

Comparative Effect of Different Potting Media on Vegetative and Reproductive Growth of Floral Shower (*Antirrhinum majus* L.)

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Abstract This research project was conducted to investigate the comparative effect of different potting media with different compositions on growth and flowering of *Antirrhinum majus* L. 'Floral Shower'. The data for both morphological and physiological parameters analyzed statistically showed significant effect of media combinations over control values. Each treatment was consisted of 10 plants and was replicated thrice. Agricultural and municipal wastes are good, cheap potting media components for the production of flowering plants. An economical and high-quality production of 'Floral shower' can be attained by using most suitable media. The results regarding growth and flowering parameters showed significant increase in Leaf Mould potting media. The media containing Farm Yard Manure alone and in combination with silt with its higher pH, showed least results for these parameters. On the other hand, plants grown in Farm Yard Manure comprising media provide minimum results for all the characteristics except for media nitrogen content which were statistically similar to control. Peat moss containing growing substrate also showed positive results for plants vegetative and reproductive growth. However, Farm Yard Manure was seen to prove less effective for better plant growth due to its less contribution for the availability of nutrients. Availability of Phosphorus contents in soil has positive relationship with growth and flowering indices. Maximum Phosphorus content was found when Farm Yard Manure and Leaf Mould were used alone in combination with silt + topsoil. Thus, it is suggested that Leaf Mould can be recommended as a standard potting media for *Antirrhinum majus* L. growth.

Keywords Potting Media, Growth & Floral Attributes, Chemical Analysis, *Antirrhinum Majus* L.

1. Introduction

Antirrhinum majus L. belongs to family Scrophulariaceae is native of Mediterranean region. The consequences of DNA analyses have, led to drastic deviations in the circumscription of the family and the reclassified as a member of the Plantaginaceae [1]. Currently, 36 species and 20, 000 cultivars of *Antirrhinum* have been renowned [2]. It is commonly known as "Snapdragon" as its hinged flowers open and close like the mouth of a dragon when pinched at the sides with thumb. Snapdragon cultivars are classified on the basis of their growth and flowering response to day length and temperature [3].

Potting media plays a key role in quality and production of flowering plants. Natural soil and peat are the most used growing substrates for the container production of annual and perennial ornamental plants [4]. Potting media containing peat is commercially an expensive and non-reusable component but developing inexpensive alternatives by the use of nutrient-rich organic media can potentially results in reduction of fertilization and irrigation rates as well as also decrease nursery costs [5]. Peat is the most widely used substrate for potted plant production in nurseries and it accounts for a significant portion of the material used to grow potted plants [6].

Growing flower crops compared with traditional crops provide more marketing at both small and large scale for growers and it becoming more selective choice now days. Globally, horticultural crops are cultivated in more than 140 countries [7]. Potting soil mixes are the most important factors for the quality production of flowers in floriculture. Ornamental floral species tend to have a higher global demand, depending on people's preferences [8]. Correct combination of substrates for growing media to optimize plant growth is demanding and represents the cost

production about 4-6% for bedding plants [9]. Potting media have positive effects against diseases, Bulluck [10] observed that disease incidence of southern blight of tomato was 67% in tilled bare soil receiving synthetic fertilizers; whereas disease incidence was 3, 12, and 16% in surface-mulched plots amended with a composted cotton-gin trash, swine manure, or a rye-vetch green manure.

Organic materials from agriculture, forestry, green areas, and livestock farming as well as residues from municipal and industrial waste are rich sources of different nutrients [11] and all have been strongly recommended for use as renewable resources in pot production, an effort that would help to palliate their harmful impact on local and global environmental degradation [6]. Moreover, various growing materials like sewage sludge, sawdust, spent mushroom compost; coco-nut coir dust and rice are also used locally in Pakistan as potting media in different combinations.

Among all the varieties of *Antirrhinum majus* L., dwarf variety is considered best for growing under container media. Therefore, keeping in view the composition, nutritional status and importance of growing media, the present study was intended to develop an efficient protocol for better growth of *Antirrhinum* cultivars in the most appropriate media to enhance their production for growers and the local markets.

