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Effect of different substrates on vegetative growth and quality of cast iron (*Aspidistra elatior* L.)

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Abstract

Cast iron (*Aspidistra elatior* L.) is a rhizomatous foliage perennial plant which is extensively cultivated as an indoor houseplant. Growing media plays an important role in plant growth and development particularly for indoor potted plants. Peat based growing media are being extensively used in growing ornamental plants, whereas it is very expensive and there is immense need to replace peat based growing media by evaluating other organic substrates. Pot experiment was conducted to evaluate growth performance of cast iron using various potting media in different combinations: i.e. garden soil, peat moss, leaf manure, compost, coconut fiber and farm yard manure at the ratio of 1:1 (v/v)to evaluate the best growing media for growth and quality of *Aspidistra elatior* L. Various morphological parameters including survival percentage, length of leaves, petiole length, roots length, rhizome length, leaf area, number of leaves/plant, fresh and dry weight of roots and fresh and dry weight of leaves were recorded using standard methods. Treatment T_2 (peat + farm yard manure + leaf compost) showed best results among all the treatments for the parameters of foliage quality, number of leaves, number of roots, fresh and dry weight of leaves, dry weight of roots and rhizome length. Growing medium analysis showed that growing medium with less water holding capacity, low nutrients and less organic matter can be altered with alteration in organic materials using different combinations at different rates.

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Introduction

Cast iron (*Aspidistra elatior* L.) is a popular rhizomatous foliage plant belongs to the family Asparagaceae. It is native to Asia and commonly used as a house plant worldwide. Cast iron is grown as a landscape plant in areas with dense shade and mild winters. It can be happily grown in both indoor and outdoor conditions and is tolerant to drought and wide range of soil types. The variegated cast iron needs almost poor soil to retain its coloration and grow best in organic matter containing growing media that has high cation exchange capacity (CEC) and water retaining capacity. These features enable this plant to be adaptive in places with shade.

There is continuing interest during the past few years, in using various agricultural-by-products as an organic nutrient source due to increasing awareness about environment related issues caused by increased use of commercial fertilizers and chemicals (Grigatti, 2008). For fulfilling the need of mineral nutrients of plants, recycling of organic waste including dairy cattle dung, animal littering and poultry manure are being utilized. Different organic substrates must be analyzed to verify the physical properties and mineral nutrients more suitable for the best growth of container grown ornamental plants. Composted materials has advantages of potential resistance against root diseases (Raviv, 2008), high water holding capacity, readily available form of nutrients and potential to substitute peat in the growing medium of potted ornamental plants (Papafotiou *et al.*,2004). Traditionally, residues such as urban solid wastes, saw dust, sewage sludge, spent mushroom substrate and even green wastes were considered as non-desirable or with little value. Nowadays, numerous studies have demonstrated that these organic residues, after proper composting, can be used with very good results as growth media instead of peat (Verdonck, 1984, 1988; Raviv *et al*., 1986; Chen *et al*., 1988; Bugbee and Frink, 1989; Piamonti *et al*., 1997; Garc_ıa-Go´mez *et al*., 2002). Hartz *et al*. (1996) found that tomato production was similar when using either peat or green waste compost mixed with perlite 50% by volume. Spiers and Fietje (2000) got similar conclusions when comparing a mixture of green waste compost (30% v/v), bark (50% v/v) and sand (20% v/v) with pine bark also for tomato production.

Growth and development of ornamental potted plants is affected by different factors among which growing media is one of the most important factors playing key role in quality production of flower and foliage plants. For optimum root and shoot growth, a potting medium should serve four major functions like nutrient supply, provision of water, gaseous exchange and physical support to plant (Nelson, 1991). Different potting media can be utilized effectively to grow cast iron plants whereas the chemical and physical properties of growing media like pH, electrical conductivity, texture, structure, particle density, consistency, organic matter contents, saturation percentage along with nitrogen, phosphorus and potassium are the crucial factors for optimum plant growth and development (Larson, 1980). Literature shows great variability between pH values, electrical conductivity, or nutrient contents among these types of compost (Hegberg *et al.,* 1991; Hartz *et al.,* 1996; Spiers and Fietje, 2000; Benito *et al.,* 2000), but all conclude that they must be considered as good quality plant growth substrates. It is known that potting media along with nutritional requirements are the key factors affecting plant growth and development (Bhattacharya *et al.,* 1994). Organic matter content of the potting media has a great effect on the biological, chemical and physical properties of plants (Kambooh, 1984). For the propagation of many potted plants peat is the most extensively used organic substrate therefore its import has increased double times. It is comparatively expensive for local growers or nurserymen due to heavy duties on its import that is why reducing its use is mandatory by using other organic media. Therefore it is need of hour to find and utilize cheaper locally available substrates to replace peat at least partially (Riaz *et al.,* 2008). Depletion of a nonrenewable resource such as peat, and environmental deterioration because of peat mining have favoured the utilization of alternative materials as growth substrates (Abad *et al.,* 2001).

