biology and life sciences forum

MDPI

Research article

Organic Amendments for Growth, Yield and Quality of Green Coriander (*Coriandrum sativum* L.)

Mausum Kumar Nath *

Department of Horticulture, Assam Agricultural University, Jorhat-13, Assam, India
* Correspondence: author email: mausumnath937@gmail.com

Abstract: Fresh and green leafy vegetables are an inevitable part human nutrition. Leafy coriander is one of the most important condiments in the world which requires adequate fertilizer input for higher production. Expanding population constraints have compelled many countries to use pesticides and fertilisers to boost farm production in order to fulfil their ever-increasing food demand. To stimulate rapid and sumptuous growth of the leafy vegetables like coriander, farmers apply a lot of nitrogenous fertilisers resulting in poor quality and shelf life. Application of organic amendments can solve this issue by improving the quality of coriander as well as prolonging its shelf life. Moreover, a good research work has been done in India and abroad on coriander as a seed spice, but as a condiment limited research has been conducted. Hence, the present investigation was taken up. The experiment was laid out with 7 treatments in Randomized Block Design and replicated 3 times in the organic block of Experimental Farm at Assam Agricultural University, India. The data of the respective field experiment were subjected to appropriate statistical analysis as per procedure given by Panse and Sukhatme. The result of the present investigation revealed that T_7 (Enriched compost @ 5 t ha^{-1}) could produce the maximum yield with the highest benefit-cost ratio of 3.18 along with the best performance in the quality of produce. Therefore, T_7 can be inferred as farmer's friendly for sustainable production due to its efficiency, higher net return in comparison to the other treatments and minimal impact on the environment which can be taken into consideration for adoption under field conditions.

Keywords: Coriander; Amendments; Organic; Sustainable; Enriched compost

1. Introduction

Coriander, also known as cilantro, is an annual herbaceous plant belonging to the family Umbelliferae, which is widely used as a condiment in global cuisine. It is a garnish ingredient in a variety of dishes, such as salad dressings and sauces, as well as in seafood and chicken dishes. As the population continues to grow, many countries are being forced to increase agricultural production through the use of pesticides and fertilizer. The green revolution has led to an increase in food productivity; however, this has been accompanied by an increase in the reliance of farmers on synthetic inputs to increase output and profits. Inorganic fertilizers have been linked to soil structure degradation and aggregation loss, while chemical pesticides have been linked to a decrease in soil microbial activity, which can have a detrimental effect on the soil's nutritional content as well as the environment. Therefore, the most effective solution is to adopt organic vegetables in view of the detrimental effects of chemical pesticides and toxic chemicals on human health and our capacity to avoid them. In light of the aforesaid aspects, the present investigation was carried out to assess the organic amendments for growth, yield and quality of Green Coriander.

2. Methodology

The present investigation was conducted during 2021-22 in the organic block of the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experimental site was situated at 26.45ºN latitude and 94.12ºE longitudes and an elevation of 86.8 m above mean sea level and under Upper Brahmaputra Valley Agro Climate Zone of Assam. The maximum and minimum temperature during the investigation period was 23.7º C-29.2º C and 9.2º C-14.4º C respectively. The experiment was laid out with 7 treatments in Randomized Block Design and replicated 3 times. The treatments were: T_1 (Absolute control), T_2 (Vermicompost @ 2.5 t ha^{-1}), T_3 (Vermicompost @ 2.5 t ha^{-1}+ microbial consortium), T_4 (Vermicompost @ 5 t ha^{-1}), T_5 (Vermicompost @ 5 t ha^{-1}+ microbial consortium), T_6 (Enriched compost @ 2.5 t ha^{-1}) and T_7 (Enriched compost @ 5 t ha^{-1}). The soil textural class of the experimental plot was sandy loam and each size of the experimental plot was 3m^2. Moreover, the soil of the experimental plot was acidic in nature, low in available nitrogen, medium in available phosphorus and available potassium. Organic manures *viz*., vermicompost, enriched compost and microbial consortium (Azotobacter + Phosphate solubilizing bacteria + Rhizobium) were applied before sowing randomly in each replication. As a soil application, microbial consortium was applied at the rate of 3.5 Kg ha^{-1}. Seeds were gently rubbed to split it into two halves and then soaked in water for 16 h. The floated seeds were discarded and the viable seeds were sown in line by opening a furrow of 2.5-3 cm depth and maintaining a 20 cm interrow spacing. The procedure described by Panse and Sukhatme [5] was used to statistically analyse the data relevant to growth, yield, and quality parameters.

