www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 640-645

www.thepharmajournal.com
Received: 16-12-2022
Accepted: 19-01-2023

Stuti Pathak
Department of Vegetable Science, College of Horticulture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Yog Raj Shukla
Department of Vegetable Science, College of Horticulture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Corresponding Author:
Stuti Pathak
Department of Vegetable Science, College of Horticulture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Differential responses of integration of organic and inorganic manures on growth and yield of garlic (*Allium sativum* L.)

Stuti Pathak and Yog Raj Shukla

Abstract
It has become feasible to produce high quality garlic through integrated farming in recent decades. The purpose of this study was to determine how the combination of organic and natural fertilizers influenced garlic growth and yield. For this, a field experiment was carried out during *Rabi* season of 2016 and 2017 to evaluate the effectiveness of different organic manures in combination with inorganic manures on garlic growth and yield attributes. It was found that 50 percent of the recommended nutrients (RDN) were applied to the field during the preparation process using farmyard manure (FYM) and vermicompost along with *Jeevamrut* and 50 percent of the recommended NPK provided the best results in terms of bulb weight, diameter, and yield. Using *Beejamrut* along with *Jeevamrut* plus FYM as a basal dose had the highest Benefit to Cost ratio (B: C). However, the maximum returns were achieved when 50 percent of the recommended nutrients (RDN) were applied during field preparation with farmyard manure (FYM) and vermicompost, plus *Jeevamrut* and 50 percent NPK. This study concluded that 50 percent of the recommended nutrients (RDN) were applied through farmyard manure and vermicompost during field preparation + *Jeevamrut* + 50 percent of the recommended NPK was the most effective for achieving higher garlic yields and better returns.

Keywords: B:C ratio, *Beejamrut*, integration, *Jeevamrut*, vermicompost

Introduction
As one of the most popularly cultivated Allium species from the family Amaryllidaceae, garlic (*Allium sativum* L.) is the most widely grown species after onion. Known worldwide for its production and economic value, it is one of the most important Allium vegetable crops. It is considered to have originated in Central Asia (Brewster, 1994) [228].
Fertilizers aid in achieving maximum yields and increasing production (Kumar *et al*., 2014) [14]. As a large part of the current farming system relies on the use of chemical fertilizers, pesticides, and growth regulators to enhance the crop productivity, chemical fertilizers have become a major part of modern agriculture, but they adversely alter soil chemical and physical properties, causing nitrate poisoning and kill soil micro flora. Inorganic fertilizers have been continuously applied to the soils, causing the soil properties to deteriorate. Integrated nutrient management (INM) is an alternative horticulture system that addresses soil degradation and declining soil fertility and crop yield. It is possible to achieve high yields and good quality of garlic by using organic and inorganic compounds efficiently and in a balanced manner. In order to sustain agriculture and maintain ecological balance, organic farming is gaining importance. According to Jaipaul *et al*. (2011) [11], organic manures can improve the soil's biological composition by supporting the growth of beneficial micro-organisms. In a low cost improvised preparation, *jeevamrut* enriches soil with indigenous microbes that are essential for mineralizing soil (Gore *et al*., 2011) [17]. An integrated use of inorganic and organic sources of plant nutrients is necessary for maintaining soil fertility to provide plant nutrients in balanced proportions for optimum growth, yield and quality under various agro-ecological conditions. Hence, using different kinds of organic and inorganic amendments together to increase farm income along with the improvisation of the quality of produce was the main objective of this research.

Material and Method
Experimental area and Planting materials
A two-year investigation was carried out at Dr. Yashwant Singh Parmar University of

Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, at Horticultural Research and Training Station of Krishi Vigyan Kendra, Kandaghat during the *Rabi* seasons of 2016-17 and 2017-18. There are generally cold winters and a sub-temperate and semi-humid climate in this area. The study was conducted on the variety 'Kandaghat Selection' which is a Himachal Pradesh clonal selection.