2. Materials and Methods

The present research was carried out at Rose Project Area, Institute of Horticultural Sciences University of Agriculture Faisalabad during 2011-2012 to evaluate the comparative effect of different potting media on vegetative and reproductive growth of *Antirrhinum majus* L. 'Floral shower' the dwarf variety was evaluated. Seeds were purchased and nursery was established in propagation trays with growing media. Pots of 12" were thoroughly filled with substrates according to treatments and three weeks old seedlings were transplanted. Substrate samples from each treatment were collected for morphological and chemical analysis. The experiment was carried out in Completely Randomized Design (CRD) and each treatment consisting of 10 plants was replicated thrice. The application of different treatments with composition given in table 1.

Table 1. Composition of different treatments

Treatments	Composition
T ₀	Control (silt+ topsoil)1:1
T ₁	Leaf mould (Leaf mould + silt + topsoil) 1:1:1
T ₂	Farm yard manure (FYM + silt + topsoil) 1:1:1
T ₃	Peat moss (Peat moss + silt + topsoil) 1:1:1

2.1. Plant Characteristics

Data regarding all the growth indices was collected during research period. Plants were uprooted carefully and washed with tap water then with distilled water to record the following morphological attributes including: plant height (cm), number of leaves and shoots plants⁻¹, leaf area (cm²), fresh and dry weight (g), stem diameter (cm), days to flower bud formation, days to flower bud opening, number of flowers per plant, flower bud diameter (cm), flower diameter (cm) and flower quality.

2.2. Chemical Analysis

Growth media was evaluated for the chemical properties such as pH, electrical conductivity (EC), nitrogen (%), phosphorus (ppm), organic matter (%). A pH meter (digital ion analyzer) was used to measure the pH of the potting media and EC was measured in dS m⁻¹ with a conductivity meter. The total nitrogen in the soil sample was determined by distillation in Kjeldahl's apparatus and titration was carried out with standard H₂SO₄. Olsen's method was used to determine the available phosphorus in the media. For the estimation of organic matter (%), 1g air-dried sample was taken into a 500 ml beaker, 10 ml 1N potassium dichromate solution and 20 ml concentrated sulfuric acid using a dispenser were added and swirled the beaker to mix the suspension. After 30 minutes, 200 mL of distilled water was added along with 10 ml concentrated orthophosphoric acid and mixture was allowed to cool. After adding diphenylamine as an indicator, beaker was placed the on a magnetic stirrer. Titration was done with 0.5M ferrous ammonium sulfate solution and reading was noted till color changed from violet blue to green.

2.3. Statistical Analysis

The collected data for the morphological traits of the plants and the chemical characteristics of the potting media were statistically analyzed by using analysis of variance (ANOVA) to check any differences between the means. The data was then subjected to Duncan's multiple range test (DMRT) for the comparison of means at a 5% probability level [12].

3. Results

3.1. Effect of Different Potting Media on Growth Attributes of *Antirrhinum majus*

Maximum increase (13.5 cm) in plant height was obtained in T₁ followed by T₃ (13 .04 cm) and T₀ (11.10 cm). The lowest plant height (10.69 cm) was observed in T₂ (Fig. 1A). Data pertaining to number of leaves per plant exhibited highly significant results. Among the application of different treatments, plants produced more number (53.33) of leaves

in T₃ which was statistically at par with T₁ (53.36). T₂ produced least number (38.63) of leaves in comparison to T₀ (44.16) (Fig. 1B). Maximum number of shoots per plant was recorded in T₁ (13.93) followed by T₃ (13). A marked reduction (9.4) in number of shoots per plant was observed by T₂ as compared to T₀ (10.6) (Fig. 1C). The availability of nutrients in growing substrate greatly affects the size of leaves. Maximum increase in leaf area (1.96 cm²) was obtained when plants grown on T₁ followed by T₃ (1.69 cm²) and T₀ (1.56 cm²). Reduction (1.34 cm²) in leaf area was observed in T₂ grown plants (Fig 1D). Stem with thickest diameter have more mechanical strength to resist breaking and bending against stress environmental conditions. It is apparent from that statistical analysis that stem diameter had non-significant differences for all the potting media.