In Pakistan, commonly available materials like sewage sludge, mushroom compost, saw dust, coconut fiber, leaf compost, farm yard manure, bark shavings and solid waste compost are not being fully utilized as potting mixtures in different compositions. If these types of potting mixtures are evaluated for ornamental plant productions, it can help in commercializing the locally available potting mixes and minimizing the use of imported potting media like peat moss.

The main objective of this present study was to evaluate the combined effect of selected growing media as culture substrate including garden soil, peat moss, solid waste compost, farm yard manure, leaf manure and coconut fiber to optimize the technology for the propagation, growth and quality of cast iron plants in order to determine that if they have any limitation in their use. Apart from studying the morphological attributes of cast iron plant, the chemical properties of growing media like organic matter, electrical conductivity (EC), pH and availability of nitrogen, phosphorous and potassium were also evaluated.

Materials and methods

This research was conducted at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture Faisalabad, Pakistan during the year 2013-2014 to evaluate the performance of different potting media for vegetative growth and quality of *Aspidistra elatior* L.

Different substrates including garden soil, peat moss, solid waste compost, leaf manure, coconut fiber and farm yard manure were used as the main source of potting media in different combinations and proportions to determine most favorable growing media for cast iron growth and quality production. Several combinations of substrates used were T_0= Garden soil, T_1= Peat + Farm yard manure + Solid waste compost, T_2= Peat + Farm yard manure + Leaf compost, T_3= Peat + Farm yard manure + Coconut fiber, T_4 = Peat + Solid waste compost + Leaf compost, T_5= Peat + Solid waste compost + Coconut fiber, T_6= Peat + Leaf compost + Coconut fiber, T_7= Farm yard manure + Solid waste compost + Leaf compost, T_8= Farm yard manure + Solid waste compost + Coconut fiber, T_9= Farm yard manure + Leaf compost + Coconut fiber and T_{10}= Compost + Leaf compost + Coconut fiber at the ratio of 1:1 (v/v).

Plants were purchased from a local nursery at 4 leaf stage and were transferred to clay pots having 12 inches diameter and 9 inches depth containing respective growth media and were allowed to establish there for 60 days in pots on March 23, 2013 at 10.30am and plants were harvested on August 23, 2013 at 10.30am.

Data recording

Several growth parameters including plant survival percentage, length of leaves (cm), length of petiole (cm), width of leaf (cm), leaf area (cm^2), number of leaves/plant, rhizome diameter (cm), rhizome length (cm), root length (cm), dry weight of roots (g), fresh weight of roots (g), fresh weight of leaves (g), dry weight of leaves (g)and foliage quality were studied. Each treatment was replicated four times with 4 plants in each replication. Total number of plants was 176. Plants were irrigated regularly and weeds were also removed. Plants were placed under shade in a greenhouse. Data were collected monthly. Analysis for all growth media in combination were also done for organic matter content, pH, EC, available nitrogen, phosphorous and potassium.

Chemical analysis of potting media

Chemical properties of all growth media after making different combinations were analyzed as described below.

Total Nitrogen

Total nitrogen was determined by following the protocol described by Chapman and Parker (1961), with the help of Kjeldahl's apparatus (Timberline Instruments, USA). Sample of the potting mixture was shifted to the Kjeldahl digestion flask with 10g digestion mixture and then 30ml of H_2SO_4 was added in it. The sample was kept as it is for 30 minutes. The mixtures were then heated slowly at the start by placing the digestion flasks on heaters and then full heat was given to the samples till it became transparent green liquid. After cooling, the samples were shifted to a 250ml volumetric flask and volume was made up to the mark. The distillation was done in micro kjeldahl apparatus by adding boric acid and methyl red as indicators. Total nitrogen in the sample was determined by titrating with standard H_2SO_4.

