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Comparison of Municipal Solid Waste Compost, Vermicompost and Leaf Mold on Growth and Development of Cineraria (*Pericallis* × *hybrida* 'Star Wars')

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Abstract

A research was conducted to determine the effect of municipal solid waste compost, vermicompost and plane (Platanus orintalis) leaf mold on growth and flowering of Cineraria (*Pericallis* × *hybrida* Willd. 'Star Wars'). These organic materials were added to a soil mixture containg farm soil and sand with the ratios of 1:1:1, 1:0:1, 2:1:1, 2:0:1 and 0:0:1 soil, sand and compost, respectively. The Cineraria seedlings with four leaves were planted pots (15 cm diameter) containing these media. When the plants were in flowering stage, the parameters such as leaf and flower number, fresh and dry weights of shoots and roots were measured. The results showed that the highest shoot fresh and dry weights and flower numbers were observed in soil mixture amended with vermicompost in ratio of 2:0:1. However, the highest number of leaves was obtained in mixture containing municipal solid waste compost in ratio of 1:1:1 and the highest root fresh and dry weights were observed in soil mixture amended with leaf mold with 2:0:1 ratio.

Keywords: Municipal solid waste compost, Leaf mold, *Pericallis* × *hybrida*, Vermicompost.

INTRODUCTION

Cineraria (*Pericallis* × *hybrida*) is a perennial plant of Asteraceae family that abundantly uses as a pot flowering plant at New year celebration in Iran. The plant needs a rich and loose soil. In this plant, root system is not growing too much but due to having large leaves a relatively high evapotranspiration can be seen in this plant (Ghasemi Ghehsareh and Kafi [23]). Compost is prepared by biological degradation of plant and animal residues under controlled, aerobic conditions (Eghball et al. [20]) Traditional composting process involves an initial stage conducted at moderate temperatures (10-40°C), during which the labile organic matter is rapidly consumed by mesophilic microorganisms, followed by a stage when thermophilic microorganisms drive the temperature up to 60°C at which lipids, proteins and complex carbohydrates are consumed and broken down. During the final curing stage, when the material cools down, mesophilic organisms are able to recolonize and break down the remaining recalcitrant organic matter (Chefetz et al. [14]).

Commercial potting media for cineraria often contains substantial amounts of peat that using it endangeres the bogs and ecosystems or may not be available in Iran. Therefore, the gardeners prefer to use other organic matters like leaf mold, municipal solid waste compost, or vermicompost. The compost prepared through the application of earthworms is called vermicompost and the technology of using local species of earthworms for culture or composting has been called Vermitech (Ismail [28]; [29]). Vermicompost is usually a finely divided peat-like material with excellent structure, porosity, aeration, drainage and moisture holding capacity (Edwards [16]; [18]). At recent years, researchers have become progressively interested in using another biological process, termed vermicompost i.e., described as "biooxidation and stablilization of organic material involving the joint action of earthworms and mesophilic microorganisms" (Aira et al. [1]).

However, both composts and vermicomposts have been widely used in traditional agriculture and horticulture and have beneficial effects, on soil structure or soil biota (Subler et al.[38];

Carpenter-Boggs et al.[11]). Benefits of compost application in agriculture mainly result from its content of organic matter, plant nutrients, promoting plant growth and inhibiting root pathogens/soil-borne plant diseases (Hoitink [27]; Alvarez et al. [3]; Perner et al. [33]). Compost is known to be product rich in microorganisms that help the plants to mobilize and acquire nutrients (Postma et al. [34]).

Various greenhouse and field studies have examined the effects of a variety of vermicomposts on a wide range of crops including cereals and legumes (Chan and Griffiths [13]), vegetable (Edwards [16]; Wilson and Carlile [39]; Subler et al. [38]; Atiyeh et al. [6]) ornamental and flowering plants (Edwards and Burrows [17]; Atiyeh et al. [8]), and field crops (Arancon et al. [4]). Despite of the beneficial effects on growth and yield of plants, higher metal concentration in this material may be a problem and limit its utilization (Jordao et al. [30]). The soil quality includes soil reaction (pH), mineral nutrient elements, water content, composition of soil atmosphere and biotic factors. Mature compost when added to soil directly affected almost all of these factors (Marinari et al. [31]).

