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EVALUATION OF CONTAINER SUBSTRATES CONTAINING COMPOST AND BIOCHAR FOR ORNAMENTAL PLANT *Dracaena deremensis*

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The application of compost and biochar has both gained significant interest as replacement of peat in horticultural as potting substrates. In this study, (1) composted material derived from plant residues such as grass clipping and leaves and (2) wheat straw biochar were evaluated as partial replacement of 10% for peat in horticultural potting substrate using *Dracaena deremensis* cv. "Lemon Lime". Five potting substrates were formulated from 10% v/v addition of both biochar and compost individually and combined in 90/10 peat/perlite mixture. Six month old plants were used for the experiment. Chemical characteristics of the potting substrates, and plant growth parameters were measured. The experiment was arranged in a completely randomized design with ten replications. Biochar and compost both helped in improving the chemical properties of peat-perlite based potting substrates. Application of biochar and compost increased the pH, EC, CEC, N, P and K and organic matter contents of the substrates (T2, T3 and T4). Addition of biochar and compost increased the vegetative growth (plant height, number of leaves, leaf area, and fresh biomass) of dracaena by 10-30% with respect to peat-perlite potting substrate. This study suggests the use of biochar and compost for replacing peat and for high quality production of dracaena.
Keywords: Biochar, compost, dracaena, peat, potting substrates, ornamental plants, waste recycling, pyrolytic material

INTRODUCTION

Ornamental plant production is commercially important aspects in horticulture sector around the globe (Younis *et al*., 2016, 2017, 2018). The demand for foliage ornamental potted plants is increasing due to urban expansion and attention to plant functions and aesthetical advantages (Zulfiqar *et al*., 2019). Substrates are usually required in large amounts for potted ornamental production to achieve optimal plant growth and they might altered plant physiology (Aghdak *et al*., 2016; Barrett *et al*., 2016). Potted substrates must increase aeration and water retention and drain properly in soil, withstand wind when produce outdoor, degradable during production with minimal pest development.

To respond these criteria, substrates usually contain organic materials such as peat and compost, and inorganic materials such as sand, perlite and vermiculite (Khan *et al*., 2006; Ronga *et al*., 2016). Among organic components, peat has been traditionally the predominant potting ingredient owing to its positive physiochemical and hydrological characteristics for supporting plant growth (Herrera *et al*., 2008; Schmilewski *et al*., 2008). Heavy reliance on this bog-excavated material, results in various environmental and ecological issues, such as atmospheric carbon dioxide sequestration (Nguyen and Wang, 2017) and destruction of the natural filtration of environment. Peat is now considered as a non-renewable resource. Combined with its increasing price due to restrictions on its harvest and high demand, there is now a search for alternatives materials, especially in the countries without peat resources (Abad *et al*., 2001; Herrera *et al*., 2008). Further, a modified method with multiple benefits of plant productivity, environment-friendly, and cost-effectiveness is urgently needed in the horticulture industry.

In addition, increasing population and waste production reduced natural resources. The regulations for environmental safety, are forcing the industry to search for alternatives and bio-based economy (Gascó *et al*., 2018). Use of these plant wastes in potting substrates could contribute to the sustainable horticulture production and bio-based economy (Zulfiqar *et al*., 2019). For instance, plant wastes, coconut coir, paper waste, spent mushroom, evergreen waste, and urban solid wastes, with or without composting, can be used as in potting substrates as a replacement of peat (Caron *et al*., 2008). In addition, biochar and compost are considered potential cheap alternatives (Caron *et al*., 2015; Nemati *et al*., 2015) and a sustainable option for waste management.

Compost is a product of biodegradable residues generated by aerobic biological decomposition (Rizzo *et al*., 2015; Jara-

Samaniego *et al*., 2017). Compost can replace peat in many potting substrates (Ghoreishy *et al*., 2018) because it increases soil nutritional status, structure, water retention and microbial communities (Edenborn *et al*., 2018; Massa *et al*., 2018). Thus, the addition of compost in soil results in improved plant growth and development (Abubakari *et al*., 2018). However, large variation in physicochemical properties exists between composts depending on their feedstock and production process (Vandecasteele *et al*., 2016). These physicochemical variations along with the variation of the potting substrates and plant resources requirements between other species results in different impacts of composts in potting substrates.

