height in T_1 (33.83). At 90 DAS maximum plant height was recorded in T_6 (69.40 cm) followed by T_7 (69.36 cm) and minimum plant height was recorded in T_1 (59.93 cm).It is clearly indicates in table 1 the data showed that maximum plant height at 30, 60 and 90 DAS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha.) respectively, while minimum plant height was recorded under the control treatment. The reason for increase in the plant height at different stages of growth may be due to the fact that the vermi-compost with a relatively high content of humus like compounds, active microorganism and enzymes, greatly contribute to the enhancement of the biochemical fertility of the soils degraded by intensive cultivation, pollution and natural causes. Vermi-compost contains a good range of some very essential micronutrient other than NPK fertilizers, required for healthy plant growth observed by Reddy and Reddy *(2005),* Gupta (2005) in garlic crop.

Number of leaves: The data showed that the maximum number of leaves at 30 DAS was counted under the treatment T_6 (5.71) followed by T_7 (5.69) and minimum number of leaves

per plant was recorded inT_1 (4.76). At 60 DAS maximum number of leaves per plant was counted under the T_6 (6.06) followed by T_7 (6.03) and minimum number of leaves per plant in T_1 (5.10). At 90 DAS maximum number of leaves per plant was counted under the T_6 (7.04) followed by T_7 (7.02) and minimum number of leaves per plant in T_1 (5.95). The integrated nutrient management significantly increased the number of leaves per plant recorded in the treatment RDF along with the vermi-compost application. It is clearly indicates that maximum number of leaves per plant at 30, 60 and 90 DAS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum number of leaves per plant was recorded under the control treatment. The reason for maximum number of leaves due to the higher N found in experimental plant than control, NPK nutrient resulting in increased to the number of leaves. The results of this study are agreements with the Reddy and Reddy (2005), Gowda*et al.* (2007), Suttar (2009) in garlic crop.

Length of leaves (cm): The effects of different treatments on the length of leaves of garlic were found significant. However, the maximum length of leaves per plant at 30 DAS was measured under the treatment T_6 (26.96 cm) followed by T_7 (26.96 cm) and minimum length of leaves per plant was measured in T_1 (22.50 cm). At 60 DAS maximum length of leaves per plant was measured under the T_6 (37.03 cm) followed by T_7 (36.40 cm) and minimum length of leaves per plant in T_1 (32.25 cm). At 90 DAS maximum length of leaves per plant was recorded under the T_6 (47.53 cm) followed by T_7 (47.06 cm) and minimum length of leaves per plant in T_1 (41.96 cm). The integrated nutrient management significantly increased the length of leaves recorded in the treatment RDF along with the vermi-compost application. It is clearly indicates that maximum length of leaves at 30, 60 and 90 DAS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50%RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum length of leaves was recorded under the control treatment. The reason for maximum length of leaves due to the vermi-compost application, there was an increase in number of tillers and of leaves application of vermi-compost with RDF nutrient resulting in increased to the length of leaves. The results of this study are agreements with the Umrao*et al.* (2013) and Kumar *et al.* (2013) in garlic crop.

Diameter of stem: The maximum diameter of stem at 30 DAS was recorded in T_6 (5.79mm) followed by T_7 (5.69 mm) and minimum diameter of stem was recorded in T_1 (4.20 mm). At 60 DAS maximum diameter of stem was recorded under the T_6 (6.21 mm) followed by T_7 (6.04 mm) and minimum diameter of stem in T_1 (5.65 mm). At 90 DAS maximum diameter of stem was recorded under the T_6 (12.08 mm) followed by T_7 (12.08 mm) and minimum diameter of stem in T_1 (9.57 mm). The integrated nutrient management significantly higher diameter of stem recorded in the treatment RDF along with the vermi-compost application. It is clearly indicates that maximum diameter of stem at 30, 60 and 90 DAS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha)

and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum diameter of stem was recorded under the control treatment. The reason for maximum diameter of stem due to the higher concentration of soil enzymes, soil organic matter and soil for rapid mineralization and transformation of plant nutrients in soil, application of vermi-compost, NPK nutrient resulting in increased to the diameter of stem. The result of this study is agreements with the Gowda*et al*. (2007) and Mandloi*et al.* (2008) in garlic crop.

