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Original Article

The effects of organic and bio-fertilizers application on N, P, K concentration and seed yield in coriander (*Coriandrum sativum* L.)

Hamed Ghasemi Tabasi

[a] *PhD Student of Agrotechnology, Department of Agronomy, Faculty of Agriculture, Roudehen Branch, Islamic Azad University, Roudehen, Iran.*

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Corressponding Author:
Hamed Ghasemi Tabasi
ghasemi.hamed84@gmail.com

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ABSTRACT

In order to study the effects of organic and bio fertilizers application on N, P and K nutrition and seed yield of coriander (*Coriandrum sativum*), an experiment was conducted as randomized complete blocks design with 12 treatments and three replications in Tehran, Iran in 2019. The treatments were vermicompost (10 t/ha), nitroxin, bio-superphosphate, bio-sulfur, vermicompost + nitroxin, vermicompost + bio-superphosphate, vermicompost + bio-sulfur, nitroxin + bio-superphosphate, nitroxin + bio-sulfur, bio-superphosphate + bio-sulfur, chemical fertilizer and control (without fertilizer). The results showed that treatments had significant effects on studied traits, as the highest plant height (75.3 cm) in integrated treatment of vermicompost and bio-superphosphate, the highest umbel no./plant (23.6) in treatment of chemical fertilizer, the highest N concentration in seed (2.92%) in integrated treatment of nitroxin and biosulfur and the highest P concentration in seed (0.83%) in treatment of bio-superphosphate were obtained. Also, the highest K concentration in seed (4.06%) and seed yield (1297.5 kg.ha^{-1}) in integrated treatment of nitroxin and bio-superphosphate were obtained. It seems that bio and organic fertilizers can consider as a replacement for chemical fertilizers in sustainable cultivation of coriander.

1. Introduction

The medicinal herb Coriander (*Coriandrum sativum* L.) is an annual herbaceous plant, belongs to the family Apiaceae and is widely cultivated in many parts of the world. This plant has many applications in food, pharmaceutical, cosmetic and health industries due to its active ingredient of essential oil with valuable compound linalool as its major part, and therefore has a high economic value in world trade (Msaada et al., 2009; Mandal & Mandal, 2015; Aghhavani Shajari et al., 2016; Mafakheri & Aminian Dehkordi, 2019). Since excessive use of chemical fertilizers in the long run reduces crop yield, and biological activities and physical properties of the soil, it can cause negative environmental consequences and finally increase costs of production. So, in recent years, much attention has been paid to the use of organic and biological fertilizers (Kamayestani et al., 2015; Aghhavani Shajari et al., 2016).

Organic and bio-fertilizers include vermicompost and bacteria *Azotobacter*, *Azospirillum*, *Bacillus* and *Thiobacillus* used aimed to eliminate or significantly reduce the use of chemical inputs to increase the quantity, quality and stability of yield of medicinal herbs. In a study on cumin (*Cuminum cyminum* L.), it was observed that single use of nitroxin and bio-phosphorus bio-fertilizers increases concentrations of nitrogen and phosphorus of seeds, respectively, and their combined use increases the potassium concentration in seed and seed yield (Karimzadeh Asl & Baghbani Arani, 2019). Studies conducted on medicinal herbs have also shown that using organic and biological fertilizers in a sustainable agricultural system provides the best conditions for the production of these plants and the maximum qualitative and quantitative yield under such conditions (Akbari & Gholami, 2016; Zendebad et al., 2018).

A field study on fennel (*Foeniculum valgare* Mill) also revealed that the combined application of bacterial bio-fertilizer (*Azotobacter* and *Pseudomonas*) and mycorrhizal fungus in comparison with their single use and control (no use) increased potassium concentration of seed and seed yield (Zamani et al., 2019). They stated that using these bio-fertilizers by improving soil microbial activity and producing some plant growth regulators, due to the positive effect on plant vegetative and reproductive growth has finally led to increased seed yield. Also, in a report of a field study on fennel, it was