Besides compost, biochar has attracted much attention in potting substrates formulation (Allaire and Lange, 2017, 2018; Lévesque *et al*., 2018; Zulfiqar *et al*., 2019). Biochar is a solid carbonaceous material with carbon stability, obtained from pyrolysis of biomass in limited oxygen supply under temperature ranging from 350 to 1000°C (Zulfiqar *et al.*, 2019). Biochar usually have high pH, high carbon content, stable particles, sorbs toxins, and slowly release nutrients. Biochar can improve water retention and drainage, nutrient balance, pH, support beneficial microbial development, such as accomplish by compost or by peat (Abideen *et al*., 2017). Most of them have the ability to improve plant growth in potted substrates by modifying physio-chemical properties of the substrates (Blok *et al*., 2017; Kaudal *et al*., 2018). Some studies reported the positive impact of biochar amendment in potting substrates (Tian *et al*., 2012; Kim *et al*., 2017; Sax and Scharenbroch, 2017). Biochar can replace up to 100% of perlite and at least 50% of peat for ornamentals (Allaire and Lange, 2017, 2018).

Mixing biochar with compost (Zulfiqar *et al*., 2019) seems to favour plant growth (Abideen *et al*., 2017). Positive benefits for plant growth were observed in soils amended with the mixture of biochar and organic or inorganic amendments such as composts. As biochar and composts characteristics vary depending upon feedstock, production conditions, and plant species, the biochar and compost-based potting substrate should be tested at scientific study. Therefore, a study was conducted to quantify the appropriate biochar/compost mixture for the optimal plant physiological responses. The study was based on the hypothesis that co-amending potting with biochar and compost substrates can partially replace peat and may led to better growth responses.

The specific objectives of this study were to (1) investigate the effects of separate or combined amendment of biochar and compost addition on the chemical properties of the peat-perlite based potting substrate, (2) determine the individual and combined effect of biochar and compost amended potting substrate on the growth of *Dracaena deremensis* under pot condition.

MATERIALS AND METHODS

***Potting substrates*:** Four components were selected: Peat, perlite, biochar and green waste based compost. Peat and perlite were sourced from Best garden Nursery, Faisalabad. Biochar was produced from the pyrolysis of wheat straw *Triticum aestivum* L. var. Galaxy-2013 at 350°C using a muffle furnace (Gallonhop, England) with 2 h residence time. As a direct product of agriculture, the feedstock was free of contaminants such as metal, rubber, plastic, stones and pollutant compounds. Some main initial selected chemical properties of the biochar are shown in Table 2. The biochar had a particle size of ≤ 2mm.

A mixture of green waste feedstock based compost developed from on-farm green waste including grass clippings, garden litter, debris, dairy farm waste (containing cow dung, manure and hey). Some initial characterization of the compost is given in Table 2. All the analyses of biochar and compost were conducted using triplicate samples.

Table 1. Formulation of four potting substrates.

Potting substrates	Components	Formulation (v/v)
T1	Peat /Perlite	70/30
T2	Peat /Perlite/Biochar	60/30/10
T3	Peat /Perlite/Compost	60/30/10
T4	Peat/ Perlite/Compost/Biochar	50/30/10/10

Table 2. Initial chemical and nutritional characteristics of biochar and compost used for the experiment.

Parameters	Units	Biochar	Compost
pH	--	8.2±0.32	7.6±0.61
EC	dSm^{-1}	2.3±0.6	3.63
CEC	$cmolkg^{-1}$	113±5,	--
Bulk density	gcm^{3-1}	0.29±0.04	0.561±0.35
Carbon content	gkg^{-1}	635±6	212.30±3.41
Total nitrogen content	gKg^{-1}	2.3±0.52	12.38±0.89
Phosphorous (P) content	gkg^{-1}	1.2±0.13	3.1±0.22
Total potassium (K) content	gkg^{-1}	6.6	12.6±0.65
Calcium (Ca) content	gkg^{-1}	1.79±1.98	18.41±1.98
Ash content	%	38±0.43	--
C/N		--	24

The pH was evaluated employing an AB 15 pH meter (Thermo Fisher Scientific, Waltham, MA, USA). Electrical conductivity (EC) was determined Torres *et al*. (2010). Total organic carbon (TOC) was determined using the method explained by Venegas *et al*. (2015). Total N (TN) was analyzed by the method of Vaccari *et al*. (2015) employing dry combustion elemental analyzer (LECO CHN-600). Total K content was determined following the extraction with H_2SO_4 and $HClO_4$ using a flame photometer (IT-FPM-1), and total P was measured according to the Olsen method (Olsen *et al*., 1954).