Phosphorus (ppm)

Available phosphorus in the growing media was estimated by the Olsen's method (Olsen *et al.,* 1954). For that, 1.25g growth media was air dried and placed in conical flask. Then extracting solution up to 25ml was added. Then the flask was vibrated for half an hour on a vibrating sieve. The suspension was poured and filtered through what man filter paper no. 42 and 1ml of this filtered solution was taken in a beaker. 3ml of distilled water and 1ml of color developing reagent was added and stirred. Mixture was left to settle for 15 minutes. The reading was recorded at 880mu on the Spectrophotometer, model Spectronic 21. Value for phosphorus was determined by the following formula. ppm from curve × 25ml/ 1.25gm × 5ml/ 1ml = ppm of P

Potassium (ppm)

The flame photometric method was used for estimation of available potassium. 5.0g air dried ground media sample was taken into a 250ml conical flask and extracting reagent at 50ml was added. It was then shaken on reciprocating shaker for 30 minutes and extractable K+ was filtered and determined by flame photometer in ppm. Meq/1 pf K = Meq /1 of K by calibration curve *x* 50ml of sample Method-18(U.S. Salinity Lab. Staff, 1954).

Electrical Conductivity (EC)

Salinity was estimated as electrical conductivity (EC) using conductivity meter (Model CM-1 Mark V) with the help of conductivity bridge (Richards, 1954). Media and water (1:1) suspension was prepared and filtered in the Buchner funnel. Vacuumed pump was started, then opened the solution section and added the suspension to Buchner funnel. Media was filtered into the Buchner funnel till it started cracking. When the filtrate was cleared then it was shifted into a 50ml bottle, immersed the conductivity cell in the solution and reading was noted down following Bridge method 3a and 4b. Electrical conductivity was measured in dS m^{-1} (U.S. Salinity Lab. Staff, 1954).

Growth media pH

The pH was measured by using pH meter (digital ion analyzer) (U.S. Salinity lab. Staff, 1954). For pH determination, 1:1 (Media: Water) dried growing media sample was taken and added distilled water. 50g of air dried media was taken into a 100ml glass beaker. 50ml distilled water was added using a graduated cylinder and mixed well with a glass rod and left undisturbed for 30 minutes. Suspension was stirred after every 10 minutes during this period. Reading was taken by putting the combined electrode in suspension (about 3cm deep). Electrode was removed from the suspension, rinsed thoroughly with distilled water in a separate beaker and excess water was carefully dried Method-21a (Mclean, 1982).

Organic matter

Samples of 1g air dry media were taken into a 500ml beaker, 10ml of potassium dichromate solution and 20ml concentrated H_2SO_4 were added and swirled the beaker to mix the suspension. After 30 minutes, 200ml of distilled water was added along with 10ml concentrated orthophosphoric acid and left the mixture to cool. 10 to 15 drops of diphenylamine indicator were also added. Titrated the solution with 0.5m ferrous ammonium sulfate solution and noted the reading till changed from violet blue to green (Walkely, 1947).

Statistical analysis

Statistical analysis of the data was carried out in CRD layout, significant differences for the means were calculated based on ANOVA and the mean comparison of different treatments was performed using Duncan's Multiple Range (DMR) test at 5% probability level (Steel *et al.*, 1997).

Results and discussion

A comparative study on efficacy of various potting media was conducted and correlated between plant growing media and responses in plants.

Table 1. Chemical Analysis of Different Potting Media.

Potting Media	pH	EC (dSm^{-1})	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	Organic matter (%)
Garden Soil	8.1	1.95	0.23	0.049	7.9	0.35
Peat + Farm yard manure + Solid waste compost	8.0	2.58	0.3	0.324	10.6	0.56
Peat + Farm yard manure + Leaf compost	7.8	2.55	0.25	0.093	9.6	0.36
Peat + Farm yard manure + Coconut fiber	7.9	2.24	0.35	0.129	11.4	0.38
Peat + Solid waste compost + Leaf compost	8.0	2.21	0.37	0.154	13.1	0.64
Peat + Solid waste compost + Coconut fiber	8.0	2.59	0.3	0.337	7.0	1.05
Peat + Leaf compost + Coconut fiber	8.1	2.22	0.32	0.096	10.3	0.98
Farm yard manure + Solid waste compost + Leaf compost	8.0	2.18	0.3	0.151	12.0	0.91
Farm yard manure + Solid waste compost + Coconut fiber	7.9	2.53	0.25	0.239	10.0	1.00
Farm yard manure + Leaf compost + Coconut fiber	7.9	2.33	0.35	0.123	12.2	0.84
Compost + Leaf compost + Coconut fiber	8.0	2.50	0.3	0.180	11.9	0.43

Morphological traits

Length of leaves (cm)

The results regarding the effect of growth media on length of leaves are shown in (Fig. 1). Maximum length of leaves (22.855cm) was gained in T_3 (Peat + Farm yard manure + Coconut fiber) followed by T_2 (Peat + Farm yard manure + Leaf compost) with leaf length of 20.175cm, while minimum length of leaves (15.282cm) was observed in T_5 (Peat + Solid waste compost + Coconut fiber).

