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# Influence of bioformulations and organic amendments on leafy coriander (*Coriandrum sativum L.*)

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**Abstract**

The present investigation was carried out during the Rabi season of 2024–25 at the farmers fieldsin Hardoi and Sultanpur, U.P. to assess the influence of organic nutrient sources and bioformulatios/biofertilizers on the physiological and biochemical characteristics of leafy coriander (*Coriandrum sativum L.*). The experiment was conducted in a Randomized Block Design comprising eleven treatments and three replications. Different combinations of recommended dose of fertilizers (RDF), farmyard manure (FYM), phosphate-solubilizing bacteria (PSB), potassium-solubilizing bacteria (KSB), Nitrogen Consortia, Bactobooster, EM Culture and Biofertisol were evaluated.

The findings indicated that the application of integrated nutrient management practices significantly enhanced the growth and quality attributes of coriander. Among the treatments, $T_5$ (75% RDF + PSB + KSB + Bactobooster) exhibited superior performance with respect to chlorophyll content index, leaf area index, leaf area duration, leaf biomass, stem biomass, vitamin C content and fiber content. The maximum protein content (2.63%) was recorded under $T_7$ (75% RDF + PSB + KSB + EM Culture), whereas $T_4$ (FYM + Nitrogen Consortia) produced the highest essential oil content (0.157%). The improved performance of these treatments may be attributed to better nutrient availability, enhanced microbial activity and increased photosynthetic efficiency resulting from the combined use of fertilizers and biofertilizers. The study demonstrated that integrating biofertilizers with reduced levels of chemical fertilizers can effectively improve the physiological and biochemical quality of leafy coriander while contributing to sustainable and environmentally friendly crop production.

**Keywords:** *Coriandrum sativum L*, integrated nutrient management, biofertilizers, physiological traits, biochemical attributes, vitamin C, protein, essential oil

## Introduction

India's tribunal system has repeatedly generated the same constitutional anxiety: bodies created to exercise judicial or quasi-judicial power have often remained administratively dependent on the executive departments whose decisions they review. The Supreme Court's tribunal jurisprudence—from S.P. Sampath Kumar and L. Coriander (*Coriandrum sativum L.*), a prominent annual herb belonging to the Apiaceae family, is cultivated in many parts of the world for its edible foliage and highly aromatic seeds. It is valued both as a leafy vegetable and a seed spice, making it one of the most important condiment crops. Fresh coriander leaves are extensively used in culinary preparations due to their characteristic flavor, aroma, and nutritional value. The crop is rich in vitamins, minerals, antioxidants, essential oils, and other bioactive compounds that contribute to human health. In addition to its nutritional significance, coriander possesses several pharmacological properties, including antioxidant, antimicrobial, anti-inflammatory, and cardioprotective effects (Mahleyuddin *et al*., 2021; Laribi *et al*., 2015) [14, 15].

The growing demand for safe, nutritious, and residue-free food has increased the need for sustainable production practices that enhance crop growth, yield, and quality while minimizing environmental impacts. Conventional agriculture has largely depended on synthetic fertilizers to improve productivity; however, their excessive and continuous use has led to soil degradation, nutrient imbalance, environmental pollution, and reduced microbial diversity (Bai *et al*., 2020; Bisht and Singh Chauhan, 2021). These concerns have encouraged the adoption of environmentally friendly nutrient management approaches that support both crop productivity and soil health [2].

Among such approaches, organic nutrients and biofertilizers have gained considerable attention as sustainable alternatives to chemical fertilizers. Organic amendments improve soil fertility, structure, and water-holding capacity, while biofertilizers containing beneficial microorganisms enhance nutrient availability through processes such as nitrogen fixation and phosphorus solubilization. They also stimulate plant growth by improving root development and microbial activity in the rhizosphere (Vessey, 2003; Bhattacharyya and Jha, 2012). The integrated use of organic nutrients and biofertilizers has the potential to improve vegetative growth, yield, and quality of coriander while reducing dependence on synthetic inputs. This integrated approach mirrors successful yield improvements and economic benefits observed when applying bio-inoculants to other multipurpose herbs (Husain *et al*., 2022) [3, 4, 8].

