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Growth response of song of India (*Dracaena reflexa*) to various growing substrates

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Abstract
House plants are usually regarded as green pets and are imperative part for living decor. Song of India "*Dracaena reflexa*" is an exquisite indoor plant. Pot production of this plant in different growing substrates was studied with the aim to identify the best one. Six months old *Dracaena reflexa* were planted in earthen pots composed of different treatments combinations of silt, coco coir, leaf manure and farm yard manure. Results showed that combination of silt + FYM improved root and shoot parameters like fresh mass, root and shoot length, SPAD value and mortality while, combination of silt + leaf manure + coco coir in increased plant height, leaf area, plant spread, number of leaves per plant and dry mass significantly than all other combinations.

Keywords: *dracaena reflexa*, leaf manure, FYM, coco coir, growing media, ornamental plant

1. Introduction
Ornamental plants especially the house plants are always appreciated for their enchanting view. They possess pivotal importance in human life because of their beauty, beliefs, culture, and environmental benefits (Falconer and Kopell, 1990) [7]. *Dracaena reflexa* formerly called *Pleomele reflexa* is described as "Song of India" belong to "Asparagaceae" family. It is illustrious for its false palm effect with crown of leaves on top of mature canes. It's richly colored evergreen leaves on irregular stem makes it a marketable house plant for survival under low light conditions with little care (Jaminson, 2012) [11].

Growing substrates respond differently for different plant groups. Peat is usually preferred globally as a growing substrate for production of potted plants. Moreover, excavation of peat, impart detrimental ecological threats to the environment. For this purpose, an economical and environment friendly substrates are always made identified. Growers usually use mixture of peat and chemical fertilizers for the production of ornamental plants in developed world. In Pakistan silt and sand are abundantly used for pot plant production as growing media, peat being unavailable and expensive, remained unused. Little knowledge about the consumption of other organic sources that are commonly available in our surroundings, impede production. Use of composted organic waste is getting much popularity in commercial use for being capable to recycle (Nappi and Barberis, 1993) [17]. Growing media generally have three components i.e. mainly with water, dissolved nutrients, solid (33-50%) and gases (50-70%) with 12% oxygen. This type of combination is reported to be good for vigorous growth and stronger root system (Gil *et al*., 2012) [8].

Quality and quantity of wastes are creating persistent interest to be used as organic source for plants (Grigatti, 2008) [9]. Substrates like sawdust, coconut coir, compost, peat moss, bark and rice hulls etc. are used as organic source for plants (Jacobs *et al.*, 2009) [10]. Composted organic material not only resists against root diseases (Raviv, 2008) [21] and are useful substitute of peat (Papafotiou *et al*., 2004) [19]. Ornamental plants respond differently to different growing substrates e.g. *Maranta bicolor* attains good height when grown in leaf mold mixture (Misra and Misra, 2002) [16]. Similarly, diffenbachia showed pronounced results regarding growth parameters when grown in composted bark (Bugbee, 2002) [6].

By-products of plants and animals, proved to be an efficient and inexpensive source of growing medium. This not only benefits the environment but also attains meaningful outcome in potted plant production. Pakistan being an agricultural country have ample resources of by-products obtained from plants and animals. Keeping in view, the environmental concerns, economic constraints, and growers need, this study was performed to investigate the impact of various compositions as potting media on growth performance of *D. reflexa*.

2. Materials and Methods
Experiment was executed in shade house in pots at Floriculture area, Institute of Horticultural Sciences, University of Agriculture Faisalabad, Pakistan (latitude 31°30N, longitude73°10E and altitude 213m).

2.1 Growth Conditions
Transplantation of six months old plants was done in 12 inches earthen pots having the total capacity of 2.5 L of the soil, in the month of July. Meteorological data for different months is represented in Table 1.

Table 1: Metrological data of the year 2014.

Months	Temperature			Relative humidity (%)	Rainfall (mm)	Sun shine Radiation (hours)	Wind speed (km/h)
	Max.(°C)	Min.(°C)	Avg.(°C)				
July	37.0	28.0	32.5	53.9	57.5	09.0	06.4
August	37.1	27.3	32.2	52.7	4.8	09.1	05.4
September	33.9	24.5	29.2	61.2	140.2	07.7	04.7
October	31.3	19.1	25.2	54.6	3.6	5.6	04=[.0

http://uaf.edu.pk/faculties/agri/depts/crop_physiology/agri_met_cell/met_bulletin.html.

