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EFFECT OF VARIOUS ORGANIC FERTILIZERS ON THE GROWTH AND YIELD PERFORMANCE OF CORIANDER (CORIANDRUM SATIVUM L.)

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Abstract
Organic food produced through the application of organic fertilizers plays a vital role in promoting human health and sustainable agriculture. This study was conducted at the Institute of Biological Sciences, Gomal University, Dera Ismail Khan, Pakistan, to evaluate the effects of different organic fertilizers on the growth and yield performance of coriander (Coriandrum sativum L.). The experiment followed a Completely Randomized Design (CRD) with three biological replicates. Organic fertilizers, including manure and compost, were applied to experimental plots, while one plot was maintained as a control. Data were collected for various growth parameters such as days to germination, number of leaves per branch, branch length, leaf area, and total chlorophyll content. Statistical analysis revealed that organic fertilizers significantly influenced all studied traits. Plants treated with manure germinated earliest (13 days) and exhibited the highest mean values for number of leaves per branch (8.31), branch length (14.66 cm), and leaf area (9.3 cm²). Chlorophyll content also varied among treatments, with manure-treated plants showing the highest value (12.49), followed by the control (9.75), while compost-treated plants showed the lowest (9.04). Based on these findings, manure fertilizer was identified as the most effective organic amendment for enhancing the growth and yield of coriander under the tested conditions and is therefore recommended for cultivation in similar agro-climatic regions.

Introduction

Coriander *(Coriandrum sativum)* is one of the most important spices and medicinal plants belonging to the family Apiaceae. The coriander plant originated from the Mediterranean region, mostly cultivated in South Asian countries, and also cultivated in high mountains in the Middle Eastern Europe and Southeast Africa regions. It is an annual herb and a cool-season crop used as a spice in the kitchen. It is mostly grown for its fruit and green leaves to provide flavour in dishes. Green leaves are good for Vitamin C and are used for making soups and sauces (Nadeem et al., 2013).

It can be grown on a variety of soils and prefers light, well-drained, moist loamy soil and can also grow on heavy black soil. India is the major producing country; other major countries that export the coriander crop include the United States of America, Indonesia, Sri Lanka and Singapore. United Kingdom, Middle East, Germany and South East Asia (Diederichsen et al., 2020). In Pakistan, it is produced in Punjab and KPK, including Nowshera, Swabi, Charsadda, Mardan and Peshawar.

It provides a significant amount of Dietary fibre, Calcium, Selenium, Iron, Magnesium and Manganese per 100 grams. The most used part of coriander plants are their fruits which have essential oils and are used in cosmetics, medicine, and spice industries, and their fresh and dry leaves are used as spices and vegetables, also its grounded mature fruits are directly used as spices (Kiczorowska et al., 2015; Imankulova et al., 2020). There are 0.03– 2.7% essential oils in matured coriander fruits. The most important component of essential oil is linalool, which is almost 50 to 70% of the whole essential oil compounds in a coriander plant. The essential oils obtained from the fruits are used in food, alcohol, and cosmetic industries. Additionally, the essential oils of coriander have antibacterial, antioxidant, antidiabetic, antidepressant, antifungal, antihypertensive, anticancer, improving memory, antimutagenic and diuretic effects (Maroufi et al., 2010; Rajeshwari and Andallu, 2011).

Organic fertilizer plays an important role in nutrient availability without having undesirable effects on the environment. Organic fertilizer enhances the vegetative and reproductive growth of the plant, such as Plant height, shoot length, number of leaves, fresh biomass and dry biomass. Organic fertilizer enhances the availability of N, P, K and other essential nutrients, which play an important role in the growth and development of plants (Sing et al., 2020). It is a superficial soil nutrient source providing the best amount of nutrients to the crop and preventing nutrient imbalances. Organic manures are natural products used by farmers to provide food (plant nutrients) for the crop plants, such as farmyard manure, green manures, compost prepared from crop residues and other farm wastes, animal bones, slaughterhouse refuse, etc. Organic manure can reduce the soil pH and enhance electrical conductivity and nutrient absorption (Chen et al., 2020). The importance of organic fertilizers for getting high yields from medicinal and aromatic plants has been reported in several studies. The demand for organic products has been continuously increasing all over the world, including Pakistan (Mehmood et al., 2017; Raza et al., 2024). For this reason, the use of organic and microbial fertilizers is being considered seriously all around the world. However, there are very few studies about the effects of organic fertilizers on medicinal and aromatic plants. Hence, this research determined how organic doses change the growth and yield of coriander.