Despite their recognized benefits, information regarding the combined effects of organic nutrient sources and biofertilizers on leafy coriander remains limited under different agro-climatic conditions. Therefore, the present study was undertaken to evaluate the effect of organic nutrients and biofertilizers on the growth attributes, yield, and quality of leafy coriander (*Coriandrum sativum L*.). The findings are expected to contribute to the development of sustainable nutrient management practices for enhancing coriander productivity and quality while maintaining environmental sustainability. [23]

## Materials and Methods

### Study Site and Soil Characteristics

The field experiment was conducted during the Rabi season of 2024–25. The experimental field featured well-drained, medium-black Vertisol soil. Pre-sowing soil analysis revealed a non-saline, slightly alkaline profile (pH 7.28; electrical conductivity 0.25 dS $m^{-1}$). The organic carbon content was categorized as low to medium (4.25 g $kg^{-1}$). Available nitrogen (258.76 kg $ha^{-1}$) and potassium (257.27 kg $ha^{-1}$) levels were medium, while available phosphorus was low (10.08 kg $ha^{-1}$). Overall, the moderate soil fertility provided an appropriate environment for testing integrated nutrient management techniques.

### Experimental Design and Crop Sowing

The trial was laid out in a Randomized Block Design (RBD) comprising 11 treatments, each replicated three times. The coriander cultivar 'PANT HARITMA' was sown using a standardized spacing of 30 cm × 10 cm.

Pant Haritma (also known as PD-1**)** is a high-yielding, dual-purpose coriander (*Coriandrum sativum*) variety cultivated for both lush green leaves and quality seed production.

### Key Characteristics & Yields

- **Plant & Leaves:** Tall, vigorous plants (up to 1.5 meters) with 8–9 primary branches featuring dark green, aromatic, and essential oil-rich leaves.
- **Maturity & Harvest:** Reaches full seed maturity in 150–160 days, alongside early green leaf cuttings.
- **Yield Potential:** Generates roughly 125–140 quintals of leaves per hectare and 15–18 quintals of seeds per hectare.
- **Disease Tolerance:** Exhibits strong resistance to stem gall caused by *Protomyces macrosporus*.

### Treatment Details

The study assessed various combinations of the Recommended Dose of Fertilizer (RDF at 60:60:30 kg NPK $ha^{-1}$), Farm Yard Manure (FYM), and several bio-inoculants.

**Table 1:** The specific treatments were as follows

| Treatment | Description |
|---|---|
| T1 | 100% RDF via chemical fertilizers (60:60:30 kg NPK/ha) |
| T2 | FYM @ 30 t/ha |
| T3 | 75% RDF + PSB & KSB @ 5 L/ha (basal) + Nitrogen consortia @ 5 L/ha (after each cut) |
| T4 | FYM (basal) + Nitrogen consortia @ 5 L/ha (after each cut) |
| T5 | 75% RDF + PSB & KSB @ 5 L/ha (basal) + Bactobooster @ 2.5 L/ha (after each cut) |
| T6 | FYM (basal) + Bactobooster @ 2.5 L/ha (after each cut) |
| T7 | 75% RDF + PSB & KSB @ 5 L/ha (basal) + EM Culture @ 5 L/ha (after each cut) |
| T8 | FYM (basal) + EM Culture @ 5 L/ha (after each cut) |
| T9 | 75% RDF + PSB & KSB @ 5 L/ha (basal) + Biofertisol @ 2.5 L/ha (after each cut) |
| T10 | FYM (basal) + Biofertisol @ 2.5 L/ha (after each cut) |
| T11 | Absolute Control |

### Nutrient Management Protocol

Following the final land preparation, FYM was incorporated at a rate of 30 t/ha according to the assigned treatment schedules. Chemical fertilizers were supplied using urea, diammonium phosphate (DAP), and muriate of potash (MOP) to meet the RDF requirements. A basal application consisting of 100% of the required phosphorus and potassium, along with 50% of the nitrogen, was administered at sowing. The remaining 50% of the nitrogen was top-dressed 30 days after sowing (DAS). For treatments involving bio-fertilizers, soil drenching with phosphate-solubilizing bacteria (PSB) and potassium-solubilizing bacteria (KSB) was performed following seed germination.

### Harvesting Methodology

Foliage was manually harvested using a sickle once the plants reached an optimal height of 20 to 25 cm, ensuring premium market quality and maximizing yield. Careful cutting techniques were used to prevent damage to the basal stems, encouraging uniform regrowth for subsequent cuts. Immediately after harvesting, the fresh leaves were tied into small rope bundles to streamline handling, transport, market presentation, and subsequent data recording.

Quality traits, including vitamin C, protein, fiber, and essential oil contents, were analyzed following the standardized methodologies of AOAC (1965) and Ranganna (1986). Finally, the recorded experimental data were subjected to an Analysis of Variance (ANOVA) as outlined by Fisher (1967) to determine statistical significance [1, 7, 21].

