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RESEARCH PAPER

Cow manure and sawdust vermicompost effect on nutrition and growth of ornamental foliage plants

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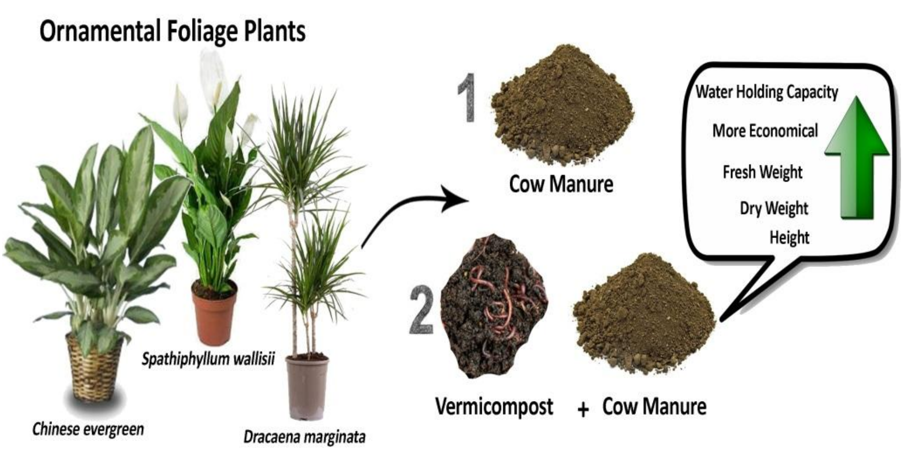
Highlights

- Cow manure + sawdust vermicompost is in better conditions than cow manure vermicompost and peat.
- Application of cow manure and cow manure + sawdust vermicompost significantly increases nitrogen, phosphorus and potassium in the leaves.
- No significant difference between the use of cow manure and cow manure + sawdust vermicompost.
- The use of sawdust can be more economical and beneficial for the environment.

Graphical Abstract



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Abstract

During this experiment, the effects of cow manure and cow manure + sawdust vermicompost replacement instead of peat in the growth media were investigated on the growth of ornamental foliage plants Aglaonema (Chinese evergreen), Dracaena marginata and Spathiphyllum wallisii. To produce vermicompost, cow manure and cow manure + sawdust (volume ratio 80 to 20) was added to *Eisenia fetida* earthworm medium. After preparation of vermicomposts for preparation of growth media, volumetric values of 25, 50, 75, and 100% vermicompost of cow manure and cow manure + sawdust replaced peat in the control (peat + perlite with a volume ratio of 2 to 1). After preparing the growth media, rooted cuttings were planted in them. Measured factors were nitrogen, potassium, calcium and magnesium in leaves and growth medium, height, diameter, fresh weight of stems and leaves, dry weight of stems and leaves and fresh and dry weight of plant roots. The results showed that increasing the levels of two types of vermicompost in peat replacement increased nitrogen, phosphorus, potassium, calcium and magnesium of the leaves in Aglaonema, Dracaena marginata and Spathiphyllumwallisii. With increasing two types of vermicompost in the growth medium, water holding capacity increased compared to peat and 100% vermicompost had the highest water holding capacity. Application of 25% of each vermicompost increased the height, diameter, fresh weight and dry weight of branches and leaves in plants compared to the control. Due to the problems caused by the accumulation of sawdust in the environment and the high cost of peat in the ornamental plant industry, the use of 25% cow manure + sawdust vermicompost is a more economical recommendation.

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1. Introduction

The ability of some earthworm species to consume and decompose a wide range of organic wastes such as sewage sludge, animal waste, crop residues and industrial waste are well known (Khomami and Zadeh, 2013; Dominguez et al., 1997; Hartenstein and Bisesi, 1989; Mahboub Khomami, et al., 2016; Ludibeth et al., 2012). Vermicomposts are usually more persistent than raw materials and have high access to nutrients, and improve the physicochemical and microbial properties of soil (Albanell et al., 1988; Edwards, 1998; Orozco et al., 1996). Numerous greenhouse and field studies have tested the effects of various vermicomposts on ornamental foliage plants and cut flowers (Atiyeh et al., 2000; Khomami, 2011). Greatly accelerates plant growth after replacement of vermicompost in growth medium due to changes in water usability, increasing access to micro and macro elements, stimulating bacterial activity, enhancing the activity of specific enzymes, producing growth accelerating substances resulting from the interaction of microorganisms And earthworms (Marinari et al., 2000). The use of earthworms to decompose organic waste has increased in different parts of the world (Edwards, 1998). Vermicomposts have lower solutes, higher cation exchange capacity and high humic acid content compared to their parent materials (Albanell et al., 1988). *Eisenia fetida* is a type of earthworm that lives in organic waste and needs high levels of suitable organic matter and dark conditions for proper growth and development (Gunadi and Edwards, 2003; Mahboub Khomami et al., 2019).