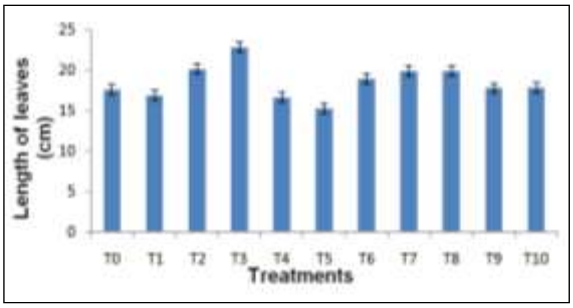

Fig. 1. Effect of different substrates on length of leaves of cast iron (*Aspidistra elatior* L.).

Results are guiding that peat along with farm yard manure and coconut fiber is a good combination for getting good leaf length.

Leaf length and leaf width are important parameters, which helps for the plant spread. Potting media of T_3 contained maximum amount of nitrogen (0.35ppm) that caused the length of leaves to increase significantly because nitrogen increases the vegetative growth of the plants.

The significant variation with respect to leaf length was reported previously in Carnation by Cardens *et al.* (2006). Our results are in contradiction with the findings of Shah *et al.* (2006) in which he concluded that maximum length of leaves (20 cm) in *Ficus binnendijkii* was obtained in leaf mold.

Number of leaves/plant

The results regarding the effect of growth media on the number of leaves are shown in (Fig. 2). Maximum number of leaves/plant (11.000) were obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_3 (Peat + Farm yard manure + Coconut fiber) with 10.333 number of leaves/plant, while minimum number of leaves/plant (5.667) were observed in T_5 (Peat + Solid waste compost + Coconut fiber). Results indicate that peat along with farm yard manure and leaf compost is the best combination for getting maximum number of leaves/plant in cast iron plant. Leaves are the main food production unit for the plant. Maximum number of leaves indicates good health of plants and also reflects suitability of environment under which plant is grown.

Growth media is important factor which exerts influence of more number of leaves on plant. More number of leaves is also due to availability of high nitrogen and potassium contents in a growing media. These results are found similar with the findings of Cardens *et al.* (2006) which showed that carnation grown in mixture of 65 and 35% rice husk and coconut coir respectively gave the maximum number of leaves per plant. While Scagel (2003) argued that media containing 80% fir bark with the combination of 20% peat, 20% coconut coir or 10% peat and 10% coconut coir gave more number of leaves.

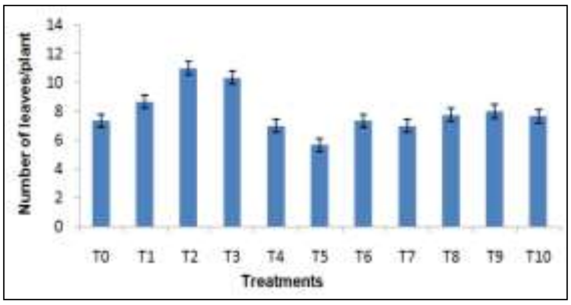

Fig. 2. Effect of different substrates on number of leaves/plant of cast iron (*Aspidistra elatior* L.).

Leaf area (cm²)

The results regarding the effect of growth media on leaf area are shown in (Fig. 3). Maximum leaf area (74.621 cm^2) was gained in T_3 (Peat + Farm yard manure + Coconut fiber) followed by T_7 (Farm yard manure + Solid waste compost + Leaf compost) with leaf area of 64.172 cm^2, while minimum leaf area (44.631cm^2) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Overall treatment means showed that T_3 gave the maximum leaf area among all the treatments and minimum leaf area was obtained with T_5 which showed that coconut fiber along with peat and farm yard manure is a best option to get maximum leaf area for cast iron and increase the plant growth and size of leaves.

These findings are more similar with the results of Cardenas *et al.* (2006) for carnation, which showed that leaf area and number of leaves were more in composted rice husk with the coconut coir used as growth media. Similar results were also found by Akparobi (2009) for amaranths, which showed that plants grown in 35t/ha leaf manure had greatest leaf area.