Pseudo stem length: The data showed that the maximum length of pseudo stem at 30 DAS was recorded in T_6 (3.36 cm) followed by T_7 (3.23 cm) and minimum length of pseudo stem was recorded in T_1 (2.61 cm). At 60 DAS maximum length of pseudo stem was recorded under the T_6 (4.43 cm) followed by T_7 (4.38 cm) and minimum length of pseudo stem in T_1 (3.48 cm). At 90 DAS maximum length of pseudo stem was recorded under the T_6 (5.25 cm) followed by T_7 (5.19 cm) and minimum length of pseudo stem in T_1 (4.21 cm). The integrated nutrient management significantly increased the pseudo stem length recorded in the treatment RDF along with the vermi-compost application. It is clearly indicates that maximum pseudo stem length at 30, 60 and 90 DAS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum pseudo stem length was recorded under the control treatment. The reason for maximum pseudo stem length due to the higher N found in experimental plant than control, NPK nutrient resulting in increased to the pseudo stem length. The results of this study are agreements with the Suttar (2009), Gupta (2005) in garlic crop.

Effect of INM on yield and yielding attributes:

Diameter of bulb The maximum diameter of bulb was recorded under treatment T_6 (44.39 mm) followed by T_7 (44.25 mm) and minimum diameter of bulb was recorded in T_1 (38.76 mm) in Table 2.The integrated nutrient management significantly higher diameter of bulb recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum diameter of bulb at harvesting time was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50 % RDF + 50% PSB @ 1 kg/ha) respectively, while minimum diameter of bulb was recorded under the control treatment. The probable reason for maximum diameter of bulb is may be due to the application of vermi-compost which enhanced the activity of some microbial population. Vermi-compost along with RDF resulting in increase to the diameter of bulb. The results of this study are agreements with the Singer *et al.* (1998) and Lal*et al.* (2002), in garlic crop.

Thickness of neck: The data showed that the maximum thickness of neck was recorded under treatment T_6 (8.17 mm) followed by T_7 (8.16 mm) and minimum thickness of neck was recorded in T_1 (5.85 mm).The integrated nutrient management significantly increased the thickness of neck recorded in the treatment RDF along with the vermi-compost application. It is clearly indicates that maximum thickness of neck at harveting was found with the treatment T_6 (50% RDF + 50% Vermi-compost

@ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha.) respectively, while minimum thickness of neck was recorded under the control treatment. The reason for maximum thickness of neck due to the vermi-compost application, there was an increase in thickness of neck, application of vermi-compost with RDF nutrient resulting in increased to the neck thickness. The results of this study are agreements with the Suttar (2009) and Gowda*et al*. (2007) in garlic crop.

Weight of bulb: The maximum weight of bulb was recorded under treatment T_6 (31.70 g) followed by T_7 (31.60 g) and minimum weight of bulb was recorded in T_1 (25.83 g). The integrated nutrient management significantly higher weight of bulb recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum weight of bulb at harvesting time was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum weight of bulb was recorded under the control treatment. The probable reason for maximum weight of bulb is may be due to the application of vermi-compost which enhance the biochemical potential of soil and consequently effect the plant population. The results of this study are agreements with the Suttar (2009), Reddy and Reddy (2005) and Lal*et al.* (2002) in garlic crops.

Number of bulb per kg: The minimum number of bulb/ kg was recorded under treatment T_6 (31.70) followed by T_7 (31.60) and maximum number of bulb was recorded in T_1 (38.73). The integrated nutrient management significantly increase size of bulb recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that minimum number of bulb at harvesting time was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while maximum number of bulb was recorded under the control treatment. The reason for minimum number of bulb the application of vermi-compost along with RDF which is increase the size of bulb. The results of this study are agreements with the Lal*et al*., (2002) and Suttar (2009) in garlic crops.