3. Results and Discussion

3.1. Growth and Yield Parameters

The study revealed that the highest values for all growth attributing characters were recorded in the treatment receiving enriched compost @ 5 t ha^{-1}.The highest plant height (24.45 cm), maximum number of leaves (33.99) and branches (12.05) was recorded in T_7 (Enriched compost @ 5t ha^{-1}) presented in Table 1. This might be due to the presence of beneficial microbes in the organic compost, which considerably increases the growth. The addition of organic inputs may have enhanced the physical, chemical, and biological characteristics of the soil, aiding in better nutrient uptake and utilisation by plants, leading to better plant development. These findings are in conformity with Gogoi et al., [6] in knolkhol and Mathukia et al., [7] in coriander. The growth performance in terms of the whole plant weight of coriander has also indicated a similar pattern. Similar result was obtained by Sakthivel et al., [8] in coriander. This could be due to more plant height with more numbers of leaves and branches, thus there is overall increase in vegetative growth of the plant in T_7 (Enriched compost @ 5t ha^{-1}). Again, the number of plants per square metre was recorded highest in T_7 due to less mortality resulting in higher number of plants (Table 2). The highest yield per square metre was obtained in T_7 (Enriched compost @ 5t ha^{-1}). Enriched compost aids in the ability of the soil to retain moisture, provides essential nutrients that release slowly, and can raise yields over the long term. Vegetative growth characteristics such plant height, number of leaves, branches, and plants per square metre increased significantly, which had a straight correlation to yield. Similar findings were reported by Mathukia et al., [7] in coriander and Chandran [9] in Chinese cabbage. The highest root: shoot ratio was obtained in T_7 (Enriched compost @ 5t ha^{-1}). Root: shoot ratio is an essential metric for evaluating the health of plants [10]. This ratio has astrong correlation with the health of the plant during all stages of vegetative growth and development [11].Better plant health and growth was observed in the plants growingunder T_7. This result is in agreement with the findings of Umlong [12] in carrot.

Table 1. Effect of organic amendments on the growth attributing characters.

Treatments	Plant height	Number of leaves per plant	Number of branches per plant

	15 DAS	30 DAS	45 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest	15 DAS	30 DAS	45 DAS	At harvest
T_1	3.87	7.77	14.09	17.66	3.55	7.16	14.37	26.27	3.17	4.08	4.85	6.25
T_2	4.10	8.35	14.50	19.55	4.99	9.10	16.50	27.83	3.83	4.81	6.38	8.38
T_3	4.25	8.60	16.79	21.10	5.28	9.80	18.80	29.00	4.06	5.05	8.12	10.13
T_4	4.53	9.02	17.18	21.54	6.06	11.32	20.08	30.80	4.16	5.77	9.13	10.30
T_5	4.54	9.16	17.29	22.50	6.83	11.63	21.62	32.24	4.72	5.96	9.54	11.64
T_6	5.06	11.26	18.15	23.16	8.41	12.62	23.25	33.68	5.10	6.02	10.87	11.93
T_7	5.63	11.53	18.91	24.45	8.73	12.90	24.51	33.99	5.17	6.34	11.11	12.05
S.Ed(±)	0.01	0.01	0.02	0.53	0.23	0.10	0.17	0.18	0.01	0.01	0.17	0.01
CD (5%)	0.04	0.02	0.04	1.17	0.50	0.23	0.39	0.40	0.03	0.04	0.39	0.03

*DAS = Days after sowing.

Table 2. Effect of organic amendments on the yield attributing characters.

