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EFFICACY OF INORGANIC FERTILIZERS AND ZERO BUDGET NATURAL FARMING (ZBNF) ON GROWTH PARAMETERS AND YIELD OF GARLIC (*ALLIUM SATIVUM*) CV. G-282

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ABSTRACT

The present investigation was carried out to evaluate the effect of basal and foliar application of various methods of nutrient management on growth, yield, and quality traits of garlic at the Horticultural Research Center of the Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (UP) 250110 in *Rabi* 2020-21. The experiment was laid out in Randomized Block Design with three replications and ten treatments *viz.*, T_1 Control (Without fertilization), T_2 R.D.F. (100:50:100 of N P K) Kg, T_3 (Vermicompost @ 2 ton/ha), T_4(F.Y.M @ 3 ton/ha), T_5(Jeevamrit @ 3% sprays every month), T_6(Jeevamrit @ 2% sprays every month), T_7(Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays), T_8(F.Y.M @ 3 ton/ha + Jeevamrit @ 3% sprays), T_9(Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) and T_{10}(F.Y.M. @ 3 ton/ha + Jeevamrit @ 2% sprays). The treatment T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) recorded longest leaf at 30, 60, 90 and 120 DAP) and maximum leaf width and similarly treatment T_7 number of clove per bulb (17.13), number of bulbils (8.17), weight of clove 1.72(gm), 100-clove weight 165.83 (gm), leaf dry content 13 (% dw), dry matter content of storage organ 24.83 (g/100g, fw), yield 10.27 (kg / plot wise) and total yield in 8.25 (ton / ha) in garlic.

Key words : Garlic, INM, Vermicompost, FYM, Jeevamrit.

Introduction

Garlic (*Allium sativum* L.) is a common bulbous crop that is commonly used as a spice or condiment. It is a member of the *Alliaceae* family and is known by a variety of local names across India. Lushun is the name given to it in India. Garlic contains a variety of therapeutic properties. It lowers blood cholesterol levels. In garlic, a combination of inorganic and organic forms of nutrient supply is preferred for better biometric observations, bulb characteristics, and marketable bulb production (Patil *et al*., 2007 and Kumar *et al*. (2019). Excessive use of chemical fertilizers led in a lack of nutrients other than those applied, as well as a decrease in soil organic carbon (Singh *et al*., 2001). Garlic production in India is just 4 tons per ha, which is far less than its potential. Low fertilizer application or none at all has been linked to low garlic production, mainly due to high fertilizer costs and farmers' lack of technical knowledge about fertilizer use and other suggested methods in vegetable production Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner ZBNF (Zero Budget Natural Farming) is a collection of farming methods as well as a grassroots peasant movement that has grown across India. It has had widespread popularity in southern India, particularly in the state of Karnataka, where it originated. ZBNF under used organic fertilizer like FYM

Vermicompost, Jeevamrit etc. Because more than half of the organic matter in dung is in the form of complex compounds, such as lignin and protein, which are resistant to further ecomposition, the nutrients found in dung are released slowly (Palekar, 2006).

Materials and Methods

Experimental site, design and soil properties

The experimental site was located at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut at 29.01^0 North latitude, 77.75^0 East longitudes and an altitude of 237 meter above mean sea level (MSL). The experiment was conducted during rabi season of 2019-20 in RBD with three replication .The experiment was comprised with 10 treatment $\mathbf{T_1}$ Control (Without fertilization), $\mathbf{T_2}$ R.D.F (100:50:100 of N P K), $\mathbf{T_3}$ Vermicompost @ 2 ton/ha, $\mathbf{T_4}$ F.Y.M @ 3 ton/ha, $\mathbf{T_5}$ Jeevamrit @ 3% sprays every month, $\mathbf{T_6}$ Jeevamrit @ 2% sprays every month, $\mathbf{T_7}$ Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays, $\mathbf{T_8}$ F.Y.M @ 3 ton/ha + Jeevamrit @ 3% sprays, $\mathbf{T_9}$ Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays and $\mathbf{T_{10}}$ F.Y.M @ 3 ton/ha + Jeevamrit @ 2% sprays combination with organic fertilizer. The soil in the experimental field had a sandy clay loam texture, was neutral in reactivity, and had a low N content, and a medium P, K and Zn content. The bulb of Garlic cv. G -282 procured from NHRDF, used as planting material.