Number of cloves per bulb: The data showed that the maximum number of cloves per bulb was recorded under treatment T_6 (29.50) followed by T_7 (29.43) and minimum number of cloves per bulb was recorded in T_1 (22.76).The integrated nutrient management significantly higher number of cloves recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum number of cloves at harvesting time was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum number of cloves was recorded under the control treatment. The probable reason for maximum number of cloves is may be due to the application of vermi-compost which enhance the biochemical potential of soil and consequently effect the plant population. The results of this study are agreements with the Suttar (2009) in garlic crops.

Length of cloves The data showed that the maximum length of cloves was recorded under treatment T_6 (4.92 cm) followed by T_7 (4.82 cm) and minimum length of cloves was recorded in T_1 (3.22 cm). The integrated nutrient management significantly increase length of cloves recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum length of cloves at harvesting was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum length of cloves was recorded under the control treatment. The reason for maximum length of cloves due to the higher concentration of soil enzymes, soil organic matter and soil for rapid mineralization and transformation of plant nutrients in soil, application of vermi-compost, NPK nutrient resulting in increased to the length of cloves. The result of this study are agreements with the Stewart *et al*. (2005), Sharma *et al*. (2013), Umrao*et al*. (2013) in garlic crop.

Yield (q/ha) : The data showed that the maximum yield was recorded under treatment T_6 (80.53 q/ha) followed by T_7 (79.28 q/ha) and minimum yield was recorded in T_1 (68.00 q/ha).The integrated nutrient management significantly increase yield recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum yield at harvesting was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha.) respectively, while minimum yield was recorded under the control treatment. The reason for maximum yield due to the higher concentration of soil enzymes, application of vermi-compost along with RDF balance nutrient supply to the plant. The result of this study are agreements with the Ghawade*et al.* (2011), Stewart *et al.* (2005), Gowda*et al*. (2007) and Sharma *et al* (2013) in garlic crop.

Total Soluble Solids: The data showed that the maximum total soluble solids was recorded under treatment T_6 (40.06 ^{o}Brix) followed by T_7 (40.03 ^{o}Brix) and minimum total soluble solids was recorded in T_1 (35.00 ^{o}Brix).The integrated nutrient management significantly increase TSS recorded in the treatment RDF along with the vermi-compost application was given. It is clearly indicates that maximum TSS was found with the treatment T_6 (50% RDF + 50% Vermi-compost @ 3 t/ha) followed by T_7 (50% RDF + 50% FYM @ 12 tones/ha) and T_8 (50% RDF + 50% PSB @ 1 kg/ha) respectively, while minimum TSS was recorded under the control treatment. The reason for maximum TSS due to the higher concentration of soil enzymes, soil organic matter and soil for rapid mineralization and transformation of plant nutrients in soil, application of vermi-compost, NPK nutrient resulting in increased to the TSS. The result of this study are agreements with the Mandloi*et al*., (2008) and Jamir*et al*., (2013) in garlic crop.

Conclusion: On the basis of experiment the application of (50% RDF + 50% vermi-compost @ 3 t/ha.) under the treatment T_6 has obtained better response of garlic over the all other treatment combinations. Hence, it is recommended as package of practices for higher production in Lucknow conditions.