observed that the combined use of nitroxin and bio-suprophosphate bio-fertilizers increased seed yield and phosphorus concentration (Movaghatian et al., 2015).
In a field study on dragonhead (*Dracocephalum moldavica* L.), it was also observed that using bio-fertilizers containing nitrogen-fixing and phosphate-solubilizing bacteria increased the concentration of nitrogen in the flowering stage (Darzi & Haj Seyed Hadi, 2016). In another study it was found that the combined use of compost and *Azotobacter* increased the plant height and the combined applying of vermicompost and *Pseudomonas* increased the umbel number per plant of fennel (Moradi et al., 2010). The researchers stated that the combined use of organic and biological fertilizers increased the height and umbel number per plant through providing adequate nutrients and improving plant vegetative growth. The results of two field studies also showed that the combined use of nitrogen-fixing and phosphate-solubilizing bacteria (*Azotobacter*, *Azospirillum* and *Pseudomonas*) increased the nitrogen concentration of aerial organ of chamomile (*Matricaria chamomilla* L.) and the nitrogen concentration of seed in anise (*Pimpinella anisum* L.) (Salehi et al., 2011; Khalesro et al., 2012). The study results on *Trachyspermum ammi* L., *Nigella sativa* L. and *Anethum graveolens* L. also showed an increase in the plant height using 10 tons of vermicompost, inoculation of seeds with *Azotobacter* and *Azospirillum* and seed inoculation with growth-promoting bacteria Enterobacter, respectively., (Khalesro & Malekian, 2017; Ghanepasand & Haj Seyed Hadi, 2016; Chegeni et al., 2019). In another study on fennel, the results showed that the highest seed yield was obtained from the treatment of bio-phosphate bio-fertilizer and then from the treatment of nitroxin bio-fertilizer (Gorgini Shabankare et al., 2017).
Regarding the importance of plant nutrition management in sustainable and organic agriculture, this study was conducted aimed to study the separate and combined effect of organic and biological fertilizers on N, P, K concentration and seed yield of coriander to reduce the use of chemical fertilizers and determine the appropriate treatment to achieving the best seed yield.

2. Materials and Methods

This study was conducted in the spring of 2019 in the Green Space Research, Training and Consulting Center of Tehran Municipality, located in the east of Tehran, Hakimieh District. First, a random composite sample (from a depth of 0-30 cm) was prepared from the field soil sent to the soil science laboratory and it was found that the soil texture is the Sandy-Clay Loam and its pH is 8.24 (Table 1).

This study was conducted based on a randomized complete block design with 12 treatments and three replications. The treatments include 1) vermicompost (10 ton ha^{-1}), 2) nitroxin, 3) bio super phosphate, 4) bio-sulfur, 5) vermicompost + nitroxin, 6) vermicompost + bio-super phosphate, 7) vermicompost + biosulfur, 8) nitroxin + bio-super phosphate, 9) nitroxin + bio-sulfur, 10) bio-super phosphate + bio-sulfur, 11) chemical fertilizers (60 and 80 kg ha^{-1} of nitrogen and phosphorus, respectively) and 12) control (without fertilizer application). Nitroxin bio-fertilizer (2 lit ha^{-1}) was a solution containing nitrogen-fixing bacteria *Azotobacter chroococcum* and *Azospirillum lipoferum*, which contained about 10^8 active bacteria per milliliter. The solution of bio-superphosphate (2 lit ha^{-1}) also contained phosphate-solubilizing bacteria (*Bacillus* sp) which contained about 10^8 active bacteria per milliliter. Bio-sulfur biofertilizer (5 kg ha^{-1}) containing *Thiobacillus* sp (about 10^9 active bacteria per gram) was used with bentonitated organic sulfur (250 kg ha^{-1}). Nitrogen was also selected as a criterion for determining the amount of vermicompost used. Coriander seeds used in this study were prepared by Isfahan GIAH GOSTAR Agricultural Co.
In order to perform the experiment, the size of each plot was 3×2.1 m with the spacing of 10 cm between the plants and 35 cm between the rows. A space of 70 cm was left between the plots and there was a distance of 2 m between replications. Coriander seeds were planted and experimental treatments were applied in spring. 10 days before planting, to apply vermicompost treatments (Table 1), first in the given plots, the estimated amount of vermicompost was poured and mixed with the soil by a rake, and then ridge and furrow were created. Coriander seeds were planted on May 10. For this purpose, in the plots treated with nitroxin and bio-superphosphate solutions, the required seeds were inoculated with them for 10 min, then dried in the shade and exposed to air and planted at a depth of 2 cm in the soil. In addition, the mentioned plots were sprayed with nitroxin and bio-super phosphate at stem elongation stage of coriander. Also, in the plots containing bio-sulfur bio-fertilizer, the required amount of bio-sulfur powder along with bentonitated organic sulfur was placed under the seeds during planting. Furrow irrigation, were first performed once every two days and after the plants were established, according to the climatic conditions of the region, about once every five days. The field weed control operations were performed in six shifts mechanically and by hand. No specific pest or disease was observed during the growth period. In the plots containing chemical fertilizer treatment, all phosphorus (triple superphosphate type) and half of the nitrogen (urea type) applied during planting and the other half were used at stem elongation stage.

