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Nisha Nitharwal
M.Sc. Scholar, SGVU, Jaipur, Rajasthan, India

DC Meenaand
Assistant Professor, Department of Horticulture, SGVU, Jaipur, Rajasthan, India

Ritu Nitharwal
Ph.D. Department of Fruit Science, CH&F, Jhalawar, Rajasthan, India

Meenu Narnolia
Ph.D. Department of Fruit Science, CH&F, Jhalawar, Rajasthan, India

Rahul Kumar Choudhary
Ph.D. Department of Fruit Science, CH&F, Jhalawar, Rajasthan, India

Savita Choudhary
Ph.D. Department of Fruit Science, CH&F, Jhalawar, Rajasthan, India

Corresponding Author:
Nisha Nitharwal
M.Sc. Scholar, SGVU, Jaipur, Rajasthan, India

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

Nisha Nitharwal, DC Meenaand, Ritu Nitharwal, Meenu Narnolia, Rahul Kumar Choudhary and Savita Choudhary

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Abstract
The present investigation aimed to find out the "Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Garlic (*Allium sativum* L.)." was conducted at Agricultural Research Farm, Suresh Gyan Vihar University, Mahal, Jagatpura, Jaipur (Rajasthan) during the *rabi* season 2023-24. The experiment was laid out in Randomized Block Design. Replicated thrice with 12 treatment combinations, comprising T_1 - Control, T_2 -RDF (100%) (100: 50: 50), T_3-FYM- (100%) – 30 t per ha, T_4 -Vermicompost - 8 t per ha, T_5 -Neem cake – 4 q per ha, T_6 -25% RDF + 75% FYM, T_7 -25% RDF +75% Vermicompost, T_8 -25% RDF + 75%, Neem cake, T_9 -50% RDF + 50% FYM, T_{10} -50% RDF + 50% Vermicompost, T_{11} - 50% RDF + 50% Neem Cake, T_{12} -25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake. The application of organic and inorganic fertilizer was found most effective improve growth yield and quality parameter like maximum plant height (29.85 and 63.67 cm), number leaves plant^{-1} (5.18 and 11.22), length of longest leaf (33.83 and 58.35 cm), number of cloves per bulb (17.08), weight of individual clove (1.22g), maximum bulb yield (3.47 kg/ plot), maximum bulb yield (t/ha) of garlic (115.60 q/ ha), maximum titratable acidity (0.89%), TSS content of bulb (40.36 ^{0}Brix) and maximum dry matter content of bulb (44.68%) were recorded under the treatment T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake).

Keywords: Organic inorganic, fertilizer, garlic

Introduction
Garlic (*Allium sativum* L.) belongs to the family Alliaceae. It is the second most important bulb crop in India after onion. It is an important vegetable crop of India since ancient times. It is originated in Central Asia and used as a vegetable as well as for medicinal purposes. It is the most nutritious crop among the bulbous crops. It is also used as spices and condiments with high nutritive and medicinal value. It contains high amount of carbohydrates (29%), proteins (6.3%), minerals (0.3%) and essential oils (0.1-0.4%) and contains appreciable quantities of fat, vitamins C and sulphur (Memane *et al*., 2008) [8]. In garlic greens, ascorbic content is very high than in dried cloves. It has antiviral, antibacterial, antifungal and antiprotozoal properties. It is beneficial to the cardiovascular and immune system due to its antioxidant and anti-cancerous properties. It is described as a hot stimulant, carminative and ant rheumatic and its oil is a powerful antiseptic mainly due to the presence of allicin an important organo-sulfur compound. It is used as a vermifuge for expelling round worms and has been recommended for cure of several ailments *viz*., wounds, ulcers, pneumonia, bronchitis and gastro-intestinal disorders (Hazra *et al*., 2011) [6].

Organic fertilizers showed a positive effect on fruit quality and also on soil microbial population resulting in enhanced soil biomass, carbon and nitrogen contents, and dehydrogenase activity (Xu, *et al*., 2003) [14]. In garlic *Rhizobium* + *Phosphotika* (PSB) 20 g per kg seed or FYM 5t per ha or poultry manure 5t/ha significantly produced higher number of cloves per bulb than the control and the yield was improve organic, respectively over the control this might be owing to that organic manure besides supplying additional of nutrients also improves the physical properties of soil Bhattarai *et al*. (2003) [4]. Maximum yield of garlic and benefit: cost ratio with the application of FYM + dense organic matter (oil seed cake, rock phosphate and wood ash)

was observed by Singh (2004) [11]. The influence of integrated nutrient management in garlic cv.-282, the application of 100% NPK +biofertilizer + vermicompost recorded significantly higher plant height, more number of leaves, maximum girth of plant and maximum bulb yield. (Gowda, *et al*., 2007) [5]. The impact of vermicompost and composted farmyard manure (FYM) along with some combination of NPK fertilizers on garlic was investigated. This study suggests that vermicompost manures may be a potential source of plant nutrient for suitable production of garlic. (Suthar, 2009) [12].

