Comparative Study of Morphological and Floral Traits in (Rosa Hybrida) cv. "Christian Dior" Cuttings Cultivated on Diverse Growing Media

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Abstract

The "Christian Dior" rose cultivar is known for its large elegant, velvety red-colored scented flowers and excellent shelf life. It has been extensively cultivated globally for its aesthetical, medicinal, and commercial uses. However, media selection also plays a key role in the vegetative and reproductive growth of cut-flower production. Under such conditions, research was conducted to examine the performance of diverse media combinations (T1: S+FYM, T2: C.C+FYM, T3: SN+FYM, T4: S+C.C+FYM, T5: SN+C.C+FYM) on phenotypic and floral attributes of "Christian Dior" rose in thermocol boxes. Results showed that treatment T3 (SN+FYM) shows the maximum plant height of 62.885 cm, number of leaves (121), leaf area (17.342cm2), shoot and root length (8.432cm) (35.765cm), while the least plant height of 25.394 cm was recorded in T1 (S+FYM) Whereas, the maximum shelf life of 12 days, flower and bud diameter (6.416cm)(0.792cm), was recorded in T4 and the least shelf life of 8.5 days was observed in T1 (S+FYM). The treatment T5 (SN+C.C+FYM) takes fewer days, 198 to produce its first flower than T1 (S+FYM) of 238 days. Similarly, results showed that T3 performed significantly better, followed by T5 which produces higher quality cut flowers by providing optimum aeration, essential nutrients, and water-holding ability to enhance its growth and development.

Keywords: Growth substrate, shoot development, rose cultivation, phenotypic traits, organic media, cut flower

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Introduction

Rose (Rose hybrida) cv. "Christian Dior" is a high-quality cutflower cultivar of hybrid tea rose developed in 1958 by Meilland International Nursery, France. This cultivar is a cross between tea roses (Rosa × odorata) and hybrid perpetual roses (Rosa × damascena), inheriting all the finest characteristics from both parental species (Ketsa et al., 1993; Taha & Awal, 1994; Singh et al., 2016). Due to its striking red velvety blossoms, elegant fragrance, and long-lasting petals, it holds a substantial reputation in the floral business and is ranked at the top of the floriculture industry (Mirjalili, 2015; Hussen & Yassin, 2013; Jadhav & Gurav, 2018). "*Christian Dior*" cut roses botanically consist of shrubby deciduous, 2-5 feet tall and 3 to 5 feet wide, dark green glossy foliage with serrated broad leaves, double blooms with 30 to 40 petals in each flower, and stems decked with sharp prickled thorns (Mortazavi *et al.*, 2007; Bhawana *et al.*, 2013). It flourishes best in temperate regions and is spread across Asia, Australia, Europe, and North America. It is also found in limited parts of Africa and South America, where suitable environments favor rose gardening. It grows best on well-drained, loamy to sandy loam soils with neutral to slightly acidic pH 6 to 6.5, requiring a minimum of 6 to 8 hours of direct sunlight daily and temperatures ranging between 15°C and 25°C daily (Sokolov & Petko, 2021). It requires moderate annual rainfall of 500 to 700 mm as high humidity will lead to fungal disease in this cultivar (Ketsa & Dadaung, 2005; Kadam *et al.*, 2023). The success of vegetative growth of *Rosa hybrida* cv. "*Christian Dior*" cuttings is significantly influenced by the category of media used for growth and rooting. For healthy plant growth and development, an optimal growing medium is required to enhance propagation efficiency. However, the inadequate comparative study availability on the effect of diverse growing media—such as soil, sand, coconut coir, and their blends creates an opportunity for the researchers (Kaushal & Kumari, 2020). Rose cultivation in alternate growth media except soil is used by the application of sand through nutrient flow method (Takano, 1988**;** Riffault *et al* ., 2014); gravel culture (Sarro *et al.*, 1989); organic manures mineral wool and aeroponics (Zieslin & Snir, 1989); rockwool (Kool & van de Pol, 1991) and perlite (Katsoulas & Baille, 1999). Aside from soil**,** the continuing interest in the farming industry is to use the organic by-products as an alternate source of growth that is comparatively cheaper and easily available with low nutritional releases (Mikkelsen, 2003; Ahmad, 2012). Over the last few years, coco coir has been used excessively as an alternate medium due to its many similarities with peat and other factors like acceptable pH, EC**,** and other chemical properties (Khandaker ***et*** *al.*, 2020). Coconut coir has other additional features to be used as a growth medium, including high cation exchange and water-holding capacities, a structure that allows good aeration, and resistance to decomposition (Ahmad *et al.*, 2012). High availability of water, nutrients, and aeration necessary for root development are the important parameters needed to characterizes a good soil substrate (Waseem *et al.*, 2013; Altun, 2024). Growth media are important in the growth of plants since they act as a storage of minerals and also facilitate the exchange of gases in plants (Ayesha *et al.*, 2011). The use of organic manure increases the fertility of soils and nutrient supply and improves the growth of plants more than the use of inorganic fertilizers does (Okwuagwu *et al.*, 2003). Potting media for roses must be light, porous, and well-drained to allow constant harvesting and metabolism of the plants (Khilari, 2021). Peat is extensively used but expensive, which creates a demand for rich alternatives like coconut coir (Dede *et al.*, 2012; Ribeiro *et al.*, 2007). The use of soil-less substrate such as perlite and coconut coir enhances flower yield and quality of stems (Fascella & Zizzo, 2004). Proper rooting and growth of the cuttings can be accomplished by the use of well-aerated and nutrient media (Keisling & Kester, 1979; Monika & Chandla, 2021). This study aimed to assess the impact of different growing media on the rooting capacity and vegetative growth parameters of *(Rosa hybrida)* cv. *"Christian Dior"* cuttings. The outcomes will aid in the selection of the most appropriate medium that will improve the propagation methods made commercially and horticulturally, thus improving the success rates of practicing rose cultivation at a more economical cost.