Table 1. Some physical and chemical properties of site soil and vermicompost

	texture	Soil response	EC (dS/m)	Organic matter	Total nitrogen	Phosphorus	Potassium
				%		mg/kg	
Soil	Loamy sand	8.24	1.10	1.4	0.14	22.1	300.3
Vermicompost	-	7.22	3.46	18.97	0.93	4800	2700

Table 2. Analysis of variance of the effect of using organic and biological fertilizers on *Coriandrum sativum* L. studied traits

Source of variation	df	Plant height	Number of flowers per plant	Nitrogen concentration in seeds	Phosphorus concentration in seeds	Potassium concentration in seeds	Seed yield
Replication	2	22.03 ^{ns}	0.176 ^{ns}	0.0016 ^{ns}	0.004 ^{ns}	0.030 ^{ns}	10836.6 ^{ns}
Treatment	11	130.58 *	11.045 **	0.971 **	0.058 **	1.039 **	107409.7 **
Error	22	47.651	3.354	0.061	0.006	0.130	10599.3
	CV (%)	10.5	8.7	12.2	12.3	10.3	10.4

ns, * and **: insignificant and significant at 1 and 5% probability levels, respectively.

Table 3. Mean comparison of the effects of different amounts of organic and biological fertilizers on Coriandrum sativum L. studied traits

Treatments	Plant height (cm)	Number of flowers per plant	Nitrogen concentration in seeds (percentage)	Phosphorus concentration in seeds (percentage)	Potassium concentration in seeds (percentage)	Seed yield (kg / ha)
10 tons of vermicompost	65.9 abcd	20.6 ab	1.66 de	0.648 b	2.63 cd	907.5 c
Nitroxin	72.8 a	19.5 b	1.88 cd	0.457 c	2.91 bc	0.905 c
Bio super phosphate	55.8 cd	21 ab	2.07 bcd	0.835 a	3.53 ab	0.990 bc
Biosulfur	66.4 abcd	21.9 ab	2.85 a	0.751 ab	4.05 a	3.1208 a
10 tons of vermicompost + nitroxin	61.9 abcd	21.7 ab	2.38 b	0.627 b	3.53 ab	1128 ab
10 tons of vermicompost + bio super phosphate	75.3 a	22.4 ab	1.28 ef	0.718 ab	3.51 ab	899.1 c
10 tons of vermicompost + biosulfur	66.7 abcd	20.7 ab	2.36 b	0.703 ab	3.82 a	980 bc
Nitroxin + bio super phosphate	68.5 abc	21.6 ab	1.96 bcd	0.705 ab	4.06 a	1297.5 a
Nitroxin + Biosulfur	63.7 abcd	21.6 ab	2.92 a	0.633 b	3.91 a	1258.3 a
Bio super phosphate + Biosulfur	71.8 ab	19.5 b	2.13 bc	0.740 ab	3.92 a	932.5 c
Chemical fertilizer	58.7 bcd	23.6 a	1.63 de	0.714 ab	3.78 a	1191.6 a
Control (without fertilizer use)	54.4 d	16 c	1.04 f	0.320 d	2.25 d	654.1 d

Means with at a same letter in each column have no statistically significant differences.

In this study, the plant height, umbel number per plant, concentrations of nitrogen, phosphorus and potassium in seeds and seed yield were investigated. To measure the plant height, the mean height of five plants per plot at full flowering stage (excluding the margin effect) was used. In order to measure the umbel number per plant, the mean umbel number of five plants per plot at seed maturity was used. The final harvest was performed to determine the seed yield at seed maturity in an area of one square meter in each experimental plot, taking into account the margin effect. To measure the concentrations of nitrogen, phosphorus and potassium in coriander, a 20 g sample of seeds from each plot was randomly prepared. After drying in the oven (70° C for 48 h), the prepared samples were powdered by electric mill, and then their extracts were prepared by digestion by sulfuric acid, salicylic acid, oxygenated water and selenium. In order to measure all desired elements in coriander seeds, this extract was used. The content of nitrogen was measured using the titration method after distillation and a single auto-analyzer. The content of phosphorus was measured using the calorimetric method (*Vanadate/molybdate* method (*yellow* method)) and spectrophotometer. The content of potassium was measured using the flame diffusion method and a flame photometer (Emami, 1996). For data analysis, SAS statistical software version 9.1 was used and the mean comparison of treatments was performed by Duncan's multiple range test at the probability level of 5%.