Materials and Methods

The experiment was conducted at the Agricultural Research Farm, Suresh Gyan Vihar University, Mahal, Jagatpura, Jaipur during Rabi season 2023-24 The carrot variety,, Ladwa‟‟ was used as experimental materials. The clove of this variety was collected from RARI Durgapura Jaipur. Design of Experiment Randomized Block Design (RBD), Spacing 15 cm x 10 cm, Total number plant per plots 200 and Seed rate (Clove) 3 q per ha.

Results and Discussion

Effect organic and inorganic fertilizers on growth attributes

Effect organic and inorganic fertilizers was found significantly influenced on all growth parameters. The data was presented in Table 1. The highest plant height (29.85 and 63.67 cm) were recorded at 30 and 90 DAP in T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake). However the shortest plant (18.01 and 47.51 cm) were found at 30 and 90 DAS respectively, in control (T_1). The significantly maximum number leaves plant^{-1} (5.18 and 11.22) were at 30 and 90 DAP, respectively recorded with T_{12} application of (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake). Significantly minimum (3.80 and 6.24) number leaves plant^{-1} was recorded in control. The length of longest leaf (33.83 and 58.35 cm) were recorded at 30 and 90DAP, respectively in T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake). While minimum length of leaf (22.25 and 48.65 cm) were observed at 30 and 90 DAP, in T_1 (control). The superiority of mixed application of vermicompost + FYM may be on account of the fact that it has the rich nutrient value with a lot of beneficial soil microorganisms and makes soil porous, friable and improve water infiltration and moisture retention Moreover vermicompost and FYM have got different nutrient contents, variation in decomposition of organic residues, C: N ratio and nutrient release pattern under the existing agro-climatic conditions. Similar results found with Acharya *et al*. (2018) [1], Aditya Kumar *et al*. (2018) [2], Sanjay Kumar *et al*. (2019) [10] and Badal *et al*. (2019) [3].

Effect organic and inorganic fertilizers on Yield and yield attributes

Effect of organic and inorganic fertilizers was found significantly influenced on all yield parameters. The data was presented in Table 2. The maximum bulb weight (17.34 g) was recorded with (T_{12}) application of 25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake. Significantly bulb weight minimum (6.78 g) was recorded in control. The significantly weight of individual clove (g) was recorded under 25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake (1.22 g) as compared to rest of all treatments and lowest weight of individual clove (g) in control (0.75 g), respectively. Significantly maximum (3.47 kg/ plot) bulb yield was recorded due to application of 25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake. Significantly minimum (1.36 kg/plot) was recorded in control. The maximum bulb yield (t/ha) of garlic (115.60 q/ ha) was obtained with T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake), while minimum bulb yield (t/ha) of garlic (45.51 q/ ha) in Control (T_1). The higher yield response due to combined use of RDF+ vermicompost and FYM may be due to improvement in the physical and biological properties of soil which resulted in better supply of plant nutrients and led to good crop growth and yield. According to Jatoliya, the improvement in bulb yield might be ascribed to better vegetative Impact of organic and inorganic fertilizers on garlic growth which has resulted in better interception, absorption and utilization of radiation energy, leaving to greater photosynthetic rate and translocation of photosynthates towards the productive organs (sink). These results are in accordance with the findings of Yadav *et al*. (2018) [15], Vikas Kumar *et al*. (2019) [7] and Sanjay Kumar *et al*. (2019) [10]. Other than fertilizer application

Effect organic and inorganic fertilizers on quality attributes

Effect of organic and inorganic fertilizers was found significantly influenced on all yield parameters. The data was presented in Table 3. The maximum titratable acidity (0.89%) was recorded under the treatment T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake. Whereas, the minimum titratable acidity (0.69%) was recorded under the treatment T_1 (control). The maximum TSS content of bulb (40.36 ^{0}Brix) was recorded under the treatment T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake). Whereas, the minimum TSS content of bulb (28.23 ^{0}Brix) was recorded under the treatment T_1 (control). The significantly maximum dry matter content of bulb (44.68%) was recorded under the treatment T_{12} (25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake), while the minimum dry matter content of bulb 29.36 per cent was recorded under the treatment T_1 (control). Increased supply of NPKS with dual organics might have increased multiple activities in plant and soil which in turn resulted in greater accumulation of carbohydrates, protein and their translocation to the reproductive organ. 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 titratable acidity TSS and dry matter content percent (Meena *et al*., 2018; Umaretiya *et al*., 2019; Kumar *et al*., 2019) [9, 13, 7].