## Results and Discussion

### 1. Physiological Attributes

### 1.1 MChlorophyll Content Index (SPAD)

The chlorophyll content index of coriander was significantly affected by different nutrient management treatments at all growth stages. The highest SPAD value at 30 DAS (17.63) was recorded under $T_7$ (75% RDF + PSB + KSB + EM Culture), while at 60 and 90 DAS, $T_5$ (75% RDF + PSB + KSB + Bactobooster) recorded the maximum values of 35.23 and 16.38, respectively. The lowest chlorophyll content was consistently observed in the control treatment ($T_{11}$). Overall, integrated nutrient management treatments produced higher chlorophyll content than sole fertilizer application and control.

The increase in chlorophyll content under integrated nutrient treatments may be attributed to improved nutrient

availability and enhanced microbial activity, which promoted chlorophyll synthesis and photosynthetic efficiency. Combining biofertilizers with reduced RDF improved plant nutrition and physiological performance, resulting in greater chlorophyll accumulation. Such enhancements in photosynthetic activity and overall plant vigor following the application of PSB and KSB were similarly highlighted by Husain *et al.* (2022) in their evaluation of fenugreek. Similar findings have been reported by Chaudhary *et al.* (2021), Tripathi *et al.* (2013), and Meena *et al.* (2020), who observed higher chlorophyll content in coriander under integrated nutrient management practices [5, 8, 17, 22].

### 1.2 Leaf Area Index (LAI)

The leaf area index (LAI) of coriander was significantly affected by various nutrient management treatments throughout the crop growth period. LAI increased from 30 DAS to 60 DAS and subsequently declined at 90 DAS as the crop approached maturity. Among all treatments, $T_5$ (75% RDF + PSB + KSB + Bactobooster) produced the highest LAI values of 0.24, 0.94 and 0.36 at 30, 60 and 90 DAS, respectively, whereas the control treatment recorded the lowest values. The superior LAI under integrated nutrient management treatments indicated enhanced leaf development and greater canopy coverage, which contributed to increased photosynthetic activity.

The improvement in LAI under $T_5$ may be attributed to the synergistic effect of chemical fertilizers and beneficial microorganisms, which improved nutrient availability and uptake. Enhanced root activity and better utilization of nutrients promoted leaf expansion and overall vegetative growth. Similar observations were reported by Patidar *et al.* (2016), Kumar *et al.* (2019) and Jini *et al.* (2023), who noted significant improvements in leaf area and plant growth under integrated nutrient management practices in coriander [10, 11, 20].

### 1.3 Leaf Area Duration (LAD)

Significant differences in leaf area duration (LAD) were observed among the treatments during both 30–60 DAS and 60–90 DAS intervals. Treatment $T_5$ recorded the maximum LAD values of 17.63 and 19.51 during the respective periods, while lower values were observed under $T_3$ and the control treatment. The higher LAD values indicated a longer persistence of photosynthetically active leaf area, enabling the crop to maintain higher photosynthetic efficiency over a prolonged period.

The enhanced LAD under integrated nutrient management treatments could be due to sustained nutrient supply and improved microbial activity, which delayed leaf senescence and maintained healthy foliage for a longer duration. This resulted in continuous assimilate production and improved crop growth. Comparable findings were reported by Jhankar *et al.* (2017), Kumar *et al.* (2019) and Jini *et al.* (2023) in coriander [9, 10, 11].

**Table 2:** Effect of Organic Nutrient and Biofertilizers on Physiological Parameters of Leafy Coriander (*Coriandrum sativum L.*)