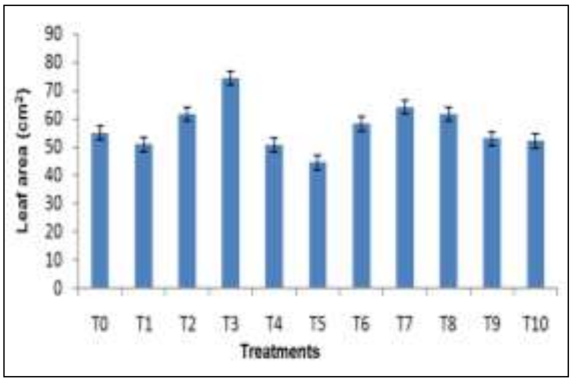

Fig. 3. Effect of different substrates on leaf area (cm^2) of cast iron (*Aspidistra elatior* L.)

Rhizome diameter (mm)

The results regarding the effect of growth media on rhizome diameter are shown in (Fig. 4). Maximum rhizome diameter (18.630mm) was observed in T_3 (Peat + Farm yard manure + Coconut fiber) followed by T_4 (Peat + Solid waste compost + Leaf compost) with rhizome diameter of 14.570mm, while minimum rhizome diameter (7.490mm) was observed in T_5 (Peat + Solid waste compost + Coconut fiber).

Overall treatment means shows that T_3 gave the maximum rhizome diameter among all the treatments and minimum rhizome diameter was obtained with T_5 which showed that coconut fiber along with peat and farm yard manure is a good choice for achieving maximum rhizome diameter of cast iron plants.

This result shows that the treatment containing peat, farm yard manure and coconut fiber have the significant effect on the diameter of rhizomes of cast iron plant. The nitrogen contents in the growing media may increase the photosynthetic activities which ultimately enhance the production of carbohydrates. These photosynthetic products translocate into the rhizomes, which may increase the rhizome size.

These results were in accordance with the findings of Raviv *et al.* (1986) that the high levels of nitrogen in growing media cause the increase in the corm size of gladiolus because of more accumulation of photosynthetic in corms.

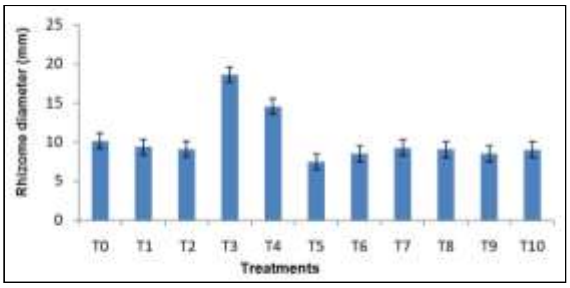

Fig. 4. Effect of different substrates on rhizome diameter of cast iron (*Aspidistra elatior* L.).

Fresh weight of leaves (g)

The results regarding the effect of growth media on fresh weight of leaves are shown in (Fig. 5). Maximum fresh weight of leaves (19.500g) was obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_7 (Farm yard manure + Solid waste compost + Leaf compost) with 13.700g fresh weight of leaves, while minimum fresh weight of leaves (6.933g) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Results showed that peat along with farm yard manure and leaf compost exhibit best growth with respect to fresh weight of leaves of cast iron plants.

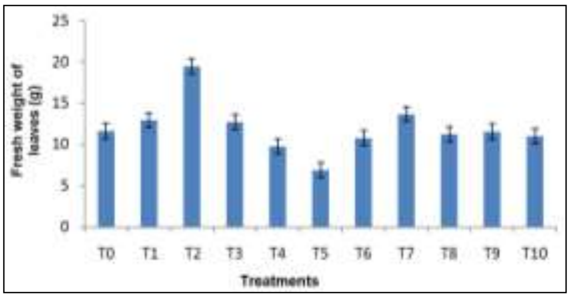

Fig. 5. Effect of different substrates on fresh weight of leaves of cast iron (*Aspidistra elatior* L.).

Increase in fresh weight of leaves may be due to organic matter present in growth media that supplied nitrogen and phosphorus in root portion of plants resulting in absorption of more nutrients and its utilization. Kumar and Haripriya (2010) concluded that the presence of nutrients accumulation in the leaves was the main cause of increment of fresh weight of leaves. Alidoust *et al.* (2012) observed that the maximum fresh weight of leaves (81.3g) of Dracaena was due to the growth media containing peanut shells compost and silt. In hyacinth, more leaf number and leaf fresh weight was observed in the media contained coconut coir + peat + sand (Nazari *et al.*, 2011).