Methodology

The leaf length and width were measured by Centimeter (cm) scale. The no. of clove per bulb and no. of bullies were counted manually and recorded. The data of weight of clove and 100 clove weights were measured by weighing machine. The leaf dry content % and Dry matter content of storage organ was calculated by the formula (LDC) = Dry leaf mass (mg) / Water saturated fresh mass (g). The yield (kg) plot basis was by measuring the economic yield by weighing machine.

Statistical analysis

Data collected during this study were subjected to ANOVA table. Statistical software OPSTAT used for the analysis, while the critical differences at 5% level of probability.

Results and Discussion

The vegetative characteristics of garlic are highly significant since they play a vital role in determining the final crop output. These characteristics changed considerably across the various treatments, and the results showed that considerable variance was detected among the treatments for all of the features investigated, as shown in Tables 1 and 2 and Figs. 1, 2, 3 and 4. According

Table 1 : Effect of Nutrients Management practices on Garlic at different stage of growth.

S. no.	Treatments	Leaf length (cm)				Leaf width(cm)			
		DAS				DAS			
		30	60	90	120	30	60	90	120
T_1	Control (Without fertilization)	7.82	20.67	33.77	35.70	0.31	0.99	1.39	1.51
T_2	R.D.F (100:50:100 of N P K) kg	10.17	25.72	38.67	42.37	0.37	1.23	1.58	1.75
T_3	Vermicompost @ 2 ton/ha	9.74	25.01	37.63	41.49	0.36	1.19	1.54	1.66
T_4	F.Y.M @ 3 ton/ha.	9.03	24.57	37.15	40.46	0.36	1.19	1.52	1.65
T_5	Jeevamrit @ 3% sprays every month	10.58	26.57	40.47	43.93	0.39	1.20	1.59	1.77
T_6	Jeevamrit @ 2% sprays every month	8.67	24.03	35.43	38.17	0.34	1.07	1.48	1.55
T_7	Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays	13.29	31.11	51.10	54.71	0.51	1.41	1.77	2.04
T_8	F.Y.M @ 3 ton/ha + Jeevamrit @ 3% sprays	12.47	29.71	47.29	49.98	0.45	1.32	1.73	1.94
T_9	Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays	12.17	28.52	44.72	48.07	0.43	1.29	1.65	1.87
T_{10}	F.Y.M @ 3 ton/ha + Jeevamrit @ 2% sprays	11.30	27.30	42.70	46.40	0.40	1.20	1.60	1.80
	S.E. ±	0.17	0.33	0.58	0.40	0.01	0.02	0.01	0.02
	CD@5%	0.51	0.99	1.74	1.18	0.02	0.05	0.03	0.06
	CV(%)	2.85	2.20	2.47	1.56	2.48	2.17	1.07	2.05

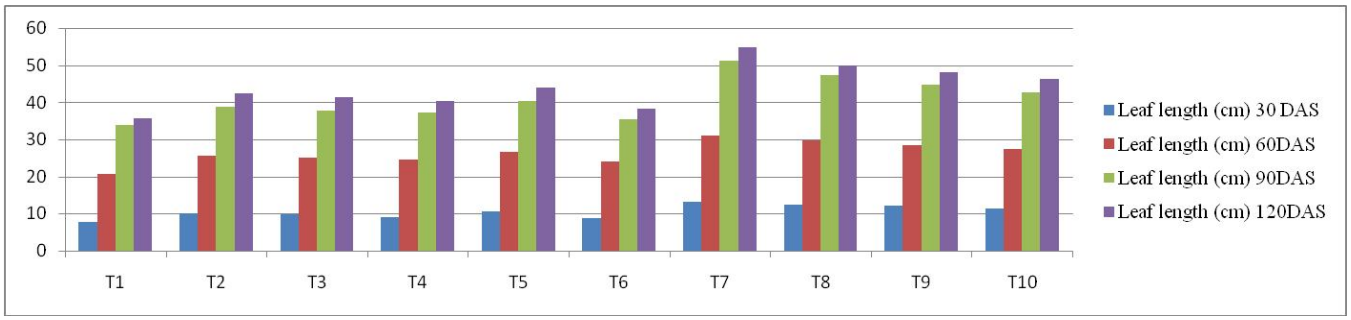

Fig. 1 : Effect of Nutrients Management practices on Garlic at different stage of growth.

