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Organic Fertilizer Effects on Morphological and Biochemical Traits and Yield in Coriander (*Coriandrum sativum* L.) as an Industrial and Medicinal Plant

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ABSTRACT

Fertilizer consumption management is one of the main factors in the successful cultivation of medicinal plants. Using nature-compatible fertilizer and suitable for optimum plant growth can have favorable effects on the plant's quantitative and qualitative indices. Farmyard manure (FYM) is one of the manure resources used in sustainable soil management systems. Therefore, to evaluate the effect of manure on coriander yield and its essential oil, a field experiment was conducted based on a randomized complete block design with three replications under Kermanshah weather conditions in 2017. The experiment treatments were 0, 15 and 25 t/ha of manure (FYM0, FYM15, FYM25, respectively). The evaluated traits included the number of umbel per plant, number of seeds per umbel, 1000-seed weight, grain yield, essential oil percentage and essential oil yield. The results showed that the effect of manure on yield and yield components was significant while the essential oil percentage and yield were not significantly affected by manure fertilizer. The highest grain yield (527.6 kg/ha) and 1000-seed weight (10.1 g) were related to fertilizer levels of 25 t/ha and the lowest ones were observed in non-use of manure. It seems that manure through improving physical and chemical properties of the soil led to increasing coriander yield and yield components.

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1. Introduction

Achieving sustainable agriculture is one of the most important agricultural goals, especially in arid and semi-arid regions. Agricultural activities in developed countries are largely dependent on fossil energy inputs in the form of fertilizers, herbicides and pesticides. Fertilizers are used as a tool to achieve maximum production per unit area. However, in addition to increasing production, the quality of agricultural products and the health of crops should also be taken into account (Balogh *et al*., 2006). Medicinal plants are of special importance and attention to their needs should be considered in research (Kazemi *et al*., 2016; Zebarjadi *et al*., 2018; Keshvari *et al*., 2018; Ghorbani *et al*., 2020). One of the requirements of these plants is to pay attention to the nutrients they need (Mohammadi *et al*., 2015). Long-term studies show that overuse of chemical fertilizers reduces crop yields. This decrease is caused by soil acidification, reduction of soil biological activities, loss of soil physical properties and lack of micronutrients in chemical fertilizers (Adediran *et al*., 2005). Todays, the use of sustainable agricultural solutions based on the consumption of organic and biological fertilizers to eliminate or significantly reduce the consumption of chemical inputs, which is one of the most important strategies for protecting the environment and achieving sustainable development, can be achieved by improving the application of these inputs and combining them with organic fertilizers. During recent decades, the use of chemical inputs in agricultural fields has caused environmental issues such as water pollution, quality reduction of agricultural products, and reduced soil fertility (Singer *et al*., 2007). The utilization of biological and organic

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fertilizers not only reduces the amount of chemical fertilizer, it can also help to retain energy, reducing environmental pollution, nutrients providing according to plant needs, increasing biodiversity, improving quality and increasing crop growth and yield (Arancon *et al*., 2004). Therefore, due to the problems caused by excessive use of chemical fertilizers, replacing these fertilizers with non-chemical fertilizers such as manures can reduce the mentioned effects through increasing soil organic matter and improving soil chemical properties such as cation exchange capacity, bulk density reduction, enhancing microorganism activity and macro/micronutrients availability that effectively enrich quantity and quality of the product (Gryndler *et al*., 2008).

Daneshian *et al*. (2011) studied different levels of cow manure (0, 15, and 30 ton/ha) on quantitative and qualitative yield of basil (*Ocimum tenuiflorum*) and found that the highest grain yield (2505 kg/ha), total dry weight (15730 kg/ha), oil content (0.47%) and oil yield (66.25 kg/ha) was obtained in the highest amount of cow manure (30 t/ha). Studies on the medicinal plant of dill (*Anethum graveolens*) have shown that consumption of 30 tons of manure improved grain yield and essential oil content about 45% and 30%, respectively (Khalid and Shafei, 2005). Other research findings on coriander (*Coriandrum sativum* L.) also determined that the application of 10 and 15 tons of manure improved the percentage and yield of essential oil (Darzi *et al*., 2012).

Accordingly, regarding the global tendency to produce and reproduce medicinal plants in sustainable and low-input agricultural systems and also lack studies on medicinal plants response to different fertilizer sources, as well as in order to reduce chemical fertilizers consumption, this study was conducted to investigate the effect of different levels of manure on grain and essential oil yields of coriander.