Dry weight of leaves (g)

The results regarding effect of growth media on dry weight of leaves are given in (Fig. 6). Maximum dry weight of leaves (4.6000g) was obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_1 (Peat + Farm yard manure + Solid waste compost) with 3.2333g dry weight of leaves, while minimum dry weight of leaves (1.3000g) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Results showed that peat along with farm yard manure and leaf compost is a good choice for getting maximum dry weight of leaves of cast iron plants. The dry weight of leaves is the measurement of mass of all its constituents excluding plants. Nitrogen is an important component of protein, nucleic acid which is required for vegetative growth and might be caused a responsible increase in dry matter accumulation in leaves (Viradia and Singh, 2004). El-Naggar and El-Nasharty (2009) mentioned that maximum dry weight of Amaryllis leaves (29.24g) was observed in growth media containing composted leaves, our results are in agreement with their results. These findings are in contradiction with Abou Dahah *et al.*, (1987) in which they concluded that the maximum dry weight of aspidistra leaves were obtained when peat, silt and sand were used as growing media.

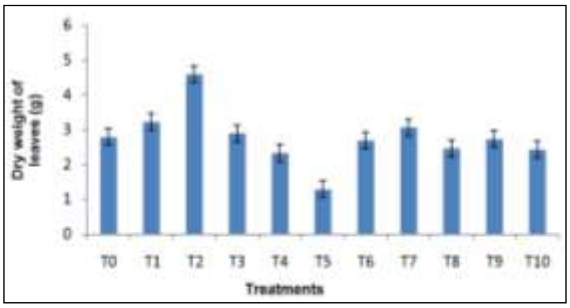

Fig. 6. Effect of different substrates on dry weight of leaves of cast iron (*Aspidistra elatior* L.).

Foliage quality

The results regarding effect of growth media on foliage quality of cast iron plants are given in (Fig. 7). Maximum foliage quality (9.0967) was obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_3 (Peat + Farm yard manure + Coconut fiber) with 8.6067 foliage quality, while minimum foliage quality (5.8806) was observed in T_5 (Peat + Solid waste compost + Coconut fiber).

Results showed that peat along with farm yard manure and leaf compost proved to be the most favorable potting media for getting good foliage quality of cast iron plants. These results could be the reflection of media properties containing high concentration of nitrogen (0.25ppm), potassium (9.6ppm), EC (2.55dSm^{-1}) and phosphorous contents 0.093ppm. These results are more related with the findings of Khan *et al.* (2002) in which gladiolus showed the maximum growth and good quality of plants in growth media containing peat, sand and silt. In another research, the effect of seven pots substrates on the growth and quality of Aphrodite cultivar was observed by Grantzau and Scharpe (1984), in which growth media comprised of sand, silt, white peat and black peat, which contained the highest phosphorous, potassium, magnesium and nitrogen level produced the excellent quality of plants.

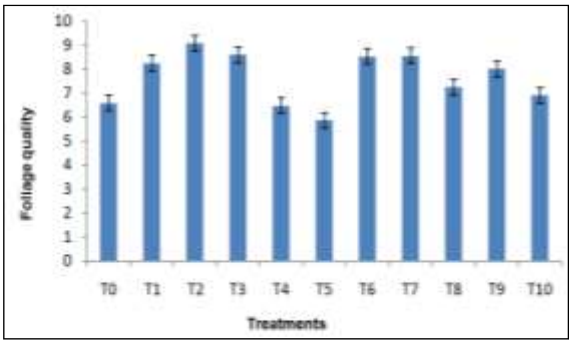

Fig. 7. Effect of different substrates on foliage quality of cast iron (*Aspidistra elatior* L.)

Dry weight of roots (g)

The effect of growth media on dry weight of roots per plant was highly significant and the effect of treatments was also found significantly different (Fig. 8). The results regarding effect of growth media on dry weight of roots are given in (Fig. 8). Maximum dry weight of roots (0.8000g) was obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_6 (Peat + Leaf compost + Coconut fiber) with 0.7667g dry weight of roots, in T_0 (Garden soil) was 0.7667g, in T_1 (Peat + Farm yard manure + Solid waste compost) 0.7667g, T_7 (Farm yard manure + Solid waste compost + Leaf compost) 0.7333g, T_{10} (Solid waste compost + Leaf compost + Coconut fiber) 0.6667g, T_8 (Farm yard manure + Solid waste compost + Coconut fiber) 0.5333g, T_9 (Farm yard manure + Leaf compost + Coconut fiber) 0.4667g, followed by T_3 (Peat + Farm yard manure + Coconut fiber) 0.3333g and T_4 (Peat + Solid waste compost + Leaf compost) with 0.3333g dry weight of roots. Minimum dry weight of roots (0.1333g) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Results indicate that peat along with farm yard manure and leaf compost is a valuable choice for getting maximum dry weight of roots of cast iron plants. Addition of peat, farm yard manure and leaf compost showed good results but the addition of solid waste compost and coconut fiber decrease the dry weight of roots of cast iron plant. These results are similar with the findings of Worrall (1981), in which he obtained maximum dry weight of roots of *Impatiens walleriana* by using peat, leaf compost and sawdust. Our results are dissimilar with the findings of Abouzari *et al.,* (2012) in which they observed that maximum dry root weight of *Ficus benjamina* cuttings (2.918g) was obtained in the composted tea waste and rice husk, while minimum dry root weight (0.596g) was obtained in the cuttings of *Ficus benjamina* cultivated in peat and perlite.