Vermicomposting is a new method for converting organic waste into usable materials. In this process, certain species of earthworms such as *Eisenia fetida* are used to stabilize organic waste (Sallaku et al., 2009). Some earthworm species live specifically in decaying organic matter and can convert these substances into rich nutrient compounds, turning the soil into a substrate for plant support. Vermicomposting increases the humic acid content and emits less air pollutants, so this method can be considered more beneficial than compost. Vermicomposting as a valuable tool for treating large quantities of waste (from municipal resources and other resources) are used. Another advantage of vermicompost compared to other organic fertilizers is the highest amount of nutrients such as nitrogen, phosphorus, potassium, calcium and magnesium and also has micro elements such as iron, zinc, copper and manganese (Hosseinzadeh et al., 2016). Another feature of vermicompost is the humic material that is obtained from the decomposing earthworm feces. These substances have similar effects to growth regulators and hormones (Bowden et al., 2010). The study of the effect of organic fertilizers on chemical and biochemical properties of soil in dry soils has shown that vermicompost increases the quantity and quality of organic carbon, nitrogen, phosphorus, microbial biomass and total enzymatic activities (Lakhdar et al., 2009).

2. Materials and Methods

In a factorial experiment with randomized complete block design, the effect of 2 types of vermicompost including vermicompost of cow manure and vermicompost of cow manure + sawdust (80 to 20% by volume) in 5 levels (zero, 25, 50, 75, and 100% by volume) was examined. Necessary growth media were prepared by replacing the volume percentages of two types of vermicompost instead of peat in the control growth medium (peat + perlite with a volume ratio of 2: 1). This experiment was performed in two stages, in the first stage, boxes with dimensions of 30×50×100 cm were prepared and holes with a diameter of 3 cm were installed on their body and floor and covered with fine wire mesh (Fig. 1), Then the raw materials, including cow manure, cow manure mixture + sawdust (80 to 20%) were transferred to the boxes and about 300 mature *Eisenia fetida* earthworms were added to the beds, creating a suitable environment in terms of moisture and shade. The vermicompost production process continued and were renewed the required raw materials in the boxes. In about 3 months, two types of vermicompost were prepared for use. In the second stage, after rooting cuttings of three types of ornamental foliage plants and transferring materials to 4-liter pots, rooted cuttings were planted in these beds. Nutritional solution until the end of the growing season every 10 days in the amount of 200 cubic centimeters containing elements in the amount of 130 mg/L nitrogen, 32 mg/L phosphorus and 117 mg/L potassium (KNO_3, $Ca(NO_3)_2$, KH_2PO_4) for each pot used (Chen et al., 1988; Azizi et al., 2008). Irrigation was performed according to bed, plant and environmental conditions. Some growth factors in plant and nutrients and the physical were measured and analyzed at the end of the growth period by using SAS software.

Fig. 1. Boxes for vermicomposting of cow manure and sawdust.

2.1. Chemical analyses

Total nitrogen of the samples was measured using a micro - Kjeldahl method (Singh and Pradhan, 1981) and the organic carbon by rapid titration method (Gilson, 1993). Phosphorus was determined by spectrophotometric and potassium by flame photometry methods. The samples of the dry leaves were ground in the furnace at 550 °C and then extracted with 2 M HCl. Measurement of K concentration was performed using a flame photometer and P concentration by spectrophotometry. The EC and pH were determined on an extract of 1:5 ratio of compost to water by weight.

2.2. Physical properties of substrates

The physical properties of the growing media were measured by using the Fonteno method (1988), and water holding capacity, total porosity, bulk density, and air-filled porosity were calculated from equations in Table 1 (Fonteno, 1988).

Table 1. Equations used for the physical properties of growth media.

	Equation	Components of Equation
(1)	Bd = (Wdsp-Wp /Vp)	Wdsp = dry weight of substrates and the container
(2)	Pd = (Wdsp-Wp/ Vp- Vwd -(Wwsp-Wdsp))	Wp= dry weight of the container
(3)	AFP = (Vwd×100/VP)	Vp= Volume of container
(4)	CC= ((Wwsp-Wp) ×100/VP)	Vwd = Volume of water drained
(5)	TP=AFP+CC	Wwsp= substrates and container fresh weight

Bd: Bulk density, Pd: Particle density, AFP: Air-fill porosity, CC: Container capacity, and TP: Total porosity.

2.3. Plant testing

Growth factors were measured at the end of the experiment was, plant height: including the height from the surface of the pot at the end of the terminal leaf sheath was measured by a ruler. Stem diameter: Approximately the crown diameter of the plant was selected as the measurement criterion and was measured by a caliper. Fresh and dry weight of shoots: The plants were cut and separated from the crown and then their fresh weight was measured. To determine the dry weight of plants, they were placed in an oven at 75 °C for 24 h to dry and then weighed.Leaf area: determined by video Area meter (model MK2 Area meter made in England).