Pots were filled with different combinations of silt, coco coir, leaf manure and farm yard manure respectively in various treatments such as T_0 (Silt 2.5 L), T_1 (Silt 1.25 L: Coco coir 1.25 L), T_2 (Silt 1.25 L: FYM 1.25 L), T_3 (Silt 1.25 L: Leaf manure 1.25 L), T_4 (Silt 0.833 L: Leaf manure 0.833 L: Coco coir 0.833 L), T_5 (Silt 0.833 L: Leaf manure 0.833 L: FYM 0.833 L) and T_6 (Silt 0.625 L: Leaf manure 0.625 L: Coco coir 0.625 L: FYM 0.625 L). Each treatment was replicated thrice with ten observational units in each treatment. Different growing media were analyzed chemically and analysis report is represented in Table 2.

Table 2: Chemical Analysis of Different Potting Media.

Growing media	Organic matter (%)	EC (dSm^{-1})	pH	N (%)	P (mgL^{-1})	K (mgL^{-1})
Silt	0.29	1.82	7.8	0.046	3.75	80
Silt+ CC	0.29	3.95	7.5	0.051	3.25	320
Silt + FYM	0.34	3.05	6.91	0.054	6.45	320
Silt + LM	0.33	2.35	6.89	0.051	5.16	380
Silt + LM + CC	0.34	2.50	6.45	0.058	4.5.	400
Silt + LM + FYM	0.33	2.89	7.0	0.047	4.34	180
Silt + LM + CC + FYM	0.30	2.75	8.0	0.054	3.9	340

This analysis was carried out at soil chemistry lab, ISES, UAF.

2.2 Qualitative Parameters
Data regarding mortality percentage was measured using standard procedure while plant quality was measured by the method of (Skogley and Sawyer, 1992) [26].

2.3 Quantitative Parameters
Data regarding quantitative parameters like plant height (cm), spread of plant (cm), number of leaves $plant^{-1}$ and root length were recorded using standard procedure. Leaf area was measured by using formula maximum length × maximum width × 0.67 as described by (Birch *et al*., 1998). SPAD value was measured by chlorophyll meter. Fresh and dry mass of shoot and root were calculated by following the procedure proposed by (Nazari *et al*., 2011) [18].

2.4 Data Analysis
The experiment was executed according to completely randomized design (CRD). Total duration for experiment was six months. Data was recorded at the end of experiment and analyzed by ANOVA. Means were compared by using LSD test at 5% significance level (Steel *et al*., 1997) [27].

3. Results
3.1 Plant Foliage Characteristics
Results depicted that T_4(silt + leaf manure + coco coir) performed significantly better in majority of plant foliage characteristics like plant height (21.71 cm), plant spread (14.70 cm), number of leaves (13.56), leaf area (13.33 cm^2) and dry mass of shoot (5.34 g). On the other hand, T_2 (silt + FYM) performed significantly better in various foliage characteristics like SPAD value (17.34), fresh mass of shoot (13.02 g) and have no mortality of plants. In case of plant quality T_4 and T_2ranked second and third respectively after T_0. Therefore, on overall basis in foliage characteristics T_4 gave best results followed by T_2 (Table 3).

3.2 Root growth Characteristics
Results regarding the root characteristics of plants depicted that maximum root length (22.75 cm) and fresh mass of root (6.67 g) were noted in T_2(silt + FYM) which were significantly greater than all other treatments. However, dry mass of root **(**1.83 g) was observed greater in T_4**(**silt + leaf manure + coco coir**)** which was significantly greater than all other treatments (Table 4).

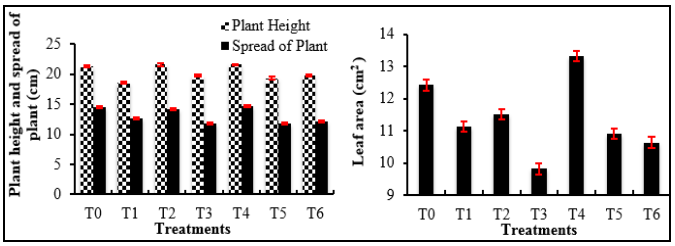
Table 3: Effect of different growing media on various plant foliage characteristics.

Plant foliage characteristics	Growing Media						
	T_0	T_1	T_2	T_3	T_4	T_5	T_6
Plant height (cm)	21.26 b	18.61 e	21.59 ab	19.77 c	21.71 a	19.35 d	19.73 cd
Spread of plant	14.55 a	12.59 c	14.2 b	11.86 de	14.7 a	11.78 e	12.2 d
No. of leaves $plant^{-1}$	11.8 b	11.91 b	11.11 c	9.82 d	13.56 a	9.6 d	9.72 d
Leaf area (cm^2)	12.43 b	11.14 d	11.52 c	9.82 f	13.33 a	10.91 de	10.64 e
SPAD value	12.77 cd	13.33 c	17.34 a	9.77 e	14.91 b	12.3 d	6.07 f
Fresh mass of Shoot (g)	7 de	8.53 c	13.02 a	7.33 d	11 b	6.58 e	5.5 f

