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Madhavan S
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Pragathi T
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Sharvesh S
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Corresponding Author:
Madhavan S
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Enhancing coriander (*Coriandrum sativum* L.) performance through sustainable organic practices

Madhavan S, Pragathi T and Sharvesh S

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Abstract

The present study, titled "Effect of Organic Manures on Growth and Seed Yield in Coriander (*Coriandrum sativum* L.), " was conducted during 2021-2023 in Sendurai village, Ariyalur District, Tamil Nadu, to evaluate the impact of various organic manures and bio-fertilizers on the growth and seed yield of coriander. The experiment followed a Randomized Block Design (RBD) with 13 treatments replicated three times, involving different combinations of vermicompost, sheep manure and cattle manure, along with Azospirillum and Azotobacter applied as seed treatments or soil applications. The best-performing treatment across all evaluated parameters was T_4 (Vermicompost 4 t/ha + Azospirillum and Azotobacter soil application). It recorded the earliest flowering (26.39 days) and earliest 50% flowering (41.72 days), indicating early crop establishment. T4 also showed the highest number of umbels per plant (18.74), maximum seeds per umbel (14.46) and highest number of seeds per umbellate (8.61), reflecting superior reproductive efficiency. In terms of yield, T4 achieved the highest seed yield per plant (8.12 g), per plot (1.07 kg) and per hectare (15.62 quintals), along with the highest test weight (9.62 g), suggesting excellent seed quality. Significant variations were observed among treatments across all growth parameters. The superior performance of T_4 could be attributed to improved nutrient availability and enhanced soil microbial activity due to the synergistic effects of vermicompost and bio-fertilizers. Overall, the study demonstrated that the application of vermicompost at 4 t/ha with Azospirillum and Azotobacter as a soil application (T_4) significantly enhanced the growth, development and yield of coriander, making it the most effective treatment among those evaluated.

Keywords: Coriander, vermicompost, biofertilizer, growth and flowering

Introduction

India, known as the "Land of Spices," is a major producer and exporter of spices, including coriander, which is cultivated primarily in Rajasthan and Madhya Pradesh, contributing about 80% of total production (Talukder *et al*., 2016; Dubey, 2017) [21, 5]. Coriander (*Coriandrum sativum* L.), an annual herb of the Apiaceae family, is valued for its aromatic seeds and nutrient-rich leaves, widely used in culinary and medicinal applications (Bhat *et al*., 2014) [1]. Organic farming, which enhances soil health through organic inputs like vermicompost and bio-fertilizers, is gaining prominence due to its eco-friendly nature and ability to improve crop yield (Charyulu and Dwivedi, 2017; Kaur *et al*., 2015) [2, 6]. Bio-fertilizers such as Azotobacter and Azospirillum help fix nitrogen, reducing reliance on chemical fertilizers and promoting sustainable spice production (Malhotra *et al*., 2006) [9]. This study aims to assess the effect of organic manures on coriander's growth and seed yield and identify the best manure combinations to optimize production.

Materials and Methods

The present study entitled "Effect of Organic Manures on Growth and Seed Yield in Coriander (*Coriandrum sativum* L.)" was carried out during 2021-2023 in Sendurai village, Ariyalur District, Tamil Nadu. The experiment followed a Randomized Block Design (RBD) with 13 treatments replicated three times. Treatments involved different combinations of vermicompost, sheep manure and cattle manure at varying rates, along with seed treatment or soil application of Azospirillum and Azotobacter. The treatments were as follows: T_1-Vermicompost 3 t/ha (Azospirillum + Azotobacter) Seed treatment, T_2-Vermicompost 3 t/ha (Azospirillum + Azotobacter) Soil application, T_3-Vermicompost 4 t/ha (Azospirillum

+ Azotobacter) Seed treatment, T_4-Vermicompost 4 t/ha (Azospirillum + Azotobacter) Soil application, T_5-Sheep manure 5 t/ha (Azospirillum + Azotobacter) Seed treatment, T_6-Sheep manure 5 t/ha (Azospirillum + Azotobacter) Soil application, T_7-Sheep manure 10 t/ha (Azospirillum + Azotobacter) Seed treatment, T_8-Sheep manure 10 t/ha (Azospirillum + Azotobacter) Soil application, T_9-Cattle manure 5 t/ha (Azospirillum + Azotobacter) Seed treatment, T_{10}-Cattle manure 5 t/ha (Azospirillum + Azotobacter) Soil application, T_{11}-Cattle manure 10 t/ha (Azospirillum + Azotobacter) Seed treatment, T_{12}-Cattle manure 10 t/ha (Azospirillum + Azotobacter) Soil application and T_{13}-Control. Each plot measured 2 m × 2 m, with a spacing of 20 cm × 15 cm, accommodating 130 plants per plot. Coriander seeds, collected from farmers' fields, exhibited bushy erect plants with dark shiny foliage, good plant vigor and dual-purpose utility. Before sowing, the seeds were rubbed to split into two halves and sown in furrows at a depth of 2-2.5 cm, followed by light irrigation. Organic manures were calculated according to treatment combinations and incorporated into the soil one week before sowing. Bio-fertilizers Azospirillum and Azotobacter were applied as per the treatment schedule at the time of sowing. Growth and seed yield parameters were recorded to assess the effects of organic manures and bio-fertilizers on coriander performance. The mean of five plants was taken for analysis. The data recorded were subjected to statistical analysis by adopting the standard procedure of Panse and Sukhatme (1985) [14]. The critical differences were arrived at 5 percent probability significance.