Materials and Methods

The present study was conducted at the research field area, Department of Horticulture, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan (2023-2024). A total number of 225 (P×P and R×R= 6 inches) cuttings (8 inches in length) of the rose cultivar "*Christian Dior*" were collected from Changa Nursery Farm, Mandi Pattoki Punjab, Pakistan. The experiment was laid on thermapol boxes (Dimension: length = 30", width = 18", depth = 10") from the National Institute of Health Islamabad (NIH), and cutting was placed at a 6-inch depth. Then holes were made with the tip of a knife on the bottom of each box for the drainage and aeration of given media. Before plantation, the basic nutrient analysis of media was done at the Soil and Water Testing Laboratory, Data Gunj Bukhsh Road, Rawalpindi, Pakistan (Table 2). The total number of treatments and calculations of different media used is shown in Table 1 of treatments with three replications.

Procedures for phenotypic and floral attributes

These plants were grown until the full flowering stage. Further phenotypic and floral (plant height, number of leaves, leaf area, fresh weight, dry weight, shoot length, root length, days to flower emergence, flower bud diameter, flower diameter, color variation of flower, shelf life) attributes of plants were recorded according to the standard procedures.

Plant height (cm)

Plant height was measured from the base of the soil to the tip of the plant for 15 plants per treatment in centimeters using a steel measuring scale (model: "NEXT") then, the average was taken.

$$\mathrm{PH}^{av} = \frac{(PH1 + PH2 + PH3 + \cdots n)}{PHt}$$

PH_{av} stands for average plant height, PH_1 stands for single plant height and PHt is the total number of plants (Heady, 1957).

Number of leaves (count)

The number of leaves was counted for 5 plants per treatment and their average was calculated using the given formula.

$$\mathrm{NL}^{av} = \frac{(NL1 + NL2 + NL3 + \cdots n)}{NLt}$$

NL^{av} is the average number of leaves, NL1 leaves are counted for plants per treatment, and NLt is the total number of plants.

Leaf area (cm^2)

It was measured with the help of a leaf area meter (model: Li-3100) in (cm^2) of 20 randomly selected leaves of 15 plants per treatment and their average was calculated.

$$\mathrm{LA}^{av} = \frac{(LA1 + LA2 + LA3 + \cdots n)}{Lt}$$

LA^{av} stands for average leaf area, LA1 leaf area of each plant selected, and Lt is the total number of selected plants.

Fresh and dry weight of flower(g)

A weighing balance (model: FA2204) was used to measure both the fresh and dried weights of the flowers in grams (g) for 15 plants per treatment separately and their average was taken.

$$\mathrm{FW/DW}^{av} = \frac{\Sigma(FW1+\ldots n)\Sigma(DW1+\ldots n)}{NFt}$$

Where FW/DW^{av} stands for average fresh and dry weight, Σ (FW1), Σ (DW1) shows the sum of the fresh weight and dry weight of each flower, and NF_T is the total number of flowers (Fanourakis *et al.*, 2020).