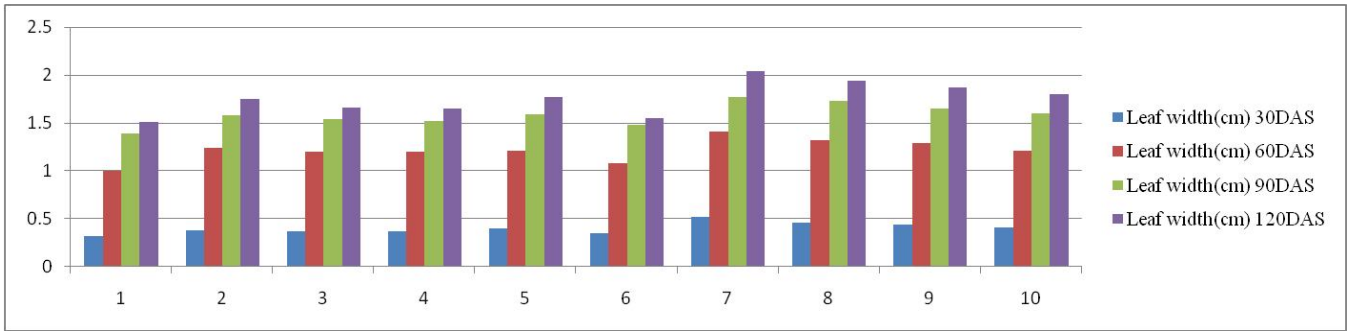

Fig. 2 : Effect of Nutrients Management practices on Garlic at different stage of growth.

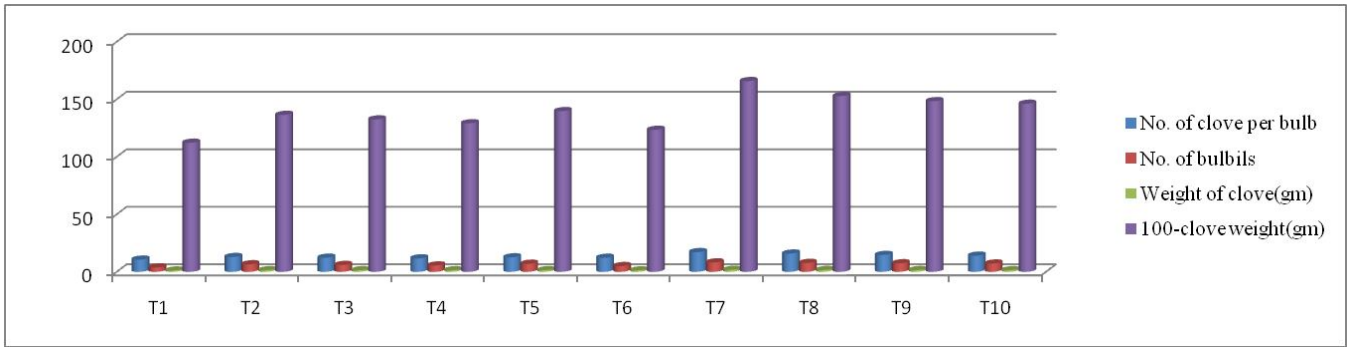

Fig. 3 : Effect of Nutrients Management practices on yield of Garlic.