Treatment Details

A plot size of 2.0 x 2.0 m was taken which was replicated thrice with ten combinations of organic and inorganic amendments (Table 1). Three replications were conducted with a spacing of 20 x 10cm in a randomized block design. On October 16, 2016 and October 2017, garlic cloves were sown. Physio-chemical properties of soil (0-15 cm depth) were analyzed in the early stage of the study, followed by an assessment of soil status after harvest. Individual plots were sown with FYM, Muriate of Potash (MOP) and SSP (Single Super Phosphorus) as a basal dose at the time of field preparation based on the treatment. There were two equal splits of urea applied; one half was applied immediately after sowing and the other half after one month of the first application. Different traditional agricultural inputs derived from Vedic Krishi were evaluated for organic fertilizers. According to Anonymous (2008) [4], traditional agricultural inputs, namely *jeevamrut* and *beejamrut*, were prepared using standard techniques. There were no insects and diseases during the course of study.

Physicochemical properties of soil (before experiment)

pH and EC of the soil was 7.11 and 0.40 dS/m respectively. The nitrogen, phosphorus and potassium content of soil were 260.89, 32.25 and 215.85 kg/ ha before the start of the experiment.

Economics

The economics was calculated based on the cost of cultivation of garlic under different treatments and the benefit drawn out of it under each treatment. In order to calculate gross income i.e. the total earnings from the treatment, we multiplied yield (q/ha) by sale rate (Rs).In addition to fixed costs per hectare, risk factors, management factors, and treatment costs per hectare, the total cost of cultivation was calculated. Total cultivation costs were subtracted from gross income to get net income. According to Sharma *et al*. (2008), net income divided by total cultivation costs gives a benefit: cost ratio.

Yield Traits under Study

Plant height (cm), number of leaves, bulb weight (g), bulb diameter (cm), number of bulbs per kilogram, total weight of bulbs were observed during the study as yield contributing characters, yield per plot was measured in kilograms, yield per hectare was calculated from this value in quintals by multiplying by a suitable factor based on the area, and number of cloves were counted from ten randomly selected bulbs.

Statistical analysis

Analysis of variance for the experiment was done as per the model suggested by Panse and Sukhatme (2000) [31].

Results and Discussion

With an application of various manures and fertilizers, plant height and number of leaves per plant showed significant positive responses. It was found (Table 2) that the maximum plant height was in *beejamrut*+ *jeevamrut* + FYM (250 q/ha) for year one T_9 (90.33 cm), 91.00 cm for the year two was recorded in T_4seed treatment with *beejamrut* + *jeevamrut* + FYM (250 q/ha), which was atpar with FYM (125 q/ha) + 50 percent vermicompost + 50 percent RDF of NPK (87.66 cm and 89.33 cm, respectively). For both years (10.57 and 10.76, respectively), the maximum number of leaves per plant was observed in T_7 (vermicompost + *jeevamrut* + 50 percent RDF of NPK). Absolute control had the fewest leaves per plant (9.33 and 9.50, respectively). Statistically, the maximum bulb weights of 65.07 grams and 66.50 grams were observed in T_9 FYM (125 q/ha) + 50 percent vermicompost + 50 percent *jeevamrut* + 50 percent RDF of NPK, which were statistically equal to *beejamrut* + *jeevamrut* + FYM (205 q/ha) 64.60 grams and 65.33 grams. A minimum bulb weight of 44.24 and 45.66 grams was recorded in absolute control. In treatment T_9, FYM (125 q/ha) + 50 percent vermicompost + 50 percent *jeevamrut* + 50 percent RDF of NPK, the maximum bulb diameter was 5.94 cm and 6.03 cm, respectively. While, absolute control has the smallest bulb diameter (4.83 cm and 4.66 cm). Absolute control had the highest number of bulbs (19.33 and 22.6, respectively) and T_6 vermicompost+ 50 percent RDF of NPK had the highest number of cloves (14.40 and 14.53).The yield for the absolute control plot was 159.80 q/ha, while the yield for the treatment $T_9$for first year was 235.24 q/ha, and second year produced 236.65 q/ha which was highest among all. Based on the economics of different treatments, Table 3 shows the highest B: C ratios for both years 2.64 and 3.41 were recorded in T_9 and T_4, respectively, T_9 i.e. FYM (125 q/ha) + 50 percent vermicompost + *jeevamrut* + 50 percent RDF of NPK had the highest B:C ratio in the first year, the same in the second year was highest as *Beejamrut* + *jeevamrut* + FYM (250 q/ha) were used. As a result, the minimum B:C ratio (1.70 and 1.79, respectively) was calculated for the absolute control (Figure 2). Characteristics that influence yield include plant height, bulb number, leaf number, bulb weight, and bulb diameter, which determine more foliar area and improved vegetative growth. Additionally, taller plants with more leaves are considered more desirable as this characteristic correlates directly and positively with more photosynthetic area, which in turn correlates with more yield and productivity. In spite of this, height and leaf number are genetically controlled characteristics, but they are also influenced by nutrient availability and cultivar. There is a possibility that a higher nitrogen supply results in more vegetative growth, which leads to a higher production rate and higher returns due to the better accumulation of photosynthates. As fertilizer supply improved, plant height increased significantly over control at all stages (Kumar *et al*., 2014) [14]. Also, Jilani *et al*. (2004) [12] confirmed that NPK combinations stimulate plant growth. In a similar manner, Al-Madini *et al*. (2000) [2], Aliyu *et al*. (2007) [1], and Islam *et al*. (2007) [10] concluded that NPK fertilizers are effective in increasing onion growth parameters. In addition, Setty *et al*. (1989) [22] pointed out that fertilizers increase the number and length of leaves, as well as the leaf area, when fertilizers are applied. The length and number of leaves increased with an increase in urea dose, but decreased beyond a certain limit, according to Khodabakhshzadeh (2001) [13]. In addition to supporting and stimulating plant growth, *jeevamrut* has beneficial micro flora that help produce good quality yield as well as better vegetative growth