Shoot and root length (cm)

The length of the shoot and root was measured in centimeters using a steel measuring scale (model: "NEXT"). The following formula was used to calculate the average length of shoots and roots.

$$\mathrm{SL/RL}^{av} = \frac{\Sigma(SL1+\ldots n)\Sigma(RL1+\ldots n)}{Nt}$$

Where SL/RL^{av} shows the average shoot and root length, Σ(SL1), Σ(SL1) denotes the sum of individual lengths of shoots or roots, and Nt is the total number of plants.

Days to flower emergence (days)

The number of days was calculated from the planting of cuttings till the day of first flower appeared among fifteen flowers from each treatment then the average was taken.

$$\mathrm{DE}^{av} = \frac{\Sigma(DE1 + DW2+\ldots n)}{Dt}$$

Where DE^{av} stands for the average days to flower emergence, DE1 stands for the day the first flower in a plant.

Flower bud and flower diameter (cm)

Flower and flower bud diameter was measured with the help of an vernier caliper (model: AOS: 500-196-30, Mitutoyo-Japan) in cm of 15 plants per treatment and average was calculated as;

$$\mathrm{FD/FB}^{av} = \frac{\Sigma(FD1 + FD2\ldots n)\Sigma(FB1 + FB2\ldots n)}{Nt}$$

FD/FB^{av} stands for average flower and bud diameter, Σ(FD and FB) refers to the sum of individual diameters measured, and N_T shows the total number of flowers or flower buds measured (Ma *et al.*, 2005; Nazari *et al.*, 2009).

Color variation of flower (chroma values)

Chromameter was used to understand the color variation in flower that occurs in 5 different treatments. To evaluate color change among various treatments, we calculated the color difference using the formula:

$$\Delta\mathrm{E} = \sqrt{(L1 - L2)^2 + (a1 - a2)^2 + (b1 - b2)^2}$$

Where L1, a1, and b1 show the color values from one treatment, L2, a2, and b2 color values from another treatment, and ΔE stands for the total color difference. The higher value of ΔE shows greater color variation.

Shelf life (days)

The shelf life of flowers was recorded by observing the number of days each flower remained healthy and in good condition till its 50% deterioration in distilled water.

$$\mathrm{SL} = \frac{(DFD - DIP)}{Nt}$$

Where SL stands for shelf life, DFD is the day when deterioration is first observed, and DIP is the day it when placed in the vase.

Statistical analysis

The data obtained from the experiment was analyzed by using a Randomized Complete Block Design (RCBD) through Analysis of Variance (ANOVA) with the help of Statistix 8.1 software (Steel 1997).

Treatment	Media Combinations	(Ratio = 1:1:1 v/v) in cubic feet per replication box
T_1	S + FYM	(1.25 + 1.25)
T_2	C.C + FYM	(1.25 + 1.25)
T_3	SN + FYM	(1.25 + 1.25)
T_4	S + C.C + FYM	(0.8333 + 0.8333 + 0.8333)
T_5	SN + C.C + FYM	(0.8333 + 0.8333 + 0.8333)

Table 1: Different types of growing media with their combinations. (S: Soil, **SN=**

Sand, **FYM=** Farm Yard Manure**, C.C =** Coconut Coir)

Treatments	E.C(dSm^{-1})	pH	O.M (%)	P (mg kg^{-1})	K (mg kg^{-1})	Sat (%)
T_1: S + FYM	1.09	7	1.63	5.6	120	55
T_2: C.C + F Y M	1.21	6.71	……	4.8	100	……
T_3: SN + FYM	0.97	6.97	1.73	5.8	100	60
T_4: S + C.C + FYM	1.37	7.04	1.70	6.2	120	70
T_5: SN + C.C + FYM	0.89	7.19	1.79	5.9	140	70

Table 2: Physical and chemical properties of different growing media (before plantation) (**S:** Soil**, SN=** Sand, **FYM=** Farm Yard Manure**, C.C =** Coconut Coir**, E.C** = Electrical Conductivity**, O.M** = Organic Matter, **P** = Phosphorus, **K** = Potassium, **Sat** = Saturation)

Soil and Water Testing Laboratory for Research, Data Ganj Bakhsh Road Rawalpindi, Pakistan.

Results

Plant height

The rose cultivar *"Christian Dior"* showed that treatment T_3 (sand + farm yard manure) attained a maximum plant height of 62.885 cm followed by T_5 (sand + coconut coir + farm yard manure) 46.190 cm. On the other hand, T_2 (coconut coir + farm yard manure) had a plant height of 42.211 cm followed by T_4 (soil + coconut coir + farm yard manure) of 36.749 cm while the least height was obtained in the case of T_1 (soil + farm yard manure) 25.394 cm. The results shown by (T_3) were highly statistically significant ($p<0.05$) as compared to other treatments as described in Fig.1(a).

