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The effect of cow manure vermicompost as the planting medium on the growth of Marigold

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ABSTRACT

The use of appropriate, cheap and available planting beds is a priority in ornamental plant production. Eleven treatments and three replicates per treatment with different rates of soil, sand and cow manure compost and vermicompost, perlite and peat were evaluated as growth media of Marigold (erecta tagetes), Tiashan variety (as test plant). After filling the pots (three liter volume) with substrates prepared in accordance with the test treatments, Marigold seeds were planted in pots. At the time of flowering, plants of the crown were cut and plant height, stem diameter, flower size, flower height, shoot fresh and dry weight were determined. The extracts were prepared from shoot dry matter and in the extracts, concentration of nutrients including nitrogen, phosphorus, potassium, calcium and magnesium were measured. Results showed that the largest stem diameter, flower size, shoot fresh and dry weight were related to mixture of 60% v/v vermicompost with 30% v/v sand plus 10% v/v soil, but the highest plant height obtained at 60% peat plus 40% perlite. Cow manure vermicompost was better than peat in many attributes of plant growth and compost effect also was better than peat. The use of vermicompost tends to increase in nitrogen, potassium and calcium concentration of plant as compared with peat and perlite.

Keywords: Compost, Growth medium, Marigold, Peat, Perlite, Vermicompost.

INTRODUCTION

Iran is the fifteenth in the world pay attention to the area under flower cultivation while due to problems has not suitable place in terms of exports. According to Census Bureau data 2004 of flowers and ornamental plants in Iran's Ministry of Agriculture in Iran, the cultivated area of flowers and ornamental plants is 25000 hectare. Many plants grow in a medium without soil in which peat is basic medium [1,2]. Peat because of characteristics such as low pH and lack of appropriate water holding capacity after drying can not be used for all plants. Also, due to ecological damage to the environment and lack of economical beneficial for producers of

ornamental plants, its use is disputed. This problem has led researchers to think about the substrates with suitable quality and inexpensive [3,4]. Today, the use of organic fertilizers and useful terrestrial organisms is the most natural and desirable way to keep the alive system and active life in the soil of agricultural lands. Supply of organic matter to soil because of response to their essential needs is the biggest advantage of organic fertilizers such as vermicompost and compost [5]. The use of vermicompost in ornamental plants beds can lead to decrease in peat consumption and production cost of ornamental plants [6,7].

In fact, vermicompost includes composting earthworm's wastes, relatively decomposed organic material, the egg capsule of earthworms and other small animals. The earthworm waste is a natural by-product of earthworms that is rich in nutrients needed by plants and can be used as amendment [8]. Atiyeh et al. [9] investigated effect of hog vermicompost on the growth and yield of French marigold in a greenhouse experiment. In this study, Marigold seeds were planted in values 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100% v/v standard commercial growth medium (Metro-Mix 360) mixed with swine manure vermicompost. The results showed that the highest growth obtained at 30 and 40% v/v replacement of standard growth medium by swine manure vermicompost.

Effects of vermicompost on growth and flowering satin in a greenhouse were investigated by Chamani et al. [10]**.** Results showed that vermicompost had a significant positive effect on flower number, leaf growth, and shoot fresh and dry weight as compared with grown plant in soil without vermicompost. The highest yield was observed in 20% vermicompost. Most iron (Fe) and zinc (Zn) in 60% v/v vermicompost and its lowest obtained without compost. Speir et al. [11] showed that the addition of sewage sludge compost increased yield of sugar beet. The purpose of this study was 1. Effects of cow manure compost and vermicompost on the qualitative and quantitative growth of Marigold, 2. The impact of cow manure compost and vermicompost in compared with substrates of perlite and peat and 3. Determination of the best mixture rates of vermicompost and compost with growth medium substrates.