(Devakumar, 2014) [7]. A number of previous studies have confirmed the findings of Chattopadhyay *et al*. (2006) [6]; Gowda *et al*. (2007) [9]; Rohidas *et al*. (2011) [21]. As a result of organic and inorganic nutrient applications, garlic and onion crops also grew more leaves and had better growth. Plants were more metabolically active and auxin-producing when 50 percent of NPK was applied, and ultimately resulted in greater bulb weights, bulb diameters, yields per plot (kg), clove weights, clove diameters, clove lengths, harvest indexes, and total yields (Yadav *et al*., 2017) [30]. The presence of beneficial microorganisms in the liquid formulation (*Jeevamrut*) as in FYM (125 q /ha) + 50 percent vermicompost + 50 percent RDF of NPK might be mainly due to their constituents such as cow dung, cow urine, legume flour and jaggery containing both macro and essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like indole acetic acid (IAA), gibberlic acid (GA) and beneficial microorganisms which directly help to enhance the growth and development of the plants (Palekar, 2006; Neelima and Sreenivasa, 2011) [18, 29]. Due to the increased nutritional status of the soil, organic manure and chemical fertilization significantly affect yield parameters such as bulb diameter and weight. A favorable effect of organic sources on microbial activity and root proliferation may be responsible for the solubilization of native nitrogen, phosphorus, and potassium. In plants, 50 percent of the recommended NPK dose stimulated metabolic and auxin activities, ultimately leading to increased bulb weight and diameter (Yadav *et al*., 2017) [30]. The effect may be explained by the favourable effect of organic sources on soil microbial activity and root proliferation, which resulted in the solubilization of native nitrogen, phosphorus, and potassium. With the application of 50 percent of the recommended NPK dose as in T_9, plant metabolism and auxin activity were enhanced, which resulted in an increase in bulb weight, bulb diameter, yield per plot, clove weight, clove diameter, clove length, harvest index, and finally total yield (Yadav *et al*., 2017) [30]. As a result, Kumara *et al*. (2014) [16] rated T_9 as the most cost-effective treatment. Furthermore, the highest benefit-cost ratio of 2.79:1 was found in the recommended dose of NPK fertilizers, while the least benefit-cost ratio was found in the combination of 75 percent of the recommended N dose through farmyard manure and 25 percent of the recommended N dose through urea. As observed by Thakur (2011) [25], the highest cost-benefit ratio resulted from the application of phosphorus at 76 kg ha^{-1}. As reported by Amareswari and Sujathamma, (2014) [3], the cost-benefit ratio of Masura rice production by chemical fertilizers was 3.0, whereas it was 3.39 for *jeevamrut*. Hamsa rice production using chemical farming had a benefit:cost ratio of 0.6, whereas the *jeevamrut* method had a benefit: cost ratio of 1.09, indicating an increase of 81 percent over chemical farming. Compared to control plots, T_9 had the highest net returns amounting to Rs. 13, 64,521.5 owing to higher yields, no disease incidence, and biotic factors. According to Chadha *et al*. (2012) [5], the findings are similar. Compared to other treatments, bulb yield, healthy and larger bulb size and higher net returns may account for the increased profit and benefit: cost ratio. As foliar sprays, *jeevamrut* was also quite effective in increasing the productivity of different crops and suppressing several plant pathogens, according to Chadha *et al*. (2012) [5].

