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Effect of organic and inorganic sources of nitrogen on growth and yield of garlic *(Allium sativum* L.) var. GG-4

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Abstract
A field experiment was conducted at Regional Horticultural Research Station, Navsari Agricultural University, Navsari (Gujarat) during *rabi* season of 2015-16 for evaluating the effect of organic and inorganic sources of nitrogen on growth and yield of garlic (*Allium sativum* L.) var. GG-4 by using Randomized Block Design with three replications and 9 treatments comprising of 25%, 50%, 75% and 100% RDN through farm yard manure (FYM) and vermicompost (VC) as well as 25%, 50%, 75% of nitrogen through urea including 100 % RDF as a control. Results revealed that the application of different sources of organic and inorganic nitrogen, found significantly maximum in growth attributes *viz.*, plant height (45.73 cm at 60 DAS and 61.80 cm at 90 DAS), number of leaves per plant (11.96 at 90 DAS) with earliest in maturity (127.15 days) by the application of 100% RDN through FYM. However, the bulb characters like fresh (24.46g) and dry weight of bulb (20.46g), diameter of bulb (39.15mm), no. of cloves per bulb (19.57), clove length (3.51cm), clove weight (2.10g) and yield (4.06 kg/plot and 8.16 t/ha) with maximum storage days (164.00 days) and minimum sprouting (6.66 %) was significantly influenced by the application of 100% RDN through vermicompost in garlic cv. GG-4.

Keywords: FYM, Garlic (*Allium sativum*), Growth, Inorganic, Nitrogen and Organic

Introduction
Garlic (*Allium sativum* L.) commonly termed as "*Lahsun*", is one of the most important spices as well as bulb crop grown throughout in India because it's higher nutritive value as compared to the other bulbous crops. It is grown all over India on an area of 2.48 lakh hectares with total production of 12.59 lakh metric tons and having productivity of 5.1 MT/ha. In Gujarat, it occupies an area of 39.20 thousand hectares with total production 277.46 thousand MT. The productivity of garlic in Gujarat is 7.07 tons per ha (Anon., 2014) [2]. Particularly in Gujarat, it is cultivated predominantly at Bhavnagar, Junagadh, Rajkot, Jamnagar and Amreli districts. However, it is grown on small scale in South Gujarat region. Garlic cultivation has assured interest among the farmers of Gujarat and other parts of the country because of its steadily increasing demand in the market at an attractive rate. Increase in demand of garlic obviated the necessity to increase its production, for which maximization of the bulb yield per unit area is rather a more desirable proposition than increasing the area under cultivation. At present, adoption of non scientific and mono cropping cultivation techniques of paddy, sugarcane and other horticultural crop required excessive amount of fertilizer and irrigation which have resulted into twin problem of water logging and secondary salinization which leads to drastic reduction in yield of crops under South Gujarat condition (Anon., 2003) [1]. Under this situation, garlic being a more remunerative crop requires less irrigation water (45 to 50%) as compared to summer paddy and sugarcane can fit in prevailing multi-cropping system in South Gujarat. So, there is a need to conduct the research on garlic by using different organic and inorganic sources of nutrients such as farm yard manure, vermicompost, urea *etc.* under South Gujarat condition.

Material and methods
A field experiment was conducted at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during *rabi* season of 2015-16 for evaluating the effect of organic and inorganic sources of nitrogen on growth, yield and quality of garlic (*Allium sativum* L.) var. GG-4.

The soil of the experimental plot is clay in texture, lower in available nitrogen, high in available phosphorus, fairly rich in potassium. The experiment was laid out in a Randomized Block Design with three replications and 9 treatments comprising of 25% RDN through FYM + 75% RDN through urea (T_1), 50% RDN through FYM + 50% RDN through urea (T_2), 75% RDN through FYM + 25% RDN through urea (T_3), 100% RDN through FYM (T_4), 25% RDN through VC+ 75% RDN through urea (T_5), 50% RDN through VC + 50% RDN through urea (T_6), 75% RDN through VC+ 25% RDN through urea (T_7),100% RDN through VC (T_8) and control (T_9). The experimental field was thoroughly prepared by ploughing and harrowing before sowing of garlic cloves and the RDF apply required quantity of FYM @ 20 t/ha as well as inorganic fertilizers (60-60-60 kg NPK/ha). The required quantity of clove @ 500 kg/ha for experimental area was worked out and sowing of cloves at 20x15 cm was carried out in the first week of December-2015. The nitrogen was applied as per the treatment at split dose whereas P and K were applied as a basal dose. For recording different observations like growth, yield and quality, ten plants of garlic, from each net plot area were selected randomly in the beginning and tagged with the labels whereas, the quality parameters was taken and recorded after six month of harvesting of bulbs from each treatment.