While vermicompost effects on growth and productivity of plants have been investigated, there have been relatively few investigations on ornamental flowering plants (Atiyeh et al. [8]; Senthilkumar et al. [37]) and none on cineraria. The aim of this study was to compare the effects of different rates of vermicompost of animal manure origin, municipal solid waste compost and leaf mold in soil mixtures, on growth and flowering of cineraria.

MATERIALS AND METHODS

Cineraria seedlings were grown in Ornamental Plants Research Greenhouse of Isfahan Parks Organization. The Cineraria seedlings with four leaves were planted in. pots (15 cm diameter) containing farm soil (control) and soil mixture of soil, sand and different organic matters. Chemical properties of soil, and organic matters were determined prior to application (Table 1).

The organic materials (municipal solid waste compost, vermicompost or plane (Platanus orintalis) leaf mold) were used in mixture of soil, sand and organic mater in ratios of 1:1:1, 1:0:1, 2:1:1, 2:0:1 and 0:0:1, respectively. When the plants were in flowering stage, the parameters such as leaf and flower numbers, fresh and dry weights of shoots and roots were measured. The experiment was arranged as a completely randomized design with 6 replications. Means were compared using Duncan's new multiple range test (DNMRT) at 5% level of probability.

RESULTS

The highest leaf number was obtained in soil mixture amended with municipal solid waste compost in ratio of 1:1:1 but had not any significant difference with other treatments. The lowest leaf number was observed in 100% vermicompost. The highest flower number was obtained in ratio of 2:0:1 of

Table.1. Chemical properties of used soil, municipal solid waste compost (MSWC), vermicompost and leaf mold.

Media	Mn	Zn	Cu	Fe	OC (%)	Mg	Ca	K	P	N
Soil	8	2.8	1.5	11	0.3	4.2	7.1	60	7.25	0.01
MSWC	378	900	232	1.06	57.27	0.25	5.4	0.85	0.7	2.3
Vermicompost	570	193	64	830	49	2.5	5.2	0.63	1.7	1.67
Leaf mold	.029	0.4	0.023	2.3	24	0.24	1.07	0.18	0.02	1.3

Table.2. Effect of municipal solid waste compost (MSWC), vermicompost and leaf mold on growth indices of cineraria (*Pericallis × hybrida*).

Treatment	Proportion	Shoot dry weight (g)	Root dry weight (g)	Root fresh weight (g)	Shoot fresh weight (g)	Flower No.	Leaf No.
MSWC	1:1:1*	5.840 a-c	1.086 a-c	6.288 ab	25.09 b-e	69.6 ab	36 a
	1:0:1	4.762 a-e	0.860 a-c	5.452 ab	33.38 a-e	55.75 a-c	20.25 a-c
	2:1:1	5.054 a-e	0.512 c	3.424 b	35.65 a-e	78 a	34 ab
	2:0:1	5.246 a-e	0.722 bc	4.488 ab	18.79 e	59 a-c	24 a-c
	0:0:1	3.404 d-e	0.858 a-c	4.880 ab	19.05 e	31 c	17.4 b-c
Vermicompost	1:1:1	5.194 a-e	1.290 a-c	6.788 ab	33.43 a-e	62.4 a-c	22.4 a-d
	1:0:1	5.054 a-e	0.856 a-c	5.388 ab	33.03 a-e	63.2 a-c	21.2 a-d
	2:1:1	4.360 b-e	0.818 a-c	4.888 ab	29.89 a-e	67 ab	18.2 b-d
	2:0:1	6.830 a	0.738 bc	4.432 ab	48.41 a	87.4 a	31 a-c
	0:0:1	4.160 c-e	0.800 a-c	5.408 ab	21.63 c-e	56 a-c	13.32 d
Leaf mold	1:1:1						
		4.494 b-e	0.932 a-c	5.412 ab	32.85 a-e	61.6 a-c	19.4 a-d
	1:0:1						
		6.530 ab	1.304 a-c	7.238 ab	46.32 a	86 a	24.6 a-d
	2:1:1						
		6.120 a-c	0.794 a-c	4.684 ab	43.73 ab	62 a-c	25.8 a-d
	2:0:1						
		5.960 a-c	1.794 a	7.880 a	42.12 a-c	57.8 a-c	21.6 a-d
	0:0:1						
Control	1:0:0	4.614 a-e	1.126 a-c	4.962 ab	30.21 a-e	59.4 a-c	17.6 b-d

