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International journal of Advanced Biological and Biomedical Research

Volume 2, Issue 3, 2014: 706-714

Influence of Vermicompost and Biostimulant on the growth and biomass of coriander (*Coriandrum sativum* L.)

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Abstract

The main objective of this study was to determine the influence of vermicompost and biostimulant on the growth and biomass in the coriander plant height, wet weight of plant ,dry weight of plant and biomass yield. The experiment was carried out as factorial experiment in the base of randomized complete blocks design with eight treatments and three replications at research field of Agriculture Company of Ran in Firouzkuh of iran in 2012 . The factors were Vermicompost in four levels (0, 3, 6 and 9 ton/ha) and biostimulant, *mixture of Azotobacter chroococcum* and *Azospirillum lipoferum* in two levels (non-inoculated and inoculated seeds). The present results have shown that the highest fresh weight of plant ,dry weight of plant and biomass yield were obtained after applying 9 ton/ha vermicompost. Biostimulant also showed significant effects on biomass yield. The maximum biomass yield were obtained by using the biostimulant (inoculated seeds). The results also showed that the interaction of vermicompost and biostimulant were significant on fresh weight and dry weight of plant.

Key Words: Coriander, Vermicompost, Azotobacter, Azospirillum, Biomass.

Introduction

Application of organic manure and biostimulant such as vermicompost and nitrogen fixing bacteria has led to quality increasing in agricultural products (Sanchez et al., 2008; Velmurugan et al., 2008). Vermicomposts are the products of the degradation of organic matter through interactions between earthworms and microorganisms. Vermicomposts contain most nutrients in the available forms such as nitrates, phosphates, exchangeable calcium and soluble potassium (Atiyeh et al., 2002; Arancon et al., 2005). Free-living nitrogen fixing bacteria such as; *Azotobacter chroococcum* and *Azospirillum lipoferum*, were found to have not only the ability to fix nitrogen but also the ability to release phytohormones similar to gibberellic acid and indole acetic acid, which could stimulate plant growth, absorption of nutrients, and photosynthesis (El Ghadban et al., 2006; Mahfouz and Sharaf Eldin, 2007). By using correct nutritional sources through organic manures and biofertilizers, growth and biomass of crops such as medicinal plants can be maximized. Coriander (*Coriandrum sativum* L.) is one of the most important of vegetables, spice and medicinal plant. It is an annual and herbaceous plant, belonging to the Apiaceae family. The coriander seeds have essential oil as an active substance, which is used in pharmaceutical industry as a antispasmodic and a carminative (Deiderichen, 1996; Carrubba *et al*., 2002; Msaada et al., 2009; Ghobadi and Ghobadi, 2010). Several studies have reported that vermicompost can increase the growth and biomass of some medicinal plants such as chamomile (Fallahi et al., 2008), plantain (Sanchez

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et al., 2008), coriander (Singh et al., 2009), fennel (Darzi et al., 2007), cumin (Saeid Nejad and Rezvani Moghaddam, 2011), moldavian balm (Mafakheri et al., 2011), anise (Darzi et al., 2012a) and dill (Darzi et al., 2012b). Some other studies have reported that biostimulants such as *Azotobacter chroococcum* and *Azospirillum lipoferum* could cause increased growth and biomass in a few medicinal plants such as coriander (Kumar et al.,2002), celery (Migahed et al., 2004), fennel (Mahfouz and Sharaf Eldin, 2007), turmeric (Velmurugan et al., 2008), hyssop (Koocheki et al., 2009), dill (Darzi et al., 2012b) and coriander (Darzi et al., 2012c). Therefore, the main objective of the present field experiment was to investigate the Influence of Vermicompost and Biostimulant on the growth and biomass of coriander (*Coriandrum sativum* L.).