3. Results and Discussion

3.1. Physicochemical properties of growth media

Physicochemical properties of the growing medium can specifically affect the quality of ornamental plants. The results of physicochemical properties of materials used in growth medium (Table 2) showed that the two types of compost in terms of macro and micro elements are in better conditions than peat. However, the nutrients in vermicompost Cow manure + sawdust are more than vermicompost in cow manure. Both types of vermicompost have less C/N than peat and are more suitable for the culture medium. In terms of pH, vermicompost of cow manure has a better pH than peat and vermicompost of cow manure + sawdust. According to EC, two types of vermicompost are in more unfavorable conditions than peat.

Table 2. Some physicochemical properties of materials used in growth medium.

Property	Peat	VCM	VCM+S (80 to 20%)
Total nitrogen (%)	0.48	1.15	1.35
Total phosphorus (%)	0.03	0.38	0.49
Total potassium (%)	0.31	0.86	0.99
Calcium (%)	0.17	0.99	1.10
Magnesium (%)	0.05	0.46	0.40
Iron (mg/kg)	638	2133	2238
Manganese (mg/kg)	28	623	642
Zinc (mg/kg)	12	93	116
Copper (mg/kg)	1.9	7.0	7.5
Organic carbon (%)	44.4	40.9	55.6
C/N ratio	91.6	35.6	41.8
PH (1:5)	3.83	6.53	7.21
EC (dS/m)	0.26	2.10	3.30

VCM: Vermicompost of Cow Manure; VCM+S: (Vermicompost of Cow Manure + Sawdust).

3.2. Physical properties of growth media

Examination of the average physical properties of growth media used in ornamental leaf plants of *Dracena marginata*, *Spathiphyllum wallisii* and Aglonama showed that the true Particle density in media containing cow manure and cow manure + sawdust vermicompost was significantly less than peat (Table 3). With the addition of cow manure and cow manure + sawdust vermicompost, as observed in previous studies (Chen et al., 2002), the bulk density of growth media increased in the media containing cow manure vermicompost, these values were higher than the media containing cow manure + sawdust vermicompost (Table 3). The porosity of the substrates was reduced by adding cow manure and cow manure + sawdust vermicompost. Decreased porosity due to the addition of vermicompost has been reported by several authors (Ingelmo et al., 1998; Guerrero et al., 2002) in materials such as peat, pine bark, sewage sludge. Generally, in peat-based substrates, the total porosity is about 85 to 95%, depending on the particle density and the bulk density (Michiels et al., 1993). An ideal growth medium should have a porosity of more than 85%. The bulk density of the substrates increased with increasing the amount of Cow manure and Cow manure + sawdust vermicompost in the growth media compared to peat. This leads to a gradual decrease in total porosity and a change in the porosity distribution in the substrates. As a result of the mentioned changes, the ventilation porosity decreases and the container capacity increases (Table 3). As bulk density increases, the number of large porosity decreases and the root force is limited to deformation, change in growth medium and longitudinal root growth (Taylor and Ratliff, 1969). By adding cow manure and cow manure + sawdust vermicompost to the growth medium, ventilation porosity was significantly less than peat (Table 3). The air and water content in the growth medium are very important physical parameters (Marfa et al., 1998). The water of the growth media should be available with minimal energy levels, and at the same time the air in the root zone should be sufficient (Inbar et al., 1993; DeBoodt et al., 1974). The optimal physical properties of an ideal substrate for plant growth with Container capacity between 55 and 75% and ventilation porosity between 20 and 30%. The percentage of ventilation porosity of all treatments containing vermicompost was ideal. The combination of peat with cow manure vermicompost and cow manure vermicompost + sawdust improved the ventilation porosity of cow manure vermicompost and cow manure vermicompost + sawdust.

Table 3. Comparison of the mean effect of physical properties of growth media.

Substrate	Particle density (g/cm)	Bulk density (g/cm)	Total porosity (%volume)	Air-fill porosity (%volume)	Container capacity (%volume)
Control	1.93 [a]	0.16 [cd]	91.3 [ab]	33.4 [a]	57.9 [e]
25% VCM	1.29 [b]	0.23 [c]	87.6 c	28.6 [b]	57.9 [e]
50% VCM	1.19 [c]	0.20 [d]	89.2 [b]	22.9 [d]	66.2 [c]
75% VCM	1.19 [c]	0.27 [ab]	87.7 [e]	15.8 [e]	69.9 [b]
100% VCM	1.88 [d]	0.35 [a]	81.3 [f]	10.0 [f]	71.3 [ab]
25% VCM+S	1.92 [ab]	0.17 [c]	91.7 [ab]	26.8 [b]	64.3 [cd]
50% VCM+S	1.19 [ac]	0.19 [b]	90.0 [b]	21.4 [c]	68.6 [bc]
75% VCM+S	1.89 [d]	0.26 [ab]	86.2 [c]	14.8 [d]	71.4 [ab]
100% VCM+S	1.85 [e]	0.27 [ab]	85.4 [cd]	11.8 [e]	73.6 [a]

The means of each column with a common letter according to Duncan test are not significant at the 5% probability level.