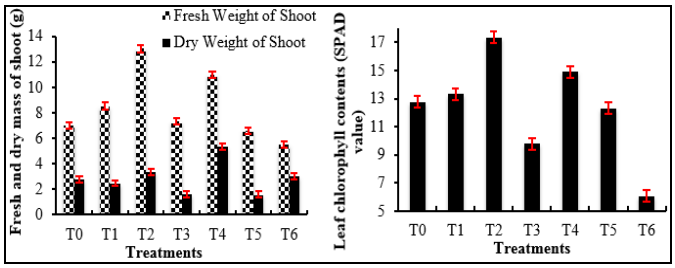
Dry mass of Shoot (g)	2.76 c	2.47 c	3.38 b	1.63 d	5.34 a	1.56 d	2.98 bc
Mortality percentage	16.67 bc	25 abcd	0.0 d	50 a	8.33 ab	33.3 bcd	41.67 cd
Plant quality	9.48 a	8.26 c	8 c	7.41 d	8.6 b	6.52 e	6.14 f

Table 4: Effect of different growing media on various plant root characteristics.

Growth parameters of root	Growing Media						
	T_0	T_1	T_2	T_3	T_4	T_5	T_6
Root length (cm)	16.83 c	9.75 e	22.75 a	10.1 e	20 b	16.01 d	7.13 f
Fresh mass of root (g)	3.63 c	3.5 c	6.67 a	2.58 d	5.33 b	4 c	3.83 c
Dry mass of root (g)	0.95 bc	0.51 c	1.37 ab	0.61 c	1.83 a	0.82 c	0.87 bc

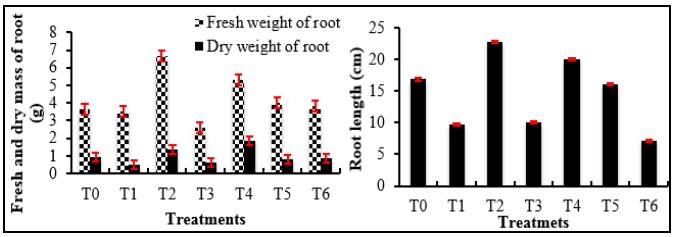


A. Plant height and spread B. Leaf area.



C. Fresh and dry mass of shoot. D. Leaf chlorophyll contents

Fig 1: Plant foliage characteristics.



A. Fresh and dry mass of root. B. Root length.

Fig 2: Root growth characteristics.

4. Discussion

Moisture retentive and well drained potting media offers ideal conditions for plant growth and development. Mixture of various organic components proved useful to support small plants grown in pots. Physical and chemical properties of growing media play key role in production of pot grown plants (Robinson and Lamb, 1975) [22]. Compost obtained from different natural waste materials such as farm yard manure and agricultural waste can be used as growing media in floriculture. It provides plant with adequate amount of nutrient and satisfactory water holding capacity (Tomati *et al.*, 1993) [28]. Absorption and retention of nutrients is solely dependent upon quality of growing media in production of healthy plants (Masarirrambi *et al*., 2010). Growing media provides adequate amount of carbon, nitrogen, phosphorous, potassium, manganese, magnesium, zinc, copper and iron, which are essential for better plant growth (Alizadeh, 2005) [2]. Nutrient availability is highly influenced by their form and nature (Barber, 1978) [4], Cation exchange capacity as well as the density of plant roots and pH are also based upon nature of growing media. Nitrogen is an important part of chlorophyll, DNA and RNA that is essential for various plant growth stages in life cycle. Phosphorus plays an important role in many plant processes such as nitrogen fixation, synthesis of nucleic acid, photosynthesis, respiration, energy metabolism and enzyme regulation that contributes to flower, fruit and root length (Raghothama, 1999) [20]. Potassium on the other hand is involved in photosynthesis, protein and carbohydrate metabolism which improves stem and root growth.

D. reflexa plants performed best in media combination T_4(silt + leaf manure + coco coir) regarding features like plant height (21.71 cm), plant spread (14.70 cm), number of leaves per plant (13.56), leaf area (13.33 cm^2) and dry mass of shoot (5.342 cm) Figure 1 (A, B. C, D). The composition of this growing media might have played role in growth and development of this plant by facilitating high uptake of nutrients from root zone. Results exhibited that T_4(silt + leaf manure + coco coir) was best growing media for increased plant height. This increase in plant height might be due to high amount of organic matter, nitrogen, potassium, and optimum range of EC and pH of growing media. These results are consistent with previous work of (Mehmood *et al*., 2013) [15] on *Antirrhinum majus* L. in the growing media comprised of leaf manure. Spread of plant was also maximum in Silt + Leaf manure + Coco coir that might be due to the reason of sufficient supply of nutrients with best physico-chemical properties of growing media. Similar findings were observed by (Shah *et al*., 2006) [25] who concluded that maximum spread of plant in *Ficus binnendijkii* was obtained in growing media in which leaf manure was used.