Four potting substrates were formulated for this experiment to encompass a comparative influence of both biochar and compost and mixture of two in a peat perlite:mixture (70:30) (Table 1). The components were mixed using rotary cement mixer for ensuring homogeneity.

The control (peat-perlite; 70-30) was selected based on previous studies and it is a typical of soilless substrates for potted and greenhouse plant production (Margenot *et al*., 2018).

Prior to dracaena transplanting, the potting substrates were characterized for chemical properties shown in Table 3, using standard methods as follows: pH of the growing substrates was measured using a pH Portable Meter (A221, Thermo Scientific, Waltham, Massachusetts, USA). Cation exchange capacity (CEC) was measured with $NH_4OAc/HOAc$ pH 7.0 (Sumner and Miller 1996). Total nitrogen (N) was measured by Kjeldahl methods (Kjeldahl apparatus, Timberline Instruments, USA). Phosphorus (P) and potassium (K) contents were determined following the methodology established by Olsen *et al*. (1954) and Blume *et al*. (1990). Electrical conductivity (EC) was determined by the methodology described by Rhoades (1996) and organic matter (OM) by the Rowell method (Rowell, 2014). The chemical properties of different potting substrates are given in Table 2. Sample from three replicate pots were taken, analyzed and presented as a mean value with standard error from the three replicate of a treatment.

***Plant growth experiment*:** The study was conducted in the greenhouse at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture Faisalabad, Pakistan. The experimental site lies on 31°300 N and longitude 73°100 E with altitude 213 m above sea level. The experiment was initiated in end of March and was completed in September 2017.

Dracaena (*Dracaena deremensis,* cv "Lemon Lime") were purchased in 6 inch pots from Best garden Nursery in Faisalabad. These four- month-old dracaena plants were transplanted into 12 x 10-inch volume clay pots, which were filled with each of the 4 potting substrates (Table 1) by hand. Each treatment was replicated ten times, each pot being one replicate. The 40 pots were arranged 20 cm apart in a completely randomized design. Plant growth was closely monitored, including daily inspection for growth disorders and disease incidence. The pots were irrigated manually as required, based on environmental conditions and plant size and each plant received ~100 mL of water day-1 during weekends. Pots were fertilized once each week with a solution of 1.5 g L^{-1} 20-20-20 (N-P2O5-K2O) fertilizer (Peters Professional, Scotts Company) at a rate of 100 mL per pot for week 1-12 and 130 mL per pot for weeks 12-24 during the experiment.

Temperature and air relative humidity were recorded daily. Monthly mean were calculated. Temperature was measured using digital thermometer (HTC-1, Changzhou) and the air relative humidity using digital hygrometer (XH-W3005). Monthly maximum and minimum mean temperatures were as 27.3, 37.7, 41.1, 39.8, 38.5, 38.1 °C and 14.2, 20.9, 26.1, 27.2, 28.9 and 28.7°C respectively. Monthly means relative humidity was as: 49.5, 30.6, 29.8, 44.5, 70.0, and 68.9 %. The illumination intensity was not controlled. The plants were grown under natural photoperiodic conditions.

***Plant growth parameters analysis*:** At the end of the experiment when the plants reached marketable size, plant height was measured from the basal end of shoots to the top tip of the main shoot; the number of leaves and buds per plant; and leaf area were measured with a portable leaf area meter; LI-3000C (scanning head is drawn over the attached mature and healthy leaf). The whole plants were uprooted. The roots were washed manually with tap water to remove the substrate. The plants were then cut into root and shoot at the substrate surface. Root length was measured using a ruler. The root and shoot were weighed. The roots and leaves were weighed for fresh mass (g). After drying in an electric oven at 70°C for 48 h and to a constant weight; they were weighted for dry matter. Root density was determined by dividing the dry mass over root volume (g ml^{-1}). Root volume was determined by immersing root in a known volume cylinder filled with water (Abideen *et al*., 2017).

***Experimental design and statistical analysis*:** Plant growth experiment was set up in a completely randomized design (CRD), where each treatment had ten replicates. One-way ANOVAs were used to determine differences in chemical

Table 3. Chemical properties of the potting substrates.