*In each column, means with the same letter (s) are not significantly different at 5% level of probability using Duncan's new multiple range test (DNMRT).

vermicompost which did not show significant differences with soil mixture amended with 2:1:1 municipal solid waste compost and 1:0:1 leaf mold. The lowest leaf number was observed in 100% municipal solid waste compost. The highest shoot fresh and dry weights were obtained in soil mixture amended with vermicompost in ratio of 2:0:1.

The lowest shoot fresh weight was obtained in 100% municipal solid waste compost and lowest dry weight observed in 100% vermicompost.

The highest root fresh and dry weights were observed in soil mixture amended with leaf mold in ratio of 2:0:1 proportion, that was not significantly different with other soil mixtures. The lowest root dry weight was obtained in soil with 2:1:1 municipal solid waste compost. Plants in 100% leaf mold dried in first month of experiment (Table 2)

DISCUSSION

According to data obtained in this study, addition of vermicompost and leaf mold were increased the growth indices and highest means were observed in soils amended with vermicompost. Using only municipal solid waste compost and vermicompost decreased plant growth. This results are in agreement with those of Atiye et al. [8] for Marigold. Similarly, incresing flower number by Use of vermicompost was increased flower number that is in accordance with Chamani et al. [12]; Arancon et al. [5]; Gutierrez-Miceli et al. [24]; Gajalakshmi and Abbasi [22] results for different plants. Vermicompost also had a positive effect on shoot fresh and dry weights. Similar results are reported by. Zaller [40]; Rajbir et al. [35]; Bachman and Metzger [10]; Arancon et al. [5]; Hameeda et al. [25].

Factors such as improvement of the physical structure of the potting medium including bulk density, total porosity and moisture holding capacity (Azarmi et al. [9]; Zink and Allen [41]) increases in populations of beneficial microorganisms, and most probably, the availability of plant growth-influencing-substances such as hormones and humates produced by microorganisms during vermicomposting, probably contributed to increased plant growth (Arancon et al. [5]).

Application of vermicompost increase the bioavailability of phosphorus in the soil effecting plant growth (Erich et al. [21]), also enhance physical and chemical characteristics of soil (Azarmi et al. [9]; Edwards et al. [19]; Marinari et al. [31]).

The use of organic amendments such as traditional thermophilic composts has been recognized generally as an effective means for improving soil aggregation, structure and fertility, increasing microbial diversity and populations, improving the moisture holding capacity of soils, increasing the soil cation exchange capacity (CEC) and increasing crop yields (Zink and Allen [41]). Vermicompost contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium (Orozco et al. [32]). Addition of vermicompost may increase soil EC, contents of soil total organic carbon, total N, P, K, Ca, Zn and Mn, and decrease of soil pH (Azarmi et al. [9]). These all may be due to improved plant growth. Microbial activities result in release of mineral nitrogen in ammonium form during composting and in nitrate form that is readily available for plant during vermicomposting (Atiyeh et al. [7]). Application of Vermicompost in soil increases enzyme activities such as urease, phosphomonoesterase, phosphodiesterase and arylsulphatase (Albiach et al. [2]). Plant growth-promoting bacteria directly stimulate growth by nitrogen fixation (Han et al. [26]), solubilization of nutrients (Rodriguez and Fraga [36]), production of growth hormones, 1-amino-cyclopropane-1-carboxylate (ACC) deaminase (Correa et al. [15]); and indirectly by antagonizing pathogenic fungi by production of siderophores, chitinase, β-1,3-glucanase, antibiotics, fluorescent pigments and cyanide (Han et al. [26]). Decreased plant growth with 100% of vermicompost could be attributed to high concentrations of soluble salts, poor porosity or poor aeration (Senthilkumar et al. [37]).

According to results of this study, application of vermicompost in comparison to leaf mold and municipal solid waste compost resulted in increase of growth and flowering of cineraria, and con be a good substitute for traditional organic materials.

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