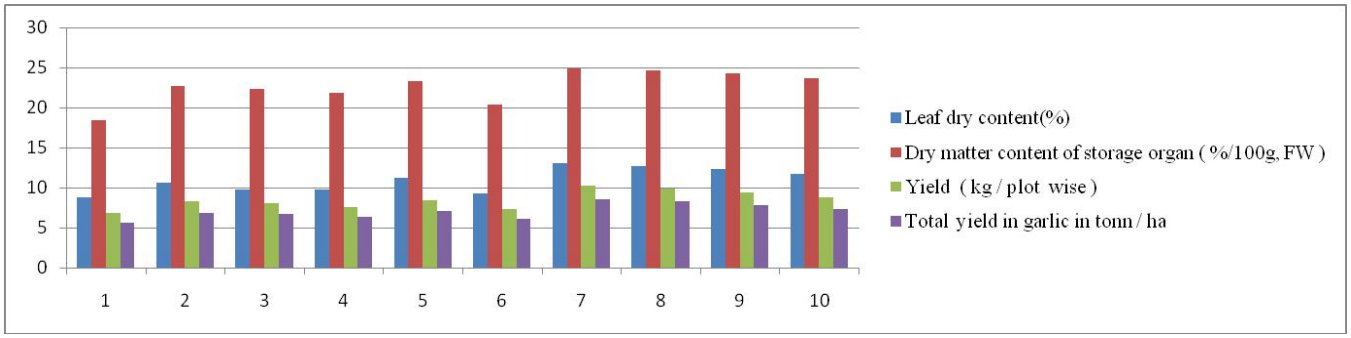

Fig. 4 : Effect of Nutrients Management practices on yield of Garlic.

to the findings of this study, treatment T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) performed well in terms of garlic growth and yield, with the exception of the T_1 control.

Leaf length (cm)

Different levels of organic and inorganic fertilizer used had a substantial influence on garlic leaf length (Table 1). Plants treated with both organic and inorganic fertilizer grew longer leaves than control plants. The maximum leaf length was recorded in plants treated with T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3 %sprays) at 30, 60, 90, and 120 DAS and recorded 13.29, 31.11, 51.10, and 54.71 (cm) of leaf length, followed by those treated with T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit@ 2% sprays). In untreated (control) plants, the minimum

leaf length (7.82 cm) was measured. The increase in Leaf length may be due to major nutrient supplied by the inorganic fertilizers will be utilized quickly by the crop and all other micro and macro nutrients available in organic manures will be released slowly and the increased root system of the plants might have resulted in an increased uptake of nutrients which were used in photosynthesis. Similar findings were reported by Mehla *et al.* (2006) and Hamma *et al.* (2013).

Leaf width (cm)

The amount of organic and inorganic fertilizer applied had a significant impact on garlic leaf width (Table 1). Plants given both organic and inorganic fertilizer grew wider leaves than control plants. Plants treated with Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays (T_7) had maximum leaf widths of 0.51, 1.41, 1.77 and 2.04 (cm) at 30, 60, 90, and 120 DAS, respectively, followed by those treated with FYM @ 3 ton/ha + Jeevamrit @ 3% sprays (T_8) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays). The greatest increase in leaf width was 63.82% at 30 to 60 days, followed by 20.33% at 60 to 90 days and 13.23% at 90 to 120 days. The minimum leaf width was measured in untreated (control) plants. It is observed that nitrogen is a necessary input for protein synthesis by the plant and many more physiological functions like photosynthesis, cell division and plant growth. Based on the current study, the application of vermicompost and FYM along with inorganic fertilizers provides excellent effect on overall plant growth and encourages the growth of new shoots / leaves and improves plant height. Mouna *et al.* (2013), Vipin *et al.* (2008) and Rizk Fatma *et al.* (2014) find similar findings in different crops.

Number of cloves per bulb

The results for the number of cloves per bulb showed that the application of organic and inorganic fertilizer had a significant impact on number of cloves per bulb (Table 2). Plants treated with combined treatments of Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays (T_7) had maximum more cloves per bulb (17.13), followed by those treated with FYM @ 3 ton/ha + Jeevamrit @ 3% sprays (T_8) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) than controls. However, the lowest number of cloves bulb-1 was seen in control plants, which was substantially different from all other treatments. An increase in the number of cloves per bulb when used inorganic fertilizer in combination with FYM, Vermicompost and Jeevamrit. Verma *et al*. (2013), Sahfeek *et al*. (2015), Singh *et al.* (1997) and Kuldeep *et al.* (2012) also observed similar findings.