3.3. *Aglaonema*

Analysis of variance for height, fresh and dry weight of shoots, number of leaves and nitrogen, phosphorus and potassium of Aglaonema (Table 4) showed that the effects of fresh weight and dry matter yield and nitrogen, phosphorus and potassium are significant. Comparison of the mean of growth factors and nutrients in agglomerates showed (Table 5) that the highest fresh and dry weight of shoots was obtained from the application of 25% vermicompost, which was significantly different from the control. The results are consistent with observations that showed that plants grown in potted medium containing vermicompost grew 2.3 times more than the control plant (Gupta et al., 2014). Comparison of the mean effect of vermicompost levels significantly increased leaf nitrogen compared to the control (at 5% probability level), but no significant difference was observed between vermicompost treatments. The results showed that the highest leaf phosphorus and potassium was obtained from the application of 100% vermicompost, which was significantly different from the control at the level of 5% probability. Studies have shown that vermicompost contains various plant nutrients such as N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, and B that can improve the nutrients in various plant components such as roots, branches and fruits (Theunissen et al., 2010).

3.4. *Spathiphyllum wallisii*

Analysis of variance (Table 6) showed a significant effect of vermicompost on height, fresh and dry weight of shoot, number of leaves, nitrogen, phosphorus and potassium of *Spathiphyllum wallisii* leaves, but the interaction between the type and amount of vermicompost in this plant was not significant. Comparison of the mean height of *Spathiphyllum wallisii* (Table 7) showed that values of 25 to 75% did not cause a significant difference in height compared to the control, but application of 100% vermicompost significantly reduced the height compared to the control. Comparison of the mean (Table 7) in relation to the effect of vermicompost on shoot fresh weight shows a significant effect of 50% vermicompost on a fresh weight of *Spathiphyllum wallisii*. Comparison of the mean effect of vermicompost (Table 7) on the dry weight of *Spathiphyllum wallisii* shoots showed a significant effect of 50% vermicompost application compared to the control and 75 and 100% vermicompost levels did not show a significant difference with the control. In terms of average number of leaves (Table 7), the comparison of the mean of the representative is a significant difference due to vermicompost levels in comparison with the control and has caused the number of leaves to decrease significantly with increasing levels. As studies have shown, adding vermicompost, in appropriate amounts, to the pot environment has significant effects on marigold seedling growth, biomass, height, number of buds and flowers (Gupta et al., 2014). Comparison of the mean amount of phosphorus (Table 7) of *Spathiphyllum wallisii* leaves under the influence of 25 to 75% level showed a significant difference with the control and the highest amount was obtained from the application of 25% vermicompost. The mean comparison of *Spathiphyllum wallisii* leaves potassium (Table 7) showed that increasing levels of vermicompost, significantly increased leaf potassium compared to the control and the highest obtained on 100% vermicompost.

Table 4. Analysis of variance of growth factors and leaf nutrient in *Aglaonema commutatum* leaves.

	Degree of freedom	Height	Canopy wet weight	Canopy dry weight	Number of leaves	N	P	K
Replication	2	23.78 ns	2710.78 ns	20.601 ns	0.20 ns	0.06 ns	0.002ns	0.194 ns
Type of vermicompost	1	0.29 ns	18.88 ns	3.19 ns	4.37 ns	0.01 ns	0.011 ns	0.177 ns
Vermicompost values	4	2.34 ns	38480.50 **	317.43 **	1.37 ns	0.43 *	0.3181**	0.67 **
TV×VV	4	9.43 ns	1671.21 ns	20.601 ns	0.40 ns	0.07 ns	0.014 ns	0.30 ns
Experimental error	18	11.59	1484.52	17.99	1.02	0.095	0.002	0.142
Total	29	-	-	-	-	-	-	-
Coefficient of variation		3.4	38.52	3.24	1.01	0.30	0.048	0.37

ns, *, **, respectively non-significant and significant at 5% and 1%. TV×VV: (Type of vermicompost × vermicompost values),

Table 5. Comparison of the mean effect of vermicompost on some growth characteristics and nutrients in the leaves Aglaonema.