METHODS

Field Experiment

A factorial experiment, arranged in a randomized complete blocks designed with three replications, was conducted in the Experimental field of the Agriculture Company of Ran, Firouzkuh, Iran during the growing season of 2012. The geographical location of the experimental station was 35º 45´ N and 52º 44´ E with the altitude of 1930 m. The treatments consisted of different levels of vermicompost (0, 3, 6 and 9 ton/ha) and biostimulant, different inoculation conditions of mixture of *Azotobacter chroococcum* and *Azospirillum lipoferum* bacteria (non-inoculated and seed inoculated). Inoculation was carried out by dipping the coriander seeds in the cells suspension of 10^8 CFU/ml for 15 min. The vermicompost was prepared from animal manure by employing epigeic species of *Eisenia foetida*. The required quantities of vermicompost were applied and incorporated to the top 5 cm layer of soil in the experimental beds before the plantation of coriander seeds. Several Soil samples (0–30 cm depth) were taken for the nutrient and trace element analysis prior to land preparation. Chemical and physical properties of the experimental soil and vermicompost are presented in Tables1 and 2. Each experimental plot was 3 m long and 2 m wide with the spacing of 10 cm between the plants and 40 cm between the rows. There was a space of one meter between the plots and 2 meters between replications. Coriander seeds were directly sown by hand. There was no incidence of pest or disease on coriander during the experiment. Weeding was done manually and the plots were irrigated weekly (as trickle irrigation system). All necessary cultural practices and plant protection measures were followed uniformly for all the plots during the entire period of experimentation.Data were recorded for the plant height, fresh weight of plant, dry weight of plant and biological yield. Twenty plants were randomly selected from each plot and the observations were recorded. At the beginning of flowering, the plant height, from plant base to the tip of plant, was measured for each plot using a ruler (±0.1 cm) (Darzi et al., 2007; Azizi et al., 2008). Fresh weight of plant was calculated using a digital balance (Sartorius B310S; ±0.01 g) at the harvest time. For evaluating the dry weight of plant, plants were put in the oven at 80º C for 48 h and dry weight was calculated using a digital balance (Sartorius B310S; ±0.01 g) (Migahed et al., 2004; Badran and Safwat, 2004) and then by using the dry weight of plant, biological yield was calculated.

Table 1. Some Traits of Physical and Chemical of soil in experiment site

Cu (mg/kg)	Fe (mg/kg)	K (mg/kg)	P (mg/kg)	N (%)	O.C (%)	EC (ds/m)	pH	Texture
1.2	8	720	48	0.127	1.86	1.55	7.6	Clay-Loamy

Table 2. Some Characteristics of Chemical of used Vermicompost

K	P	N	O.C	O.M	EC	pH
(%)					(ds/m)	
3.9	0.67	11.3	26.1	45	1.8	8.5

Statistical Analysis

All the data were subjected to statistical analysis (one-way ANOVA) using SAS software (SAS Institute, version 8, 2001). Differences between the treatments were performed by Duncan's Multiple Range Test (DMRT) at 5% confidence interval. Transformations were applied to the data to assure that the residuals had normal distribution (Zar, 1996).

RESULTS AND DISCUSSION

Plant height

The results indicated that plant height was not affected by vermicompost and biostimulant (Figure 1 and table 3).

Fresh weight of Plant

The results have indicated that fresh weight of plant was affected by the application of vermicompost (Figure 2). Significant increase in fresh weight of plant was observed in vermicompost application. The highest fresh weight of plant were obtained with applying 9 ton/ha vermicompost (85.4 g). This finding is in accordance with observations of Fallahi et al. (2008) on chamomile and Mafakheri et al. (2011) on moldavian balm. Biostimulant did not show significant effect on fresh weight of plants (table 3). The present results show that the interaction of vermicompost and biostimulant was significant. The highest fresh weight of plant (91.3 g) was obtained after the integrated application of 9 ton/ha vermicompost and non-inoculated seeds by biostimulant.

Dry weight of Plant

The results have indicated that dry weight of plant was affected by the application of vermicompost (Figure 3). Significant increase in dry weight of plant was observed in vermicompost application. The highest dry weight of plant were obtained with applying 9 ton/ha vermicompost (79.6 g). The results clearly demonstrate the effectiveness of vermicompost in increasing the dry weight of plant. Vermicompost increases the growth rate because of the water and mineral uptake such as; nitrogen and phosphorus (Arancon et al., 2006; Zaller, 2007), which leads to the dry weight of plant improvement. This finding is in accordance with the previous observations (Anwar et al., 2005; Moradi et al. 2010; Darzi, 2012; Saeid Nejad and Rezvani Moghaddam, 2011). Biostimulant did not show significant effect on dry weight of plants (table 3). The present results show that the interaction of vermicompost and biostimulant was significant. The highest dry weight of plant (83.7 g) was obtained after the integrated application of 9 ton/ha vermicompost and non-inoculated seeds by biostimulant.

Biomass yield

The results have indicated that biomass yield was affected by the application of vermicompost (Figure 4). Significant increase in biomass yield was observed in three treatments of vermicompost application (3, 6 and 9 ton/ha) as compared to the control experiment (non-vermicompost). The highest biomass yields were obtained with applying 9 ton/ha vermicompost (19924 kg/ha). The results clearly demonstrate the effectiveness of vermicompost in increasing the biomass yield. Vermicompost increases the growth rate because of the water and mineral uptake such as; nitrogen and phosphorus (Arancon et al., 2006; Zaller, 2007), which leads to the biomass yield improvement. This finding is in accordance with the previous observations (Anwar et al., 2005; Moradi et al. 2010; Darzi and Haj Seyed Hadi, 2012; Darzi et al. 2012a; Saeid Nejad and Rezvani Moghaddam, 2011). Biofertilizer showed significant effect on biomass yield (Table 3), as the highest biomass yield (18717.5 kg/ha) was obtained in the second treatment level of nitrogen fixing bacteria (inoculated seeds). Effect of biostimulant on the biomass yield was due to increased nitrogen uptake (Mahfouz and Sharaf Eldin, 2007; Kalyanasundaram et al., 2008). The result of present work are in agreement with the reports of Swaminathan et al. (2008) and Kumar et al. (2009) on *Artemisia pallens*, Valadabadi and Farahani (2011) on *Nigella sativa* and Darzi et al. (2012b) on *Criandrum sativum*).