Table 1: Details of the treatments used in the studies

Treatment	
T_1	Absolute Control
T_2	FYM (250 q/ha) basal dose
T_3	Seed treatment with *beejamrut* (overnight) + FYM (250 q/ha) basal dose
T_4	Seed treatment with *beejamrut* (overnight) + *jeevamrut* (fortnight application) + FYM (250 q/ha) basal dose
T_5	FYM (250 q/ha) as basal dose + *jeevamrut* (fortnight application) + 50% RDF of NPK
T_6	Vermicompost (Equivalent to N content of Recommended FYM) as basal dose + 50% RDF of NPK
T_7	Vermicompost (Equivalent to N content of Recommended FYM) as basal dose + *jeevamrut*(Fortnight application) + 50% RDF of NPK
T_8	FYM (125 q/ha) + 50% Vermicompost (Equivalent to N content of 50% FYM) as basal dose + 50% RDF of NPK
T_9	FYM (125 q/ha) + 50% Vermicompost (Equivalent to N content of 50% Recommended FYM) as basal dose + *jeevamrut*(Fortnight application) + 50% RDF of NPK
T_{10}	Recommended dose of FYM (250 q/ha) and NPK

Recommended dose of NPK (125 kg N, 75 kg P and 60 kg K per ha)

Table 2: Differential responses of different treatments on yield contributing characters

Parameters	**Plant Height (cm)**		**Number of leaves per plant**		**Bulb Weight (g)**		**Bulb Diameter (cm)**		**Number of bulbs per kg**		**Bulb yield per hectare (q)**		**Number of cloves per bulb**	
Treatments	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**
T1	76.27	78	9.23	9.5	44.24	45.66	4.83	4.66	22.60	24	159.8	165.04	14.20	14.23
T2	83.33	87	9.63	9.6	49.97	50.60	4.99	5.63	20.01	22.05	180.41	180.77	14.33	14.06
T3	84.13	83.66	9.33	9.76	53.20	64.23	5.31	5.33	18.80	21.02	195.92	198.4	13.33	14.26
T4	83.06	91	10.30	10	64.60	65.33	5.23	5.41	15.47	16.48	233.33	238.03	13.53	13.4
T5	86.06	89.66	9.57	10.4	64.13	61.8	5.29	5.68	15.59	17.77	231.48	232.69	14.13	14.33
T6	82.93	83.66	10.40	10.5	61.00	61.43	5.47	5.63	16.39	18.42	220.36	220.01	14.40	14.53
T7	83.90	84.33	10.57	10.90	62.30	62.66	5.49	5.62	16.05	17.15	225.04	226.1	14.27	14.27
T8	90.33	86.66	9.83	10.83	62.40	65.3	5.50	5.32	16.02	15.11	225.46	226.54	14.07	13.26
T9	87.67	89.33	10.40	10.76	65.07	66.5	5.94	6.03	15.37	16.55	235.24	236.65	13.93	13.86
T10	88.67	84.66	9.43	9.63	61.47	53.86	5.26	5.41	16.26	15.55	222.06	223.12	14.20	14.2
CD $_{(0.05)}$	3.85	3.61	0.52	0.33	3.71	3.17	0.25	0.18	0.81	0.73	9.78	9.21	0.53	0.75

Table 3: Differential responses of different treatments on Yield and cost economics of garlic during 2016-2017 and 2017-2018.