Substrate	Canopy wet weight (gr)	Canopy dry weight (gr)	N (%)	P (%)	K (%)
Control	126.30 d	14.07 c	1.73 b	0.29 d	2.91 c
25% vermicompost	335.25 a	32.52 a	2.14 a	0.57 c	3.36 c
50% vermicompost	293.70 ab	29.46 a	2.22 a	0.71 b	3.98 b
75% vermicompost	279.20 b	24.25 b	2.33 a	0.82 a	4.42 ab
100% vermicompost	232.39 c	20.73 b	2.43 a	0.85 a	4.84 a

The means of each column with a common letter according to Duncan test are not significant at the 5% probability level.

Table 6. Analysis of variance of vegetative traits and nutrients in *Spathiphyllum wallisii* leaves.

	Degree of freedom	Height	Canopy wet weight	Canopy dry weight	Number of leaves	N	P	K
Replication	2	30.48 ns	380.07ns	8.60 ns	3.00 ns	0.035 ns	0.008 ns	0.015 ns
Type of vermicompost	1	3.80 ns	38.53 ns	0.012 ns	0.83 ns	0.061 ns	0.01 ns	0.0007 ns
Vermicompost values	4	19.51 *	1065.7 **	25.77 **	17.45 **	0.039 ns	0.02 **	1.807 **
TV×VV	4	1.83 ns	71.07 ns	1.40 ns	0.55 ns	0.018 ns	0.0009 ns	0.157 ns
Experimental error	18	5.88	208.07	3.96	0.63	0.023	0.003	0.037
Total	29	-	-	-	-	-	-	-
Coefficient of variation		2.42	14.42	1.99	0.79	0.05	0.05	0.19

ns, *, **, respectively non-significant and significant at 5% and 1%.

Table 7. Comparison of the mean effect of vermicompost on some growth characteristics and nutrients in in *Spathiphyllum wallisii* leaves.

Substrate	Height (cm)	Canopy wet weight (gr)	Canopy dry weight (gr)	Number of leaves	P (%)	K (%)
Control	19.33 ab	46.64 bc	6.53 c	5.11 a	0.32 c	3.07 e
25% vermicompost	20.00 a	63.58 ab	9.38 ab	9.16 b	0.48 a	3.43 d
50% vermicompost	17.94 ac	75.99 a	10.98 a	8.80 bc	0.41 ab	3.82 c
75% vermicompost	16.99 bc	56.90 ac	7.89 bc	7.70 cd	0.39 b	4.14 b
100% vermicompost	15.50 c	42.87 c	5.92 c	7.12 d	0.37 bc	4.45 a

The means of each column with a common letter according to Duncan test are not significant at the 5% probability level.

3.5. Spathiphyllum wallisii

Analysis of variance (Table 6) showed a significant effect of vermicompost on height, fresh and dry weight of shoot, number of leaves, nitrogen, phosphorus and potassium of *Spathiphyllum wallisii* leaves, but the interaction between the type and amount of vermicompost in this plant was not significant. Comparison of the mean height of *Spathiphyllum wallisii* (Table 7) showed that values of 25 to 75% did not cause a significant difference in height compared to the control, but application of 100% vermicompost significantly reduced the height compared to the control. Comparison of the mean (Table 7) in relation to the effect of vermicompost on shoot fresh weight shows a significant effect of 50% vermicompost on a fresh weight of *Spathiphyllum wallisii*. Comparison of the mean effect of vermicompost (Table 7) on the dry weight of *Spathiphyllum wallisii* shoots showed a significant effect of 50% vermicompost application compared to the control and 75 and 100% vermicompost levels did not show a significant difference with the control. In terms of average number of leaves (Table 7), the comparison of the mean of the representative is a significant difference due to vermicompost levels in comparison with the control and has caused the number of leaves to decrease significantly with increasing levels. As studies have shown, adding vermicompost, in appropriate amounts, to the pot environment has significant effects on marigold seedling growth, biomass, height, number of buds and flowers (Gupta et al., 2014). Comparison of the mean amount of phosphorus (Table 7) of *Spathiphyllum wallisii* leaves under the influence of 25 to 75% level showed a significant difference with the control and the highest amount was obtained from the application of 25% vermicompost. The mean comparison of *Spathiphyllum wallisii* leaves potassium (Table 7) showed that increasing levels of vermicompost, significantly increased leaf potassium compared to the control and the highest obtained on 100% vermicompost.