| Treatment | Chlorophyll content index | | | Leaf area Duration (LAD) | | Leaf area Index | | |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 30-60 DAS | 60-90 DAS | 30 DAS | 60 DAS | 90 DAS |
| T1 | 16.58 | 34.77 | 15.46 | 16.39 | 17.15 | 0.17 | 0.92 | 0.22 |
| T2 | 16.38 | 35.03 | 14.82 | 16.84 | 18.53 | 0.19 | 0.93 | 0.31 |
| T3 | 15.54 | 34.02 | 15.74 | 13.26 | 15.5 | 0.15 | 0.74 | 0.3 |
| T4 | 15.95 | 31.74 | 14.78 | 17.23 | 18.85 | 0.22 | 0.93 | 0.33 |
| T5 | 16.89 | 35.23 | 16.38 | 17.63 | 19.51 | 0.24 | 0.94 | 0.36 |
| T6 | 15.52 | 33.89 | 14.84 | 14.27 | 16.9 | 0.13 | 0.82 | 0.3 |
| T7 | 17.63 | 32.26 | 15.76 | 16.24 | 18.44 | 0.19 | 0.89 | 0.34 |
| T8 | 15.88 | 31.03 | 16.06 | 15.01 | 16.72 | 0.2 | 0.8 | 0.31 |
| T9 | 15.59 | 33.75 | 15.49 | 15.02 | 15.95 | 0.22 | 0.78 | 0.28 |
| T10 | 16.32 | 31.37 | 14.53 | 14.45 | 15.8 | 0.2 | 0.76 | 0.29 |
| T11 | 14.31 | 30.57 | 14.17 | 13.72 | 16.54 | 0.12 | 0.79 | 0.31 |
| SEm ± | 0.47 | 0.56 | 0.41 | 0.21 | 0.25 | 0.01 | 0.01 | 0.01 |
| CD @ 5% | 1.38 | 1.65 | 1.21 | 0.61 | 0.74 | 0.02 | 0.04 | 0.02 |
| CV | 5.04 | 2.93 | 4.66 | 2.3 | 2.53 | 5.11 | 2.57 | 4.72 |

### 1.4 Leaf Biomass Weight

Leaf biomass accumulation was significantly influenced by the different nutrient management treatments at all growth stages. The highest leaf biomass was recorded under $T_5$, with values of 0.057 g, 4.67 g and 2.71 g at 30, 60 and 90 DAS, respectively. Treatments receiving organic manures and biofertilizers along with inorganic fertilizers generally produced greater leaf biomass than the control. The control treatment consistently recorded the lowest biomass accumulation.

The greater leaf biomass under $T_5$ may be attributed to improved nutrient uptake, increased chlorophyll content, and enhanced photosynthetic capacity. The beneficial effects of biofertilizers on nutrient solubilization and availability likely contributed to higher dry matter production. This synergistic effect of inorganic and bio-inoculant combinations on dry matter accumulation is well-supported by Husain *et al.* (2022). Similar results were reported by Rathore *et al.* (2018), Patidar *et al.* (2016) and Kumar *et al.* (2022), who observed increased biomass production in coriander under integrated nutrient management systems [8, 20].

### 1.5 Stem Biomass Weight

Stem biomass was also significantly affected by nutrient management practices. The highest stem biomass values of 0.057 g, 5.17 g and 3.90 g at 30, 60 and 90 DAS, respectively, were obtained under $T_5$. In contrast, the control treatment recorded the lowest stem biomass throughout the growth period. Integrated nutrient treatments were generally superior to individual nutrient applications in promoting stem growth and dry matter accumulation.

The enhanced stem biomass under $T_5$ may be due to improved nutrient availability and efficient translocation of

photosynthates within the plant. The combined application of fertilizers and biofertilizers likely created favourable soil conditions that supported better root growth and nutrient absorption, ultimately leading to greater stem development. Similar findings were documented by Meena *et al*. (2017), Patel *et al*. (2018) and Kumar *et al*. (2019) [11, 16].

### 1.6 Leaf–Stem Ratio

The leaf–stem ratio varied significantly among treatments and showed a declining trend with crop age. The highest ratio at 30 DAS was observed under $T_2$ and $T_4$ (1.17), while $T_9$ recorded the highest value (1.17) at 60 DAS. At 90 DAS, $T_2$ maintained the highest leaf–stem ratio of 0.79. The lowest ratios were consistently recorded in the control treatment. These results suggest that nutrient management practices influenced the distribution of dry matter between leaves and stems.

The higher leaf–stem ratio observed under FYM-based and integrated nutrient treatments indicates a greater allocation of assimilates towards leaf production, which is advantageous in leafy coriander where leaves constitute the economic yield. Improved nutrient availability and microbial activity may have enhanced leaf growth relative to stem growth. The reduction in leaf–stem ratio at later stages could be associated with increased stem thickening and plant maturation. Similar results were reported by Choudhary *et al*. (2021) and Kumar *et al*. (2022), who observed improved leaf development and favourable biomass partitioning under integrated nutrient management practices.