Material & Method Experimental design

The experiment was conducted in a Completely Randomized Design (CRD). First, three plots were prepared (two for fertilizers and one for the control group). Manure was applied to one plot, compost was applied to the second plot, and

nothing was added in the third plot. An organic fertilizer (250g) was added to the soil only once. After fertilization, the seed was sown in the soil (30 seeds for each plot). Watering daily and observing the growth difference in both samples.

Soil analysis

Soil analysis was done to study soil nutrient status like pH, density, electrical conductivity, soil texture, soil moisture content and Organic Matter. Soil samples were analyzed before fertilization in the laboratory of the Faculty of Agriculture, Gomal University, D.I. Khan. The soil pH was determined according to the method of Thomas (1996). Soil electrical conductivity (EC) is a measure of the amount of salts in soil (salinity of soil). It is an excellent indicator of nutrient availability and loss, soil texture, and available water capacity. Soil electrical conductivity was determined by the method of Nadler et al. (1980). The electrical conductivity of the soil was measured by taking a 20 g soil sample and making a saturated paste of the soil and deionized water. Water was extracted and checked for its conductivity using the conductivity meter. The conductivity of the analyzed soil sample was 0.7 µS/cm.

Soil texture analysis

Soil texture refers to the proportion of sand, silt, and clay-sized particles that make up the mineral fraction of the soil. Light soil refers to a soil high in sand relative to clay, while heavy soils are made up largely of clay. Soil texture was determined according to the method of Mwendwa (2022). The soil texture was calculated by using the following formulas.

1. % silt + clay = reading after 40sec / amount of soil x 100
2. % clay = reading after 2 hours / amount of soil x 100
3. % silt = (% silt + clay) - % clay
4. % sand = 100 – (% silt + % clay)

The soil texture of the analyzed soil sample was % clay = 20%

Soil organic matter analysis

Soil organic matter represents the remains of roots, plant material and soil organisms in various stages of decomposition and synthesis and is variable in composition. Organic matter has a major influence on soil aggregation, nutrient reserve and its availability, moisture retention and biological activity. Soil organic matter was analyzed by the method of Kögel-Knabner (2000). The organic matter of the soil sample was calculated by the following formula;

% organic matter (w/w) = 1.724 x total organic carbon

The amount of total organic carbon in the analyzed soil was 0.83

% organic matter (w/w) = 1.724 x 0.83

% organic matter (w/w) = 1.43

Measurement of growth and yield-related parameters

Growth and yield-related parameters determined in this study were:

1. Days to germination
2. Number of leaves in branch^{-1}
3. Length of branches
4. Leaf area
5. Chlorophyll content

Statistical analysis

All data collected was subjected to Statistics v.8.1 for tabular and graphical presentation.

Results & Discussion Soil characterization

Different parameters of soil showed that pH was 8, density = 17, electrical conductivity 0.7 µS/cm, Clay 20%, Silt 30% and Sand = 50%. Moisture contents were 35.4% while organic matter was 1.43%

Table 1: Properties of soil determined in this study.

