biology and life sciences forum

MDPI

Proceeding Paper

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

Mausum Kumar Nath

Department of Horticulture, Assam Agricultural University, Jorhat 785013, Assam, India; mausumnath937@gmail.com

† Presented at the 2nd International Online Conference on Agriculture, 1–15 November 2023; Available online: https://iocag2023.sciforum.net/.

Abstract: Fresh and green leafy vegetables are an inevitable part of human nutrition. Leafy coriander is one of the most important condiments in the world and requires adequate fertilizer input for higher production. Expanding population constraints have compelled many countries to use pesticides and fertilizers in order to boost farm production and fulfil their ever-increasing food demands. To stimulate the rapid and sumptuous growth of leafy vegetables like coriander, farmers apply a lot of nitrogenous fertilizers, resulting in poor quality and shelf lives. The application of organic amendments can solve this issue by improving the quality of coriander, as well as prolonging its shelf life. Moreover, various research work has been carried out in India and abroad on coriander as a seed spice, but limited research has been conducted on coriander as a condiment. Hence, this investigation was taken up. The experiment was prepared with seven treatments in a randomized block design and was replicated three times in the organic block of the Experimental Farm at Assam Agricultural University, India. The data from the respective field experiment were subjected to appropriate statistical analysis, as per the procedure proposed 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 terms of the quality of produce. Therefore, T_7 can be inferred as farmer-friendly for sustainable production due to its efficiency, higher net return in comparison to other treatments, and minimal impact on the environment (and thus its adoption can be taken into consideration under field conditions).

Keywords: coriander; amendments; organic; sustainable; enriched compost

Citation: Nath, M.K. Organic Amendments for Growth, Yield and Quality of Green Coriander (*Coriandrum sativum* L.). *Biol. Life Sci. Forum* **2024**, *30*, 26. https://doi.org/10.3390/IOCAG2023-17342

Academic Editor: Amanullah

Published: 18 April 2024

1. Introduction

Coriander, also known as cilantro, is an annual herbaceous plant that belongs 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 [1]. 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 [2], 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 [3]. 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. As such, organic amendments can play a vital role in regenerating soil biological matter, increasing soil bulk density and improving water retention capacity of soil [4]. In light of the aforesaid aspects, this investigation was carried out to assess the organic amendments that can be used to improve the growth, yield, and quality of green coriander.

2. Methodology

This investigation was conducted during 2021–22 in the organic block of the Experimental Farm, the Department of Horticulture, Assam Agricultural University, Jorhat. The experimental site was situated at a 26.45° N latitude, a 94.12° E longitude, and an elevation of 86.8 m above mean sea level and under the Upper Brahmaputra Valley Agro-Climate Zone of Assam. The maximum and minimum temperatures during the investigation period were 23.7–29.2 °C and 9.2–14.4 °C, respectively. The experiment was prepared with 7 treatments in a randomized block design and replicated 3 times. The treatments were as follows: 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 experimental plot size was 3 m^2. Moreover, the soil of the experimental plot was acidic in nature, and it had low availability of nitrogen and medium availability of phosphorus and available potassium. Organic manures, viz., vermicompost, enriched compost, and microbial consortium (azotobacter + phosphate-solubilizing bacteria + rhizobium), were applied before being randomly sowed in each replication. As a soil application, microbial consortium was applied at a rate of 3.5 Kg ha^{-1}. Seeds were gently rubbed to split them 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 with a depth of 2.5–3 cm and maintaining a 20 cm inter-row spacing distance. The procedure described by Panse and Sukhatme [5] was used to statistically analyze 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 characteristics were recorded in the treatment comprising enriched compost @ 5 t ha^{-1}. The highest plant height (24.45 cm) and the maximum number of leaves (33.99) and branches (12.05) were recorded in T_7 (enriched compost @ 5 t ha^{-1}) and are presented in Table 1. These values can be attributed 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, improving the plants' nutrient uptake and utilization, leading to better plant development. These findings are in conformity with Gogoi et al.'s [6] remarks on knolkhol and Mathukia et al.'s [7] remarks on coriander. The growth performance, in terms of the whole plant weight of coriander, has also indicated a similar pattern. A similar result was also obtained by Sakthivel et al. [8] in relation to coriander. This could be due to an increased plant height with a higher number of leaves and branches; thus, there was an overall increase in the vegetative growth of the plant in T_7 (enriched compost @ 5 t ha^{-1}). Again, the number of plants per square meter was the highest in T_7 due to less mortality, resulting in a higher number of plants (Table 2). The highest yield per square meter was obtained in T_7 (enriched compost @ 5 t ha^{-1}). Enriched compost facilitates the ability of the soil to retain moisture, provides essential nutrients that are released slowly, and increases yields over the long term. Vegetative growth characteristics, such plant height, as well as the number of leaves, branches, and plants per square meter, increased significantly, exhibiting a positive correlation with yield. Similar findings were reported by Mathukia et al. [7] on coriander and by Chandran [9] on Chinese cabbage. The highest root–shoot ratio was obtained in T_7 (enriched compost @ 5 t ha^{-1}). The root–shoot ratio is an essential metric for evaluating the health of plants [10]. This ratio has a strong 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 growing under T_7. This result is in agreement with the findings of Umlong [12] on carrot.