Table 1: Impact of integrated nutrient management on growth parameters of garlic

Treatment	Plant height (cm)			Number of leaves per plant			Length of leaves (cm)			Diameter of stem (mm)			Length of pseudo stem (cm)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Absolute control (no manures & fertilizers).	24.63	33.83	59.93	4.76	5.10	5.95	22.50	32.25	41.96	4.20	5.65	9.57	2.61	3.48	4.21
RDF 100%.	27.00	35.53	61.36	5.44	5.51	6.86	25.00	33.76	44.23	5.08	5.78	10.78	2.86	4.04	4.51
100% Farm yard manure @ 24 t/ha.	26.83	36.70	64.80	5.44	5.95	6.89	25.20	33.23	43.36	5.16	5.81	10.96	2.76	3.68	4.43
100% Vermi-compost @ 6 t/ha.	26.93	37.36	66.80	5.57	5.86	6.71	25.23	34.76	44.06	4.59	5.95	11.65	2.92	3.85	4.78
100% PSB @ 2 kg/ha.	26.83	37.10	64.73	5.37	5.96	6.88	24.80	34.83	44.26	5.00	5.93	10.69	3.00	3.81	4.83
50% RDF + 50% Vermi-compost @ 3 t/ha.	30.20	38.60	69.40	5.71	6.06	7.04	26.96	37.03	47.53	5.79	6.21	12.08	3.36	4.43	5.25
50% RDF + 50% FYM @ 12 t/ha.	30.10	38.43	69.36	5.69	6.03	7.02	26.96	36.40	47.06	5.69	6.04	12.08	3.23	4.38	5.19
50% RDF + 50% PSB @ 1 kg/ha.	29.83	38.33	69.03	5.59	6.00	6.98	26.56	36.33	47.03	5.20	5.99	11.86	3.22	4.27	5.03
50% vermi-compost @ 3 t/ha + 50% FYM @ 12 t/ha.	29.50	36.56	66.40	5.49	5.96	6.75	25.83	36.10	44.93	4.97	5.94	11.05	2.99	4.00	4.91
50% Vermi-compost @ 3 t/ha + 50% PSB @ 1 kg/ha.	28.43	37.03	65.23	5.40	5.72	6.77	26.50	36.06	45.06	4.99	5.93	11.01	3.06	4.00	4.39
50% PSB @ 1 kg/ha + 50% FYM @ 12 t/ha.	28.50	36.43	67.36	5.58	5.91	6.87	26.43	36.23	45.73	4.98	5.95	11.16	2.88	3.80	4.68
25% RDF+ 25% PSB @ 0.5 kg/ ha + 25% vermi-compost @ 1.5 t/ha + 25% FYM @ 6 t/ha.	28.80	38.00	67.96	5.15	5.85	6.95	26.03	35.96	45.13	4.76	5.85	11.04	3.03	3.92	4.51
S.E.m (±)	0.495	0.483	0.775	0.113	0.077	0.041	0.568	0.557	0.523	0.042	0.036	0.245	0.040	0.045	0.028
C.D. (5%)	1.462	1.424	2.288	0.334	0.227	0.121	1.676	1.645	1.543	0.125	0.107	0.723	0.119	0.133	0.083

Table 2: Impact of integrated nutrient management on yield and yield attributing traits of garlic

Treatment	diameter of bulb (mm)	Thickness of neck (mm)	Weight of bulb (g)	Number of bulb per kg	Number of cloves per bulb	Length of cloves (cm)	Yield (q/ha)	TSS (^{o}Brix)
Absolute control (no manures & fertilizers).	38.76	5.85	25.83	38.73	22.76	3.22	68.00	35.00
RDF 100%.	40.61	6.98	27.93	35.81	24.91	3.63	70.88	35.90
100% Farm yard manure @ 24 t/ha.	40.41	6.46	27.90	35.84	25.30	3.57	73.25	35.46
100% Vermi-compost @ 6 t/ha.	40.05	6.93	28.50	35.09	25.10	4.05	73.20	36.06
100% PSB @ 2 kg/ha.	40.51	7.40	27.96	35.76	25.66	3.75	74.38	35.96
50% RDF + 50% Vermi-compost @ 3 t/ha.	44.39	8.17	31.70	31.55	29.50	4.92	80.18	40.06
50% RDF + 50% FYM @ 12 t/ha.	44.25	8.16	31.60	31.65	29.43	4.82	79.28	40.03
50% RDF + 50% PSB @ 1 kg/ha.	44.19	8.06	30.80	32.42	28.30	4.61	78.53	39.66
50% vermi-compost @ 3 t/ha + 50% FYM @ 12 t/ha.	41.11	7.79	29.53	33.88	27.20	4.09	76.41	38.66
50% Vermi-compost @ 3 t/ha + 50% PSB @ 1 kg/ha.	40.58	6.86	28.16	35.51	27.06	3.79	77.56	39.00
50% PSB @ 1 kg/ha + 50% FYM @ 12 t/ha.	41.77	6.90	30.13	33.19	27.46	4.23	74.76	37.36
25% RDF+ 25% PSB @ 0.5 kg/ ha + 25% vermi-compost @ 1.5 t/ha + 25% FYM @ 6 t/ha.	41.47	7.06	29.76	32.47	27.16	4.44	75.76	38.90
S.E.m (±)	0.510	0.239	0.484	0.476	0.265	0.063	0.503	0.076