Soil's Properties	Values
pH	8
Density	17
Electrical Conductivity	0.7 µS/cm
Soil Texture	Clay = 20%, Silt = 30%, Sand = 50%
Moisture Content	35.4%
Organic Matter	1.43%

Days to germination

Data on days to germination are presented in Table 2). Statistical analysis of the data showed that manure significantly affected the days of germination. Late germination (15.25) occurred in the control group, which is statistically similar to the plot of compost plot (15.75), while early germination (13.2) occurred in fertilizer fertilizer-treated plot. The plants of the manure sample produced seedlings 3 to 4 days earlier than the control group and compost (Fig. 1). These results are also confirmed by Moghaddam and Mahallati (2016), who reported that organic manure can accelerate seed germination and also improve their percentage.

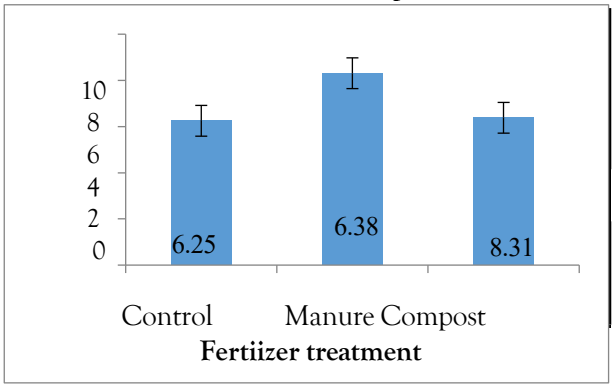

Fig. 1 Day to germination in response to fertilizer treatment.

Number of leaves in branch^{-1}

Statistical analysis of the data (Table 2) showed that organic manure significantly affected the number of leaf branches. A large number of leaves branch^{-1} (8.31) was recorded in the manure plot while a small number of leaves branch^{-1} (6.38) was

recorded in the compost plot which was statistically similar to the number of leaves branch^{-1} (6.25) in the control group plot (Fig. 2). The more number of leaves branch^{-1} was recorded in the manure plot, possibly due to higher availability of nitrogen due to manure application. The increase in the number of leaves in branch^{-1} with the application of organic manure is also in agreement with Khalid (2012), who reported that manure contains more nitrogen than plant nutrients, which improves growth and provides plant nutrients under stress conditions. Zandvakili *et al.* (2019) reported that cow manure provides enough nutrients to increase the number of leaves in lettuce, which accelerates leaf growth.

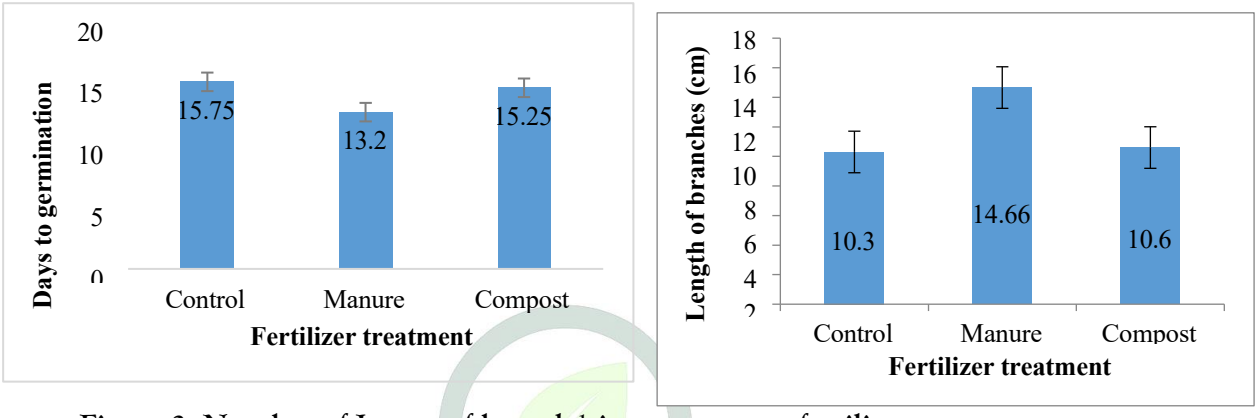

Figure 2: Number of Leaves of branch^{-1} in response to fertilizer treatment.