Treatments	Weight of the whole plant (g)	Number of plants per square metre	Root: shoot ratio	Yield per square metre (Kg)
T_1	7.11	83.11	0.32	0.10
T_2	7.91	88.33	0.38	0.22
T_3	8.20	91.00	0.40	0.24
T_4	8.97	91.55	0.42	0.38
T_5	10.09	93.11	0.43	0.40
T_6	12.46	94.00	0.46	0.34
T_7	13.77	95.33	0.49	0.56
S.Ed(±)	0.10	0.45	0.01	0.01
CD (5%)	0.22	1.00	0.02	0.02

3.2. Quality Parameters

In case of quality parameters, T_7 **(**Enriched compost @ 5t ha^{-1}) had the highest moisture content of 86.88 % (Table 3). It could be related to the fact that the leaves in the T_7 treatment were larger in comparison to the other treatments, thus resulting in more moisture content. Such finding was in accordance with Nayak et al., [13] in palak. The present study shows that the highest ascorbic acid content (99.82 mg 100^{-g}) was recorded in T_7 **(**Enriched compost @ 5t ha^{-1}). The reason can be assigned to the fact that the use of biofertilizer and organic fertilizer may have boosted the intake of major and micronutrients, resulting in an increase in vitamin production. Consequently, there are more carbohydrates than needed that can be utilized to produce ascorbic acid [14]. Similar findings were reported by Sharma and Agarwal [15] in spinach, Hazarika et al., [16] in cauliflower and Vethamoni and Thampi [17] in palak. Again, the fibre content was found to be highest in T_5 (Vermicompost @ 5 t/ha+ microbial consortium) i.e., 8.27 % presented in Table 3. Gontijo et al., [18] observed that that organically cultivated crops recorded higher fibre contents compared to conventional crops. Since the phenolic compounds are produced by the plant asa defence against pathogens and that lignin is a component of total fibre, it is possible that the treatment could prevent an increase in phenolic compounds [19]. The increasein phenolic compound production by plants as a defence against insect invasion can be attributed to the increase in fibre content [20]. These results are in accordance with Premsekhar et al., [21] in okra, Shankar et al., [22] in amaranthus and Jabeen et al., [23] in spinach beet.

Table 3. Effect of organic amendments on the quality attributing characters.

Treatments	Moisture content (%)	Ascorbic acid(mg 100^{-g})	Fibre content(%)	Iron content(mg 100^{-g})	Protein(g 100^{-g})	Ash content (%)
T_1	85.35	90.23	6.14	19.02	3.09	2.60
T_2	86.28	92.18	6.29	20.42	3.25	2.85

T_3	86.11	94.29	6.61	20.76	3.46	3.10
T_4	86.18	97.28	7.69	21.77	3.59	3.36
T_5	86.43	98.16	8.27	21.84	3.84	4.12
T_6	85.68	99.57	7.43	22.05	3.82	3.64
T_7	86.88	99.82	7.96	22.71	4.03	3.84
S.Ed(±)	0.32	0.02	0.14	0.01	0.01	0.01
CD (5%)	0.72	0.05	0.30	0.02	0.02	0.02

The maximum iron content of 22.71 mg 100^{-g} was found in T_7 (Enriched compost @ 5t ha^{-1}). Such effect of enriched compost on iron assimilation could be attributed to the organic carbonpresent in the applied organic manures, which serves as a source of energy for soil microbes and, upon mineralization, releases organic acids and thus increases the availability of iron. This is in conformity with the results of Roy et al., [24] in Indian spinach, who reported that addition of organic matter to the soil increases the mineralization impact of the soil and hence increases the uptake of micronutrients like iron. Similar outcomes were reported by Kavitha et al., [25] in amaranthus and Jamoh [26] in palak. The maximum protein content of 4.03 g 100^{-g} was recorded in T_7 (Enriched compost @ 5t ha^{-1}). The increase in protein content could be attributed to higher P and NH_4^+-N absorption, improved mineral uptake, and synthesis of phytohormones such IAA and gibberellins due to application of the compost [27]. Similar findings were reported by Sanwal et al., [28] in coriander, Ravimycin [29] and Islam et al., [30] in coriander. Moreover, the highest ash content of 4.12 % was recorded in T_5 (Vermicompost @ 5 t/ha+ microbial consortium). It is ascribed to the higher proportion of non-combustible substances present in the organic treatment, as organic fertilisers are less potent, as well as the fact that the organically treated soil has more biological activity, which enables plants to absorb more nutrients from the soil [31]. This finding was in accordance with Kumar et al., [14] in cabbage and Gogoi et al., [6] in Knolkhol.

