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Effect of Different Levels of Vermicompost and Fungal Compost on Several Traits of *Ziziphora clinopodioides* Lam. in Northern Khorasan, Iran

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Abstract

Organic materials are the most useful sources of organic matters, which improve soil quality and enhance the yield of different plants. A field experiment was conducted in 2013-2014 in faculty of agriculture of higher education complex of Shrivan in order to investigate the effect of different levels of organic fertilizers such as fungal compost and vermicompost on morphological traits of *Ziziphora clinopodioides*. Also, laboratory experiments were carried out at Gorgan University of Agriculture the experiments were designed as a randomized complete block with seven treatments and 3 replications. The treatments were included three levels of fungal compost (3, 6 and 9 tons per hectare), three levels of vermicompost (3, 6 and 9 tons per hectare) and the control (no fertilizer). The results indicated that the treatments had a significant effect on the studied traits. Application of organic fertilizers could increase the rate of some morphological traits including height, crown cover diameter, crown spread, weight of fresh and dry matter yield and chlorophyll content of the plant. The fungal compost treatment with 6 tons per hectare had the highest height (28.66 cm), weight of fresh yield (464.66 gr per m^2) and weight of dry yield (174.389 gr per m^2) and chlorophyll content (63.63 mg per cm^2). However, the highest crown cover diameter (33.33 cm) and crown spread (10.5 cm) were observed in vermicompost treatment with 9 tons per hectare.

Keywords: Ziziphora clinopodioides, fungal compost, vermicompost, morphological traits

Introduction

Fertilizer management is an important factor in successful cultivation of herbs. Accordingly, identifying the fertilizers which are fitted with appropriate environmental conditions could have favorable effects on plant quantitative and qualitative indices. Organic fertilizers increase soil organic matter and pH. These materials increase soil fertility by improving some soil chemical properties such as cation exchange capacity and increasing microorganism's activity and the availability of food (Renato *et al.*, 2003). Compost is an important organic matter which is considerably important due to many numerous benefits (Eshraghi, 1976). Vermicompost is another organic material commonly used in sustainable agriculture to improve the growth and quality of crops and horticultural products due to some characteristics like high porosity, absorbency and retention of minerals and gradual release of minerals and high water retention capacity (Arancon*et al.*, 2004; Atiyeh*et al.*, 2002). *Ziziphora clinopodioides* is an aromatic and herbal plant belongs to Lamiaceae family (Mozafarian, 1998). The active ingredients of this plant is used in pharmaceutical and food industries etc. Azizi *et al.* (2008) conducted a study on German chamomile herb and reported that yield has increased in different levels of vermicompost. Macginis *et al.* (2003) examined the effect of vermicompost on basil seedlings. They concluded that dry weight and the number of complete leaves treated with vermicompost have significantly increased. Singh *et al.* (1998) examined the effect of compost on fleawort, henbane and rue. The results showed that biomass components of all of these plants have increased with compost application. Application of vermicompost in Roman chamomile increased some growth indices as the number of flowers per plant (Liucand Pank, 2005). Several researchers also examined the effect of vermicompost on plant growth including Wilson and Carlile, 1989, Subler *et al.*, 1998 and Atiyeh *et al.*, 2000.They showed that vermicompost could significantly improve plant growth and seed germination. The present study aimed to examine the effect of fungal compost and vermicompost on morphological traits of *Ziziphora clinopodioides.*

Materials and Methods

This study was conducted in faculty of agriculture of higher education complex of Shrivan and Gorgan University of agricultural sciences and natural resources in 2013. The treatments were included various levels of fungal compost (3, 6 and 9 tons per hectare) and different levels of vermicompost (3, 6 and 9 tons per hectare) and control (no fertilizer). At first, soil samples were taken and soil physical and chemical analysis tests were carried out and the percentage of main elements were determined (Table 1). planting was conducted with15 × 50 cm distance

in plots with 3 × 2 m on 24th March, 2013. Irrigation was performed immediately after planting. All plots were covered with plastic in order to uniform germination. After 20 days, the plastic was removed from the plots. Then, the second irrigation was performed. Irrigation was performed in 7 days intervals and the weeding was done manually once a week. No chemical fertilizer, herbicide, pesticide or fungicide was used at the time of preparing the field and during the growth period from planting to harvesting. The plants were harvested on 27th July in 2014 after 80% flowering. Five plants were randomly selected from each plot to determine the components of yield. Plant height, crown cover diameter, crown spread, fresh weight and dry weight yield and chlorophyll content were measured. SAS was used to analyze the data. The means were compared by LSD test at 5% level.