Length of branches

The plant length data are presented in Table 2, Fig. 3. Statistical analysis of the data showed that the significantly affected the length of branches. The branches of the control group were shorter in length (10.3 cm while the branches of the compost sample were longer (10.6 cm). The length of the branches of the manure sample was the largest. Our results are from Ahmad et al. (2017), who showed that both the length of branches and the yield of coriander are significantly improved by the application of organic fertilizers.

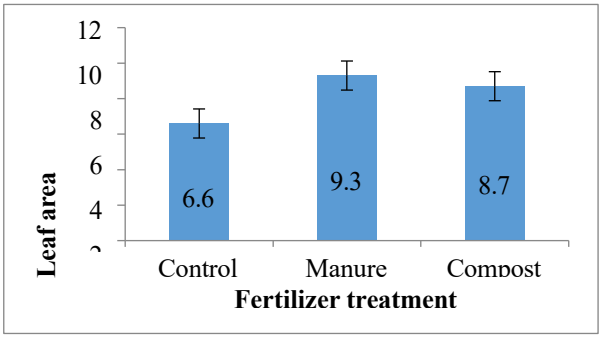

Fig. 3 Length of branches in response to fertilizer treatment.

Leaf Area

Statistical analysis of the data (Table 2) showed that organic manure significantly affected leaf area. The highest leaf area (9.3 cm) was recorded in the manure plot which was statistically similar to the leaf area (8.7 cm) of the plot treated with compost while the lowest leaf area (6.6 cm) was recorded in the control plot (Fig. 4). The highest leaf area recorded in the manure plot may be due to efficient availability of

nitrogen which resulted in higher nitrogen uptake by the plant and resulted in larger leaves observed. The results also agreed with Balyeri *et al.* (2016), who studied that manure affects the growth, yield and nutrition of containerized aromatic pepper. They concluded that fertilization increased leaf area due to the availability of sufficient nitrogen, which in turn improved crop plant growth. These findings are also confirmed by Shah *et al.* (2016), who found more leaf area with manure application.

Chlorophyll Content

Statistical analysis of the data (Table 3) showed that organic manure significantly affected the total chlorophyll content of the plants. The plants of the manure sample showed the highest amount of chlorophyll (12.49) while the plants of the control group showed less amount of chlorophyll (9.75) and the compost samples showed the lowest amount of chlorophyll (3.04) (Fig. 5).

Table 3: Chlorophyll Cotents

Treatments TCC.	Chl a	Chl b
Control 9.75		
Manure 12.49	16.79	2.71
Compost 3.04		
	12.17	12.82
	3.32	2.77

Chl a; Chlorophyll a, Chl b; Chlorophyll b and TCC; Total Chlorophyll Content.

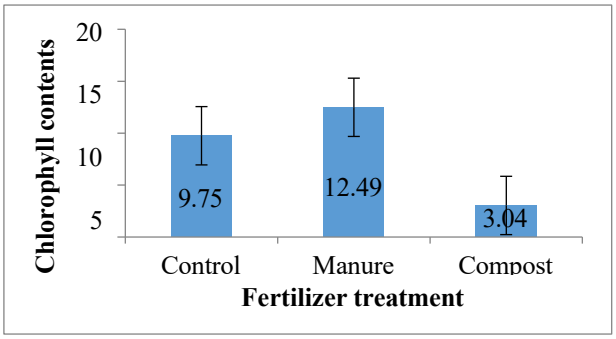

Fig. 5 Chlorophyll contents in response to fertilizer treatment.

Conclusion

The study concluded that the application of manure beneficially affected the number of leaves, plant length and leaf area compared to compost. The study illustrates that the manure shows the best result on plant growth, plant height, number of leaves and leaf area. Determining the appropriate ratio of manure experiment can be repeated at different locations for proper analysis.

Based on theabove results, it is concluded that manure affected the yield andquality crop characteristics of coriander compared to compost and hence recommended for better crop production.

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