Table 1. The effect of organic amendments on the growth-attributing characteristics.

Treatments	Plant Height				Number of Leaves per Plant				Number of Branches per Plant			
	15 DASs	**30 DASs**	**45 DASs**	**At Harvest**	**15 DASs**	**30 DASs**	**45 DASs**	**At Harvest**	**15 DASs**	**30 DASs**	**45 DASs**	**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

DASs = days after sowing.

Table 2. The effect of organic amendments on the yield-attributing characteristics.

Treatments	**Weight of the Whole Plant (g)**	**Number of Plants per Square Meter**	**Root–Shoot Ratio**	**Yield per Square Meter (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 the case of quality parameters, T_7 (enriched compost @ 5 t ha^{-1}) had the highest moisture content, with 86.88% (Table 3). This could be related to the fact that the leaves in the T_7 treatment were larger in comparison to those in the other treatments, thus resulting in a higher moisture content. This finding was in accordance with Nayak et al.'s [13] study on palak. This study shows that the highest ascorbic acid content (99.82 mg 100^{-g}) was recorded in T_7 (enriched compost @ 5 t ha^{-1}). This can be attributable to the fact that the use of biofertilizers and organic fertilizers may have boosted the intake of major- and micronutrients, resulting in an increase in vitamin production. Consequently, more carbohydrates that can be utilized to produce ascorbic acid are needed [14]. Similar findings were reported by Sharma and Agarwal [15] on spinach, Hazarika et al. [16] on cauliflower, and Vethamoni and Thampi [17] on palak. Again, the fiber content was found to be the highest, i.e., 8.27%, in T_5 (vermicompost @ 5 t/ha+ microbial consortium), as presented in Table 3. Gontijo et al. [18] observed that that organically cultivated crops recorded higher fiber contents compared to conventional crops. Since phenolic compounds are produced by the plant as a defense against pathogens, and given that lignin is a component of total fiber, it is possible that the treatment could prevent an increase in phenolic compounds [19]. Plants' production of increased phenolic compounds as a defense against insect invasion can be attributed to the increase in fiber content [20]. These results are in accordance with those obtained by Premsekhar et al. [21] on okra, Shankar et al. [22] on amaranthus, and Jabeen et al. [23] on spinach beet.

Table 3. The effect of organic amendments on the quality-attributing characteristics.

Treatments	Moisture Content (%)	Ascorbic Acid (mg 100^{-g})	Fiber 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 (22.71 mg 100^{-g}) was found in T_7 (enriched compost @ 5 t ha^{-1}). The effect of enriched compost on iron assimilation can be attributed to the organic carbon present in 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] on Indian spinach, which indicate that the addition of organic matter to soil increases the mineralization impact of soil and hence increases the uptake of micronutrients like iron. Similar outcomes were reported by Kavitha et al. [25] in relation to amaranthus and Jamoh [26] in relation to palak. The maximum protein content of 4.03 g 100^{-g} was recorded in T_7 (enriched compost @ 5 t ha^{-1}). The increase in protein content could be attributed to higher P and NH_4^+-N absorption, improved mineral uptake, and the synthesis of phytohormones such IAA and gibberellins due to the application of the compost [27]. Similar findings were reported by Sanwal et al. [28], Ravimycin [29], and Islam et al. [30] on coriander. Moreover, the highest ash content (4.12%) was recorded in T_5 (vermicompost @ 5 t/ha+ microbial consortium). This is ascribed to the higher proportion of non-combustible substances present in the organic treatment, as organic fertilizers 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.'s [14] results on cabbage and Gogoi et al.'s [6] results on Knolkhol.