Table: 1: Effect of Organic and Inorganic Fertilizers on growth of plant at 30 and 90 DAP of Garlic

Sr. No.	Treatments	Plant height (cm)		Number of leaves		Leaf length (cm)	
		30 DAP	90 DAP	30 DAP	90 DAP	30 DAP	90 DAP
T_1	Control	18.01	47.51	3.80	6.24	22.25	48.65
T_2	RDF (100%) (100: 50: 50)	22.35	57.34	4.30	8.63	24.95	50.26
T_3	FYM- (100%) – 30 t per ha	23.00	56.73	4.33	7.53	26.56	49.65
T_4	Vermicompost - 8 t per ha	20.87	55.29	4.24	8.57	27.65	50.75
T_5	Neem cake – 4 q per ha	25.02	56.99	4.50	6.83	27.44	52.65
T_6	25% RDF + 75% FYM	24.60	59.72	4.46	9.23	26.36	52.55
T_7	25% RDF +75% Vermicompost	22.13	55.66	4.40	8.40	27.11	51.86
T_8	25% RDF + 75%, Neem cake	26.20	58.29	4.36	8.17	28.24	53.65
T_9	50% RDF + 50% FYM	26.98	56.68	4.56	9.07	29.13	54.55
T^{10}	50% RDF + 50% Vermicompost	28.35	58.00	5.12	7.53	28.36	56.22
T^{11}	50% RDF + 50% Neem Cake	27.65	56.67	4.70	9.34	29.32	55.65
T^{12}	25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake	29.85	63.76	5.18	11.22	33.83	58.35
	S.Em ±	1.02	2.10	0.17	0.32	0.85	2.27
	CD @ 5%	2.98	6.17	0.50	0.94	2.49	4.70
	CV%	7.16	6.40	6.57	6.65	5.34	5.25

Table: 2: Effect of Organic and Inorganic Fertilizers on yield of Garlic

Sr. No.	Treatments	Bulb weight (g)	Weight of individual clove (g)	Bulb Yield (kg/plot)	Bulb Yield (q/ha)
T1	Control	6.78	0.75	1.36	45.21
T2	RDF (100%) (100: 50: 50)	11.36	0.86	2.27	75.76
T3	FYM- (100%) – 30 t per ha	11.61	0.89	2.32	77.39
T4	Vermicompost - 8 t per ha	12.23	0.93	2.45	81.55
T5	Neem cake – 4 q per ha	12.66	0.96	2.53	84.42
T6	25% RDF + 75% FYM	12.95	0.95	2.59	86.37
T7	25% RDF +75% Vermicompost	14.11	0.98	2.82	94.06
T8	25% RDF + 75%, Neem cake	14.81	1.02	2.96	98.74
T_9	50% RDF + 50% FYM	15.80	1.04	3.16	105.32
T_{10}	50% RDF + 50% Vermicompost	16.25	1.15	3.25	108.33
T_{11}	50% RDF + 50% Neem Cake	17.02	1.17	3.40	113.47
T_{12}	25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake	17.34	1.22	3.47	115.60
	S.Em ±	0.52	0.03	0.07	2.41
	CD @ 5%	1.54	0.09	0.20	7.08
	CV%	6.69	5.28	4.35	4.62

Table: 3: Effect of Organic and Inorganic Fertilizers on Titratable Acidity (%), TSS 0Brix and dry Matter (%) of Garlic

Sr. No.	Treatments	Titratable Acidity (%)	TSS 0Brix	Dry Matter (%)
T_1	Control	0.69	28.23	29.36
T_2	RDF (100%) (100: 50: 50)	0.72	32.50	31.62
T_3	FYM- (100%) – 30 t per ha	0.70	32.75	32.32
T_4	Vermicompost - 8 t per ha	0.76	34.25	35.04
T_5	Neem cake – 4 q per ha	0.75	34.20	33.65
T_6	25% RDF + 75% FYM	0.78	37.85	37.54
T_7	25% RDF +75% Vermicompost	0.82	36.96	39.65
T_8	25% RDF + 75%, Neem cake	0.81	35.87	35.69
T_9	50% RDF + 50% FYM	0.77	38.65	40.44
T_{10}	50% RDF + 50% Vermicompost	0.79	35.54	41.36
T_{11}	50% RDF + 50% Neem Cake	0.85	37.14	43.65
T_{12}	25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake	0.89	40.36	44.68
	S.Em ±	0.01	0.49	0.58
	CD @ 5%	0.04	1.43	1.69
	CV%	2.87	2.39	2.70

Conclusion

On the basis of results obtained in present investigation, it can be concluded that T_{12} 25% RDF + 25% FYM + 25% Vermicompost + 25% Neem Cake), produced highest growth parameters, Maximum total yield of bulbs was observed, Whereas, the minimum Growth attributes and yield attributes of Garlic were recorded with T_1 Control. The results showed that application of T_{12}. This treatment proved to be promising for the enhancement the yield of garlic.

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The authors declare that we do not have any funding source.

Conflict of Interest

The authors declare that there is no conflict of interest among all co-authors.

Ethical statement

This article does not contain any studies with human participants

or animals performed by any of the author

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