Table 3. Mean comparison of the some characteristics of coriander at various levels of biostimulant

Treatments	Plant height (cm)	Fresh weight of plant (g)	Dry weight of plant (g)	Biomass yield (kg/ha)
Biostimulant (nitrogen fixing bacteria)				
b1	73.2 a	73.5 a	68.2 a	16802.3 b
b2	72.7 a	79.6 a	73.8 a	18717.5 a

Means, in each column for each factor followed by at least on letter in common, are not significantly different at 5% probability level using Duncans' Multiple Range Test.

b1 and b2 represent non-inoculated and inoculated seeds by nitrogen fixing bacteria, respectively.

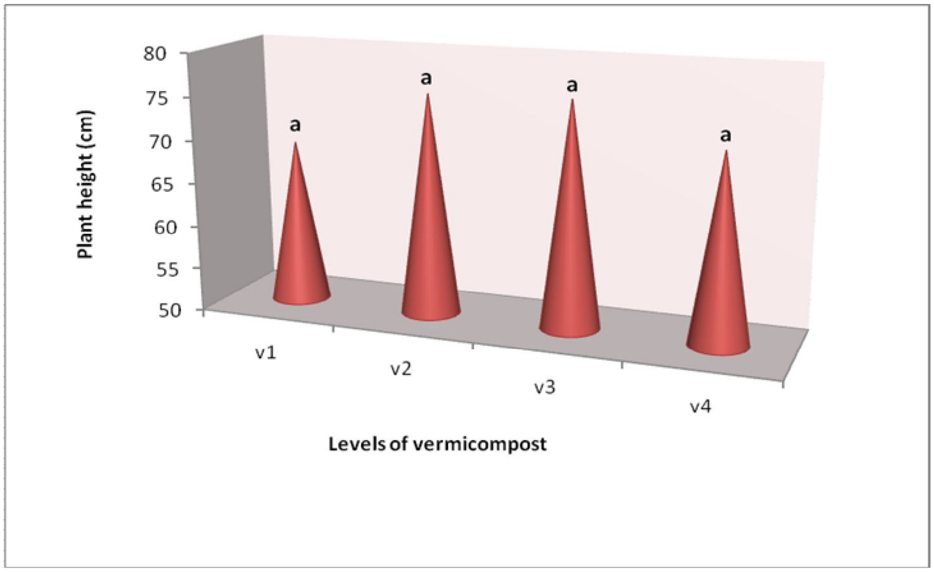

Figure 1. Mean comparison for plant height in different levels of vermicompost

v1, v2, v3 and v4 represent 0, 3, 6 and 9 ton vermicompost per hectare, respectively.

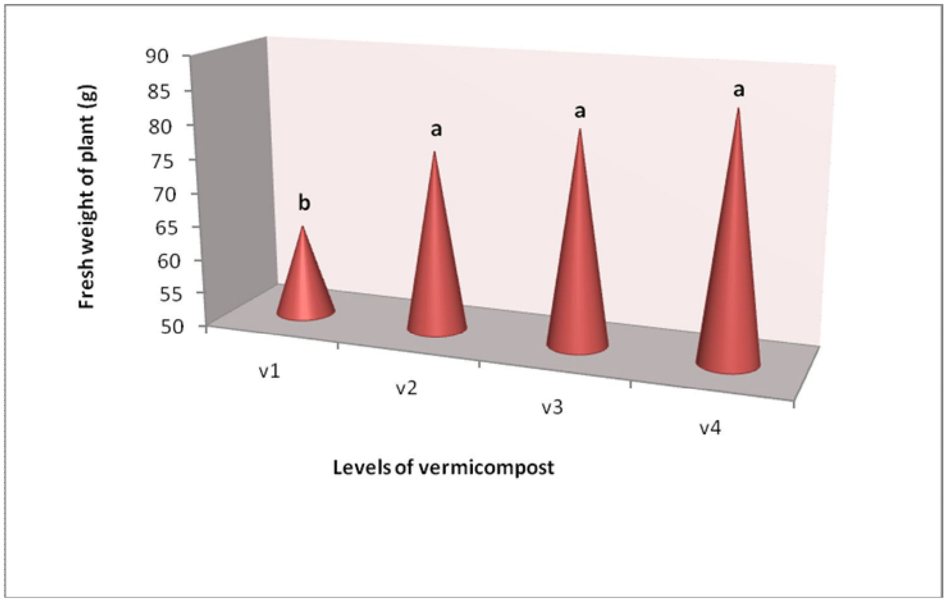

Figure 2. Mean comparison for fresh weight of plant in different levels of vermicompost