2. Materials and methods

This study was conducted at the research farm of Agriculture and Natural Resources Campus, Razi University, Kermanshah, Iran (34° 21' N, 47° 9' 13" E, 1318.6 m a.s.l) during 2017-2018. This research was conducted based on a randomized complete blocks design (RCBD) with three replications. Treatments included cattle manure at three levels of 0, 15, and 25 t/ha (FYM0, FYM15, FYM25, respectively). Before implementation of the project, soil sampling (From 0 to 30 cm depth of soil) was performed and physical and chemical properties of soil were determined (Table 1). The dimensions of each experimental plot were 2×2 meters and within each plot, 10 rows of planting were considered. Manure was added to the soil before planting. Coriander seed, which was selected from Kermanshah indigenous mass, was planted in each plot with a distance of 8 cm on the surface and a depth of 1-2 cm on May 30, 2017. Irrigation was done immediately after planting and then weekly by a leaky method. To obtain suitable density, plants were thinned at 4-6 leaf stages after the complete establishment of the plant. Weed control was done manually four times during the growing season. To determine grain yield, when most of the plants turned into yellow, harvesting from one square meter per plot was carried out by eliminating the marginal effect. Before the final harvest, five plants were selected randomly and the number of umbels in the plant and the number of grains per plant were counted. After grain drying, samples of each plot were prepared to measure the essential oil content. Essential oil was extracted by means of steam distillation method by the Clevenger apparatus . Analysis of variance and mean comparisons (LSD, $P \leq 0.05$) were conducted using SAS software.

3. Results and discussion

3.1. The number of umbel per plant

The effect of farmyard manure levels on the number of umbels per plant was significant at 1% level (Table 2). Mean comparison indicated that there was a significant difference between different levels of manure in terms of the number of umbels per plant so that FYM0 and FYM15 (5.4 and 6 umbels, respectively) did not show significant differences, but FYM25 (9.88 umbels) had a considerable superiority about 45% and 40% compared to the first two

Table 1. Physico-chemical properties of soil determined in this study.

Phosphor (ppm)	Potassium (ppm)	PH	Nitrogen (%)	Organic Carbon (%)	Sand (%)	Silt (%)	Clay (%)	Soil Texture	Soil Depth (cm)
20.6	282.4	7.4	0.15	1.5	10.7	54.4	43.9	Clay-Silt	0-30

treatments (Table 3). It seems that consumption of suitable amounts of farmyard manure by increasing soil minerals, improving soil microbial activities and providing more nutrients absorption, leading to increase photosynthesis and plant dry matter, which ultimately led to improvement of flowering and number of umbels in coriander. The number of umbels per plant in Fennel also increased significantly under the use of biological fertilizers (Mahfouz *et al*., 2007). Salem and Awad (2005) reported that by increasing the application of organic fertilizer, the number of umbels per plant in coriander was improved.

3.2. 1000-grain weight

Analysis of variance results showed that farmyard manure levels had no significant effect on 1000-grain weight (Table 2). Ghanbari et al. (2005) by investigating the effect of manure application on cumin showed that the 1000-grain weight was not significantly affected by different treatments. However, Darzi et al. (2012) reported a 4.5% increase in the 1000-grain weight of coriander with the consumption of 15 t/ha of manure, which was consistent with the results of Bastami et al. (2015).

Table 2. Analysis variance for the studied traits of coriander under different levels of manure treatment

SOV	df	Mean of squares					
		Seed yield	1000-grain weight	Number of seed per plant	Number of umbel per plant	Essential oil (%)	Essential oil yield
Replication	2	25.464*	0.156^{ns}	80.319^{ns}	0.009^{ns}	0.274	970.47^{ns}
Treatment	2	253.320**	1.124^{ns}	2779.834*	17.590**	6.834^{ns}	27518.05*
Error	4	2.985	0.250	362.446	0.467	1.651	3608.53
CV (%)		4.05	5.62	14.07	9.619	37.68	39.12

**Significance at the 1% probability level, * Significance at the 5% probability level, and ns no significance. SOV refers to source of variance.