3.5. Dracaena marginata

Analysis of variance of growth factors and nutrients in *Dracaena marginata* (Table 8) showed that the effect of vermicompost on height, diameter, fresh and dry weight of dry and dry leaves, the percentage of nitrogen, phosphorus and potassium of leaves at the 1% probability level were significant. The mean comparison of *Dracaena marginata* height (Table 9) showed that 25 and 50% vermicompost compared to the control a significant difference but other vermicompost levels did not differ significantly from the control. Comparison of mean diameter of *Dracaena marginata* (Table 9) showed that only 25% vermicompost significantly increased the diameter, and application of 100% vermicompost decreased the diameter compared to the control. Comparison of fresh and dry weight of Dracaena leaves mean under the influence of vermicompost levels (Table 9) showed that application of 50and 75% vermicompost significantly increased leaf fresh and leaf dry weight compared to control, but no significant difference was observed between these levels. Comparison of the mean effect of vermicompost levels on stem fresh weight (Table 9) showed a significant difference between 50 and 75% levels compared to the control, but no significant difference was observed between other levels and the control. Comparison of stem dry weight mean (Table 9) showed that levels of 50 to 75% vermicompost did not differ significantly compared to the control and no significant difference was observed between these two levels.

As reported, 10, 20, 30, 40, and 50% (in terms of volume) of sewage sludge compost in marigold bed caused a significant increase in stem dry weight and the highest growth in bed culture contained 30% of compost (Bugbee and Frink, 1989).The results of comparing the mean effect of vermicompost levels showed a significant increase in leaf nitrogen, phosphorus and potassium. The results of comparing the mean effect of vermicompost on nitrogen, phosphorus and leaf potassium showed a significant increase in these factors under the influence of 100% vermicompost compared to the control but no significant difference was observed between 75 and 100% levels. As observed, the best plant growth response with all required nutrients occurs when vermicomposts are relatively low (10 to 20%) and mixing the culture medium with a higher vermicompost ratio does not always improve plant growth (Dominguez et al., 1997).

Table 8. Analysis of variance of vegetative traits and nutrients in *Dracaena marginata* leaves.

	Degree of freedom	Height	Diameter	Fresh leaf weight	Leaf dry weight	Stem fresh weight	Stem dry weight	N	P	K
Replication	2	25.77 **	6.150 **	8401.99 **	485.29 **	43.029 **	105.9**	0.014 ns	0.033 ns	1.285 **
Type of vermicompost	1	6.219 ns	0.675 ns	0.908 ns	7.15 ns	1.015 ns	0.81 ns	0.005 ns	0.013 ns	0.280 ns
Vermicompost values	4	27.96 **	3.212 **	744.58 **	241.97 **	8.945 **	58.55 **	0.366 **	0.097 **	0.028**
TV×VV	4	4.264 ns	0.952 ns	130.88 ns	12.68 ns	2.985 ns	5.07 ns	0.006 ns	0.028 ns	0.084 ns
Experimental error	18	3.873	0.351	74.322	28.64	1.322	6.51	0.014	0.010	0.153
Total	29	-	-	-	-	-	-	-	-	-
Coefficient of variation		1.968	0.593	8.69	5.35	1.15	2.55	0.11	0.10	0.39

ns, *, **, respectively non-significant and significant at 5% and 1%.

Table 9. Comparison of the mean effect of vermicompost on some growth characteristics and nutrients in *Dracaena marginata* leaves.

Substrate	Height (cm)	Diameter (cm)	Leaf fresh weight (gr)	Leaf dry weight (gr)	Stem fresh weight (gr)	Stem dryweight (gr)	N (%)	P (%)	K (%)
Control	35.83 c	15.83 b	82.75 b	60.75 b	18.86 a	12.92 b	1.82 b	0.29 b	1.44 c
25% vermicompost	36.27 bc	15.59 b	92.75 b	59.56 b	15.03 b	12.46 b	2.01 b	0.41 b	1.48 c
50% vermicompost	38.55 ab	16.25 ab	108.67 a	68.47 a	20.55 a	14.69 a	3.07 a	0.53 a	1.77 b
75% vermicompost	40.88 a	16.78 a	106.03 a	72.44 a	21.06 a	14.97 a	3.10 a	3.10 a	1.90 ab
100% vermicompost	36.38 bc	14.83 c	88.96 b	57.66 b	14.31 b	12.51 b	3.38 a	3.38 a	1.99 a

The means of each column with a common letter according to Duncan test are not significant at the 5% probability level.

Conclusion

The results of growth factors and nutrients in Dracaena, Spathiphyllum, and Aglonema showed that the application of 25% of the two types of vermicompost significantly affected the height and diameter of the plant, and nitrogen, phosphorus and potassium of the leaves and caused a significant difference with the control. Observations showed that with increasing the amount of vermicompost, the amount of nutrients in the leaves increased compared to the control. In this experiment, yield was expected to increase with increasing nutrient levels due to increased vermicompost levels in the growth medium. However, reduced yield at higher levels of vermicompost can be the result of the inhibitory effect of increasing EC and pH and undesirable physical properties of the growth medium at higher levels of vermicompost. The effect of higher amounts of cow manure vermicompost + sawdust on reducing plant growth in this experiment could be more due to its higher salinity levels than cow manure vermicompost. As EC higher than 1 to 3 miles Siemens per meter has been reported to have an adverse effect on plant growth (Gajdoš, 1997).