Table 1. - Physical and chemical characteristics of soil and fungal compost and vermicompost fertilizer used in the test

	Texture	N %	P (ppm)	K (ppm)	EC (ds/Cm^3)	pH
Fungal compost		0.18	47	58	11.32	6.78
Vermicom post		0.08	58	4.8	4.24	6.64
Field soil	clayed – silted	0.021	11.65	445	2.92	7.81

Results and Discussion

Plant Height

Analysis of variance (Table 2) showed that the effect of treatments on plant height was significant at 1% level. Maximum height (28.66 cm) was observed in 6 tons per hectare fungal compost treatment. Mean comparison showed no significant difference between 6 tons per hectare fungal compost and other levels of fungal compost. The minimum plant height (23.106 cm) was observed in the control treatment. The highest plant height was observed in 9 ton per hectare vermicompost. No significant difference was observed between 3 and 6 tons per hectare vermicompost. It is reported that application of vermicompost was significant on plant height in German chamomile (*Matricaria chammimila* L.) (Azizi *et al.,* 2008). Delate (2000) investigated the effect of organic fertilizers on several herbal medicinal plants and concluded that adding compost increases plant height in coneflower (Delate, 2000). Azizi *et al.* (2007) conducted an experiment on basil and reported that different levels of vermicompost have significant effect on plant height compared to the control (Azizi *et al*., 2007).

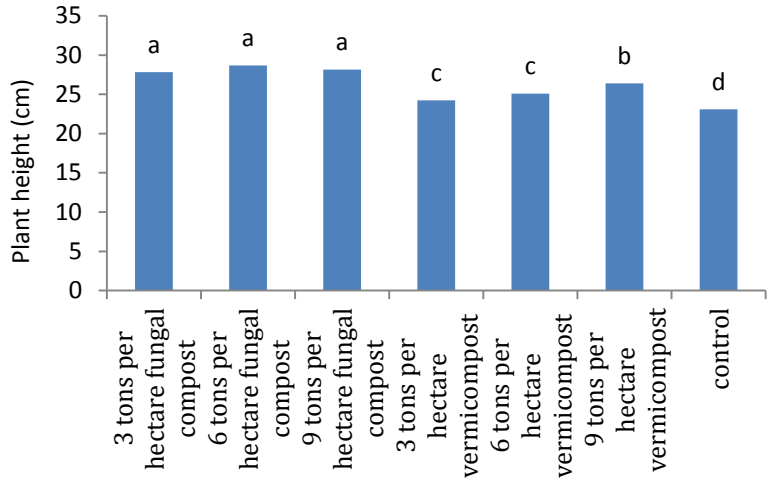

Figure 1 –plant height comparison at various levels of organic fertilizer

Crown cover diameter

Analysis of variance (Table 2) showed that the effect of treatments on the measured traits were significant at 1% level. Maximum crown cover diameter (33.33 cm) was observed in 9 tons per hectare vermicompost treatment. Results of mean comparison showed no significant difference between 6 and 9 tons per hectare vermicompost. The minimum crown cover diameter (24.65 cm) was observed in the control group. No significant difference was observed between control and the treatments.

Crown spread

Analysis of variance (Table 2) showed that the effect of treatment on the measured traits was significant at 1% level. The maximum crown spread (10.5 cm) was observed in 9 ton per hectare vermicompost while the minimum crown spread (7.15 cm) was observed in the control treatment. The control treatment had a statistically significant difference with other treatments except 9 tons per hectare fungal compost. The maximum crown spread was observed in 3 tons per hectare fungal compost, which had no significant difference with 6 tons per hectare fungal compost. However, a significant difference was observed between 3 and 9 tons per hectare fungal compost.