Table 3. The effect farmyard manure treatments on the studied traits of Coriander

Treatment	Grain yield (Kg/ha)	Number of umbels per plant	Number of seeds per plant	Essential oil yield (Kg/ha)
0	348.6	544	103.86	60.45
15	402.2	5.99	137.13	148.39
25	527.6	9.88	164.65	251.76
LSD	3.91	1.55	43.15	136.18

3.3. Grain yield

Results showed that different levels of manure significantly affected grain yield at 1% level (Table 2) so that by increasing the application of manure, grain yield in FYM25 improved by about 34% compared to non-application conditions of manure. The highest grain yield (52.76 kg/ha) belonged to the FYM25 and the lowest yield (34.86 kg/ha) was observed in the non-application of manure (Table 3). Regarding the effect of farmyard manure on coriander grain yield, it seems that increasing organic fertilizer by improving soil organic matter, through the effect on absorption, retention, and proper availability of moisture as well as nutrients such as nitrogen, phosphorus and potassium, led to improvement of yield components such as umbel number and 1000-grain weight, thus improved grain yield. Koocheki et al. (2007) found that consumption of 5, 10 and 15 t/ha of animal fertilizer increased grain yield of *Plantago ovata* and *Plantago psyllium* compared to control treatment. Bastami et al. (2015) also found that coriander grain yield improved as manure increased. Drazi et al. (2014) showed that application of different amounts of farmyard manure and growth moisturized bacteria led to improvement in coriander yield.

3.4. Essential oil content and yield

The results of this study also showed that the content of essential oil was not affected by the treatments, while the changes in essential oil yield were significant at 5% (Table 2). Among treatments, the highest essential oil yield was related to the FYM25 of manure

(251.8 kg/ha) and the lowest was related to non-application of manure (60.4 kg/ha) (Table 3). It seems that manure increases the essential oil yield of coriander due to having nutrient elements that may be released gradually and at the end of the plant growth period.

Based on our findings, manure may provide favorable conditions in the early growth period in terms of water retention around the root environment and improving soil conditions to deeper penetrate the roots into the soil, which can be effective in promoting plant growth. In research on Coriander, essential oil yield increased due to the application of 30 tons of manure (Bastami *et al*., 2015). In addition, Bigonah et al. (2014) indicated an increase in coriander essential oil yield in a production system based on the combined use of organic and mineral nitrogen fertilizers. Niknejad et al. (2013) by investigating the effect of organic and chemical fertilizers on German chamomile (*Matricaria chamomilla* L.) also found that the highest and lowest yields of essential oils by 0.37 and 0.18%, respectively belonging to the mixed and control treatments. Also, the use of chemical fertilizer treatment resulted in a 2.1% reduction in essential oil compounds (Niknejad *et al*., 2013).

4. Conclusion

The results of the experiment indicated that farmyard manure had a positive effect on grain yield, its components and the essential oil yield of coriander. The highest amount of traits was observed in FYM25. Chemical fertilizers provide only one or more necessary elements for plant growth, while organic fertilizers not only make available many micro and macronutrients, It also improve the physical and chemical properties of the soil and create a suitable environment for better growth. Considering that what is measured in the production of medicinal plants is the increase of biomass and the production of active substances lacking pesticide residues and chemical fertilizers, it seems that using organic fertilizers can be an effective step in the healthy and sustainable production of medicinal plants.

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References

Adediran J., Taiwo L., Akande M., Sobulo R., Idowu O. 2005. Application of organic and inorganic fertilizer for sustainable maize and cowpea yields in Nigeria. Journal of Plant Nutrition. (27): 1163-1181. https://doi.org/10.1081/PLN-120038542

Arancon N., Edwards C.A., Bierman P., Welch C., Metzger J.D. 2004. Influences of vermin composts on field strawberries: 1. Effects on growth and yields. Bioresource Technology (93):145-153. https://doi.org/10.1016/j.biortech.2003.10.014

Balogh Á., Pepó P., Hornok M. 2006. Interactions of crop year, fertilization and variety in winter wheat management. Cereal Research Communications (34): 389-392. https://doi.org/10.1556/CRC.34.2006.1.97

Bastami, A., Majidian, M. 2015. Effects of bio fertilizer and manure application on the absorbtion of N, P and K nutrients and yield quantity in coriander (*Coriandrum sativum* L.). Research in Crop Ecosystems. 8: 1(4):49-64.