Number of leaves

The maximum number of leaves found in T_3 (sand + farm yard manure) is 121.28 followed by plants placed in treatment T_5 (sand + coconut coir + farm yard manure) 93.104. The cuttings placed in media T_4 (soil + coconut coir + farm yard manure) were 82.544. Similarly, the number of leaves for rose cutting in T_2 (coconut coir + farm yard manure) was 74.717. The minimum number of leaves was observed in T_1 (soil + farm yard manure) 62.544. From the recorded data it can be concluded that there was a statistically significant ($p<0.0.5$) effect of different treatments applied while the results of T_3 were highly significant as shown in Fig 1(b).

Leaf area

The maximum leaf area of 17.342 cm^2 was observed in T_3 (sand + farm yard manure) followed by T_5 (sand + coconut coir + farm yard manure) 14.954 cm^2, T_4 (soil + coconut coir + farm yard manure) 13.961cm^2, and T_2 (coconut coir + farm yard manure) 13.927 cm^2 respectively. The lowest possible leaf area was attained by T_1 (soil + farm yard manure) (11.71 cm^2). The different treatments showed different results that were quite significant statistically at ($p<0.05$) as explained in Fig.1(c).

Fresh weight of flower

The maximum fresh weight attained by T_4 (soil + coconut coir + farm yard manure) was 9.2366 g followed by T_2 (coconut coir + farm yard manure) 8.5843 g, T_3 (sand + farm yard manure 8.5268 g and T_5 (sand + coconut coir + farm yard manure) 8.3852 g. The minimum fresh weight was obtained in the case of T_1 (soil + farm yard manure) 7.0685 g. The results indicated that treatment T_4 was significant while other treatments were non-significant for increasing the fresh weight as given in Fig. 1(d).

Dry weight of flower

The maximum dry weight measured in T_4 (soil + coconut coir + farm yard manure) has 1.4252 g followed by T_2 (coconut coir + farm yard manure) 0.9508 g, T_5 (sand + coconut coir + farm yard manure) 0.8476 g and T_3 (sand + farm yard manure) 0.8404 g.

The minimum dry weight was observed in T_1 (soil + farm yard manure) 0.7564 g. Among all treatments, (T_4) performed better and its results were significant at ($p<0.05$) as shown in Fig. 1(e).

Shoot Length

The maximum shoot length recorded in T_3 (sand + farm yard manure) was 8.276 cm followed by T_2 (coconut coir + farm yard manure) 7.2293 cm, T_4 (soil+ coconut coir+ farm yard manure) 6.98 cm, and T_5 (sand+ coconut coir+ farm yard manure) 6.7573 cm. The minimum shoot length was observed in T_1 (soil+ farm yard manure) 6.6427 cm. The treatments applied showed statistically significant results at ($p<0.05$). Similarly, the result shown by treatment (T_3) was substantial as indicated in Fig.1(f).

Root length (cm)

The maximum root length observed in T_3 (sand + farm yard manure) was 35.756 cm followed by T_2 (coconut coir + farm yard manure) 29.308 cm, T_4 (soil + coconut coir + farm yard manure) 26.904 cm, and T_5 (sand + coconut coir + farm yard manure) 25.452 cm. In comparison, T_1 (soil + farm yard manure) had a minimum root length that was 19.740 cm. The different treatments when applied significantly affected the root length while (T_3) had significantly better performance as shown in Fig. 1(g).

Days to flower emergence

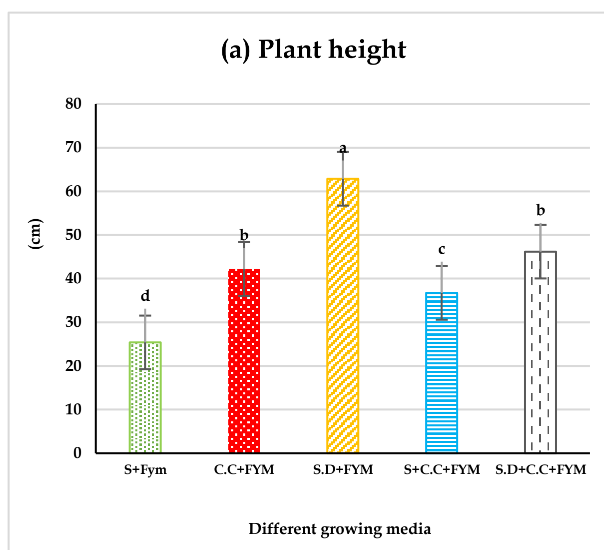
The treatment T_5 (sand + coconut coir + farm yard manure) has taken a minimum duration of 198.6 days followed by T_4 (soil + coconut coir + farm yard manure) 205.8 days, T_3 (sand + farm yard manure) 211.6 days, and T_2 (coconut coir + farm yard manure) 222.2 days. The maximum time to initiate flowering was taken by T_1 (soil + farm yard manure) of 238.4 days. The treatments have significantly produced different days to initiate flowering while (T_5) significantly minimum days to initiate flowering as described in Fig. 2(a).