3. Results

3.1 Plant height

The effect of different single and combined treatments of organic and biological fertilizers on the plant height was significant (Table 2). Plant height in the combined use of 10 tons of vermicompost and bio-superphosphate (75.3 cm) compared to chemical fertilizer (58.7 cm), bio-superphosphate (55.8 cm) and control (54.4 cm)

treatments showed significant superiority and did not differ significantly from other treatments (Table 3).

3.2 Umbel number per plant

The effect of different treatments of organic and bio-fertilizers on the umbel number per plant was significant (Table 2) and the mean comparison showed that all single and combined treatments of organic and bio-fertilizers and chemical fertilizer treatment were significantly different from the control treatment (without fertilizer use). So that the highest umbel number per plant was obtained from chemical fertilizer treatment (23.6 umbel) and the combined use of 10 tons of vermicompost and bio-superphosphate (22.4 umbel) (Table 3). In addition to chemical fertilizer treatment, organic and biological fertilizers treatments had significant superiority in terms of the umbel number per plant compared to the control, and among them, the highest umbel number per plant was obtained from the combined treatment of vermicompost and bio-superphosphate. This is due to the properly supply of water and nutrients (especially nitrogen and phosphorus), which has played an effective role in increasing vegetative growth properties such as the umbel number per plant in the present test.

3.3 Nitrogen concentration in seed

The effect of different treatments on nitrogen concentration in seed was significant (Table 2), So that the mean comparison showed that the highest concentration of nitrogen in seed was obtained from the two treatments of combined use of nitroxin and biosulfur (2.92%) and bio-sulfur (2.2%) and had significant superiority to other treatments, especially vermicompost (1.66%), chemical fertilizer (1.63%), combined use of vermicompost and bio-super phosphate (1.28%) and control treatment (1.04%) (Table 3).

3.4 Concentrations of phosphorus and potassium in seed

In this study, the concentration of phosphorus in seed was also affected by different treatments of organic and bio-fertilizers (Table 2). The mean comparison of treatments showed a significant difference, So that the highest phosphorus concentration in seed was obtained from the treatment of bio-superphosphate (0.835%) which compared to vermicompost (0.648%), combined use of nitroxin and biosulfur (0.633%), combined use of vermicompost and nitroxin (0.627%), nitroxin (0.457%) and control treatment (0.320%) was about 29, 32, 33, 83 and 161% higher and showed no significant difference with other treatments (Table 3). Also, the phosphorus concentration in seed was high in the two treatments of biosulfur (0.751%) and the combined use of bio-superphosphate and bio-sulfur (0.740%) and after the treatment of bio-superphosphate. The effect of organic and biological fertilizer treatments on the potassium concentration in seed was significant (Table 2) and the mean comparison of the treatments showed a significant difference, So that the potassium concentration in seed in the treatment of the combined use of nitroxin and bio-superphosphate (4.06%) was significantly superior to nitroxin (2.91%), vermicompost (2.63%) and control (2.25%) treatments and did not differ significantly from other treatments (Table 3). The highest phosphorus concentration in seed was obtained from the treatment of bio-superphosphate application and the highest potassium concentration in seed was obtained from the combined treatment of nitroxin and bio-superphosphate.

3.5 Seed yield

The effect of different single and combined treatments of organic, biological and chemical fertilizers on seed yield was significant (Table 2). Also, the mean comparison of the treatments showed a significant difference, So that the highest seed yield was obtained from the treatment of combined application of nitroxin and bio-superphosphate (1297.5 kg ha^{-1}), which in comparison with most of the treatments had significant superiority and with treatments of the combined use of nitroxin and bio-sulfur (1258.3 kg ha^{-1}), bio-sulfur (1208.3 kg ha^{-1}), combined use of vermicompost and nitroxin (1128.0 kg ha^{-1}) and chemical fertilizer (1191.6 kg ha^{-1}) showed no significant difference (Table 3).