Bigonah R., Rezvani Moghaddam P., Jahan M. 2014. Effects of intercropping on biological yield, percentage of nitrogen and morphological characteristics of coriander and fenugreek. Iranian Journal of Field Crops Research 12(3):369-77.

Daneshian J., Yousefi M., Zandi P. 2011. Effect of planting density and cattle manure on some qualitative and quantitative traits in two Basil varieties under Guilan conditions, Iran. American-Eurasian Journal of Agricultural and Environmental Sciences (11): 95-103.

Darzi M.T., Haj SeyedHadi M.R., Rejali F. 2012. Effects of cattle manure and biofertilizer application on biological yield, seed yield and essential oil in coriander (*Coriandrum sativum*). Journal of Medicinal Plants 9(11): 77-90.

Ghanbari A., Ahmadiyan A., Gelavi M. 2005. The effect of irrigation times and animal manure on yield and yield components of cumin (*Cuminum cyminum*). Iranian Journal of Field Crops Research 3(2):255-62.

Ghorbani M., Kahrizi D., Chaghakaboodi Z. 2020. Evaluation of camelina sativa doubled haploid lines for the response to water-deficit stress. Journal of Medicinal Plants and By-product 9(2): 193-199.

Gryndler M., Sudová R., Püschel D., Rydlová J., Janoušková M., Vosátka M. 2008. Cultivation of high-biomass crops on coal mine spoil banks: Can microbial inoculation compensate for high doses of organic matter? Bioresource Technology (99): 6391-6399. https://doi.org/10.1016/j.biortech.2007.11.059

Kazemi N., Kahrizi D., Mansouri Karim M. H., Vaziri S., Zargooshi J., Khanahmadi M., Shokrinia M., Mohammadi N. 2016. Induction of linalool as a pharmaceutical and medicinal

metabolite via cell suspension culture of cumin (*Cuminum cyminum* L.). Cellular and Molecular Biology 62(6): 65-68.

Keshvari T., Najaphy A., Kahrizi D., Zebarjadi A.R. 2018. Callus induction and somatic embryogenesis in Stevia rebaudiana Bertoni as a medicinal plant. Cellular and Molecular Biology 64(2): 46-49. https://doi.org/10.14715/cmb/2018.64.2.9

Khalid K.A., Shafei A.M. 2005. Productivity of dill (*Anethum graveolens* L.) as influenced by different organic manure rates and sources. Arab Universities Journal of Agricultural Sciences(13):901-913. https://doi.org/10.21608/ajs.2005.15330

Koocheki A., Tabrizi L., Mahallati M.N. 2007.The effects of irrigation intervals and manure on quantitative and qualitative characteristics of Plantago ovata and Plantago psyllium. Asian Journal of Plant Sciences 6(8): 1229-1234. https://doi.org/10.3923/ajps.2007.1229.1234

Mahfouz S. A., Sharaf-Eldin A. 2007. Effect of mineral vs. biofertilizer on growth, yield, and essential oil content of fennel (*Foeniculum vulgare* Mill.). Agrophysics Journal. (21): 361-366. https://doi.org/10.1055/s-2007-987419

Mohammadi G.R., Chatrnour S., Jalali-Honarmand S., Kahrizi D. 2015. The effects of planting arrangement and phosphate biofertilizer on soybean under different weed interference periods. Acta Agriculturae Slovenica 105(2):313-322. https://doi.org/10.14720/aas.2015.105.2.14

Niknejad, M., Lebaschy, M.H., Jaimand K., Hatami, F. 2013. Effect of organic and chemical fertilizers on essential oil of Matricaria chamomilla L. Iranian Journal of Medicinal and Aromatic Plants Research 29(2):373-86.

Salem A.G., Awad A.M. 2005. Response of coriander plants to organic and mineral fertilizers fertigated in sandy soils. Egyptian Journal of Agricultural Research 83(2): 829-858.

Singer J.W., Logsdon S.D., Meek D.W. 2007. Tillage and compost effects on corn growth, nutrient accumulation, and grain yield. Agronomy Journal. (99): 80-87. https://doi.org/10.2134/agronj2006.0118

Zebarjadi A., Kazem S., Kahrizi D. 2018. Cell dedifferentiation and multiplication of Burdock (*Arctium lappa*) as a medicinal plant. Cellular and Molecular Biology 64(7): 92-96. https://doi.org/10.14715/cmb/2018.64.7.16

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