Maximum increase in stem diameter was showed by T₁ (0.31 mm) while T₂ showed minimum (0.28 mm) stem diameter. Other treatments were recorded statistically non-significant (Fig. 1E). Plants attaining maximum increase in their fresh weights depict the nutrient rich growing media. Analysis of variance regarding fresh weight of plant showed highly significant results. Maximum increase in fresh weight of plant (63.41 g) was shown by T₁ followed by T₃ (58.44 g) and T₀ (46.45 g). On the other hand, plants grown in T₂ showed marked reduction (22.02 g) in fresh weight (Fig. 1F). A significant increase (11.73 g) in dry weight of plant was observed in T₁ which was statistically at par with T₃ (10.39 g). A non-significant difference was recorded in T₀ (5.50 g) and T₂ (4.58 g) treatments (Fig. 1G).

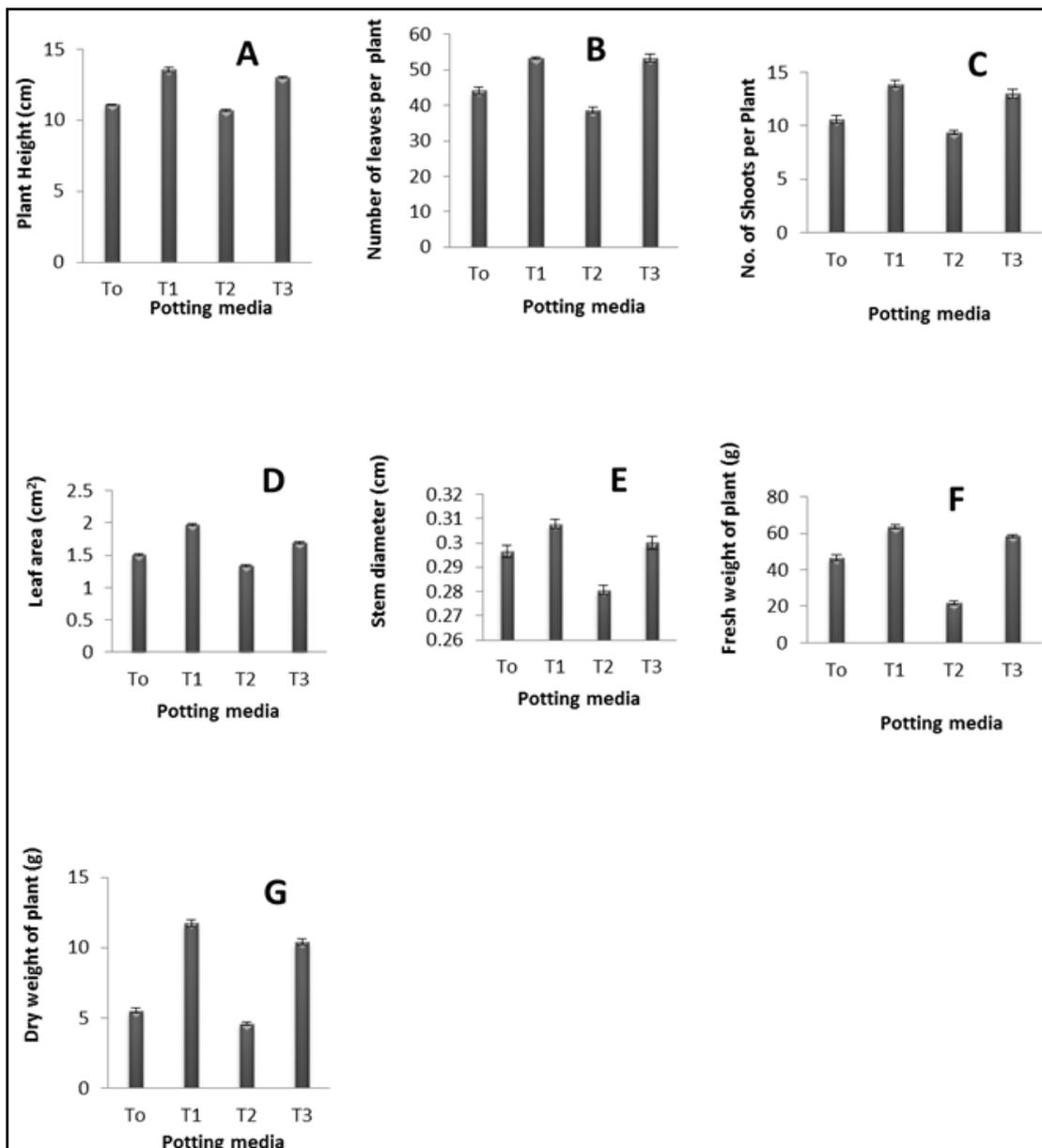


Figure 1. Effect of different potting media on growth attributes of *Antirrhinum majus*

3.2. Effect of Different Potting Media on Floral Attributes of *Antirrhinum majus*

Potting media with rich nutrient contents showed to promote plant vegetative growth and delayed maturity and application of such growing substrates were seen to minimize the time taken by plant to give flower formation or emergence. T₂ took maximum days to flower bud formation (42.90) followed by T₃ (39.43) which was statistically same with T₀ (40.10). T₁ took minimum days (37.70) to flower