Particulars	T1	T2	T3	T4
pH	5.43±0.189 d	6.13±0.189 c	8.1±0.189 a	7.11±0.189 b
EC	0.313 ±0.051 d	1.017 ±0.051 c	1.733 ±0.051 a	1.317±0.051 b
CEC	122.1±3.092 a	84.4±3.092 b	86.4±3.092 b	87.8±3.092 b
OM	1.007±0.028 b	1.227±0.028 a	1.213±0.028 a	1.273±0.028 a
N	0.153±0.052 b	0.477±0.052 a	0.491±0.052 a	0.417±0.052 a
P	37.3±2.577 c	94.3±2.577 b	185.2±2.577 a	185.6±2.577 a
K	495.3±2.506 d	663.6±2.506 c	795.3±2.506 a	698.6±2.506 b

Values are the means ± SE of three replications. Means in a row followed by different letters are significantly different at P < 0.05 according to the DMR test.

parameters among treatments. When significant ($P < 0.05$), the means were compared using Duncan's Multiple Comparison Range (DMR) test (Steel *et al*., 1997). The vegetative parameters of dracaena plants were also analyzed using the same method. Excel 2013 (Microsoft Inc., Redmond, USA) and SPSS 20.0 (SPSS Inc., Chicago, IL, USA) were used for statistical analyses. Three replications were used for measuring chemical properties. Seven replications were used for measuring plant growing parameters. All of these data were analyzed in the same way.

RESULTS AND DISCUSSION

***Substrate chemical analysis*:** The main chemical and nutritional properties of the potting substrates are listed in the Table 3. At the onset of experiment, chemical properties of the peat-perlite based potting substrate were greatly affected by the addition of biochar and compost individually or in combination. Since the pH of the amended biochar and compost was alkaline, all amended substrates (T2, T3, T4) with these organic amendments showed a remarkable pH increase in the order of T1 > T3 > T2 compared to unamended peat-perlite mixture (Table 3). The pH ranged from 5.43 to 8.1 and was lowest in control. The pH value of peat-perlite based potting substrates containing biochar was within the ideal range (5.3-6.5), while the compost and biochar-compost mixture showed pH values beyond the ideal range defined for an optimal potting substrate in potted plant production (Bunt, 1988; Abad *et al*., 2001). Although we now know that pH requirements varies plant to plant and dracaena has a slightly alkaline pH requirement (Poole *et al*., 2018). Similarly, calathea grow better when cultivated in a mixture of peat (pH 6.2) and biochar (1:1), because it is acidic compared to grown in biochar because of basic pH (7.11) (Tian *et al*., 2012). It may be recommended to add amendment with organic acids to biochars (e.g. citric acid) to optimize their pH (Margenot *et al*., 2018).

The electrical conductivity (EC) is an important parameter for potting substrates, because salt accumulate rapidly in potting substrates, reducing plant growth (Bustamante *et al*., 2008). EC of the potting substrates ranged from 0.313 to 1.733 dS/m and was higher than the suggested reference level (<0.5 dSm^{-1}) for ideal potting substrates (Table 3, Abad *et al*., 2001). The T1 (peat-perlite mixture) treatment had among the lowest and within the ideal suggested salinity level. Substrate with compost amendment has more soluble salts (EC = 1.733 dSm^{-1}) as compared to potting substrates (Table 3). In a previous study, the EC of different waste material based compost ranged from (2.22 to 3.47 dSm^{-1}) without adversely affecting the growth and quality of potted lady palm plants (Younis *et al*., 2016). Our results are in line with the findings of Méndez *et al*. (2016) and Dispenza *et al*. (2016), in which they found that biochar amendment in peat-based potting substrates modified their chemical characteristics including pH and EC.