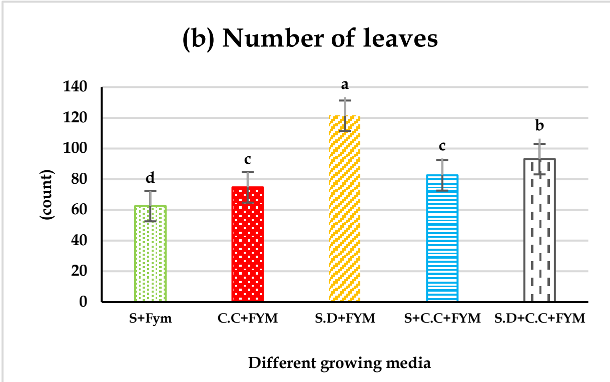
Flower bud diameter

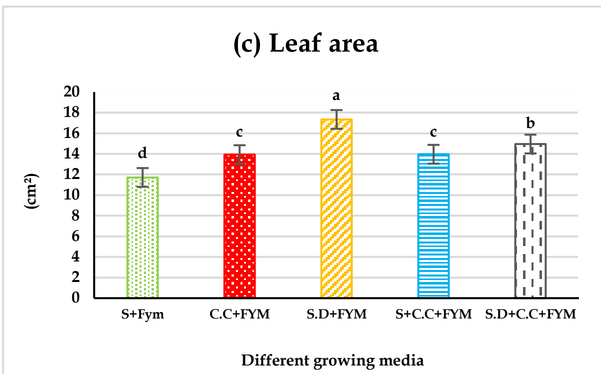
The maximum flower bud diameter recorded in T_4 (soil + coconut coir + farm yard manure) was 0.792 cm followed by T_2 (coconut coir + farm yard manure) 0.724 cm, T_5 (sand + coconut coir + farm yard manure) 0.7 cm, and T_3 (sand + farm yard manure) 0.664 cm. The minimum flower bud diameter was measured in T_1 (soil + farm yard manure) 0.62 cm. There is not much difference among the treatments applied except the treatment T_4 (soil + coconut coir + farm yard manure) and T_1 (soil + farm yard manure) a clear difference had been indicated. The results of the treatment (T_4) were significant ($p<0.05$) among the treatments applied for flower bud diameter as shown in Fig 2(b).

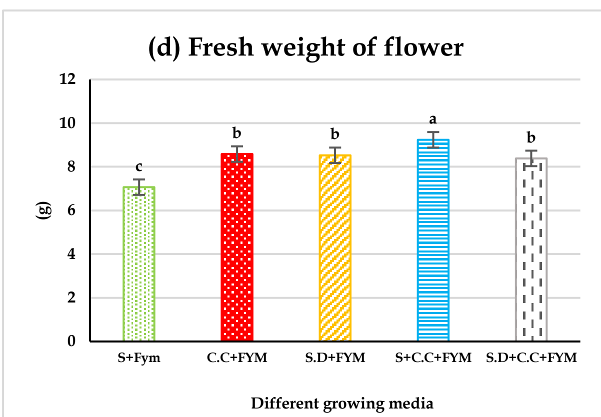
Flower diameter (cm)