4. Conclusions

The results of this 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 growth performance and quality of produce in comparison to the other treatments. Therefore, T_7 (enriched compost @ 5 t ha^{-1}) can be inferred as farmer-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 the other treatments (and thus its adoption can be taken into consideration under field conditions).

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are contained within the article.

Acknowledgments: The author is thankful to the Department of Horticulture, Assam Agricultural University, for the support extended in carrying out the lab and field work during the tenure of the research program.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Singletary, K. Coriander: Overview of potential health benefits. *Nutr. Today* **2016**, *51*, 151–161. [CrossRef]
2. Bhatt, M.K.; Labanya, R.; Joshi, H.C. Influence of long-term chemical fertilizers and organic manures on soil fertility—A review. *Univers. J. Agric.* **2019**, *7*, 177–188.
3. Arora, S.; Sahni, D. Pesticides effect on soil microbial ecology and enzyme activity—An overview. *J. Appl. Nat. Sci.* **2016**, *8*, 1126–1132. [CrossRef]
4. Sharma, M.; Reynnells, R. Importance of soil amendments: Survival of bacterial pathogens in manure and compost used as organic fertilizers. In *Preharvest Food Safety*; Thakur, S., Kalmia, K.E., Eds.; ASM Press: Washington, DC, USA, 2018; pp. 159–175.
5. Panse, V.G.; Sukhatme, P.V. *Randomized Design and Square and Factorial Experiment in Statistical Methods of Agricultural Workers*; ICAR: New Delhi, India, 1995.
6. Gogoi, P.; Phookan, D.B. Effect of organic inputs and microbial consortium on yield and quality of Knolkhol (*Brassica oleracea* L. var. *gongylodes*). *J. Pharmacogn. Phytochem.* **2017**, *6*, 365–368.
7. Mathukia, R.K.; Adhithi, M.V.; Hirapara, K.V.; Surya, P.R. Enhancing Coriander (*Coriandrum sativum* L.) Yield through Integration of Chemical Fertilizers, Enriched Compost and Biofertilizers. *Int. J. Curr. Microbiol. Appl. Sci.* **2020**, *9*, 1538–1545. [CrossRef]
8. Sakthivel, P.; Sujeetha, A.R.; Ravi, G.; Girish, A.G.; Chander, P. Effect of vermicompost with microbial bio inoculums on the growth parameter of coriander (*Coriandrum sativum* L.). *Int. J. Curr. Microbiol. Appl. Sci.* **2020**, *9*, 613–622. [CrossRef]
9. Chandran, D. Response of Chinese Cabbage (*Brassica campestris* ssp. *pekinensis*) to Organic Amendments. Master's Thesis, Assam Agricultural University, Jorhat, India, 2021.
10. Agathokleous, E.; Belz, R.G.; Kitao, M.; Koike, T.; Calabrese, E.J. Does the root to shoot ratio show a hormetic response to stress? An ecological and environmental perspective. *J. For. Res.* **2019**, *30*, 1569–1580. [CrossRef]
11. Bláha, L. Importance of Root-Shoot Ratio for Crops Production: A Review. *Curr. Top. Agric. Sci.* **2021**, *1*, 37–49.
12. Umlong, M.R. Growth, Yield and Quality of Carrot (*Daucus carota*) as Influenced by Organics and Lime. Master's Thesis, Assam Agricultural University, Jorhat, India, 2010.
13. Nayak, P.K.; Maji, S. Response of nutrient and cutting management for quality and green yield of Palak (*Beta vulgaris* var. *bengalensis*). *J. Crop Weed.* **2018**, *14*, 126–129.
14. Kumar, J.; Phookan, D.B.; Lal, N.; Kumar, H.; Sinha, K.; Hazarika, M. Effect of organic manures and biofertilizers on nutritional quality of cabbage (*Brassica oleracea* var. *capitata*). *J. Eco-Friendly Agric.* **2015**, *10*, 114–119.