Treatment code	Yield (q/ha)		Cost of cultivation(Rs)		Gross income (Rs)		Net income (Rs)		B:C ratio	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T_1	159.8	165.04	4,72,228	4,72,228	12,78,400	13,20,320	8,06,172	8,48,092	1.7	1.79
T_2	180.41	180.77	5,12,228	5,12,228	14,43,280	14,46,160	9,31,052	9,33,932	1.82	1.82
T_3	195.68	198.4	5,12,230	5,12,230	15,65,440	15,90,160	10,53,210	10,77,930	2.06	2.1
T_4	233.32	238.03	5,12,432	5,12,432	18,66,560	22,64,240	13,54,128	17,51,808	2.63	3.41
T_5	231.62	232.69	5,16,975.5	5,16,975.5	18,52,960	18,61,520	13,35,984.5	13,44,544.5	2.58	2.6
T_6	220.36	220.01	5,17,475.5	5,17,475.5	17,62,880	17,60,080	12,45,404.5	12,42,604.5	2.41	2.4
T_7	225.04	226.1	5,17,673.5	5,17,673.5	18,00,320	18,08,800	12,82,646.5	12,91,126.5	2.48	2.49
T_8	225.46	226.54	5,17,475.5	5,17,475.5	18,03,680	18,12,320	12,86,204.5	12,94,844.5	2.49	2.5
T_9	235.24	236.65	5,17,398.5	5,17,398.5	18,81,920	18,93,200	13,64,521.5	13,75,801.5	2.64	2.66
T_{10}	222.06	223.12	5,05,628	5,05,628	17,76,480	17,84,960	12,70,852	12,79,332	2.51	2.53

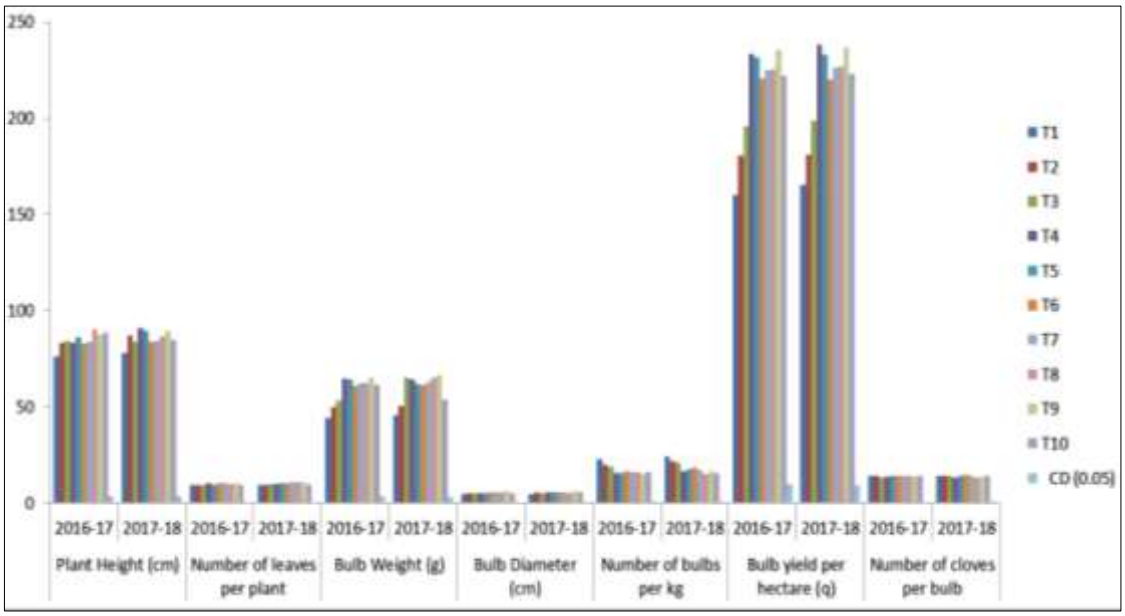

Fig 1: Differential responses of different treatments on yield contributing characters