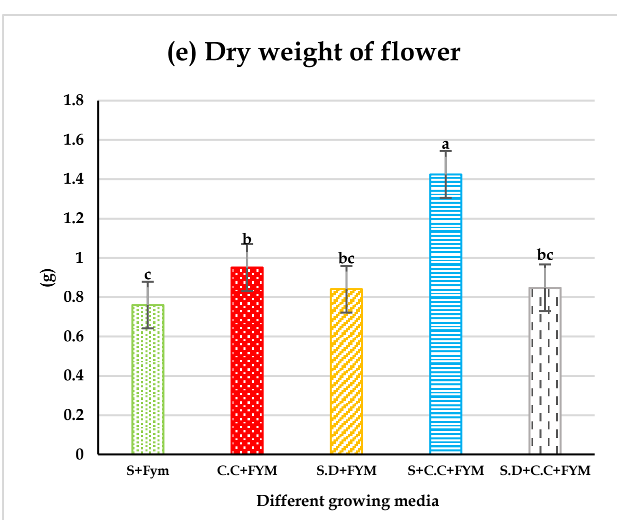
The maximum flower diameter observed in T_4 (soil + coconut coir + farm yard manure) was 6.416 cm, followed by T_2 (coconut coir + farm yard manure) 5.432 cm, T_3 (sand + farm yard manure) 5.404 cm, and T_5 (sand + coconut coir + farm yard manure) 5.316 cm. The minimum flower diameter was attained in treatment T_1 (soil + farm yard manure) 5.064 cm. Among all the treatments applied T_4) significantly performed better as shown in Fig. 2(c)

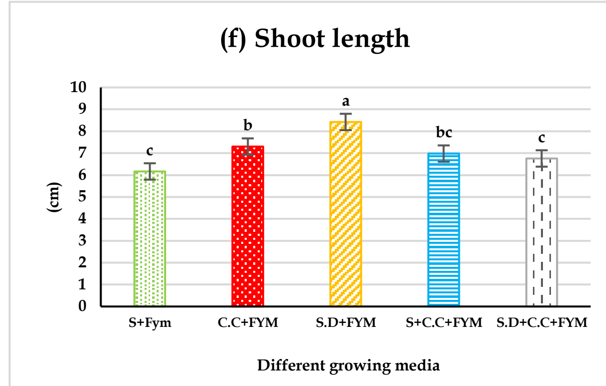












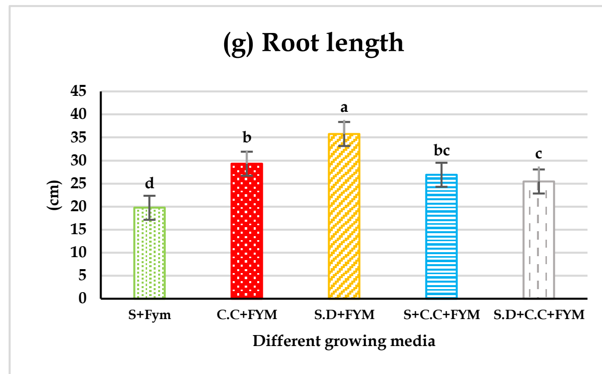


Fig 1. Effect of different growing media on (a) plant height (b) number of leaves (c) leaf area (d) fresh weight of flower (e) dry weight of flower (f) shoot length and (g) root length of rose cutting where different treatments applied shown statistically significant results at ($p<0.05$). (S: Soil, SN= Sand, FYM= Farm Yard Manure, C.C = Coconut Coir)

Color variation of flower

The chroma meter was used to analyze color variation in flowers across different treatments, with measurements based on light intensity. The maximum lightness value (ΔE) was recorded for T_4 (soil + coconut coir + farm yard manure) with a value of 42.126, followed by T_2 (coconut coir + farm yard manure) with 37.948, T_3 (sand + farm yard manure) with 36.687, and T_5 (sand + coconut coir + farm yard manure) with 29.236. The lowest lightness value was seen in T_1 (soil + farm yard manure) with 24.917. Overall, T_4 showed the most intense color variations with the highest values for both red and yellow hues, while T_1 displayed the least variation in all aspects as shown in Fig. 2(d).