bud formation (Fig. 2A). Among the application of different treatments, T₂ took maximum days (56.03) to flower bud opening. Other treatments showed no significant difference among each other and were statistically alike with 50.90, 49.30 and 50.10 for T₀ T₁ and T₃ respectively (Fig. 2B). Maximum flowers production in plants highlights their adaptability to suitable environment. Data regarding the number of flowers per plant was subjected to analysis of variance showed highly significant results. Among the application of different treatments, T₁ produced maximum number (22.83) of flowers per plant followed by T₃ (22.73) and T₀ (19.76). T₂ produced less number of flowers (7.83) per plant (Fig. 2C). Data regarding flower bud diameter showed significant results for flower bud diameter. Maximum flower bud diameter was found in T₁ (0.71 cm) followed by T₃ (0.66 cm). A gradual reduction in flower bud diameter in T₀ (0.62 cm) and T₂ (0.55 cm) was observed (Fig. 2D). Maximum increase in flower diameter was observed in T₁ (0.98 cm) followed by T₃ (0.89 cm). T₂ showed less increase (0.68 cm) in flower diameter. (Fig. 2E). Rich supply of nutrients like K, N and P in growing substrate is sufficient for production of good quality flowers. T₁ produced best quality flowers (7.73) followed by T₃ (7.40) and T₀ (7.03) whereas, T₂ exhibit poor quality flowers (5.26) than all the treatments (Fig. 2F).