Results and discussion

Effect on growth parameters: An application of organic and inorganic sources of nitrogen gave significant results in term of growth attributes of garlic (Table-1). The maximum plant height was noticed in T_4 (25.73 cm) at 30 days after sowing was found to be non-significant due to application of different source of organic and inorganic nitrogen. However, the plant height at 60 days after sowing was found to be a significant difference among treatments, the maximum height was reported in T_4 (45.73 cm) whereas, minimum plant height was noticed in T_9 (31.53 cm). Similarly maximum plant height (61.80 cm) at 90 DAS was reported in same treatment. The statistical analysis revealed that the maximum number of leaves at 30 DAS (3.95 cm) and 60 DAS (7.11 cm) showed the non-significant difference but there was a significant difference at 90 DAS (11.96 cm) when the plants are treated with 100% RDN through FYM (T_4) among the rest of treatments. Data projected on different treatment revealed that there was significant influence of different nitrogenous fertilizers and manures on the days to maturity of garlic bulb. It was noticed that T_4 (100% RDN through FYM) was took the minimum days (127.15 days) for maturity of garlic bulbs. Whereas, T_9 (control) was noticed to be late matured treatment (136.12 days). The significant effect was found due to the application of FYM and it is a well known fact that the plants require number of macro and micro elements for their normal and healthy growth which were subsequently supplied by FYM (Mohd *et al.*, 2011) [8]. The slow decomposition of FYM gradually releases the nutrients to the plants which enhanced the growth and development in garlic. Organic manures activate many species of living organisms which release phytohormones and may stimulate the plant growth and absorption of nutrients and such organisms need nitrogen for multiplication. By this, it can be stated that the organic manure has a significant role in the growth and development of garlic crop (Yoldas *et al.*, 2011) [16]. The early maturity of bulb might be due to the hormones and organic acid secreted by organic manures during decomposition might have lead to early maturity. Inadequate availability of nutrients resulted into more time to complete the vegetative growth in control. The results obtained in the present investigations confirm with the earlier findings of Seno *et al*. (1995) [14], Chattopadhyay *et al*. (2006) [4], Gowda *et al*. (2007) [5], Rohidas *et al*. (2011) [12] and Puttaraju *et al*. (2011) [11] who reported better growth of garlic and onion crops with the application of organic and inorganic sources of nitrogen.

Effect on bulb and yield parameters: All the important attributes related to bulb characteristics were significantly influenced by the application of different organic and inorganic sources of nitrogen (Table-2). The fresh weight of bulb was significantly influenced by different treatments, the maximum fresh weight of bulb (24.46 g) and dry or cured weight (20.46 g) of bulb, diameter of the bulb (39.15 mm), number of cloves per bulb (19.57), clove length (3.51 cm) and clove weight (2.10 g) was recorded in the T_4 *i. e.* 100% RDN through FYM. This might be due to gradual and steady release of nutrient during the growth period as well as enhanced biological activity and proper nutrition to the crop (Patil *et al*., 2007 and Nainwal *et al*., 2015) [10, 9]. On the contrarily, the maximum bulb yield (4.06 kg/plot and 8.13 t/ha) was recorded in 100% RDN through FYM (T_4). The application of FYM enhanced the production of biometric observations as well as bulb characters in garlic were significantly influenced by the combined use of inorganic chemical fertilizers with organic sources of nutrients. In case of bulb yield treatment applied with FYM showed the highest yield because of the reason that major nutrient supplied by inorganic fertilizers will be utilized quickly and showed a good plant growth and other essential nutrients available in organic substances will be released slowly which enhanced the yield in garlic. Similar result was found in onion by Banjare *et al.* (2015) [3]. Moreover, FYM contains a good range of some very essential micronutrient other than NPK fertilizers required for healthy plant growth. The prolified growth and production in FYM treated plots could be due to the presence of certain phytoharmone, produced by microorganisms in worm worked materials. The higher concentration of soil enzymes, soil organic matter and soil microorganisms in worm casts creates suitable microclimatic conditions in soils for rapid mineralization and transformation of plant nutrients in soil (Suthar, 2009) [15]. In case of storage days, the treatment T_8 (100% RDN through VC) which showed the maximum days (164 days) of storage at room temperature followed by T_5 (156.66 days) while, minimum storage days (135.66 days) was noticed with 75% RDN through FYM + 25% RDN through urea (T_3). Moreover, the maximum sprouting (21.33%) was observed in T_1 (25% RDN through FYM + 75% RDN through urea) whereas, minimum sprouting (6.66%) was observed in the T_8 (100% RDN through VC) followed by T_5 (8.66%). The reason for maximum storage with minimum sprouting may be due to the less sprouting percentage and treatment showed maximum storage days as the cloves had maximum amount of total soluble solids and ascorbic acid content. Similar findings were also found in onion and turmeric by Rohidas *et al.* (2011) [12], Meena *et al.* (2015) [7], Sarma *et al*. (2015) [13] and Kumara *et al*. (2014) [6].