Shelf life

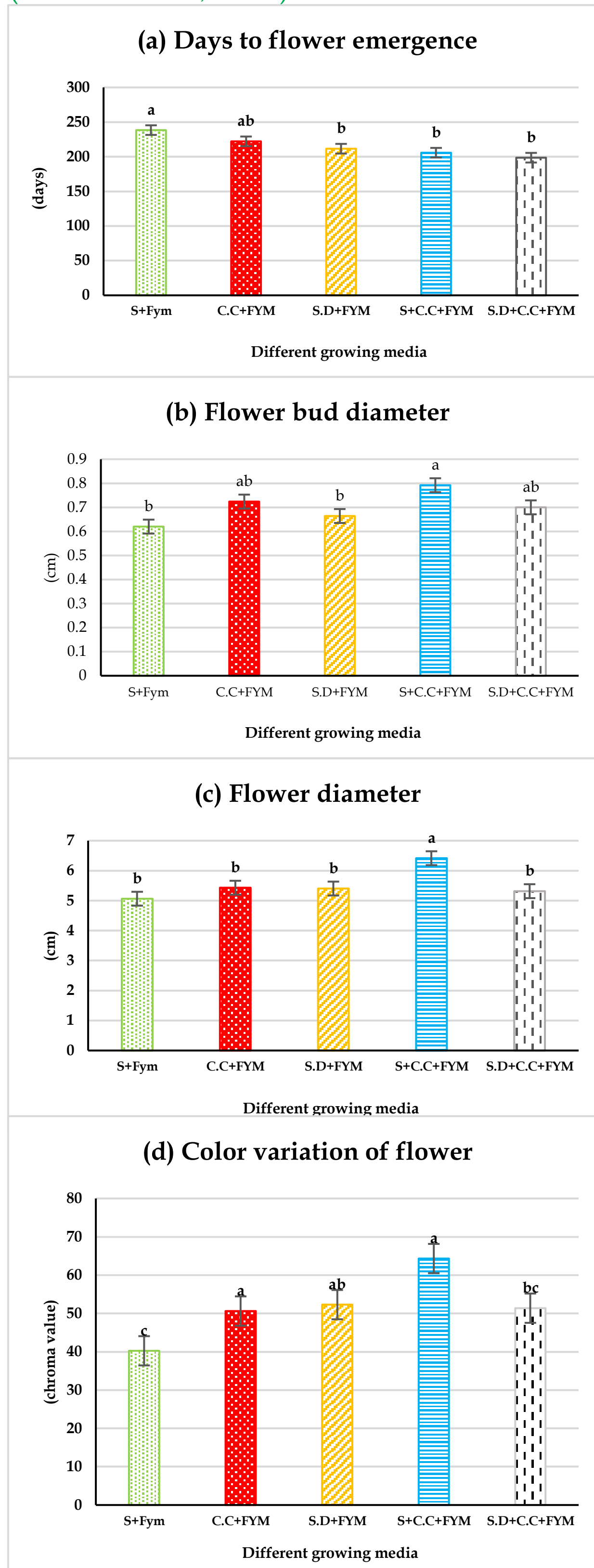
The treatments T_2 (coconut coir + farm yard manure), T_3 (sand + farm yard manure), T_4 (soil + coconut coil + farm yard manure), and T_5 (sand + coconut coir + farm yard manure) show better and same shelf life of cut flower i.e. 9.7 days as compared to T_1 (soil + farm yard manure) which counts 8.5 days of shelf life as shown in Fig. 2(e).

Discussions

The significant increase in plant height noted in T_3 (sand + farmyard manure) can be attributed to the good drainage, aeration, and nutrient supply provided by sand mixed with farmyard manure (Ahmad *et al.,* 2012). Sand-based media increase root development by helping oxygen availability, which supports nutrient uptake and overall plant vigor (Okwuagwu *et al.,* 2003). The lowest performance of T_1 (soil + farmyard manure) may be due to poor compaction and aeration, which inhibits nutrient absorption and root growth (Awang *et al.*, 2009).

The maximum number of leaves recorded in T_3 reflects the suitable physical properties of sand, which help robust root development and nutrient absorption. Sand-based substrates are known to prevent waterlogging, ensuring efficient nutrient uptake and, root respiration (Fascella & Zizzo, 2004). In contrast, T_1's lesser leaf count may result from reduced compaction in soil and oxygen availability, limiting nutrient uptake and overall vegetative growth (Keisling & Kester, 1979).

The larger leaf area in T_3 aligns with studies that highlight the importance of well-aerated and nutrient-rich media for foliage development (Ahmad *et al.,* 2012). Sand improves root growth by improving air porosity, while farmyard manure supplies essential nutrients, supporting larger leaf development. Conversely, the minimal leaf area observed in T_1 can be attributed to poor soil aeration, limiting nutrient availability, and leaf expansion (Waseem *et al.,* 2013).