4. Discussion

organic treatments, the combined use treatment of 10 tons of vermicompost and bio-superphosphate could possibly increase the plant height of coriander by improving soil conditions and subsequent better root growth and nutrient uptake. The results of a study on Foeniculum vulgare also showed that the combined treatment of organic and biological fertilizers (compost and *Azotobacter*) increased the plant height (Moradi et al., 2010). The researchers stated that the treatment increased the plant height through providing adequate nutrients and improving the plant growth. In three other studies, it was reported that the combined use of mycorrhiza and bio-phosphorus bio-fertilizers, nitrogen-fixing (*Azotobacter* and *Azospirillum*) and phosphate-solubilizing (*Pseudomonas*) bio-fertilizers and mycorrhiza and *Azospirillum* bio-fertilizers increased the plant height of Trachyspermum ammi, Cuminum cyminum and Nigella sativa (Khorramdel et al., 2009; Saeidnejad & Rezvani Moghaddam, 2010; Haghir Ebrahimabadi et al., 2018). The study results of Khalesro and Malekian (2017) on Trachyspermum ammi, Ghanepasand and Haj Seyed Hadi (2016) on Nigella sativa and Chegeni et al. (2019) on Anethum graveolens also indicate an increase in the plant height due to using 10 tons of vermicompost, inoculation of

seeds by *Azotobacter* and *Azospirillum* and inoculation of seeds with growth-promoting bacteria.

The results of a study also showed that the highest umbel number per plant in Cuminum cyminum was obtained from the treatment of combined use of chemical fertilizer (nitrogen + phosphorus) and biological fertilizers (nitroxin + bio-phosphate) (Talaei & Amini Dehaghi, 2015). They stated that inoculation of cumin with microorganisms in bio-phosphate fertilizer and nitroxin bio-fertilizer due to the production of growth-promoting hormones increased vegetative growth and consequently the umbel number per plant. In a study on dill, it was observed that the highest umbel number per plant was obtained from chemical fertilizer (urea) treatments and combined use of bio-fertilizer (*Azotobacter* and *Azospirillum*) and 50% of chemical fertilizer (Makkizadeh et al., 2012). A study report also revealed that the combined use of organic (15.3 tons of cow manure) and biological fertilizer (bio-sulfur) increased the number of capsules per plant of Nigella sativa (Rezvani Moghaddam et al., 2017). In another study, Moradi et al. (2010) showed that single and combined use of organic and biological fertilizers, including the combined use of vermicompost and phosphate-soluble bacteria (Pseudomonas) caused a significant increase in the umbel number per plant in fennel compared to the control (without fertilizer use).

Regarding the increase in nitrogen concentration in seed in the treatment of combined use of nitroxin and bio-sulfur, nitrogen-fixing and phosphate-solubilizing bacteria in the mentioned bio-fertilizer, through improving the amount of nutrients absorbed through root development and availability of nutrients in the soil, as well as the consequent increase in growth, development and biomass of coriander, has significantly improved the concentration of nitrogen in seed (Zamani et al., 2019). In this regard, the results of two field studies also showed that the combined use of nitrogen-fixing and phosphate-solubilizing bacteria (*Azotobacter*, *Azospirillum* and Pseudomonas) increased the concentration of nitrogen in aerial organ of chamomile and seed of anise (Salehi et al., 2011; Khalesro et al., 2012) which is consistent with the results of the present study. Also, in a field study on Dragonhead plant, it was observed that using biofertilizers containing nitrogen-fixing and phosphate-solubilizing bacteria increased the concentration of nitrogen in the flowering stage (Darzi & Haj Seyed Hadi, 2016). The researchers stated that increasing the biological activity of these bacteria during growth, stabilization, proper mobility and gradual release of nitrogen, played a significant role in increasing the uptake and relative improvement of nitrogen concentration. In a field study on *Satureja hortensis* L., it was found that using nitroxin bio-fertilizer increased the concentration of nitrogen in the plant compared to the control (Haj Seyed Hadi & Darzi, 2018). In another field study on cumin, it was reported that using nitroxin bio-fertilizer increased the content of nitrogen in seed by about 10% compared to the control (Karimzadeh Asl & Baghbani Arani, 2019).