References

1. **Annonymous 2015.** State wise area, production and productivity data for garlic www.nhrdf.com.
2. **Ghawade S.M. Patil, M.J. Kolhe, P.P. and Gawande P.P. 2011.** Influence of planting dates, bio-fertilizers, organic manures on yield and economical returns in garlic. *Annals of Plant Physiology*. 25(2):156-160.
3. **Gowda M.C., Vijayakumar M. and Gowda A.P.M., 2007.** Influence of integrated nutrient management on growth, yield and quality of garlic (*Allium sativum*L.) cv. G-282. Crop Res. Hisar. 33(1/3):144-147.
4. **Greenland D.J. 1975.** The magnitude and importance of problem, pp 3-7 In: *John Wiley and sons*, NY USA.
5. **Gupta P.K. 2005**. Vermi-composting for Sustainable Agric. *Agrobios* (India), Jodhpur, pp. 210.
6. **Jamir S., Singh V.B., Kanaujia, S.P. and Singh, A.K., (2013)** Effect of integrated nutrient management on growth, yield and quality of onion (*Allium cepa* L.) *Progressive Horticulture.* 45 (2):45.
7. **Kumar A., Kumar S., Kumar A. and Singh K.V., 2013,** Response of different organic and inorganic fertilizers on growth and yield of garlic (*Allium sativum*L.). *Haryana J. of Agron.* 29 (1/2):77-79.
8. **Lal S., Yadav A.C. Mangal, J.L. Singh, A. and Batra, V.K. 2002.** Effects of FYM and irrigation levels on growth and yield of onion cv. Hisar-2. *Haryana J. Hort. Sci.* 31 **(**3-4):256-258.
9. **Mandoli K.S., Bose U.S. and Deshmukh K.S., 2008.** Effect of organic manures and inorganic fertilizers on growth and yield of onion (*Allium cepa* L.). *Asian journal of Horticulture.* 3 (2): 238-240.
10. **Panse, V.G. and Sukhatme, P.V. Indian Council of Agricultural Research, New Delhi. 1978, 381**
11. **Reddy K.C. and Reddy K.M. 2005**. Differential levels of vermicompost and nitrogen on growth and yield in onion (*Allium cepa*L.) – radish (*Raphanussativus*L.) cropping system. J. Res. ANGRAU. 33 (**1**): 11- 17.
12. **Sharma A., Das J.C. and Rajkhowa D.J. 2013.** Productivity and profitability of garlic (*Allium sativum*L.) under different levels of drip irrigation and nutrient management. *Advances in Plant Sci*. 26 (2):499-503.
13. **Singer S.M., Sawan O.M., Abdel-Mouly M.M. and Salman S.R. 1998.** Study of the effects of Delta mix TM and organic matter on growth and productivity of bean plants grown under calcareous soil condition. *Egypt. J. Hort.,* 25 (3): 335-347.
14. **Stewart M.W., Dibb W.D., Johnston E.A. and Smyth J.T. 2005.** The Contribution of Commercial Fertilizer Nutrients to Food Production. Agron. J. 97: 1-6.
15. **Suthar S. 2009**. Impact of vermicompost and composted farmyard manure on growth and yield of garlic (Allium sativum L.) field crop. *International J.of Plant Prod*. 3 (1):27-38.
16. **Umrao R., Meyase S., Khare N. and Anand R.K. 2013.** Effect of organic fertilizers on the growth and yield of garlic (*Allium sativum*) under teak (Tectonagrandis) based agroforestry system. *Trends in Bioscis.* 6 (6):815-817.