4. Conclusion

The result of the present investigation revealed that T_7 (Enriched compost @ 5 t ha^{-1}) could produce the maximum yield with the highest benefit-cost ratio of 3.18 along with the best performance in the growth and quality of produce in comparison to the other treatments. Therefore, T_7 (Enriched compost @ 5 t ha^{-1}) can be inferred as farmer's friendly for sustainable production based on its efficiency, minimal effect on the environment and higher net return of Rs. 4,29,200 per ha over other treatments which can be taken into consideration for adoption under field conditions.

Acknowledgments*:* Author is thankful to the Department of Horticulture, Assam Agricultural University for the support extended in carrying out the lab as well as field works during the tenure of the research programme.

References

1. K. Singletary **(2016).** Coriander: Overview of potential health benefits. Nutr. Today., **51:**151-161.
2. M.K.; Bhatt, R. Labanya and H.C. Joshi **(2019)**. Influence of long-term chemical fertilizers and organic manures on soil fertility-A review. Univers. J. Agric., **7**: 177-188.
3. S. Arora and D. Sahni **(2016)**. Pesticides effect on soil microbial ecology and enzyme activity-An overview. J. Appl. Nat. Sci., **8**:1126-1132.
4. M. Sharma and R. Reynnells **(2018)**. Importance of soil amendments: Survival of bacterial pathogens in manure and compost used as organic fertilizers. *In*: Thakur, S. and Kalmia, K.E. (eds) Preharvest food safety. ASM Press, pp.159-175.
5. V.G. Panse and P.V.Sukhatme **(1995)**. Randomized design and square and factorial experiment in statistical methods of Agricultural workers. ICAR, New Delhi.
6. P. Gogoi and D.B. Phookan **(2017)**. Effect of organic inputs and microbial consortium on yield and quality of Knolkhol (*Brassica oleracea* L. var. *gongylodes*). *J. pharmacogn. phytochem*., **6:**365-368.