References

Albanell, E., Plaixats, J., Cabrero, T., 1988. Chemical changes during vermicomposting (Eiseniafetida) of sheep manure mixed with cotton industrial wastes. *Biol. Fertil. Soils,* **6**(3), 266-269. https://doi.org/10.1007/BF00260823

Aleagha, M.M., Ebadi, G., 2011. Study of heavy metals bioaccumulation in the process of vermicomposting. *Afr. J. Biotechnol.*, **10**(36), 6997-7001.
https://doi.org/10.4314/ajb.v10i36

Atiyeh, R.M., Subler, S., Edwards, C.A., Bachman, G., Metzger, J.D., Shuster, W., 2000. Effects of vermicomposts and composts on plant growth in horticultural container media and soil. *Pedobiologia,* **44**(5), 579-590. https://doi.org/10.1078/S0031-4056(04)70073-6

Azizi, P., Khomami, A.M. Mirsoheil, M., 2008. Influence of cow manure vermicompost on growth of dieffenbachia. *Ecol. Environ. Conserv.*, **14**(1), 1-4. [In Persian]

Bowden, C.L., Evanylo, G.K., Zhang, X., Ervin, E.H., Seiler, J.R., 2010. Soil carbon and physiological responses of corn and soybean to organic amendments. *Compost Sci. Util.,* **18**(3), 162-173. https://doi.org/10.1080/1065657X.2010.10736952

Bugbee, G.J., Frink, C.R., 1989. Composted waste as a peat substitute in peat-lite media. *HortScience,* **24**(4), 625-627. ISSN: 0018-5345

Chen, J., McConnell, D.B., Robinson, C.A., Caldwell, R.D., Huang, Y., 2002. Production and interior performances of tropical ornamental foliage plants grown in container substrates amended with composts. *Compost Sci. Util.*, **10**(3), 217-225. https://doi.org/10.1080/1065657X.2002.10702083

Chen, Y., Inbar, Y., Hadar, Y., 1988. Composted agricultural wastes as potting media for ornamental plants. *Soil Sci.*, **145**(4), 298-303. https://doi.org/10.1097/00010694-198804000-00009

Deboodt, M., Verdonck, O., Cappaert, I., 1974. Method for measuring the water release curve of organic substrates. *Acta Hort.*, **37**, 2054-2062. https://doi.org/10.17660/ActaHortic.1974.37.20

Dominguez, J., Edwards, C.A., Subler, S., 1997. A comparison of vermicomposting and composting. *Biocycle,* **38**, 57-59.

Edwards, C.A., 1998. The use of earthworms in the breakdown and management of organic wastes. CRC Press, Fl, 327-354. https://doi.org/10.1201/9781482285246-27

Fonteno, W.C., 1988. An approach to modeling air and water status of horticultural substrates. *Symposium Substrates Horticulture Soils situ,* **238**, 67-74. https://doi.org/10.17660/actahortic.1989.238.7

Gajdoš, R., 1997. Effects of two composts and seven commercial cultivation media on germination and yield. *Compost Sci. Util.*, **5**(1), 16-37. https://doi.org/10.1080/1065657X.1997.10701861

Gilson, M.K., 1993. Multiple-site titration and molecular modeling: Two rapid methods for computing energies and forces for ionizable groups in proteins. *Proteins Struct. Funct. Bioinform.*, **15**(3), 266-282. https://doi.org/10.1002/prot.340150305

Guerrero, F., Gascó, J.M., Hernández-Apaolaza, L., 2002. Use of pine bark and sewage sludge compost as components of substrates for Pinuspinea and Cupressusarizonica production. *J. Plant Nutr.,* **25**(1). 129-141. https://doi.org/10.1081/PLN-100108785

Gunadi, B., Edwards, C.A. 2003. The effect of multiple applications of different organic wastes on the growth, fecundity and survival of *Eiseniafoetida* (Savigny) (Lumbricidae). *Pedobiologia,* **47**(4), 321-330. https://doi.org/10.1078/0031-4056-00196

Gupta, R., Yadav, A., Garg, V.K., 2014. Influence of vermicompost application in potting media on growth and flowering of marigold crop. *Int. J. Recycl. Org. Waste. Agric*., **3**(4), 1-7. https://doi.org/10.1007/s40093-014-0047-1

Hartenstein, R., Bisesi, M.S., 1989. Use of earthworm biotechnology for the management of effluents from intensively housed livestock. *Outlook Agric.,* **18**(2), 72-76. https://doi.org/10.1177/003072708901800205