**Table 3:** Effect of Organic Nutrient and Biofertilizers on Physiological Parameters of Leafy Coriander (*Coriandrum sativum L*.)

| Treatment | Leaf biomass weight (g) | | | Stem biomass weight (g) | | | Leaf – Stem Ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| T1 | 0.043 | 2.27 | 1.49 | 0.047 | 2.43 | 2.99 | 0.81 | 0.87 | 0.5 |
| T2 | 0.047 | 2.16 | 2.3 | 0.037 | 2.41 | 2.89 | 1.17 | 0.94 | 0.79 |
| T3 | 0.047 | 2.28 | 1.87 | 0.047 | 2.56 | 3.03 | 1 | 0.89 | 0.62 |
| T4 | 0.037 | 2.7 | 1.72 | 0.047 | 2.97 | 2.77 | 1.17 | 0.91 | 0.62 |
| T5 | 0.057 | 4.67 | 2.71 | 0.057 | 5.17 | 3.9 | 1 | 0.9 | 0.69 |
| T6 | 0.033 | 3.97 | 1.87 | 0.043 | 4.11 | 2.85 | 1 | 0.97 | 0.66 |
| T7 | 0.047 | 2.42 | 2.08 | 0.047 | 2.77 | 2.77 | 1 | 0.87 | 0.75 |
| T8 | 0.037 | 2.67 | 2.04 | 0.047 | 2.84 | 2.87 | 0.78 | 0.94 | 0.71 |
| T9 | 0.047 | 2.31 | 1.72 | 0.053 | 2.63 | 2.48 | 0.85 | 1.17 | 0.69 |
| T10 | 0.043 | 2.43 | 1.96 | 0.043 | 2.36 | 2.74 | 1 | 1.02 | 0.72 |
| T11 | 0.033 | 2.11 | 1.18 | 0.033 | 2.07 | 2.4 | 0.77 | 0.82 | 0.49 |
| SEm ± | 0.003 | 0.16 | 0.07 | 0.003 | 0.12 | 0.05 | 0.07 | 0.08 | 0.03 |
| CD @ 5% | 0.01 | 0.48 | 0.21 | 0.01 | 0.36 | 0.14 | 0.2 | 0.22 | 0.09 |
| CV | 13.635 | 10.32 | 6.42 | 12.817 | 7.12 | 2.94 | 12.21 | 14.06 | 8.03 |

## 2. Biochemical Attributes

### 2.1 Vitamin C Content

A significant effect of different nutrient management treatments on vitamin C content of coriander leaves was observed at all three cuttings. The highest vitamin C concentration was recorded under $T_5$ (75% RDF + PSB + KSB + Bactobooster), which produced 141.67, 91.67 and 81.33 mg/100 g during the first, second and third cuttings, respectively. Treatments $T_7$ and $T_3$ also recorded comparatively higher vitamin C levels, whereas the lowest values were generally observed under $T_2$ and the control treatment. A decreasing trend in vitamin C content was noticed with successive cuttings across all treatments.

The enhanced vitamin C content under $T_5$ may be attributed to improved nutrient availability and greater metabolic activity resulting from the combined application of inorganic fertilizers and biofertilizers. Increased nutrient uptake and improved photosynthetic efficiency may have stimulated ascorbic acid synthesis in the leaves. The reduction in vitamin C content during later cuttings could be associated with physiological maturity and depletion of nutrient reserves within the plants. Similar results have been reported by Singh *et al*. (2018), Patidar and Mali (2019), Yadav *et al*. (2022) and Kumari *et al*. (2020), who observed improvements in vitamin C content under integrated nutrient management systems [11, 13, 24].

### 2.2 Protein Content (%)

Protein content was significantly affected by various nutrient management treatments. Among all treatments, $T_7$ (75% RDF + PSB + KSB + EM Culture) recorded the highest protein content (2.63%), followed by $T_9$ (2.27%) and $T_8$ (2.13%). The minimum protein content was observed under $T_2$ (1.60%), while the control treatment recorded 1.88%. The findings indicate that the integration of chemical fertilizers with biofertilizers was more effective in enhancing protein accumulation than the application of individual nutrient sources alone.

The increase in protein content under $T_7$ may be due to enhanced nitrogen fixation, phosphorus solubilization and microbial activity in the rhizosphere. Nitrogen is a key component of amino acids and proteins; therefore, its increased availability promotes protein synthesis in plant tissues. The beneficial effects of EM culture may have further enhanced nutrient assimilation and nitrogen metabolism, leading to greater protein accumulation. Similar observations were reported by Yamuna *et al*. (2022) and Mishra *et al*. (2020), who documented higher protein content in crops receiving integrated nutrient management treatments [18, 25].