7. R.K.; Mathukia, M.V.; Adhithi, K.V. Hirapara and P.R. Surya **(2020)**. Enhancing Coriander(*Coriandrum sativum* L.) Yield through Integration of Chemical Fertilizers, Enriched Compost and Biofertilizers. Int.J. Curr. Microbiol. App. Sci., **9**:1538-1545.
8. P.; Sakthivel, A.R.; Sujeetha, G.Ravi, A.G. Girish and P. Chander **(2020)**. Effect of vermicompost with microbial bio inoculums on the growth parameter of coriander(*Coriandrum sativum* L.). Int J Curr Microbiol App Sci., **9**: 613-622.
9. D. Chandran **(2021)**. Response of Chinese cabbage (*Brassica campestris* ssp. *pekinensis*) to organic amendments. M.Sc (Agri.) Thesis, Assam Agricultural University, Jorhat, India.
10. E.; Agathokleous, R.G. Belz , M. Kitao ,T.Koike and E.J.Calabrese **(2019)**. Does the root to shoot ratio show a hormetic response to stress? An ecological and environmental perspective. *J. For. Res*., **30**:1569-1580.
11. L. Bláha **(2021)**. Importance of Root-Shoot Ratio for Crops Production: A Review. Current Topics in Agricultural Sciences., **1**:37-49.
12. M.R.Umlong **(2010)**. Growth, yield and quality of carrot (*Daucus carota*) as influenced by organics and lime. M.Sc (Agri.) thesis, Assam Agricultural University, Jorhat, India.
13. P.K.Nayak and S.Maji **(2018)**. Response of nutrient and cutting management for quality and green yield of Palak (*Beta vulgaris* var. *bengalensis*). J. crop weed., **14**: 126-129.
14. J.Kumar , D.B.; Phookan, N. Lal , H. Kumar , K. Sinha and M. Hazarika **(2015)**. Effect of organic manures and biofertilizers on nutritional quality of cabbage (*Brassica oleracea* var. *capitata*). J.Eco-friendly agric., **10:**114-119.
15. J.Sharma and S. Agarwal **(2014)**. Impact of organic fertilizers on growth, yield and quality of spinach. *Indian, J. Plant Sci*., **3**: 37-43.
16. P.; Hazarika, D.B. Phookan and S.Barua **(2017)**. Performance of cauliflower as influenced by organic inputs and microbial consortium. Indian, J. Hortic., **74**: 75-79.
17. P.I.Vethamoni and S.S. Thampi **(2018)**. Effect of organic manuring practices on growth and yield of palak (*Beta vulgaris* var. *bengalensis* Hort.). Int. J. Curr. Microbiol. App. Sci., **7**: 1855-1863.
18. L.N.; Gontijo, C.O. da Silva, L.G.; Stort, R.M.T.; Duarte, C.Betanho and E.M.M. Tassi **(2017)**. Nutritional composition of vegetables grown in organic and conventional cultivation systems in Uberlndia, MG. Afr. J. Agric. Res., **12**: 1848-1851.
19. O.; Daniel, M.S.; Meier, J.Schlatter and P.Frischknecht **(1999)**. Select phenolic compounds in cultivated plants: Ecologic functions, health implications, and modulation by pesticides. Environ. Health Perspect., **107:**109-114.
20. J.E.Young, X.; Zhao, E.E.Carey, R.; Welti, S.S. Yang and W.Wang **(2005)**. Phytochemical phenolics in organically grown vegetables. Mol. Nutr. Food Res., **49**: 1136-1142.
21. M. Premsekhar and V. Rajashree **(2009)**. Influence of organic manures on growth, yield and quality of okra. Am. -Eurasian, J. Sustain. Agric., **3**:6-8.
22. K.S.Shankar, S.; Sumathi, M.; Shankar, K.U Rani and N.N Reddy **(2013)**. Effect of organic farmingon nutritional profile, quality characteristics and toxic parameters of amaranthus. Indian, J. Hortic., **70**: 378-382.
23. A.; Jabeen, S. Narayan , K. Hussain ,S.M. Ahmed and F.A. Khan **(2018)**. Effect of organic manures and biofertilizers on quality of spinach beet (*Beta vulgaris* var. *bengalensis*). Int. J. Curr. Microbiol. Appl. Sci., **7**: 1312-1317.
24. S.; Roy, Z. Afsar and A. Kashem **(2014)**. Nutrient content of Indian spinach in saline soil as affected by different organic manures. Int. J. Environ. Sci., **4**: 694-702.
25. Kavitha, S. Srinivasan and Ranjini **(2013)**. Individual and combined effect of biofertilizer, chemical fertilizer and vermicompost on *Amaranthus Tristis*. Int. J. Pharm. Sci. Rev. Res., **20**: 190-195.
26. O. Jamoh **(2021)**. Performance of Palak (*Beta vulgaris var. bengalensis* Hort.) as influenced by organic inputs, microbial consortium and packaging materials. M.Sc (Agri.) Thesis, Assam Agricultural University, Jorhat, India.

27. R.; Verma, B.R. Maurya and V.S. Meena **(2014)**. Integrated effect of bio-organics with chemical fertilizer on growth, yield and quality of cabbage (*Brassica oleracea* var *capitata*). Indian J Agric Sci., **84**: 914-919.
28. R.C. Sanwal and Y. Sharma **(2017)**. Impact of vermicompost, nitrogen and phosphorus on yield, quality and uptake of coriander (*Coriandrum sativum* L.) under arid condition. Int. J. Chem. Stud., **5**: 1698-702.
29. T. Ravimycin **(2016)**. Effects of Vermicompost (VC) and Farmyard Manure (FYM) on the germination percentage growth biochemical and nutrient content of Coriander (*Coriandrum sativum* L.). Int. J. Adv. R*es.*, **3**:91- 98.
30. M.M.Islam, S.M.; Akther, S.A.; Sujon, M.A. Karim and M.K. Rahman **(2020)**. Effects of vermicompost and PK on growth and protein content of spinach (*Spinacia oleracia* L.). Bangladesh, J. Bot., **49**:141-146.
31. T.T.A. Sangma **(2015)**. Comparative assessment of biofertilizer consortium on garden pea (*Pisum sativum* L.). M.Sc (Agri.) Thesis, Assam Agricultural University, Jorhat, India.

.

2. .

.

.

.