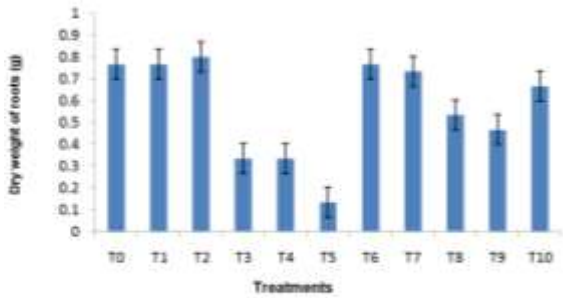

Fig. 8. Effect of different substrates on dry weight of roots of cast iron (*Aspidistra elatior* L.).

Width of leaves (cm)

The results regarding the effect of growth media on width of leaves are shown in (Fig. 9). Maximum width of leaves (3.2067cm) was gained in T_3 (Peat + Farm yard manure + Coconut fiber) followed by T_0 (Garden soil) with leaf width of 3.2000cm, T_6 (Peat + Leaf compost + Coconut fiber) was 3.1767cm, in T_7 (Farm yard manure + Solid waste compost + Leaf compost) 3.1633cm, T_8 (Farm yard manure + Solid waste compost + Coconut fiber) 3.0633cm, T_{10} (Solid waste compost + Leaf compost + Coconut fiber) 3.0567cm, T_2 (Peat + Farm yard manure + Leaf compost)

3.0467cm, T_9 (Farm yard manure + Leaf compost + Coconut fiber) 3.0267cm, followed by T_1 (Peat + Farm yard manure + Solid waste compost) 3.0067cm and T_4 (Peat + Solid waste compost + Leaf compost) with 2.9767cm leaf width. Minimum width of leaf (2.8633cm) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Leaf length and leaf width are the important parameters which help for the plant spread. Our results are in contradiction with the findings of Wilson *et al.* (2001) who reported that increased plant height, leaf width, more number of branches and leaves/plant and greater biomass was obtained in golden shrimp plant (*Pachystachys lutea* Nees.*)* when grown in compost. In another study Zawadzinska and Janicka (2007), concluded that leaves with greatest width were obtained in *Gardenia jasminoides* when grown in composted media.

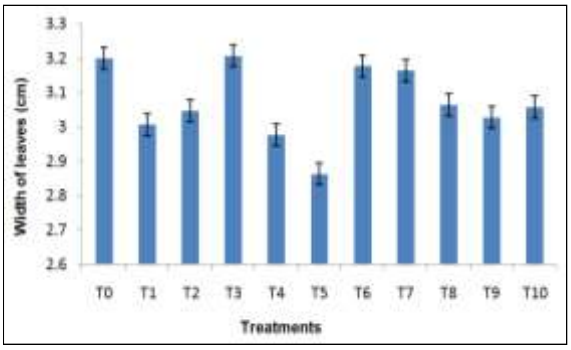

Fig. 9. Effect of different substrates on width of leaves of cast iron (*Aspidistra elatior* L.).

Number of roots

The results regarding the effect of growth media on number of roots are shown in (Fig. 10). Maximum number of roots (36.250) were obtained in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_6 (Peat + Leaf compost + Coconut fiber) with 35.500 number of roots, in T_1 (Peat + Farm yard manure + Solid waste compost) were 34.000, in T_0 (Garden soil) 31.250, T_9 (Farm yard manure + Leaf compost + Coconut fiber) 28.500, T_7 (Farm yard manure + Solid waste compost + Leaf compost) 26.000, T_{10} (Solid waste compost + Leaf compost + Coconut fiber) 25.250, T_8 (Farm yard manure + Solid waste compost + Coconut fiber) 24.000, followed by T_3 (Peat + Farm yard manure + Coconut fiber) 21.000 and T_4 (Peat + Solid waste compost + Leaf compost) with 18.500 number of roots.