15. Sharma, J.; Agarwal, S. Impact of organic fertilizers on growth, yield and quality of spinach. *Indian J. Plant Sci.* **2014**, *3*, 37–43.
16. Hazarika, P.; Phookan, D.B.; Barua, S. Performance of cauliflower as influenced by organic inputs and microbial consortium. *Indian J. Hortic.* **2017**, *74*, 75–79. [CrossRef]
17. Vethamoni, P.I.; Thampi, S.S. Effect of organic manuring practices on growth and yield of palak (*Beta vulgaris* var. *bengalensis* Hort.). *Int. J. Curr. Microbiol. Appl. Sci.* **2018**, *7*, 1855–1863. [CrossRef]
18. Gontijo, L.N.; da Silva, C.O.; Stort, L.G.; Duarte, R.M.T.; Betanho, C.; Tassi, E.M.M. Nutritional composition of vegetables grown in organic and conventional cultivation systems in Uberlndia, MG. *Afr. J. Agric. Res.* **2017**, *12*, 1848–1851.
19. Daniel, O.; Meier, M.S.; Schlatter, J.; Frischknecht, P. Select phenolic compounds in cultivated plants: Ecologic functions, health implications, and modulation by pesticides. *Environ. Health Perspect.* **1999**, *107*, 109–114. [PubMed]
20. Young, J.E.; Zhao, X.; Carey, E.E.; Welti, R.; Yang, S.S.; Wang, W. Phytochemical phenolics in organically grown vegetables. *Mol. Nutr. Food Res.* **2005**, *49*, 1136–1142. [CrossRef] [PubMed]
21. Premsekhar, M.; Rajashree, V. Influence of organic manures on growth, yield and quality of okra. *Am.-Eurasian J. Sustain. Agric.* **2009**, *3*, 6–8.
22. Shankar, K.S.; Sumathi, S.; Shankar, M.; Rani, K.U.; Reddy, N.N. Effect of organic farming on nutritional profile, quality characteristics and toxic parameters of amaranthus. *Indian J. Hortic.* **2013**, *70*, 378–382.
23. Jabeen, A.; Narayan, S.; Hussain, K.; Ahmed, S.M.; Khan, F.A. Effect of organic manures and biofertilizers on quality of spinach beet (*Beta vulgaris* var. *bengalensis*). *Int. J. Curr. Microbiol. Appl. Sci.* **2018**, *7*, 1312–1317. [CrossRef]
24. Roy, S.; Afsar, Z.; Kashem, A. Nutrient content of Indian spinach in saline soil as affected by different organic manures. *Int. J. Environ. Sci.* **2014**, *4*, 694–702.
25. Kavitha, S. Srinivasan and Ranjini. Individual and combined effect of biofertilizer, chemical fertilizer and vermicompost on *Amaranthus Tristis*. *Int. J. Pharm. Sci. Rev. Res.* **2013**, *20*, 190–195.
26. Jamoh, O. Performance of Palak (*Beta vulgaris* var. *bengalensis* Hort.) as Influenced by Organic Inputs, Microbial Consortium and Packaging Materials. Master's Thesis, Assam Agricultural University, Jorhat, India, 2021.
27. Verma, R.; Maurya, B.R.; Meena, V.S. Integrated effect of bio-organics with chemical fertilizer on growth, yield and quality of cabbage (*Brassica oleracea* var *capitata*). *Indian J. Agric. Sci.* **2014**, *84*, 914–919. [CrossRef]
28. Sanwal, R.C.; Singh, A.; Reager, M.L. Impact of vermicompost, nitrogen and phosphorus on yield, quality and uptake of coriander (*Coriandrum sativum* L.) under arid condition. *Int. J. Chem. Stud.* **2017**, *5*, 1698–1702.
29. Ravimycin, T. 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. Res.* **2016**, *3*, 91–98.

30. Islam, M.M.; Akther, S.M.; Sujon, S.A.; Karim, M.A.; Rahman, M.K. Effects of vermicompost and PK on growth and protein content of spinach (*Spinacia oleracia* L.). *Bangladesh J. Bot.* **2020**, *49*, 141–146. [CrossRef]
31. Sangma, T.T.A. Comparative Assessment of Biofertilizer Consortium on Garden Pea (*Pisum sativum* L.). Master's Thesis, Assam Agricultural University, Jorhat, India, 2015.