In this regard, the results of a study on cumin revealed that the highest phosphorus concentration in seed was obtained from the use of bio-phosphorus bio-fertilizer and the highest potassium concentration in seed was obtained from the combined using of nitroxin and bio-phosphorus fertilizers (Karimzadeh Asl & Baghbani Arani, 2019) which is consistent with the results of the present study. They stated that using bio-fertilizers by increasing the absorption of water and available root elements through increasing the root volume, penetrating into the pores of the soil, preventing leaching of nutrients increased the absorption and transfer of phosphorus and potassium to seeds. The study results of Behzadi and Salehi (2017) on Pimpinella anisum also confirm that the combined use of bio-fertilizers containing nitrogen-fixing and phosphate-solubilizing bacteria increased the potassium concentration in seed compared to the control. Also, in a report of a field study on Foeniculum vulgare, it was observed that the combined application of nitroxin and bio-superphosphate biofertilizers increased the phosphorus concentration in seed (Movaghatian et al., 2015). They stated that under conditions of lack of nutrients in the soil, growth-promoting bacteria acted better and increased the concentration of phosphorus in seed of fennel. In another study on fennel, researchers attributed the increase in the concentration of potassium in seed by the combined use of growth-promoting bacteria (*Azotobacter*, *Pseudomonas* and *Bacillus*) and mycorrhiza fungi to the ability of these bacteria to increase usable potassium in the soil and improve mycorrhizal symbiosis (Zamani et al., 2019). The results of two field studies also showed that the application of phosphate bio-fertilizer (containing Pseudomonas bacteria) increased the concentration of phosphorus and potassium in fennel and coriander compared to the control (Darzi et al., 2009; Bastami & Majidian, 2014). In another study, it was observed that the use of bio-fertilizer (mycorrhiza fungus) increased the concentration of phosphorus in seeds of fennel (Jamshidi et al., 2011). The researchers attributed the increase in phosphorus concentration to the spread of plant roots inoculated with the fungus and an increase in growth-promoting hormones.

It seems that increasing seed yield in some biofertilizer treatments (such as bio-sulfur) and especially the combined using of nitroxin and bio super phosphate is due to the positive and obvious effect of bacteria in these biofertilizers on the optimal absorption of nitrogen, phosphorus and potassium and subsequent improvement

in growth and yield characters such as the umbel number per plant. In this regard, in a study on fennel, it was observed that the combined use of nitroxin and bio-superphosphate biofertilizers increased seed yield compared to the control (Movaghatian et al., 2015). In another study on the effect of bio-fertilizers on Foeniculum vulgare, the results showed that the highest seed yield was obtained from bio-phosphate bio-fertilizer treatment and then in nitroxin treatment (Gorgini Shabankare et al., 2017). They stated that using bio-fertilizer, due to the availability of more bacterial volume by the plant, increase growth and better yield. The results of a field study also showed that using bio-fertilizers containing *Azotobacter* and *Pseudomonas* bacteria and mycorrhizal fungus increased the seed yield of fennel (Zamani et al., 2018). They stated that using bio-fertilizers due to an increase in the speed and duration of photosynthesis has increased the efficiency of photosynthetic matter transfer to the sink, which has led to an increase in the yield of this medicinal herb. In two other study on Cuminum cyminum, it was observed that using *Azotobacter* and *Pseudomonas* bacteria and integrated application of nitroxin and bio-phosphate increased seed yield (Saeidnejad & Rezvani Moghaddam, 2010; Karimzadeh Asl & Baghbani Arani, 2019). A study by Kamayestani et al. (2015) on Pimpinella anisum also confirmed that using bio-sulfur bio-fertilizer increased seed yield compared to other single and combined treatments of organic and biological fertilizers such as vermicompost treatments. They found that the presence of *Thiobacillus* bacteria as a bio-fertilizer by producing sulfuric acid and reducing acidity in alkaline soils can increase the solubility of macro and micro-nutrients such as phosphorus, iron, manganese and zinc and thus increase their uptake by plants in these soils and improve yield of Pimpinella anisum through increasing the plant resistance to pathogens and drought.

In the present study, most of the single and combined treatments containing vermicompost did not have the expected seed yield, which seems that the proper condition of the organic matter and nitrogen percent in the experimental soil has reduced the effect of vermicompost.

5. Conclusion

In general, the study results showed that nutritional management of medicinal herb of coriander using organic and biological fertilizers had a significant effect on the studied characters, so that in all studied traits, separate and combined use of organic and biological fertilizers were superior to the control treatment (no fertilizer use) and superior or equal to the chemical fertilizer treatment. Also, among biological (nitroxin, bio-superphosphate and bio-sulfur) and organic (vermicompost) fertilizers, separate and combined treatments of biofertilizers had a significant superiority to separate and combined treatments of organic fertilizer (vermicompost), So that in the present study, the highest seed yield was obtained from the integrated treatment of nitroxin and bio-superphosphate.

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