Cation exchange capacity (CEC) is a measure of the ability of the potting substrate medium to adsorb exchangeable cations which are available to the plant. A high CEC means a lesser amount of nutrients will be leached during watering. The highest CEC correspond to T1 and T4 whereas lowest value was correspond to T3 and T2 (Table 3). Chen and McConnell. (2002) reported CEC of 5 to 50 to be desirable for foliage production. The differences in CEC for different substrates may be caused by the differences in organic matter content. In a study investigating the production and interior performance of tropical ornamental foliage plants in container substrates amended with composts, Younis *et al*. (2016) found that pH, EC, and CEC increased as the compost percentage in substrates increased. Nitrogen (N) is one of the important elements required for plant growth and development. It ranks after carbon, hydrogen, and oxygen in total quantity needed and is the mineral element most demanded by plants. The highest nitrogen content corresponded to T4 and T3. N content increased following the sequence T0 > T1 > T2 > T3 > T4 (Table 2). Concluding, biochar and compost amendment can increase the nitrogen content in the potting substrate, thus eliminating the fertilization cost along with improves plant growth. In a study conducted by Zhang *et al*. (2014), amendment of biochar in compost based growing substrate increased the total NPK content. Further, in another study by Kim *et al*. (2017), increased macronutrients concentrations were observed in the growing substrates amended with rice hull biochar. Potting substrates containing compost and biochar-compost mixture (T4 and T3) had the highest P content (185. 66mg kg^{-1} and 183.26). The rest of the two substrates, with the exception of T1, showed P contents less than the acceptable threshold for growing media (5–50 mg kg^{-1}) (Table 3). These results are in accordance with the findings of Kaudal *et al*. (2018), they reported an increase and sustained release of P from all biochar amended mixes. In addition, all potting substrates except T0, showed high K contents, and therefore, this nutrient would not limit the plant growth. Our results were supported by Gascó *et al*. (2018) and Sáez *et al*. (2016) in which they observed high K^+ contents in substrates amended with biochar and compost amendment. Further, Fascella *et al*. (2018), comparing the performance of growing substrates with different peat-biochar ratios, reported an increase in K^+ content by increasing the amendment of conifer biochar from 25 to 75%. Also, the use of biochar and compost alone and in combination increased the organic matter (OM) as compared to peat-perlite mixture. The experimental results showed an increase in organic matter for T4, T3 and T2 whereas T1 showed the lowest value (Table 3).

***Dracaena growth*:** Plant height achieved in peat-perlite based potting substrate (T1). Difference in dracaena performance regarding plant height was found among all treatments (T1, T2 and T3) and control (T1). Compared to T1 (control), the plant height of dracaena significantly increased by 10.35% in

Table 4. Analyses of variance data for morphological attributes of dracaena and chemical properties for different potting substrates (Means).

Source of variation	df	Plant height	Number of leaves	Number of buds	Leaf area	Root length
Treatment (T)	3	48.5625ns	3.7291667ns	10.990833***	465.2225***	24.90916***
Error	12	22.020833	2.6458333	0.7904167	2.0341667	0.6591667
		Root fresh mass	**Root dry mass**	**Root density**	**Leaf fresh mass**	**Leaf dry mass**
Treatment (T)	3	162.03833***	48.6875***	0.0119063***	0.400625*	0.1541667***
Error	12	2.3704167	2.3229167	3.7292e	0.0747917	0.0129167
		pH	**EC**	**CEC**	**Organic matter**	**Nitrogen**
Treatment (T)	3	5.8319444***	0.0360222ns	143.65639***	0.0420444***	0.0745907**
Error	8	0.1166667	0.0092417	3.2291667	0.0023833	0.0080806
		Phosphorous	**Potassium**			
Treatment (T)	3	15707.103***	46896.528***			
Error	8	19.925	18.833333			

T2, while 5.13 and 2.12% for T4 and T3 respectively (Fig. 1A; Table 4), indicating that biochar addition in peat-perlite based potting substrate promoted the growth of dracaena but a slight increase was observed in other amendments (e.g. compost and biochar-compost).