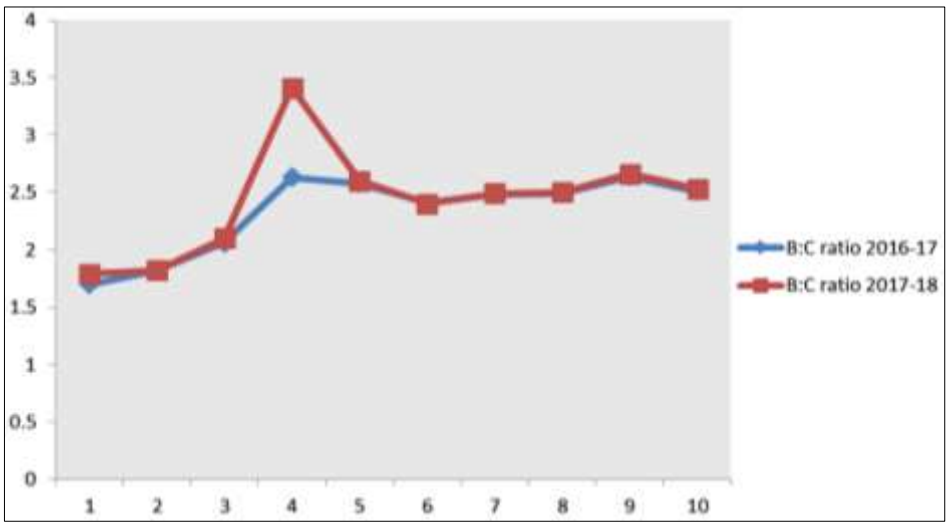

Fig 2: Differential responses of different treatments on B: C ratio

Conclusion

Based on the results of this study, it can be concluded that FYM (125 q /ha) + 50 percent vermicompost + 50 percent RDF of NPK was regarded as the best treatment in terms of growth, yield, and yield contributing characteristics, as well as the most economical treatment when compared to other treatments. There was a good response to this treatment when vermicompost was prepared on the farm. There was an optimal amount of nutrition provided to the plants that resulted in a better uptake which resulted in a good yield and a good yield contributing factor. After the results of this trial have been verified and thorough testing has been completed in multiple locations in the form of OFTs (onfarm field trials) on the farmers' fields, this treatment can be recommended to farmers for use on their farms and generate more income.

Acknowledgements
The authors are grateful to the Department of Vegetable Science, College of Horticulture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India for supporting the study and KVK, Kandhaghat where the research was carried out for both the years.

Conflict of Interest
The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work.