Result and Discussion

The data presented in Table 1 indicate significant variations among treatments regarding Other attributes related to yield *viz*., umbels plant^{-1}, umbellate umbel^{-1}, seeds umbellate^{-1} and yield (per plant, plot and hectare) were significantly affected by the application of organic manures and bio-fertilizers in coriander.

Flowering patterns also varied across treatments. The earliest flowering occurred in T_4 (26.39 days), with T_{12} (27.97 days) and T_6 (29.55 days) following, while T_{13} took the longest (45.28 days), succeeded by T_7 (43.71 days) and T_9 (42.15 days). The earliest 50% flowering was recorded in T_4 (41.72 days), followed by T_{12} (43.70 days) and T_6 (45.69 days), whereas T_{13} had the most delayed 50% flowering (65.48 days), with T_7 (63.50 days) and T_9 (61.53 days) closely behind. The enhanced flowering response observed with organic and bio-fertilizer treatments may be attributed to improvements in the soil environment, including physicochemical and biological conditions, which facilitated better nitrogen and phosphorus availability two key nutrients for plant growth and yield in coriander (Sanwal *et al*., 2022) [17]. These findings align with previous reports by Tripathi *et al*. (2019) [22] in coriander.

The highest number of umbels per plant was recorded in T_4 (18.74), followed by T_{12} (17.69) and T_6 (16.63), suggesting improved flowering with these treatments. The lowest number of umbels per plant was observed in T_{13} (5.99), followed by T_7 (7.06) and T10 (7.05). The result might be due to application of vermicompost with biofertilizers has improvement of biological activities of soil and mineral element absorption which, leads to more biomass production and subsequently enhanced number of umbels per plant. Darzi *et al*., (2015) [4] has suggested that, vermicompost increases the growth rate and yield attributing parameters through gradual mineralization, water and mineral uptake in coriander.

According to Sanwal *et al*. (2022) [17] report, in coriander the maximum umbels plant^{-1} might be accountable to lush vegetation development which leads to increase in number of umbellate umbel^{-1}, number of seeds umbellate^{-1} and seed yield.

The antibiotics, growth hormone and enzymes are available in vermicompost it may be factor for best results in coriander. This is in accordance to the findings of Choudhary and Jat (2004) [3] in fenugreek, Metha *et al.* (2007) [10] in Ajwain, Singh *et al.* (2012) [11], Sonali *et al.* (2012) [19] in fenugreek. Similar observations were reported by Mounika *et al*. (2017) [11] and Suman *et al*. (2018) [20] in coriander.

The maximum number of seeds per umbel was found in T_4 (14.46), followed by T_{12} (13.60) and T_6 (12.73), indicating better seed formation. The least number of seeds per umbel was recorded in T_{13} (3.97), followed by T_7 (4.84) and T_9 (5.70). The result might be due to the balanced nutrition of biofertilizers and organic manures in establishment of proliferous root system and higher absorption of nutrients and water with enhanced physical environment. Numbers of umbellate per umbel, were highest with the combine application of biofertilizers and organic manures. The present results are in close accordance with the findings of Darzi *et al*., (2015) [4] and Patidar *et al*., (2016) [15] in coriander.

The highest number of seeds per umbellate was observed in T_4 (8.61), followed closely by T_{12} (8.06) and T_6 (7.49). On the other hand, T_{13} recorded the lowest number of seeds per umbellate (1.81), with T_7 (2.39) and T_9 (2.96) following. This might be due to, number of seeds per umbel, of coriander influenced significantly due to various organic treatments. However, the progressive increase in yield attributing traits might be attributed to increase in growth parameters due to balance nutrition, which might have resulted in accelerating the photosynthetic activities and improved the sink. The present findings are in close conformity with the findings of Kumar *et al*., (2015) [7] in coriander.