Number of bulbils

Results regarding number of bulbils indicated that this parameter was significantly affected by the applied organic and inorganic fertilizer (Table 2). Plants applied with integrated treatments of Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays (T_7) had greater number of bulbils (8.17) followed by those treated with FYM @ 3 ton/ha + Jeevamrit @ 3% sprays (T_8) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 7.40 bulbous per plant as compared with control. However, the minimum number of bulbils was observed in control plants, which was significantly different from all other treatments applied. High rate of microbial transformations as a result of the availability of Jeevamrit, vermicompost, FYM, and chemical fertilizers. Increased fertility application may be linked to an improved nutritional environment in the root zone as well as in the plant system. Similar findings were reported by Damse *et al.* (2014) and Hamma *et al.* (2013).

Weight of clove

There was highly significant difference among the treatments in weight of clove. Maximum weight of clove (1.72 gm) was obtained from the combined application of Vermicompost @ 2 ton/ha + Jeevamrit @ 3 % sprays (T_7) followed by application T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) 1.57(gm) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 1.53 (gm) and the lowest weight of clove 1.13 (gm) was obtained from the control (T_2). In general, all plots that received either vermicompost or farmyard manure alone or in combination with inorganic nitrogen significantly increased the weight of clove. This might be due to more translocation of photosynthates from leaves to bulb causing increased bulb weight and diameter (Singh *et al*., 1997; Diriba *et al*., 2014). This was also due to solubilization effect of plant nutrients by the addition of vermicompost and FYM leading to increased uptake of NPK.

100-clove weight

The highest 100 clove weight was recorded by the application of T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) 165.83 (gm), which was increase over control treatment 47.76% followed by application T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) 152.83 (gm) and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 148.37(gm). The increased mean 100-clove weight due to the increase in organic fertilizer which is known to contain micronutrients apart from major nutrients. Verma *et al*. (2013) and Singh *et al*. (1997) also reported that humic acids released from VC enhanced nutrient uptake by the plants by increasing the

Table 2 : Effect of Nutrients Management practices on yield of Garlic.

S. no.	Treatment	No. of clove per bulb	No. of bulbils	Weight of clove (gm)	100-clove weight (gm)	Leaf dry content (%)	Dry matter content of storage organ (%/100g, FW)	Yield (kg/ plot wise)	Total yield in garlic in ton/ha
T_1	Control (Without fertilization)	10.60	3.77	1.13	112.23	8.77	18.43	6.77	5.60
T_2	R.D.F (100:50:100 of N P K) kg	12.87	6.53	1.39	136.43	10.60	22.63	8.27	6.89
T_3	Vermicompost @ 2 ton/ha	12.27	5.97	1.35	132.47	9.77	22.37	8.00	6.66
T_4	F.Y.M @ 3 ton/ha.	11.67	5.50	1.32	129.10	9.70	21.87	7.57	6.31
T_5	Jeevamrit @ 3% sprays every month	12.60	6.97	1.44	139.70	11.20	23.30	8.43	7.02
T_6	Jeevamrit @ 2% sprays every month	12.20	5.00	1.27	123.47	9.30	20.33	7.27	6.06
T_7	Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays	17.13	8.17	1.72	165.83	13.00	24.83	10.27	8.56
T_8	F.Y.M @ 3 ton/ha + Jeevamrit @ 3% sprays	15.87	7.73	1.57	152.83	12.63	24.60	9.90	8.25
T_9	Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays	14.67	7.40	1.53	148.37	12.30	24.30	9.40	7.83
T_{10}	F.Y.M @ 3 ton/ha + Jeevamrit @ 2% sprays	14.00	7.20	1.40	146.10	11.70	23.60	8.80	7.30
	S.E. ±	**0.45**	**0.09**	**0.02**	**2.21**	**0.10**	**0.36**	**0.13**	**0.10**
	CD @ 5%	**1.33**	**0.26**	**0.06**	**6.58**	**0.29**	**1.06**	**0.37**	**0.31**
	CV (%)	**5.77**	**2.35**	**2.60**	**2.77**	**1.55**	**2.73**	**2.57**	**2.57**

permeability of root cell membrane and stimulating root growth.