Leaves are the major site for photosynthesis in plants and higher leaf number is the index of plant health and vigor. Growing media must exhibit features that favor the growth of aerial parts particularly in perennial house plants. Number of leaves per plant in *D. reflexa* were maximum in media containing T_4(Silt + Leaf manure + Coco coir) that might be due to optimized accumulation of various nutrients especially higher nitrogen contents. Khyyat *et al*. (2007) observed more number of leaves produced per plant in zinnia grown in potting media containing Silt + leaf manure + coco coir. Appreciable results regarding leaf area were also observed in T_4 (Silt + leaf manure + coconut coir) that significantly increased leaf area as compared to the other treatments tested. Higher leaf area is coined with exposure of leaves to light

accompanied with optimum organic matter contents, available nutrients, EC and pH. Akparobi (2009) [1] also observed maximum leaf area for Amaranthus when grown in potting mix containing leaf manure. Results regarding SPAD value were higher in the media composed of T_2 (silt + farm yard manure) that might be due to high nitrogen and optimum range of pH and EC that supported plants to absorb maximum nutrients from the growing media. Sangwan *et al*. (2010) [23] grew marigold plants in the media containing 20 % cow dung produced maximum SPAD value in plants as this media is an efficient source of nitrogen for plants.

Fresh mass of shoot is the indicator of plant biomass above the ground level. Increased level of plant fresh mass of shoot was seen in the plants grown in the media composed of T_2 (silt + farm yard manure) that made efficient use of nutrients especially nitrogen containing compounds to develop proteins buildup leading to accelerated growth and development of structural parts (Figure. 1C). This feature resulted in proliferation of meristematic cells destined to form new shoots and leaves. Kumar and Haripriya, (2010) [13] concluded that the presence of nutrients accumulation in the leaves was the main cause of increased fresh mass of shoot. Sangwan *et al*. (2010) [23] when grew marigold plants in substrate containing 30% horse dung vermi-compost produced maximum fresh mass of shoot. Similarly, plant dry mass reveals the actual quantity of organic compounds like carbohydrates, proteins and fats that plant has acquisitioned to build its structures excluding the water contents. Maximum dry mass of shoot was obtained in growing media containing T_4 (silt + leaf manure + coco coir) (Figure.1 C). Nitrogen is the constituent element of proteins and nucleic acids that are involved in vegetative growth and development of plant parts. Viradia and Singh (2004) [29] found out promising results regarding plant morphological traits in field grown cut roses cv. Gladiator when provided with 40g nitrogen per plant. In another study conducted by (Sardoi *et al*., 2014) found maximum dry mass of shoots in zinnia plants grown in media comprised of leaf manure + silt.

As this plant is sensitive to malicious environmental conditions so roots and shoots are prone to damaging effects and growing media may support to develop tolerance. Minimum mortality percentage was observed in the media composed of T_2 (Silt + FYM). In a previous experiment (Alonso *et al*., 2012) [3] reported 25-50% mortality in chrysanthemum plants when they increased percentage of poultry manure in potting media. Plants with more surface area to volume ratio of roots are able to absorb nutrients and water more efficiently, hence growing media must be supportive to permute root development. T_2(Silt + FYM) hastened root length in *D. reflexa*Figure 2 (B). More length of root was might be due to presence of high phosphorus level and soil texture. Shah *et al*. (2006) [25] observed increased root length of *Ficus binnendijkii* when farm yard manure was more in growing media. Similarly, fresh mass of root represents the amount of total biomass below the ground level that favors overall plant growth. Increase in root fresh mass was found maximum in the media composed of T_2 (Silt + farm yard manure) (Figure. 2 A). Sangwan *et al*. (2010) [23] found maximum root fresh mass in marigold plants when grown in 30% horse dung vermi-compost. Although, Silt + leaf manure + coco coir showed best results regarding root dry mass Figure 2 (A). Similar findings were reported by (Sardoi *et al*., 2014) who concluded that maximum dry mass of roots in zinnia (*Zinnia elegans*) in growing media containing leaf manure + silt.

5. Conclusion

From above information it can be concluded that the combination of T_2 (silt + farm yard manure) and T_4(silt+ leaf manure + coco coir) are useful growing media for *D. reflexa* as compared to others. Thus, it is suggested that these combinations may be used as a potting media for quality *D. reflexa* production and may be exploited for other ornamental potted plants.

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