Hosseinzadeh, S.R., Amiri, H., Ismaili, A., 2016. Effect of vermicompost fertilizer on photosynthetic characteristics of chickpea (Cicerarietinum L.) under drought stress. *Photosynthetica,* **54**(1), 87-92. https://doi.org/10.1007/s11099-015-0162-x

Inbar, Y., Hadar, Y., Chen, Y., 1993. Recycling of cattle manure: the composting process and characterization of maturity. *J. Environ. Qual.,* **22**(4), 857-863. https://doi.org/10.2134/jeq1993.00472425002200040032x

Ingelmo, F., Canet, R., Ibañez, M.A., Pomares, F., Garcíat, J., 1998. Use of msw compost, dried sewage sludge and other wastes as partial substitutes for peat and soil. *Bioresour. Technol.,* **63**(2), 123-129. https://doi.org/10.1016/S0960-8524(97)00105-3

Khomami, A.M., 2011. Effect of sawdust vermicompost in pot media on nutrition and growth of Dieffenbachia (*Dieffenbachia amonea*) Plant. *Seed Plant Prod. J.,* **4**, 435-444.

Khomami, A.M., Zadeh, M.M., 2013. Influence of earthworm processed cow manure on the growth of *Ficusbenjamnia. Intl. J. Agri. Crop. Sci.,* **6**(7), 361-363.

Lakhdar, A., Rabhi, M., Ghnaya, T., Montemurro, F., Jedidi, N., Abdelly, C., 2009. Effectiveness of compost use in salt-affected soil. *J. Hazard. Mater.,* **171**(1-3), 29-37. https://doi.org/10.1016/j.jhazmat.2009.05.132

Ludibeth, M., Marina, I.E., Vicenta, E.M. 2012. Vermicomposting of sewage sludge earthworm population and agronomic advantages solis. *Compost Sci. Util.,* **20**(1), 11-17. https://doi.org/10.1080/1065657X.2012.10737016

MahboubKhomami, A., Mammadov, G. M., FatemiChokami, A., Sedaghathoor, S. 2016. Growth and reproductive performance of *Eiseniafoetida*in Cow Manure, Cow Manure + Sugarcane Bagasse, and Cow Manure + sawdust waste. *Appl. Ecol. Environ. Res.,* **14**(1), 237-247. https://doi.org/10.15666/aeer/1401_237247

MahboubKhomami, A., Padasht, M.N., AjiliLahiji, A., Shirinfekr, A., 2019. The effect of sawdust vermicompost extract on *Syngoniumpodophyllum* growth and nutrition. *J. Plant Nutr.,* **42**(4), 410-416. https://doi.org/10.1080/01904167.2018.1554071

Marfa, O., Tort, J.M., Olivella, C., Caceres, R., Martinez, F.X., 1998. Cattle manure compost as substrate. ii. Conditioning and formulation of growing media for pot plants and bag growths. In: Proceedings of the ISHS. *Acta Hort.,* **469**, 305-312. https://doi.org/10.17660/ActaHortic.1998.469.32

Marinari, S., Masciandaro, G., Ceccanti, B., Grego, S., 2000. Influence of organic and mineral fertilizers on soil biological and physical properties. *Bioresour. Technol.,* **72**, 9-17. https://doi.org/10.1016/S0960-8524(99)00094-2

Michiels, P., Hartmann, R., Coussenes, C., 1993. Physical properties of peat in an ebb/flood irrigation system. *Acta Hort.,* **342**, 205-219. https://doi.org/10.17660/actahortic.1993.342.23

Orozco, F.H., Cegarra, J., Trujillo, L.M., Roig, A. 1996. Vermicomposting of coffee pulp using the earthworm *Eiseniafetida:* Effects on C and N contents and the availability of nutrients. *Biol. Fert. Soils,* **22**(1), 162-166. https://doi.org/10.1007/BF00384449

Sallaku, G., Babaj, I., Kaciu, S., Balliu, A., 2009. The influence of vermicompost on plant growth characteristics of cucumber (*CucumisSativus*L.) seedlings under saline conditions. *J. Food Agric. Environ.,* **7**(3 & 4), 869-872. https://doi.org/10.1234/4.2009.2818

Singh, R., Pradhan, K., 1981. Determination of nitrogen and protein by Kjeldahl method. *Forage Evaluation Science. Pvt. Publishers Ltd., New Delhi*, 23.

Taylor, H.M., Ratliff, L.F., 1969. Root elongation rates of cotton and peanuts as a function of soil strength and soil water content. *Soil Sci.*, **108**(2), 113-119. https://doi.org/10.1097/00010694-196908000-00006

Theunissen, J., Nhakidemi, P., Laublsher, C.P., 2010. Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. *Int. J. Phys. Sci.*, **5**, 1964-1973. https://doi.org/10.5897/IJPS.9000448

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