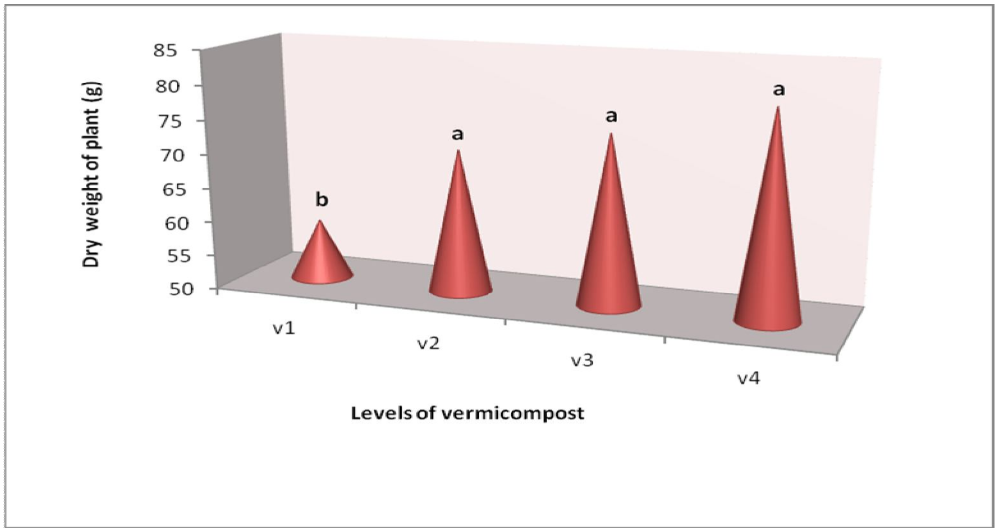

Figure 3. Mean comparison for dry weight of plant in different levels of vermicompost

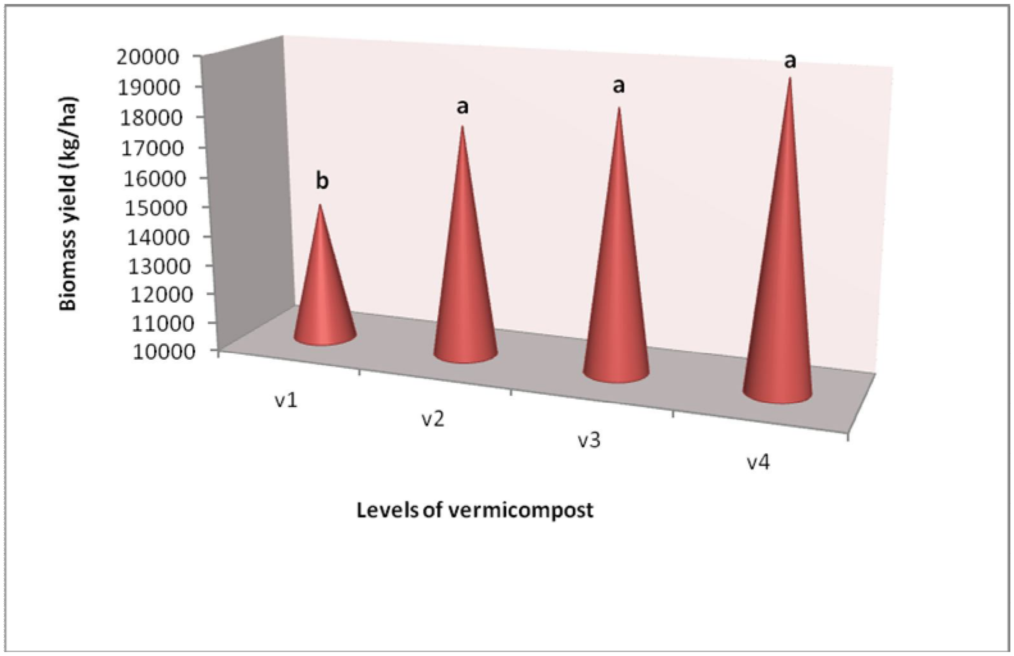

Figure 4. Mean comparison for biomass yield in different levels of vermicompost

Conclusion

It is clear from the present study that vermicompost and biostimulant successfully manipulate the growth of coriander, resulting in beneficial changes in biomass. The highest biomass yield was obtained by using 9 ton vermicompost per hectare. Maximum biomass yield was observed by using biostimulant application (inoculated seeds). Thus, combined application of vermicompost and biostimulant (azotobacter + azospirillum) can be helpful in the development and production in coriander.

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