Leaf dry content

Weight samples from a minimum of five plants per plot was dried at 80 centigrade to coasted weight, reweight and the dry matter content for the accession presented as a percentage results concerning dry leaf weight revealed significant variation due to the applied organic and inorganic. Plants applied with both comparatively more dry leaf weights as compared with control treatments (Table 2). Results showed that the maximum dry leaf weight was recorded in plants applied with T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) 13 % comparatively more dry leaf weight as compared with control treatments followed by application T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) 12.63% and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 12.30 %, while the minimum dry leaf weight was observed in untreated (control) plants. A previous research study conducted by Shafeek *et al*. (2015), Vipin (2020) and Bhandari *et al* (2012) were also reported increase in dry weight of leaves, when FYM and vermicompost along with inorganic fertilizer was used in garlic. They also reported that same inorganic fertilizers gave less dry weight of leaves when applied alone. The improvement in plant height, number of leaves with application of FYM and vermicompost might be due to better moisture holding capacity and availability of major and micro nutrients due to favorable soil conditions.

Dry matter content of storage organ

Plants applied with both organic and natural composition comparatively more Dry matter content of storage organ as compared with control

treatments. Results showed that the maximum Dry matter content of storage organ was recorded in plants treated with T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) 24.83 % comparatively more dry leaf weight with control treatments followed by application T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) 24.60% and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 24.30%, while the minimum dry leaf weight was observed in untreated (control) plants. The improvement in dry matter with application of FYM and vermicompost might be due to better moisture holding capacity and availability of major and micro nutrients due to favorable soil conditions. Similar findings were reported by Stewart *et al*. (2005), Damse *et al*. (2014) and Hamma *et al*. (2013).

Yield (kg / plot)

Results indicated that the bulb yield kg / plot was significantly varied due to applied organic and inorganic (Table 2). Plants receiving both forms of organic and inorganic gave higher bulb yield as compared with control. About 34.07% more yield was recorded in plants applied with T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) as compared with control plants. All the treatments in which both organic and natural farming treatments were applied in combination were statistically at par. The minimum bulb yield was recorded in untreated control plants.

Abdel Nabi (2017), Damse *et al*. (2014) and Hamma *et al*. (2013) observed that overall garlic bulb yield per hectare was higher in those plots, which were treated with integrated application of FYM and inorganic fertilizers. The combined doses of organic and natural farming not only increased the bulb weight but also enhanced overall yield of garlic.

Total yield in garlic in (ton / ha)

Highly significant variation existed among the treatments with respect to total bulb yield (Ton/ha). The highest total bulb yield was achieved with T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays) 8.56 (ton / ha) which was 52.71% increase over control, followed by application T_8 (FYM @ 3 ton/ha + Jeevamrit @ 3% sprays) 8.25 ton/ha and T_9 (Vermicompost @ 2 ton/ha + Jeevamrit @ 2% sprays) 7.33 and lowest yield obtained from control (5.60 t ha^{-1}). The lowest yield in the control treatment may be due to the fact that plots did not receive any organic and inorganic fertilizers and hence were deficient of essential plant nutrients. Lalitha *et al*. (2000) also noted that application of organic inputs like vermicompost attributed to better growth of plants and higher yield by slow release of nutrients. Similar results were attained by Mouna *et al*. (2013) and Rizk *et al*. (2014), whose findings recorded the highest yield of onion bulbs by the combination of Organic with inorganic fertilizers than with mineral fertilizers alone.

Conclusion

The present study concludes that integration of natural farming by using Jeevamrit, FYM and Vermicompost had a great effect on growth and yield related parameters of garlic. The highest garlic bulb weight per plant and yield per hectare were achieved when inorganic source and other half was from organic source T_7 (Vermicompost @ 2 ton/ha + Jeevamrit @ 3% sprays). Therefore, it is suggested to local garlic farmers that for achieving higher yield and better-quality garlic, they must use natural and organic fertilizers in an integrated manner. On the basis of results of present study, it may be concluded that combination of natural and organic nutrients may enhance the quality and yield of garlic. As a consequence, farmers can be advised to use treatment T_7 to minimize inorganic fertilizer doses while seeing substantial increases in mineral nutrients, Jeevamrit, vermicompost, FYM and chemical fertilizer growth.

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