MATERIALS AND METHODS

This experiment was conducted at year 2011 in a greenhouse of Meshkinshahr municipality, Ardebil province, Iran. Marigold (*erecta Tagetes*) variety Tiashan was used as the test plant and the study was conducted by a randomized completely block design with three replications. Organic materials used in this study were: 1. cow manure compost, 2. cow manure vermicompost, 3. Peat and 4. perlite. Planting beds according to the following eleven treatments (three replicates per treatment) were prepared in three-liter pots (as volume):

1. 30% soil + 70% sand (*control*),
2. 20% vermicompost + 30% sand + 50% soil,
3. 40% vermicompost + 30% sand + 30% soil,
4. 60% vermicompost + 30% sand + 10% soil,
5. 20% compost + 30% sand + 50% soil,
6. 40% compost + 30% sand + 30% soil,
7. 60% compost + 30% sand + 10% soil,
8. 100% perlite,
9. 20% peat + 80% perlite,
10. 40% peat + 60% perlite,
11. 60% peat + 40% perlite.

Eight seeds were planted randomly in each pot. The planted seeds were irrigated and the number of bush thinned to five. Before planting seeds, 75 $mgkg^{-1}$ nitrogen, 100 $mgkg^{-1}$ potassium 50 $mgkg^{-1}$ phosphorus were added to the planting beds from urea, potassium sulfate and super phosphate sources, respectively. Nitrogen to the growth medium was added in two stages. At the time of flowering, plants were cut of the crown, and after washing (three times) with distilled water, plant height, number of lateral branches, flower size, shoot fresh and dry weight were measured.

Chemical properties of the used soil for preparation of growth media include the pH of the mud-saturated; EC in the saturation extract, the texture by hydrometer method, equivalent calcium carbonate percent by titration method, available phosphorus and potassium respectively by spectrophotometry and flame photometry methods (Jones, 2001) were measured. EC, pH, equivalent calcium carbonates, total nitrogen, available phosphorus and potassium in the used soil was 4.8 dS/m, 8.03, 3.30%, 0.12%, 14.3 mg/kg and 656.8 mg/kg, respectively. Soil texture was Silt loam.

Vermicompost chemical properties including pH and EC in 1:5 extracts vermicompos to distilled water, CEC by Chapman method, the organic matter by oxidation method, total nitrogen by Kjeldal method [12] were measured (Table 1).One gram of dry vermicompost was ashed in 550°C and was extracted by HCl 2N. In produced extraction from shoot dry matter [13], potassium, phosphorus, total nitrogen, calcium and magnesium were determined. Variance analysis of data was performed by using SAS software and LSD test was used to compare mean data.

Table 1. Some Chemical properties of cow manure compost and vermicompost used in the growth media

Property	Vermicompost	Compost
EC(dS/m)	23.4	20.3
pH	7.17	7.52
CEC (meq/100g)	43.4	61.1
Organic carbon (%)	65.4	50.7
Total nitrogen (%)	0.308	0.504
Available phosphorus (mg/kg)	3.90	5.20
Available potassium (mg/kg)	750.0	1140.0
Available Magnesium (mg/kg)	130.2	77.0
Available Calcium (mg/kg)	85.0	162.0

RESULTS

1. The impact of growth beds on plant growth characteristics

Variance analysis of data (Table 2) showed that the impact of growth media on plant height, stem diameter, flower size, flower height, shoot fresh weight and dry weight was significant at one percent level.

Plant height: Table 3 shows the effect of planting beds on the height of plant. Maximum height of plant is related to 60% peat and plant height of this treatment was more than 20% peat, significantly. There is not a significant difference in compost and vermicompost treatments than in the control. Minimum height of plant obtained in 100% perlite treatment.

Flower size: The results in Table 3 showed the largest flower was in 60% vermicompost. Treatment was 60%. Treatments 40 and 60% of Peat; 20 and 40% compost and 40% vermicompost were in the next ranks, but had not significant differences with together. The size

of the flowers in 20% vermicompost treatment and control were similar. Adding compost to pots increased the size of the flower than in the 100% perlite, but with the increasing percentage of compost, flower size decreased. The smallest size of the flowers obtained in 100% Perlite. Figure 1 shows the size of the flowers treated with 100% perlite in compare with 60% vermicompost.

Flower Height: Results showed that the maximum height obtained in 40 and 60% peat; and 20 and 40% compost, respectively. Minimum height of flower treatment was 100% perlite (Table 3).