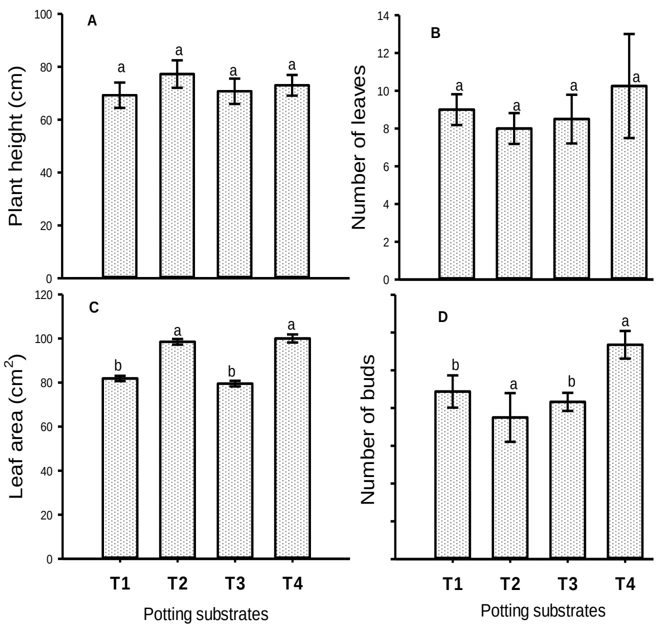

Figure 1. Effect of biochar, compost and biochar-compost amendment on the plant height (A), number of leaves (B), leaf area (C), and number of buds per plant (D) of dracaena plant (*Dracaena deremensis*) of marketable size, in the peat-perlite potting substrate. T1, peat-perlite (90/10 v/v), T2, peat/perlite/biochar (50/10/40), T3, peat/perlite/compost (50/10/40), and T4, Peat/ Perlite/Compost/ Biochar (50/10/20/20). Different small letters indicated significant difference, which was analyzed by Duncan's multiple range test ($P < 0.05$) using SPSS 20.0.

Figure 1B shows number of leaves for dracaena plant in different potting substrates. Compared with that of peat-perlite potting substrate (T1), the number of leaves of dracaena increased by 12.19% in T4 potting substrate, while decreased by 5.88 and 12.5% in T3 and T1 respectively, indicating a negative effect of biochar and compost addition on the number of leaves in dracaena (Fig. 1B).

Biochar (T1) and biochar-compost amendment (T4) increased the leaf canopy of dracaena by 16.90 and 18.15%, respectively and while only compost addition (T3) decreased the leaf area by 2.95% (Fig. 1C; Table 4). The number of buds increased about 21.80% in T4 treatment, while decreased by 6.60 and 11.66% in T3 and T1 treatments, respectively (Fig. 1D).

Compost (T3), Biochar (T2), and Biochar-compost (T4) increased the root fresh mass by 12.88, 20.21, and 28.56% respectively (Fig. 2A). Root dry mass decreased by 12.88, 20.21 and 28.56% for T3, T2 and T4 respectively (Fig. 2B). Compared with the T1, the root density of dracaena in T2, T3, and T4 increased by 6.89, 40, and 43.75%. With respect to the peat-perlite treatment, root length increased in T3, T4, and T2 by 0.47, 20.97, and 33.01% respectively. The positive effects of biochar and compost amendment alone and in combination on root development may be due to the nutrients supplied by these amendments or to the effects of the amendments on nutrient and chemical characteristics such as pH, CEC of the potting substrates. Compared to the T1 treatment, the leaf fresh mass of dracaena increased by 15.62% in both, T2 and T4, while decreased by 15.71 in T3 treatment (Fig. 3A; Table 5), indicating that the addition of compost in peat-perlite based potting substrate suppressed the leaf fresh mass. However, the leaf dry mass increased by 16.66, 31.03, and 39.39% in T3, T2, and T4 respectively (Fig. 3B). Changes in potted plants vegetative traits and biomass (roots and shoots) largely depend on the plant growing condition especially the availability of plant nutrients in the potting substrate (Zhang *et al*., 2014). The observations of present study agree with those of Méndez *et al*. (2016) and Álvarez *et al*. (2018), who reported that amendment of biochar or compost to growing substrates increased plant production.

Table 5. Changes in different growth traits of potted *D. deremensis* for different potting substrate.

Growth traits	Biochar T2	Compost T3	Biochar + compost T4
Plant height	↑	—	↑
Number of leaves	↓	↓	↑
Leaf area	↑	—	↑
Number of buds	↓↓	↓	↑
Root length	↑↑	—	↑
Root density	—	↑	↑↑
Root fresh mass	↑↑	↑	↑↑
Root dry mass	↓	↓↓	↓
Leaf fresh mass	↑	↓	↑
Leaf dry mass	↑	↓	↑↑

The direction of arrow shows the change in comparison with the control treatment, and number of arrow shows the intensity of response at P<0.05.