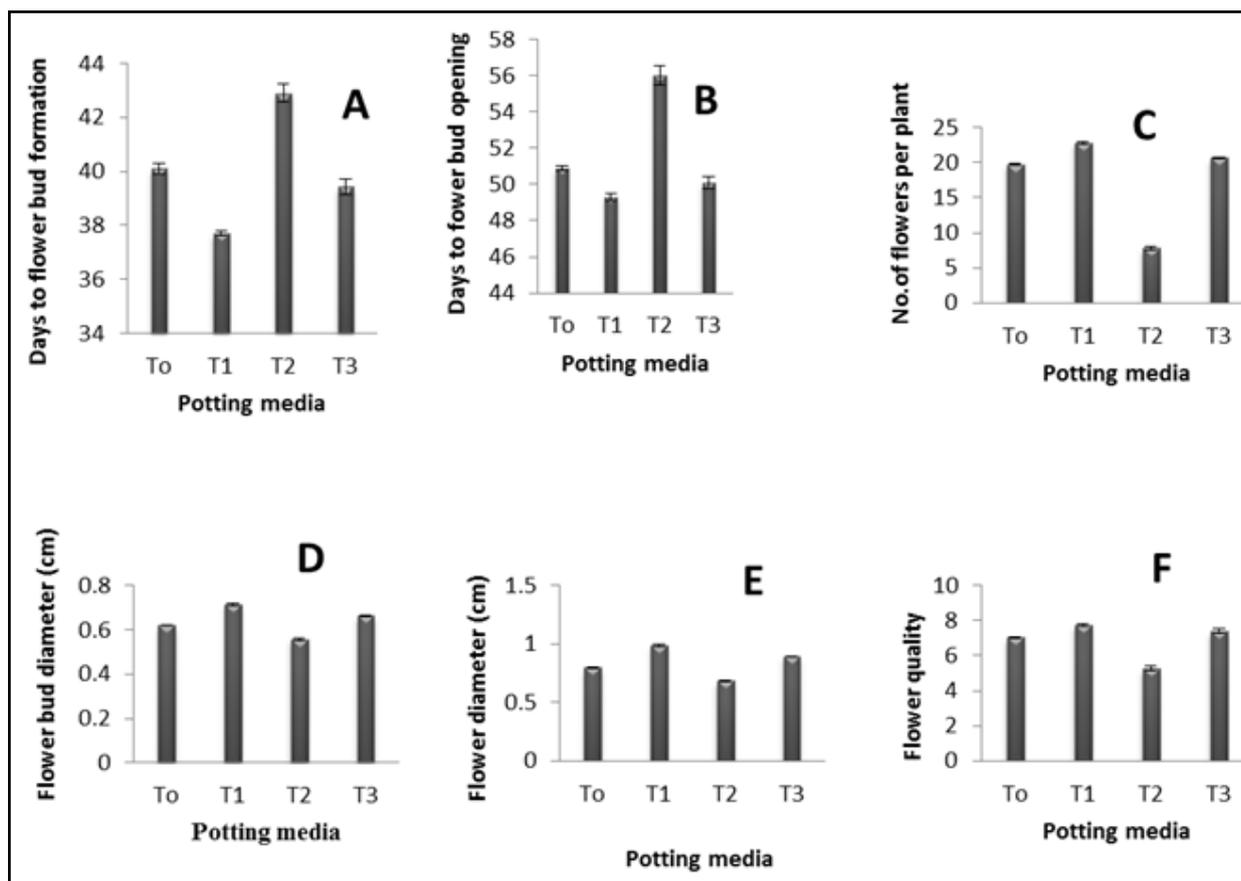


Figure 2. Effect of different potting media on floral attributes of *Antirrhinum majus*

3.3. Effect of Different Potting Media on Chemical Attributes of *Antirrhinum majus*

Accessibility of nutrients to plants in growing media is coupled with the changes in media pH. It is evident from statistically analyzed data that there was no significant difference in pH of different potting media. Maximum media pH (7.7) was observed in plants grown in T₀ and minimum (7.5) in T₂ media. Other treatments T₁ and T₃ (7.6) were statistically alike among each other (Fig. 3A). It is depicted that application of different potting media had a significant effect on the electrical conductivity. Maximum value (9.5) of EC was recorded in T₂ followed by T₃ (5.5) which were statistically at par (5.4) with T₁. Minimum value (4.5) of EC was observed in T₀ (Fig 3B). Total N content was obtained in potting media T₂ that showed the best results for N content (0.083 %) which was statistically similar to T₀ (0.082). Least (0.063 %) and medium (0.073 %) were observed in T₁ and T₃ respectively (Fig 3C).

amount of N content was observed in T₁ and T₃ respectively (Fig. 3C). Maximum phosphorus contents were present in T₂ (20.50) followed by T₁ (20.30) which was statistically at par with T₃ (20.10 ppm), whereas, minimum contents (14.5 ppm) were observed in T₀ (Fig 3D). Among the application of different potting media, maximum value for organic matter was found in T₂ (1.25), whereas, a non-significant difference was observed among all other treatments T₀, T₁ and T₃ (1.14%, 1.15% and 1.16%) respectively (Fig. 3E).