Minimum number of roots (14.000) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Results revealed that peat along with farm yard manure and leaf compost is an optimum choice for maximum number of roots of cast iron plants. Roots are generally underground parts of plant and works as an organ of absorption, food storage and aeration and it also provides anchorage and support to the plant. These results are in accordance with the findings of Poole (1970), Verdonck (1988), in which they obtained better root system in *Dieffenbachia maculate* 'camille' by using leaf compost, calcined clay, garden soil, silt and peat as a media respectively. These observations are dissimilar with the findings of Poole and Conover, (1982) who observed that in calcined clay and garden soil, the number of roots of *Codiaeum variegatum* was not as much as in farm yard manure and silt.

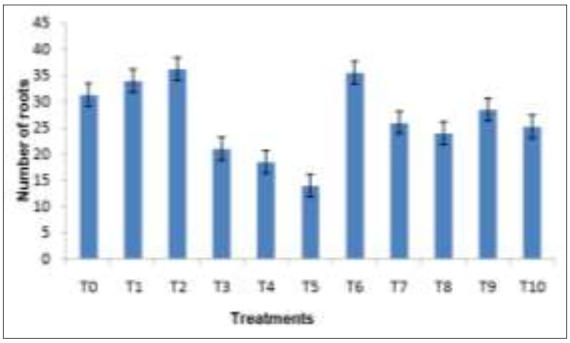

Fig. 10. Effect of different substrates on number of roots of cast iron (*Aspidistra elatior* L.).

Rhizome length (cm)

The results regarding the effect of growth media on rhizome length are shown in (Fig. 11). Maximum rhizome length (9.8000cm) was observed in T_2 (Peat + Farm yard manure + Leaf compost) followed by T_9 (Farm yard manure + Leaf compost + Coconut fiber) with rhizome length of 9.4000cm, in T_3 (Peat + Farm yard manure + Coconut fiber) was 8.1667cm, in T_6 (Peat + Leaf compost + Coconut fiber) 8.1667cm, T_1 (Peat + Farm yard manure + Solid waste compost) 7.8667cm, T_4 (Peat + Solid waste compost + Leaf compost) 7.333cm, T_7 (Farm yard manure + Solid waste compost + Leaf compost) 7.2667cm, T_8 (Farm yard manure + Solid waste compost + Coconut fiber) 7.2667cm, followed by T_{10} (Solid waste compost + Leaf compost + Coconut fiber) 7.1667cm and T_0 (Garden soil) with 7.000cm rhizome length.

Minimum rhizome length (5.7667cm) was observed in T_5 (Peat + Solid waste compost + Coconut fiber). Overall treatment means shows that T_2 gave the maximum rhizome length among all the treatments and minimum rhizome length was obtained with T_5. The comparison of treatment means shows that the effect of treatments is non-significantly different. These results are in accordance with the findings of Poole (1970), Verdonck (1988), in which they obtained better corm length (11.2cm) in gladiolus by using leaf compost, calcined clay, garden soil, silt and peat as a media respectively. These observations are dissimilar with the findings of Poole and Conover, (1982) who observed that in calcined clay and garden soil, the corm length of gladiolus was not as much as in farm yard manure and silt.

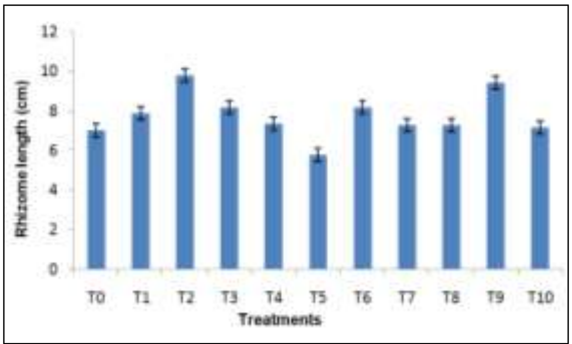

Fig. 11. Effect of different substrates on rhizome length of cast iron (*Aspidistra elatior* L.).

Conclusion

It is clearly seen in the results that when solid waste compost used as potting substrate gave the least results for all growth parameters due to high levels of EC and pH of the media containing solid waste compost. Evidence from chemical analysis of potting media indicating poor growth of plants in media containing solid waste compost is due to low levels of nitrogen and potassium in the media. Therefore it is concluded that plant growth in solid waste compost was lowest as compared to other potting media. It was concluded from the above discussion that T_2 is the optimum growing media forecast iron plants because of containing all nutrients i.e; nitrogen and potassium, optimum level of pH, along with appropriate soil structure. It is therefore suggested that T_2 (Peat + Farm yard manure + Leaf compost) may further be exploited as standard growing substrate for maintenance of optimum growth and quality of *Aspidistra elatior* L.

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