Seed yield per plant was the highest in T_4 (8.12 g), with T_{12} (7.86 g) and T_6 (7.61 g) also showing good performance. The lowest seed yield per plant was observed in T_{13} (5.05 g), followed by T_7 (5.29 g) and T_9 (5.56 g). In terms of seed yield per plot, T_4 (1.07 kg) recorded the highest yield, followed by T_{12} (1.04 kg) and T_6 (1.01 kg). The lowest seed yield per plot was observed in T_{13} (0.67 kg), with T_7 (0.70 kg) and T_9 (0.73 kg) recording slightly higher values. Seed yield per hectare was also significantly higher in T_4 (15.62 q), followed by T_{12} (14.98 q) and T_6 (14.33 q), while T_{13} registered the lowest (7.90 q), followed by T_7 (8.54 q) and T_9 (9.17 q).

Table 1: Effect of organic manures and biofertilizers on flowering and yield attributes

Treatments	Days taken for first flowering (days)	Days taken for 50% flowering (days)	Number of umbels plant^{-1}	Number of seeds in umbellate (umbel^{-1})	Number of seeds umbellate^{-1}	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (kg)	Seed yield ha^{-1} (q)	Test weight (g)
T_1	40.58	59.55	9.20	3.51	6.57	5.81	0.77	9.83	4.58
T_2	31.14	47.67	15.56	6.91	11.85	7.37	0.98	13.67	7.94
T_3	35.85	53.61	12.38	5.23	9.21	6.55	0.87	11.75	6.26
T_4	26.39	41.72	18.74	8.61	14.46	8.12	1.07	15.62	9.62
T_5	39.00	57.56	10.27	4.10	7.46	6.05	0.80	10.48	5.13
T_6	29.55	45.69	16.63	7.49	12.73	7.61	1.01	14.33	8.51
T_7	43.71	63.50	7.06	2.39	4.84	5.29	0.70	8.54	3.45
T_8	34.29	51.62	13.45	5.78	10.10	6.82	0.90	12.40	6.81
T_9	42.15	61.53	8.12	2.96	5.70	5.56	0.73	9.17	4.02
T_{10}	32.71	49.97	7.05	6.36	10.98	7.07	0.94	13.04	7.36
T_{11}	37.41	55.59	11.33	4.66	8.34	6.31	0.83	11.12	5.70
T_{12}	27.97	43.70	17.69	8.06	13.60	7.86	1.04	14.98	9.07
T_{13}	45.28	65.48	5.99	1.81	3.97	5.05	0.67	7.90	2.90
S.Ed	0.70	0.97	0.38	0.21	0.37	0.11	0.01	-	0.25
CD (p=0.05)	1.40	1.94	0.76	0.43	0.75	0.22	0.03	-	0.50

The improved yield and yield components may be attributed to the balanced and readily available supply of essential nutrients. Enhanced plant height and the number of branches per plant likely contributed to increased photosynthetic activity and better translocation of photosynthates towards the sink organs (umbels and seeds). The favorable effect on yield attributes might also result from the improved availability of major, secondary and micronutrients due to vermicompost and bio-fertilizers, promoting better synthesis and partitioning of assimilates to sink tissues (Tripathi *et al*., 2013) [22] in coriander.

According to Munnu Singh *et al*. (2011) [12], the available phosphorus present in vermicompost may significantly contribute to increased seed yield in coriander. Kumari Pushpa *et al*. (2022) [8] reported a steady and higher availability of nutrients from vermicompost and bio-fertilizers throughout the crop growth period, resulting in improved seed yield in fenugreek. Similar findings were reported by Raghuwanshi *et al*. (2016) [16] and Verma *et al*. (2017) [23].

The highest test weight was observed in T_4 (9.62 g), followed by T_{12} (9.07 g) and T_6 (8.51 g), indicating better seed quality. Conversely, the lowest test weight was recorded in T_{13} (2.90 g), followed by T_7 (3.45 g) and T_9 (4.02 g). These findings are quite similar findings to that of present findings were reported by Yadav (2010) [24] and Nareshbhai (2019) [13] in coriander. An increase in the test weight of 1000 seeds might be due to increased supply of major plant nutrients.

Conclusion

The study clearly demonstrated that treatment T_4 (Vermicompost 4 t/ha + Azospirillum and Azotobacter soil application) was the most effective among all the treatments tested for coriander. T_4 consistently outperformed others by promoting early flowering, enhancing floral traits such as the number of umbels per plant, seeds per umbel, and seeds per umbellate, and significantly improving yield parameters including seed yield per plant, per plot, and per hectare. Additionally, it recorded the highest test weight, indicating superior seed quality. These results suggest that the application used in Vermicompost, Azospirillum and Azotobacter through soil application can be recommended as the best practice for maximizing growth, yield, and quality in coriander cultivation.

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