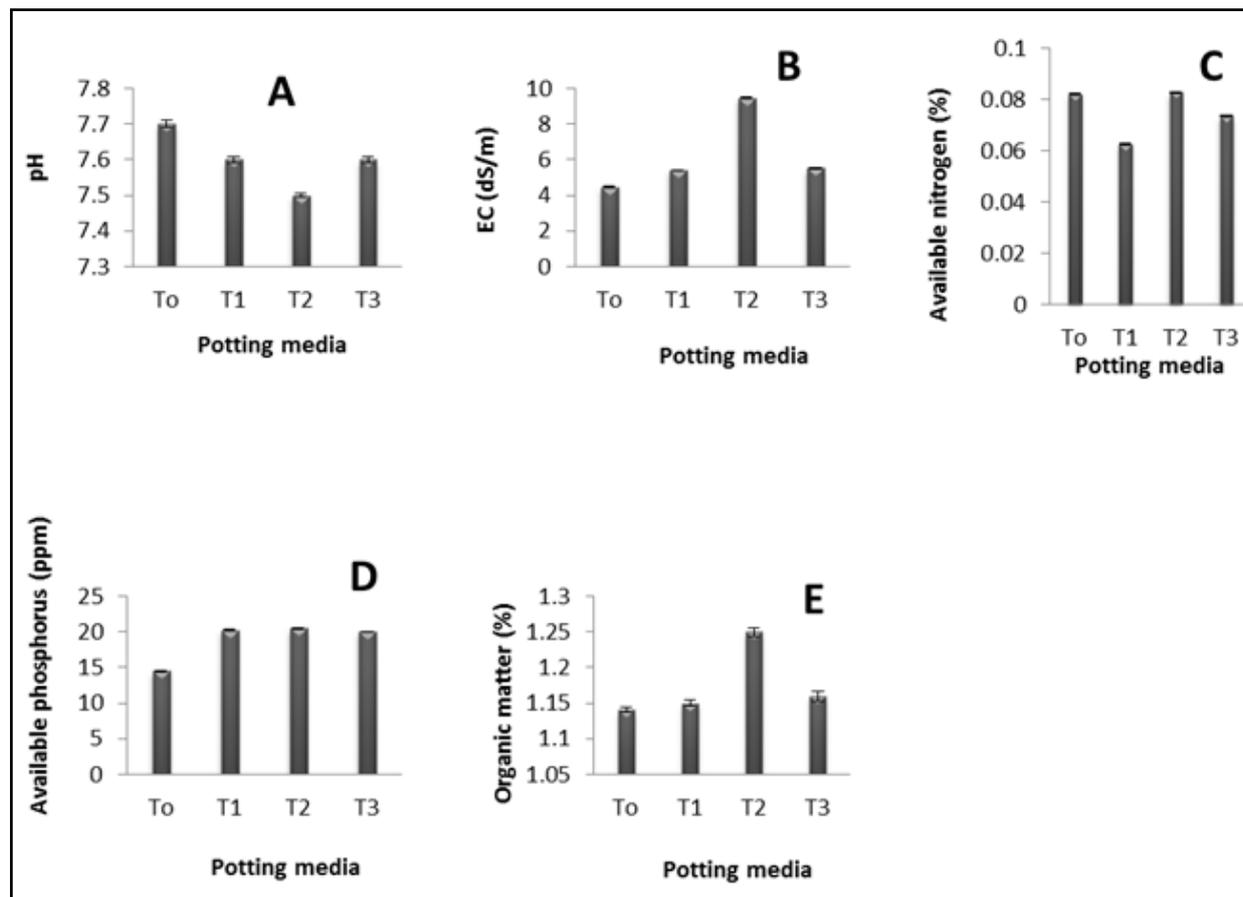


Figure 3. Effect of different potting media on chemical attributes of *Antirrhinum majus*

3. Discussion

A balanced rooting medium that contains an adequate supply of nutrients is essential for plants to attain maximum growth and development. Balanced rooting media greatly affects the plant height and availability of growing substrate with the supplement of essential nutrients is essential for attaining maximum plant height Ikram [13] Results showed that use of different potting media affect plant height differently. Maximum increase in plant height was attained in Leaf Mould media which might be due to maximum uptake of nutrients [14]. Our findings are in line with Bashir [15] who observed maximum plant height in *Dieffen bachia* plants in Leaf Mould potting media. Maximum plant growth in Geraniums was also obtained when Leaf Mould and Peat growing substrates were used [16]. Similar findings were reported by Dubsy [17] who reported excellent growth of perennials in Leaf Mould and peat substrate with the addition of rock wool and observed maximum plant height under such media. Increase in plant height under Leaf Mould potting media was also supported by Treder [18].