Table 2. Variance analysis of data related to the effect of treatments on the plant growth and nitrogen, potassium, calcium and magnesium concentration in shoots organs

Variation Sources	Freedom Degree	Mean Squared								
		Plant height	Flower size	Flower height	Shoot fresh weight	Shoot dry weight	N	P	K	Ca
Treatment	10	8.3**	24.7**	101.2**	10704.5**	76.9**	14.3**	0.05**	2.1**	0.14**
Replication	2	5.6^{ns}	12.3^{ns}	61.4^{ns}	246.6^{ns}	3.4^{ns}	72.4	0.003^{ns}	0.24^{ns}	0.13*
Error	20	1.8	13.1	15.7	102.2	2.6	3.9	0.003	0.13	0.03
CV (%)		6.4	4.7	8.2	6.8	9.7	43.7	26.1	13.5	12.7

*** Significant at 1% level,*
**Significant at 5% level,*
^{ns} not significant

Shoot fresh and dry weight: Results of Table 3 showed the largest fresh weight of shoot is related to 40 and 60% vermicompost and lowest weight obtained in 100% perlite. The largest and the lowest shoot dry weight obtained in 60% vermicompost and 100% perlite, respectively. Shoot dry weight increased with increasing percentage of peat.

Table 3. The effect of different treatments on plant height, stem diameter, flower size, flower height, fresh and dry shoot weight of Marigold

Treatment	Plant height (cm)	Flower size (mm)	Flower height (mm)	Fresh shoot weight (g)	Dry shoot weight (g)
30% soil + 70% sand (*control*)	20.7 ab	76.4 bc	43.7 c	123.9 d	14.8 c
20% vermicompost + 30% sand + 50% soil	22.4 ab	76.7 bc	50.3 abc	192.8 b	19.5 ab
40% vermicompost + 30% sand + 30% soil	22.0 ab	82.1 ab	52.2 ab	230.5 a	19.7 ab
60% vermicompost + 30% sand + 10% soil	20.9 ab	84.9 ab	47.0 abc	227.3 a	22.2 a
20% compost + 30% sand + 50% soil	21.5 ab	81.1 ab	52.2 a	150.7 c	18.3 b
40% compost + 30% sand + 30% soil	21.0 ab	79.7 ab	53.4 a	165.0 c	19.8 b
60% compost + 30% sand + 10% soil	21.0 ab	72.0 cd	45.2 bc	148.4 c	20.1 b
100% perlite	16.7 c	58.7 c	35.1 d	41.4 f	4.9 e
20% peat + 80% perlite	20.0 b	65.9 d	43.1 c	61.9 e	10.7 d
40% peat + 60% perlite	22.0 ab	83.0 ab	52.8 a	120.9 d	15.4 c
60% peat + 40% perlite	22.9 a	82.0 ab	52.7 a	161.0 c	18.9 b

2. The effect of treatments on nutrients concentrations

Variance analysis of data (Table 2) showed that the impact of planting beds on the concentration of nitrogen, phosphorus, potassium and calcium was significant at 1% level.

Nitrogen: Table 4 shows the impact of growth media on the total nitrogen of shoot dry matter. Plants grown in treatments containing 20 and 40% compost and 100% peat showed a significant difference with 100% perlite. The results also showed that plants treated with different levels vermicompost had further total nitrogen than plants treated with compost and Peat.

Figure 1. The effect of the growth medium of flower size (the planting medium containing 60% vermicompost at right hand in compare with 100% perlith at left hand)

Table 4. The effect of different treatments on nitrogen, phosphorus, potassium, calcium and magnesium concentration of shoot organs of Marigold

Treatment	N	P	K	Ca
	(%)			
30% soil + 70% sand (*control*)	7.8 a	0.20 b	2.50 bc	0.83 c
20% vermicompost + 30% sand + 50% soil	5.7 abc	0.14 bc	2.06 cd	1.56 a
40% vermicompost + 30% sand + 30% soil	6.5 ab	0.18 b	4.16 a	1.50 ab
60% vermicompost + 30% sand + 10% soil	7.2 a	0.21 b	2.80 b	1.60 a
20% compost + 30% sand + 50% soil	4.0 abcd	0.19 b	2.63 bc	1.40 ab
40% compost + 30% sand + 30% soil	4.5 abcd	0.12 bc	4.13 a	1.53 a
60% compost + 30% sand + 10% soil	5.3 abc	0.16 b	2.86 b	1.36 ab
100% perlite	1.1 d	0.45 a	1.30 d	1.32 ab
20% peat + 80% perlite	1.9 cd	0.44 a	2.73 bc	1.17 b
40% peat + 60% perlite	2.7 bcd	0.17 b	2.40 bc	1.33 ab
60% peat + 40% perlite	3.3 bcd	0.05 c	2.20 bc	1.26 ab