References
1. Aliyu U, Magaji MD, Singh A, Mohammed SG. Growth and yield of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus levels. International Journal of Agricultural Research. 2007;2(11):937-944.
2. Al-Madini A, M.Al-Thabat SS, Hamail AF. Effect of different application rates of two compound fertilizers on growth, yield and yield mineral composition of onion. Egyptian Journal of Applied Science, 2000, 15(10).
3. Amareswari PU, Sujathamma P. *Jeevamrutha* as an alternative of chemical fertilizers in rice production. Agricultural Science Digest-A Research Journal. 2014;34(3):240.
4. Anonymous. Organic farming newsletter. National Centre of Organic Farming, Ghaziabad. 2008;4(4):3-17.
5. Chadha S, Saini JP, Paul YS. Vedic Krishi: Sustainable livelihood option for small and marginal farmers; c2012.
6. Chattopadhyay PK, Hasan MA, Mandar KK, Chand S. Dynamics of growth and yield of garlic (*Allium sativum* L.) in variable planting time and applied nutrients. Indian Journal of Horticulture. 2006;63(3):298-301.
7. Devakumar N, Shubha S, Gowder SB, Rao GGE. Microbial analytical studies of traditional organic preparations *beejamrutha* and *jeevamrutha*. Building organic bridges. 2014;2:639-642.
8. Gore NS, Sreenivasa MN. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. Karnataka Journal of Agricultural Science. 2011, 24(2).
9. Gowda MC, Vijayakumar M, Gowda APM. Influence of integrated nutrient management on growth, yield and quality of garlic (*Allium sativum* L.) cv. G-282. Crop Research-Hisar. 2007;33(1/3):144.
10. Islam MK, Alam MF, Islam AKMR. Growth and yield response of onion (*Allium cepa* L.) genotypes to different levels of fertilizers. Bangladesh Journal of Botany. 2007;36(1):33-38.
11. Jaipaul SS, Dixit AK, Sharma AK. Growth and yield of capsicum (*Capsicum annum*) and garden pea (*Pisum sativum*) as influenced by organic manures and biofertilizers. Indian Journal of Agricultural Sciences. 2011;81(7):637-42.
12. Jilani MS, Ghaffoor A, Waseem K, Farooqi JI. Effect of different levels of nitrogen on growth and yield of three onion varieties. International Journal of Agriculture and Biology. 2004;6(3):507-510.
13. Khodabakhshzadeh A. Effect of different levels of nitrogen on growth and development, yield and nitrate accumulation in three cultivars of garlic (Doctoral dissertation, M. Sc. Thesis of Horticultural Science. Islamic Azad University. Science and Research Unit); c2001.
14. Kumar A, Singh B, Kumar D, Kumar P, Kumar T, Kumar S, Goswami A. Effect of balanced fertilizer and planting techniques on growth and yield of garlic (*Allium sativum* L.). Annals of Horticulture. 2014;7(2):123-128.
15. Kumar JA, Rangaswamy E, Khanagoudar S, Sreeamuiu KR. Effect of microbial inoculants on the nutrient uptake and yield of beetroot (*Beta vulgaris* L.). Current Agriculture Research Journal. 2014;2:123-130.
16. Kumara BR, Shankargouda P, Gangadharappa PM, Hegde NK. Effect of organic and inorganic sources of nitrogen on growth, yield and quality of garlic (*Allium sativum* L.). Trends in Biosciences. 2014;7:1327-1330.
17. Gore NS, Sreenivasa MN. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. Karnataka Journal of Agricultural Sciences. 2011, 24(2).
18. Palekar S. Text book on Shoonya Bandovaladanaisargika Krushi, published by Swamy Anand, Agri Prakashana, Banglore. 2006
19. Puttaraju TB, Lingaiah HB, Padmaraja SR, Thygaraj GN, Kumar B. Effect of integrated nutrient management on growth and yield of garlic (*Allium sativum* L.) cv. G-282. In: National symposium on Alliums: current scenario and emerging trends, DOGR, Rajagurunagar, Pune: 206; c2011.
20. Rizk FA. Productivity of onion plant as affected by method of planting and NPK application. Egyptian Journal of Horticulture. 1997;24(2):219-238.
21. Rohidas SB, Kamble VP, Kalalbandi BM, Patil VK. Effect of organic and inorganic fertilizers on growth, yield and quality of onion cv. N-53. In: National symposium on Alliums: current scenario and emerging trends, DOGR, Rajagurunagar, Pune; c2011. p. 12-14.
22. Setty BS, Sulikeri GS, Hulamani NC. Effect of N, P and K on growth and yield of garlic (*Allium sativum* L.). Karnataka Journal of Agricultural Sciences. 1989;2:160-164.
23. Sharma R, Negi YS, Vaidya M. Analysis for forestry and horticultural crops: theory with application. Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh; c2008. 32-35.
24. Srinivasan V, Sadanandan AK, Hamza S. Efficiency of rock phosphate sources on ginger and turmeric in an Ustic Humitropept. Journal of the Indian Society of Soil Science. 2000;48(3):532-536.
25. Thakur BS. Effect of planting date, nitrogen and phosphorus levels on marketable bulb yield in garlic (*Allium sativum* L.) under mid hill conditions of Himachal Pradesh. Journal of Hill Agriculture. 2011;2:42-46.
26. Warade SD, Desale SB, Shinde KG. Effects of organic, inorganic and biofertilizers on yield of onion bulbs cv. B-780. Journal-Maharashtra Agricultural Universities. 1995;20:467-467.
27. Vishwakarma G, Yadav AL, Kumar A, Singh A, Kumar S. Effect of Integrated Nutrient Management on Physico-Chemical Characters of Bael (*Aegle marmelos* Correa) cv. Narendra Bael-9. International Journal of Current Microbiologyand Applied Science. 2017;6(6):287-296.
28. Brewster KL. Neighborhood context and the transition to

sexual activity among young black women. Demography. 1994 Nov;31(4):603-14.
29. Neelima SG, Sreenivasa MN. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* L.) in the sterilized soil. Karnataka J. Agric. Sci. 2011;24(2):153-7.
30. Yadav R, Pathak GS. Determinants of consumers' green purchase behavior in a developing nation: Applying and extending the theory of planned behavior. Ecological economics. 2017 Apr 1;134:114-22.
31. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi; c1967. p. 381.