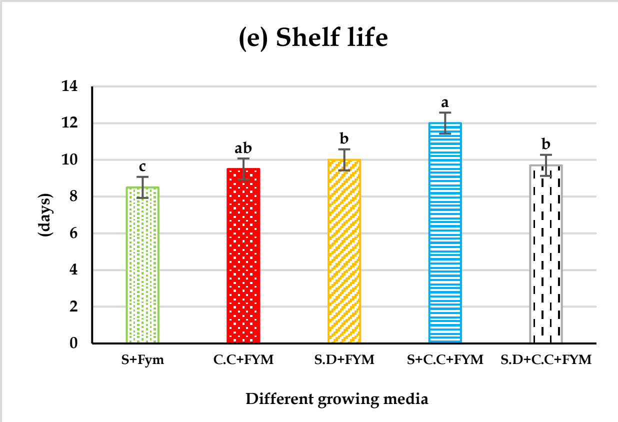


Fig 2. Effect of different growing media on (a) days to flower emergence (b) flower bud diameter (c) flower diameter (d) color variation of flower (e) shelf life of rose cutting where different treatments applied shown statistically significant results at ($p<0.05$). (S: Soil, SN= Sand, FYM= Farm Yard Manure, C.C = Coconut Coir)

The highest fresh weight of flowers in T_4 (soil + coconut coir + farmyard manure) suggests that coconut coir improves water retention and nutrient availability. Coconut coir is known for its ability to retain nutrients and high water-holding capacity, supporting flower growth (Ribeiro *et al*., 2007). T_1's lower fresh weight due to soil compaction, restricting water and nutrient uptake (Dede *et al*., 2012).

The superior dry weight in T_4 can be attributed to the balanced moisture preservation and aeration properties of coconut coir combined with the nutrient supply from farmyard manure (Fascella & Zizzo, 2004). This combination helps prolonged nutrient availability and optimal plant metabolism. The reduced dry weight in T_1 indicates limited nutrient absorption and poor aeration (Keisling & Kester, 1979).

The maximum shoot length in T_3 is consistent with findings that sandy media improve root aeration and nutrient uptake, helping vegetative growth (Ahmad *et al*., 2012). Conversely, the minimum shoot length in T_1 reflects the adverse effects of nutrient absorption and poor soil structure on root development (Awang *et al*., 2009).

The height root length in T_3 supports the idea that sand increases root elongation by improving drainage and aeration (Fascella & Zizzo, 2004). Suitable oxygen availability in sandy media promotes nutrient absorption and root growth. In contrast, the short root length in T_1 is likely due to poor soil aeration and compaction, hindering root development (Keisling & Kester, 1979).

T_5 showed the minimum time to flower emergence due to the ideal balance of aeration, water retention, and nutrient availability provided by sand, coconut coir, and farmyard manure (Ahmad *et al*., 2012). In comparison, the late flowering in T_1 due to poor soil structure hinders root development and nutrient uptake, delaying flowering (Tariq *et al*., 2012).

The big flower bud diameter in T_4 reflects the favorable water retention and nutrient availability provided by coconut coir and farmyard manure (Ribeiro et al., 2007). The bad performance in T_1 is likely due to poor aeration and nutrient uptake (Okwuagwu *et al*., 2003).

The larger flower diameter in T_4 highlights the importance of balanced moisture retention and nutrient supply for ideal flower development (Awang *et al*., 2009). Soil compaction in T_1 restricts nutrient absorption, resulting in smaller flowers (Keisling & Kester, 1979).

The highest lightness value in T_4 indicates ideal nutrient availability and water retention, enhancing flower pigmentation (Waseem *et al*., 2013). Poor soil structure in T_1 results in lesser pigmentation due to nutrient deficiencies (Ahmad *et al*., 2012).

Treatments T_2, T_3, T_4, and T_5 showed enhanced shelf life due to the balanced nutrient availability and moisture retention provided by coconut coir and sand (Dede *et al*., 2012). T_1 shorter shelf life is likely due to poor nutrient supply and moisture preservation (Ribeiro *et al*., 2007).

Conclusion

In conclusion, on phenotypic characters the T_3 (sand + farm yard manure) performed best due to their natural properties like better soil aeration, best water with holding capacity, and maximum availability of nutrients like freely available phosphorous and potassium in addition to organic contents while, on the other hand in reproductive parameters T_4 (soil + farm yard manure + coconut coir) showed good results because in that treatment media provided a suitable environment for flowering like balanced pH, maximum availability of nutrients with good water holding capacity and improved the physiochemical environment require for optimum flowering. In case of the number of days taken to produce the first flower, the treatment T_5 (sand + farm yard manure + coco peat) performed better because farm yard manure provided the required amount of nutrients and coconut coir added the suitable growth environment by adjusting media pH with increasing the withholding capacity of water besides it also optimized the uptake of nutrients along with farm yard manure. Moreover, the added sand helped to leach down excessive water with other excessive nutrients that were of no use for plant growth.

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