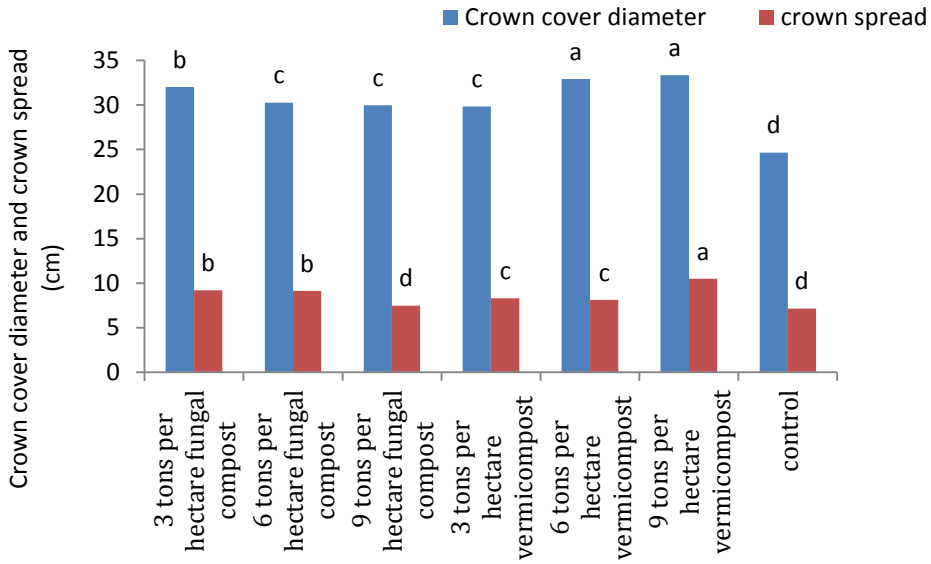

Figure 2 – Crown cover diameter and crown spread comparison at different levels of organic fertilizer

Plant fresh weight

Analysis of variance showed that fresh weight of vegetative organs significantly increased under the influence of organic fertilizer treatments at 5% level. The maximum fresh weight of vegetative organs (464.66 g) was observed in 6 tons per hectare fungal compost treatment while the minimum weight (214.17 grams) was observed in the control (no fertilizer). Delate (2000) investigated the effect of organic fertilizers on several herbs. They showed that adding compost increased the fresh and dry weights in *Melissa officinalis* (Delate, 2000).

Plant dry weight

Analysis of variance showed that vegetative dry weight significantly increased under the influence of different treatments of organic fertilizer at 5% level. Results of mean comparison showed no significant difference between treatments (Fig. 3). The highest dry weight of aerial vegetative organs (174.389 g per m^2) was observed in 6 tons per hectare fungal compost treatment while the minimum weight (79.44 g per m^2) was observed in the control treatment (no fertilizer). According to the results, it could be stated that nitrogen content of organic fertilizers boosts vegetative growth and increases biomass. High potassium content of these fertilizers not only accelerates cell division, but also directly affects vegetative growth. This is because potassium participates in the construction of carbohydrates and proteins and cell sap concentration and consequently increases plant dry weight. Khalil (2006) examined the effect of manure, poultry manure and biocompost on plantation of herbal plant. He stated that fresh and dry weights are not affected by the treatments. Mahshwari *et al.* (2000) conducted a study on fleawort herbal plant and reported that chemical

and biological fertilizers had no significant effect on growth traits. Therefore, it could be concluded that the plants react differently to various organic fertilizers.