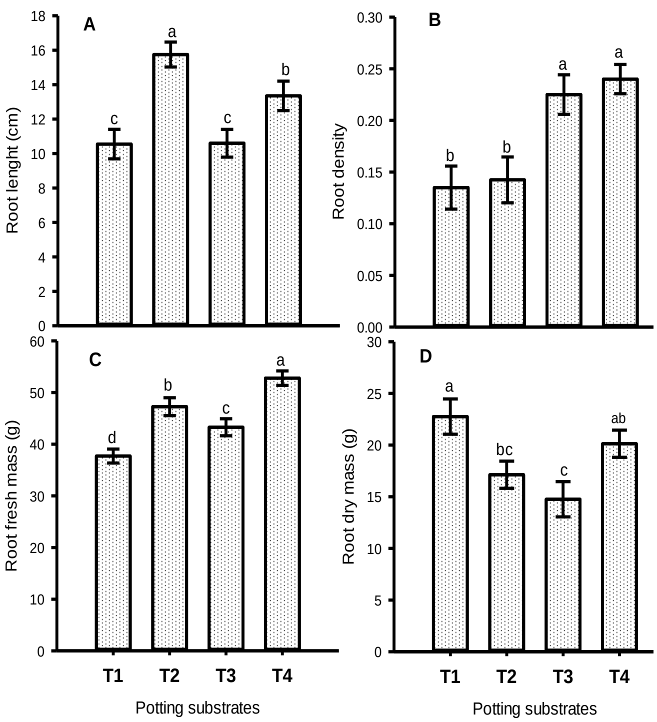

Figure 2. Effects of biochar, compost and biochar-compost amendment on the root length (A), root density (B), root fresh mass (C), and root dry mass (D) of dracaena, in the peat-perlite potting substrate. T1, peat-perlite (90/10 v/v), T2, peat/perlite/biochar (50/10/40), T3, peat/perlite/compost (50/10/40), and T4, Peat/ Perlite/Compost/Biochar (50/10/20/20). Different small letters indicated significant difference, which was analyzed by Duncan's multiple range test (P < 0.05) using SPSS 20.0

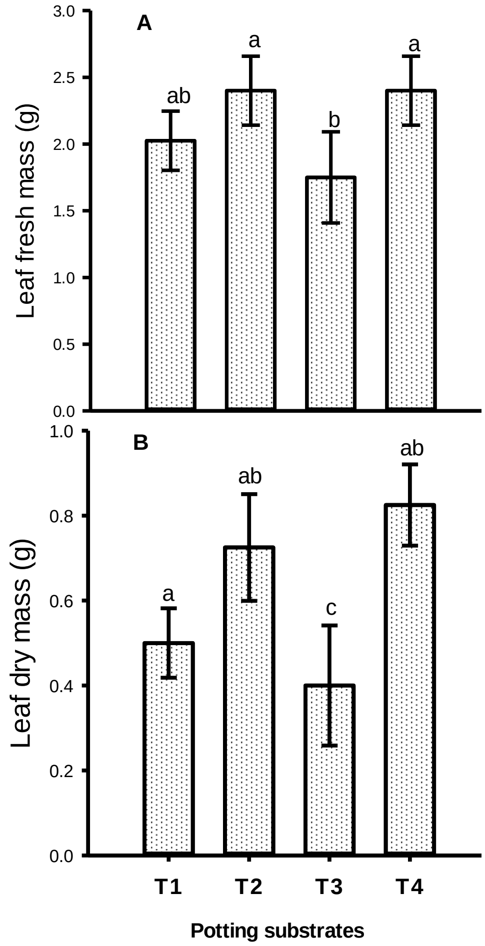

Figure 3. Effects of biochar, compost and biochar-compost amendment on the leaf fresh mass (A), and leaf dry mass (B) of dracaena, in the peat-perlite potting substrate. T1, peat-perlite (90/10 v/v), T2, peat/perlite/biochar (50/10/40), T3, peat/perlite/ compost (50/10/40), and T4, Peat/ Perlite/Compost/ Biochar (50/10/20/20). Different small letters indicated significant difference, which was analyzed by Duncan's multiple range test (P < 0.05) using SPSS 20.0

***Practical implications*:** This study explores the use of different alternative materials such as biochar and compost as a supplement to a peat-perlite based potting substrates. A comprehensive evaluation of these materials was carried out to evaluate chemical characteristics and growth of dracaena in potted production. Amendment of biochar and compost in potting substrates can reduce the fertilization cost as their addition increase the CEC and concentration of macronutrients thus directly reducing the input costs. Addition of biochar and compost showed the potential to minimize peat use in potted plant production.

***Conclusion*:** The six months pot experiment revealed that amendment of biochar and compost with desired properties could be a feasible alternative to partial replace peat for ornamental plants especially dracaena production. Moreover, the addition of biochar and compost should be kept at an optimal level, which may produce expected positive results. Our results will be helpful for supporting the strategy of designing right biochar-compost for the soilless potting substrates.

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