Table 1: Effect of organic and inorganic sources of nitrogen on growth attributes of garlic var. GG-4

Treatments	Plant height (cm)			Number of leaves			Days to maturity
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
T_1 : 25% RDN Through FYM + 75% RDN through Urea	23.50	33.66	56.61	2.83	6.33	9.18	128.90
T_2 : 50% RDN Through FYM + 50% RDN through Urea	24.30	41.00	53.73	3.36	6.68	10.76	129.99
T_3 : 75% RDN Through FYM + 25% RDN through Urea	25.30	40.00	58.66	3.44	6.86	11.33	131.42
T_4 : 100% RDN Through FYM	25.73	45.73	61.80	3.95	7.11	11.96	127.15
T_5 : 25% RDN Through VC+ 75% RDN through Urea	24.00	33.56	54.50	3.17	6.56	9.14	127.16
T_6 : 50% RDN Through VC + 50% RDN through Urea	24.80	37.56	47.33	3.41	6.73	11.16	128.21
T_7 : 75% RDN Through VC+ 25% RDN through Urea	25.53	43.23	52.03	3.53	6.95	10.63	130.80
T_8 : 100% RDN Through VC	25.40	39.03	49.20	3.47	6.92	11.56	131.68
T_9 : 100% RDF Control	23.33	31.53	46.96	2.80	6.20	8.90	136.32
S.Em. ±	0.58	1.81	2.46	0.06	0.06	0.51	1.09
C.D. at 5%	NS	5.46	7.43	NS	NS	1.54	3.29
C.V.%	4.10	8.19	8.07	3.08	1.72	8.44	1.45

Table 2: Effect of organic and inorganic sources of nitrogen on bulb, yield and quality attributes of garlic var. GG-4

Treatments	Fresh weight (g)	Dry (cured) weight (g)	Diameter of bulb (mm)	Number of cloves per bulb	Clove length (cm)	Clove weight (g)	Yield (kg/plot)	Yield (t/ha)	Storage days	Sprouting (%)
T_1 : 25% RDN Through FYM + 75% RDN through Urea	18.92	14.56	31.46	16.00	2.91	1.55	3.40	6.80	137.00	21.33
T_2 : 50% RDN Through FYM + 50% RDN through Urea	20.07	16.36	34.73	15.61	3.08	1.58	3.03	6.07	144.33	13.00
T_3 : 75% RDN Through FYM + 25% RDN through Urea	23.83	19.71	37.94	15.86	3.37	1.61	3.43	6.87	135.66	18.00
T_4 : 100% RDN Through FYM	24.46	20.46	39.15	19.57	3.51	2.10	4.06	8.13	146.00	16.33
T_5 : 25% RDN Through VC+ 75% RDN through Urea	18.51	14.11	30.99	14.48	2.72	1.52	3.06	6.13	156.66	8.66
T_6 : 50% RDN Through VC + 50% RDN through Urea	19.37	15.49	32.26	17.41	2.71	1.57	2.96	6.00	155.66	10.66
T_7 : 75% RDN Through VC+ 25% RDN through Urea	21.07	17.26	37.01	17.88	3.11	1.59	3.24	6.47	146.33	14.66
T_8 : 100% RDN Through VC	22.78	18.19	37.13	16.52	3.21	2.03	3.80	7.60	164.00	6.66
T_9 : 100% RDF Control	17.16	13.39	29.96	14.04	2.47	1.41	3.00	5.93	142.66	20.66
S.Em. +	0.10	0.85	1.71	0.78	0.15	0.12	0.22	0.45	1.63	0.98
C.D. at 5%	3.00	2.57	5.16	2.35	0.46	0.36	0.68	1.37	4.91	2.96
C.V.%	8.36	8.91	8.60	8.26	8.72	12.57	11.77	11.78	1.91	11.82

Conclusion

Due to low production of garlic in South Gujarat an attempt was made to increase the production by supplementing recommended dose of NPK with organic and inorganic nitrogen fertilizers. In the present study application of organic and inorganic nitrogen fertilizers enhanced the growth, yield and quality parameters. Based on the result it can be concluded that 100% RDN through FYM significantly proved as a better treatment for growth and yield parameters.

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