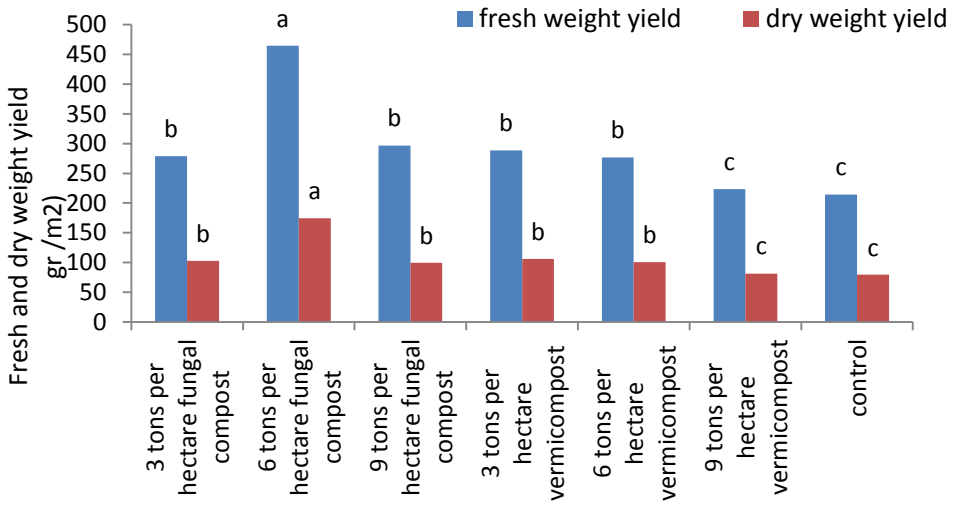

Figure 3 - Comparison of wet and dry weight yield in different levels of organic fertilizers

Chlorophyll content

Analysis of variance showed a significant difference between organic fertilizers in term of chlorophyll content. The maximum chlorophyll content was observed in 6 tons per hectare fungal compost (63.63 mg per cm^2) and the minimum chlorophyll content (56.73 mg per cm^2) was observed in the control treatment. The maximum chlorophyll content was observed in 9 tons per hectare vermicompost treatment. No significant difference was observed between 3 and 6 tons per hectare vermicompost treatments. There was no significant difference between different levels of fungal compost.

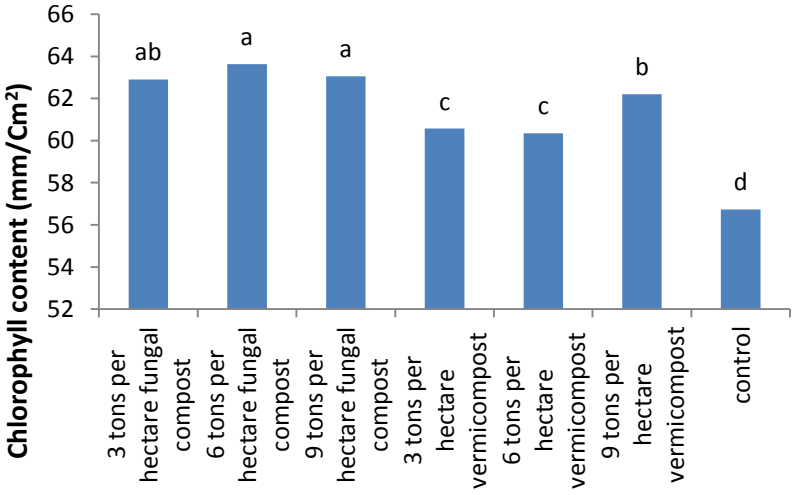

Figure 4 - Comparison of chlorophyll content at different levels of organic fertilizer

Table 2 - Analysis of variance of the perennial *Ziziphora clinopodioides* herb in response to organic fertilizers

Source of variation	df	Height	Crown cover diameter	Crown spread	Fresh weight yield	Dry weight yield	Chlorophyll
Block	2	0.1^{ns}	0.13^{ns}	0.0075^{ns}	59.58^{ns}	34.28^{ns}	0.47^{ns}
Treatment	6	13.58^{**}	25.53^{**}	3.93^{**}	2049.64^{**}	303.63^{**}	17.07^{**}
Error	12	0.27	0.33	0.095	130.171	58.05	0.39
CV	-	2.01	1.91	3.59	3.9	7.16	1.02

ns and **, respectively insignificant and significant at 1% level of probability.

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