Major food manufacturing units in plants are leaves that are influenced by environmental conditions and soil is one of the factors which have prime importance in this regard. More number of leaves in plants reflects its good vigor and suitability of environment. It is depicted from results that maximum number of leaves in plants obtained in potting media containing Leaf Mould which is in accordance with the findings of Khayyat [19] who found leaf mould is the best growing substrate in combination with cocopeat (3:1) for attaining more number of leaves. Riaz [20] found significant results for leaf numbers in a growing media with the combination of silt + leaf Manure + coco coir substrates. According to Benito [21] peat and leaf manure as growing substrates with adequate supply of nitrogen content are good for healthy plant growth.

Maximum increase in number of shoots per plant highlighted the vigorous vegetative plant growth. Nutrient rich growing media promotes the growth of plants. Results depicted that treatments having Leaf Mould and peat moss in combination with silt + topsoil produced maximum number of shoots per plant which showed the enhanced vegetative

growth in *Antirrhinum majus* L. These findings are confirmatory with Bashir [15] who noted the maximum number of shoots of *Sinmondsia chinensis* in Leaf Mould. Similar findings were also reported by Riaz [20] in ornamental plants having much increased side branches in coconut compost growing media in combination with silt + leaf manure.

The availability of nutrients in growing substrate greatly affects the size of leaves. Best substrate having adequate supply of nutrients can be used to accomplish significant results. Maximum increase in size of leaves shows adaptability of plants to soil. Best results regarding leaf area were obtained in media comprising Leaf Mould and peat moss when used alone in combination with silt + topsoil. These results are in line with Khayat [19] who found maximum increase in leaf area of *Epipremnum aureum* Lindl. Moreover, results highlighting maximum increase in leaf area are also in agreement with Turhan [14] who found significant results for carnation in growing substrate containing rice husk mixed with Leaf Manure.

Stem with thickest diameter have more mechanical strength to resist breaking and bending against stress environmental conditions. Plants exhibiting maximum stem diameter with strong vigor can be used successfully. Leaf Mould medium showed maximum stem diameter was in agreement with Kiran [22] who observed thickest stem of Dahlia in sand + silt + Leaf Mould medium.

Ornamental plants grown under different potting media showed their suitability to the media. Plants attaining maximum increase in their fresh weights depict the nutrient rich growing media. Results showed that plants gave maximum increase in fresh weight in Leaf Mould and peat moss containing media. In this regard, Wang and Konow [2] observed highest increase in fresh weight of plants in peat comprising medium than any other media. Such findings are also in accordance with Treder [18] who observed flowers maximum fresh and dry weights in the same substrates. Liopa [23] documented Leaf Mould as the growing substrate increasing fresh and dry weights of tarragon and lemon balm plants. Highest increase in dry weight was obtained when Leaf Mould and peat moss were used as a potting medium in combination with silt + topsoil. Similar results were observed for *Epipremnum aureum* by Khayat [19]. Moreover, results depicted by Chavez [24] also found marked increase in *Petunia hybrida* plant when grown in Leaf Mould and river waste.

Potting media with rich nutrient contents showed to promote plant vegetative growth and delayed maturity and application of such growing substrates were seen to minimize the time taken by plant to give flower formation or emergence. Results showed that use of Leaf Mould potting media took minimum days to flower bud formation among all other treatments. These results were in accordance with Kiran [22] who also examined minimum days for flower bud formation of Dahlia (*Dahlia pinnata* L.) for same substrate. It was observed that application of Leaf Mould took minimum days to flower bud opening among all other

treatments. Grassotti [25] also found minimum days for lily and gladiolus flower emergence. Flowering plants seem more attractive and marvelous and frequently used in landscape. Maximum flowers production in plants highlights their adaptability to suitable environment. It was observed that adequate availability of nutrients such as K and P in growing media provide significant results regarding growth and flowering indices. Nowak and Strojny [26] observed that optimum amount of P in organic residues provide maximum increase in flowering. Best results regarding more number of flowers per plant which were achieved in silt + topsoil + Leaf Mould media are similar to the results of Kiran [22] who observed more number of flowers for Dahlia (*Dahlia pinnata*) in same combination.