Phosphorus: The plant cultivated in compost, vermicompost and control treatments did not show a significant difference with together, but it is observed a significant difference with 100% perlite. The largest phosphrus concentration of shoot obtained in 100% perlite and 20% peat treatments.
Potassium: The results in Table 4 showed that 40% vermicompost and 40% compost treatments were significantly different from control. All treatments showed a significant difference with 100% perlite.

Calcium: plants grown in substrates containing 20 and 60 percent vermicompost and 40 percent compost had the highest percentage of calcium in their shoot organs; and control medium had the lowest calcium. Other treatments had no significant differences (Table 4).

Magnesium: Results showed that most magnesium concentration is related to the plants grown in 100% perlite substrate. Lowest percentage of this element was observed in the plants cultivated in 40 and 60% vermicompost beds.

DISCUSSION

In recent years, the use of natural compounds of plant origin instead of chemical compounds has increased [14]. By the use of organic materials and proper nutrition can produce plants with a better quality and appropriate height. Vermicompost contains plant growth hormones, several enzymes, more microbial populations and it is free of harmful pathogens and small animals such as form colonies bacteria and Salmonella. The results of this experiment showed that the effect of vermicompost on plant height was similar to peat, while in the perlite bed, plant height was lowest. Walker and Bernal [15] reported that application of compost and organic fertilizer dramatically increased growth of best branch. The effect of vermicompost on plant growth is through effect on photosynthesis and various products of plants such as leaves, stem and root to stimulate the material stored in the leaves and nutrients uptake and water by roots. Bwamiki et al. [16] showed that the use of organic amendments such as compost can increase the production of yield.

Vermicompost indirectly through the impact on soil micro flora will affect on plant growth. For example, adding vermicompost to the growth medium containing Peat increases the colony formation of mycorrhiza [17]. Domingues et al. [18] showed that hormone-like compounds and decrease in hevy metal availability increase the growth rate and plant height. The results showed that with increasing percentage of vermicompost, shoot fresh and dry weight increased. The best results of treatment obtained at 60% vermicompost treatments, while the other researchers have proposed a mixture 20-40 percent of the vermicompost in planting beds that is probably due to the low salinity of the compost used in this study (Table 1).

The size of the flowers in the urban landscape is an important indicator. Vermicompost contains nutrients such as phosphorus, potassium, and magnesium as available to plants [19]. Between treatments, beds containing vermicompost had a flower size larger than other treatments. Atiyeh et al. [9] studied the effect of pigs manure vermicompost on the growth and yield of French marigold. The most vegetative growth had obtained at 30 and 40% v/v vermicompost and the least growth obtained of 90 and 100% values. The highest and the lowest number of flower buds was related to 40% and 100%, respectively.

The plants cultivated at control and 60% vermicompost treatments had the highest nitrogen concentration and the lowest was in 100% perlite. The further nitrogen of these treatments can be due to more maintenance and lower leaching of nitrogen. The further percentage of phosphorus at 20% peat and 100% perlite treatments can be due to the dilution effect in resulting decrease in dry yield and P uptake. The nitrogen, phosphorus and potassium levels of the earthworm wastes mostly 5 to 11 times is more than soil and during the processing, the calcium, magnesium and micronutrients can also increase [8]. There is much evidence that the activity of earthworms accelerates organic matter mineralization, decomposition of polysaccharides, increase the humus material, reducing the carbon to nitrogen ratio and reducing availability of heavy elements [18].

CONCLUSION

Plants grown in 60% vermicompost treatment had the more fresh and dry weight of shoot organs. Flower weight in different levels of vermicompost was higher than others. Therefore, for maximum yield and quality of marigold, mixing soil with 40 to 60% vermicompost by volume is recommended and vermicompost is appropriate alternative substrates for the preparation of growth medium of pots. Effect of combined application of organic and chemical fertilizers is suggested in compare with the separately use of them.

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