### 2.3 Essential Oil Content

Essential oil content of coriander leaves varied significantly among the different nutrient management treatments. The highest essential oil content (0.157%) was recorded under $T_4$ (FYM + Nitrogen Consortia), which was statistically comparable with $T_3$ (0.137%) and $T_2$ (0.130%). The lowest essential oil content (0.013%) was observed under the control treatment. In general, treatments supplemented with organic manure and microbial inoculants recorded higher essential oil percentages than untreated plants.

The increased essential oil content under $T_4$ may be associated with improved nitrogen nutrition and enhanced microbial activity, which stimulate the production of secondary metabolites responsible for aroma and flavour. Organic manure and microbial inoculants improve plant vigour and metabolic efficiency, thereby promoting the synthesis and accumulation of essential oil constituents. Similar findings were reported by Sharma *et al*. (2016), Verma *et al*. (2019) and Kumar *et al*. (2020), who observed increased essential oil content in aromatic crops following the application of organic and biological nutrient sources [11, 12].

### 2.4 Fiber Content

The fiber content of coriander leaves was significantly influenced by nutrient management practices. The highest fiber content (2.70%) was recorded in $T_5$ (75% RDF + PSB + KSB + Bactobooster), followed by $T_{10}$ (2.03%) and $T_9$ (1.90%). The lowest fiber content (0.90%) was observed under the control treatment. The results clearly indicate that integrated nutrient management enhanced fiber accumulation compared to untreated plants and individual nutrient applications.

The higher fiber content recorded under $T_5$ may be attributed to improved plant growth and enhanced synthesis of structural carbohydrates such as cellulose and lignin. Balanced nutrient availability and increased microbial activity may have promoted stronger cell wall development and tissue maturation, resulting in greater fiber deposition. On the other hand, nutrient-deficient plants under the control treatment exhibited reduced vegetative growth and lower structural development, which led to lower fiber content. Similar findings were reported by Pandey *et al*. (2018) and Das *et al*. (2021), who observed increased fiber accumulation in leafy vegetables under integrated nutrient management practices [6, 19].

**Table 4:** Effect of Organic Nutrient and Biofertilizers on Quality Parameters of Leafy Coriander (*Coriandrum sativum L*.)

| Treatments | Vitamin C (mg/100 g) | | | Protein % | Essential oil % | Fiber content % |
|---|---|---|---|---|---|---|
| | 1st cutting | 2nd cutting | 3rd cutting | | | |
| T1 | 115.00 | 85.00 | 68.33 | 2.07 | 0.067 | 0.96 |
| T2 | 110.00 | 65.33 | 51.67 | 1.90 | 0.130 | 0.92 |
| T3 | 133.00 | 73.33 | 57.67 | 2.53 | 0.137 | 1.63 |
| T4 | 130.33 | 70.00 | 68.33 | 1.96 | 0.157 | 1.47 |
| T5 | 141.67 | 91.67 | 81.33 | 2.13 | 0.097 | 2.70 |
| T6 | 125.00 | 78.00 | 73.00 | 1.60 | 0.073 | 1.04 |
| T7 | 136.33 | 86.00 | 78.33 | 2.63 | 0.030 | 1.62 |
| T8 | 122.33 | 66.67 | 62.67 | 2.13 | 0.027 | 1.14 |
| T9 | 127.33 | 74.33 | 63.33 | 2.27 | 0.023 | 1.90 |
| T10 | 120.00 | 78.67 | 68.67 | 1.92 | 0.027 | 2.03 |
| T11 | 113.00 | 69.00 | 61.67 | 1.88 | 0.013 | 0.90 |
| SE ± | 2.26 | 2.74 | 3.59 | 0.07 | 0.004 | 0.05 |
| CD @ 5% | 6.68 | 8.10 | 10.59 | 0.20 | 0.012 | 0.15 |
| CV | 3.14 | 6.24 | 9.31 | 5.61 | 10.152 | 5.86 |

## Conclusion

The present study revealed that organic nutrients and bioformulations/biofertilizers significantly improved the physiological and biochemical performance of leafy coriander. Among the treatments, $T_5$ (75% RDF + PSB + KSB + Bactobooster) was the most effective in enhancing chlorophyll content, leaf area development, biomass production, vitamin C and fiber content, while $T_7$ recorded the highest protein content and $T_4$ produced the maximum essential oil content. The results indicate that integrated nutrient management involving biofertilizers with reduced chemical fertilizers can improve crop quality and productivity while supporting sustainable coriander cultivation.

## Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and Chat GPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

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