Accessibility of nutrients to plants in growing media is coupled with the changes in media pH. Increase or decrease in pH has direct effect on plant growth and development. Changes in pH above or low than the optimum range adversely affects plants by damaging roots and decreasing nutrient availability. Awang [27] reported the best pH range (5.9-7.0) for plants better growth and development. Our findings showed that pH was ranged between 7.5-7.7 in all the treatments. Increase in pH induced reduction in N and P contents of potting media [28]. Electrical conductivity (EC) provides a measurement of dissolved salts in soil which affects the plant growth [29]. The best range of dissolved salt contents in soil reveals the better plant growth [25]. Maximum EC (9.5 dS m⁻¹) was found in FYM treatment. Due to high EC value, FYM showed minimum results regarding growth parameters than all other treatments. Results are coordinated with Miller [30] who found that substrate having higher EC affects the plant growth.

Organic matter in growing substrate and optimum amount of N, P and K manipulate plant growth and flower size. Media comprising peat encloses mainly phosphorus. Different potting media were used with different proportions and best results for flower diameter were obtained when Leaf Mould and peat moss were used in combination with silt + topsoil. Such findings were in agreement with Riaz [20] who found that growing substrate with adequate availability of nitrogen and potassium with high increase in flower diameter. Rich supply of nutrients like K, N and P in growing substrate is sufficient for production of good quality flowers. Good quality flowers were obtained in leaf mould and peat moss containing media. These results are supported by Younis [31] who reported similar findings for *Chrysanthemum* under with combination of different substrates.

It was observed that all of the growing substrates exhibit nutrient supply however, the availability of nitrogen content up to the maximum was found in FYM but due to higher pH and EC value of growing substrate, it restricted the N availability to plants ultimately plant growth depressed. Such findings are supported by Altland [28] who found that reduction in available N content due to high pH decreased the growth of hydrangea (*Hydrangea macrophylla* Thunb.), Japanese maple (*Acer palomatii* var. *atropurpureum* Thunb.) and leucothoe (*Leucothoe axillaris* Lam.). Peat showed best

results regarding several growth indices due to optimum nutrients availability. Growing substrate with excellent nutrient quality influences plant growth. Availability of P contents in soil has positive relationship with flowering indices. Treder [18] reported that plants have long stem and maximum number of flowers in growing media with optimum phosphorus contents. Potting media comprising FYM showed maximum amount of P content. Younis [31] results who observed maximum flowering of *Dahlia coccinia* in high P content substrate. Organic matter in potting media promotes the plant growth due to high availability of nutrients [32]. Maximum organic matter was found in FYM containing substrate while other treatments showed no significant results and it might be due to substrate natural fertility. Chemical attributes of high organic matter encourage the plant growth and peat also improves good substrate in this regard [33].

It is concluded from the comparative study that agricultural and municipal wastes are good, cheap potting media components for the production of flowering plants. An economical and high-quality production of 'Floral shower' can be attained by using most suitable media. Application of Leaf Mould in combination with silt + topsoil showed best results regarding plant growth. Peat moss containing growing substrate also showed positive results for plants vegetative and reproductive growth. However, Farm Yard Manure was seen to prove less effective for better plant growth due to its less contribution for the availability of nutrients. Availability of P contents in soil has positive relationship with growth and flowering indices. Maximum amount of available P content was found when Farm Yard Manure and Leaf Mould were used alone in combination with silt + topsoil. Thus, it is suggested that Leaf Mould can be recommended as a standard potting media for *Antirrhinum majus* L. growth.

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