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Effect of Various Potting Media on the Growth and Root Development of Bougainvillea (*Bougainvillea* spp.) Cuttings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study aims to enhance the propagation efficiency of Bougainvillea, a popular ornamental plant, by evaluating the effects of different potting media on its growth and root development. The experiment was conducted over 180 days using Bougainvillea hardwood cuttings and was arranged in a Randomized Block Design (RBD). The study revealed that a mixture of soil, sand, FYM, and vermicompost significantly improved plant height, stem girth, number of branches, number of leaves, leaf area, root weight, and survival rate compared to other treatments, highlighting its potential as an optimal potting medium for Bougainvillea propagation.The highest root length was recorded in the combination of Soil +Sand + Rice husk (1:1:1).

Keywords: Bougainvillea; potting media; plant height; survival.

1. INTRODUCTION

Bougainvillea is native to the tropics and subtropics of South America, which was first collected by Commerson, a French Botanist from Rio de Janeiro (Brazil) in 1766. Name the plant after famous French navigator Lois Antoine de Bougainvillea. Bougainvillea is a highly adaptable plant with variety of colours and blooms to make the environment colourful and magnificent. Bougainvillea is a popular plant for landscaping because of its stunning flashy bracts and growing habit. It has great demand among landscape architects, horticulturists and garden lovers for development of house gardens (indoor and outdoor), bonsai, hanging basket, pot culture etc. no garden is complete without bougainvillea, since it is very easy to maintain [1]. It is propagated by cuttings, layering, and budding. The methods to be employed for propagation would largely depend on the cultivar and agro-climatic condition prevailing at particular location. Cuttings can best planted in june – july after pruning. Hardwood cuttings showed better growth compared to softwood and semi hardwood cuttings [2]. The most effective method for commercial propagation is using hardwood cuttings that are 10-15 cm long and have two to three nodes. Hardwood stem cuttings with pencil size thickness used in commerce [3].

Konkan is a hub of fruit crop and ornamental plant nurseries. At the time of transportation of plant at nursery stage, the root ball disturbance is common problem and due to this the plants experience transplant shock. To reduce this problem and increasing water holding capacity and aeration different media combinations used in this study. By using the different combinations of light weight media, it helps to reduce the bag weigth as compared to other traditionally used media. Research on potting media for bougainvillea had not been carried out in Konkan region and hence there is immense need for reliable research data regarding this field of research.

2. MATERIALS AND METHODOLOGY

The experiment was conducted during the year 2023-24 i.e May-November at College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was conducted in the Randomized Block Design with eight treatments and three replications. The planting material i.e. of bougainvillea hardwood cuttings of 15 cm length of pencil size thickness were selected prior to planting.

Eight different growing media were used: T_1 Soil, T_2 Soil + Sand + FYM (1:1:1), T_3 Soil +Sand + Rice husk (1:1:1), T_4 Soil + Sand + Cocopeat (1:1:1), T_5 Soil + Sand + Vermicompost (1:1:1), T_6 Soil + Sand + FYM + Rice husk (1:1:1:1), T_7 Soil + Sand + FYM + Cocopeat (1:1:1:1), T_8 Soil + Sand + FYM +Vermicompost (1:1:1:1). Potting mixtures were prepared with different proportions of media on volume basis and *trichoderma* was added at the rate 10g per 100 kg. Then as per the treatments, the mixture filled in polythene bags of size 9" x 11". A slanting cut was given at the base of the cuttings and each cutting had about three to four buds. A transverse cut was given at top of each cutting. For keradix powder treatment, the basal end of the cutting was dipped in water and later dipped in keradix powder taken in a beaker. Then the treated cuttings were planted in polybags (9" x 11") containing media as per treatments.

Plant height (cm), stem girth (mm), number of leaves were recorded at 30 days interval up to 180 days after cutting. Number of branches, total

leaf area (cm^2), survival percentage, root length (cm), fresh weight of root (g), dry weight of root (g) recorded at 180 days after cutting. The data obtained in the present investigation were statistically analysed by the method suggested by Panse and Sukhatme [4].

3. RESULTS AND DISCUSSION

Plant height: The maximum plant height (Table 1) was found in treatment T_8 (56.76 cm) (soil + sand+ FYM + vermicompost) and followed by treatments T_6 (51.43 cm) and T_7 (50.94 cm) which was found superior over rest of the treatments. The lowest plant height was recorded in treatment T_1 (40.60 cm). Plant height is the most important morphological character of plant. In present investigation, it was found that different media had significant effect on height of cuttings. The media containing FYM and vermicompost produced the highest plant height. It might be due to vermicompost and FYM play important role to improve physical and chemical properties of rooting media by improving its water holding capacity, aeration, organic matter mineralization and solubilisation and availability of micronutrient permitted gaseous exchange between roots and atmosphere which might have increased the growth of cuttings producing more length of shoots. Similar results were also recorded by Seifeldin and Samah [5] in (silty soil 75 per cent + compost 25 per cent) for bougainvillea, Minj et al. [6] (soil + sand + cocopeat) for bougainvillea.

Stem girth: The significant effect of potting media on stem girth (Table 1) on T_8 (11.81 mm) (soil + sand + FYM + vermicompost) which was at par with treatments T_6 (11.67 mm), T_2 (11.49 mm), T_5 (11.46 mm). The minimum stem girth (10.73 mm) were noticed in treatment T1 (soil). Shoot thickness is mostly influenced by biomass and food that is stored inside the stem. Results of present study reported that, treatment T_8 (soil + sand + FYM + vermicompost) showed maximum stem girth. A thicker stem suggests nutritional value in the medium. Shoot thickness increases as a result of media with increased nutrients and water-holding capacity, which provide adequate nutrition and water availability at all times [7].The media containing vermicompost and FYM triggered the growth of cuttings faster than soil by increasing photosynthesis activity, cell division, cell elongation, and meristematic activity. The number of cells and vascular bundles increases due to meristematic activity of cells present in stem, which leads to increase in girth of cutting [8]. Similar outcomes were reported by Mehmood et al. [9] for fig cuttings in FYM. Seifeldin and Samah [5] for bougainvillea in media containing silty soil 75 per cent + compost 25 per cent and silty soil 50 per cent + compost 50 per cent.

Number of branches: There was a significant difference among all the treatments (Table 1) and the maximum number of branches (3.47) recorded in treatment T_8 (soil + sand + FYM + vermicompost) which at par with treatment T_6 (3.40) (soil + sand + FYM + rice husk) and T_7 (3.33) (soil + sand + FYM + cocopeat) minimum number of branches in treatment T_1 (2.27). Maximum number of branches per plant demonstrated the vigorous vegetative plant growth. plant growth is encouraged by growing media which is rich in nutrient, provides aeration, better water holding capacity and cation exchange capacity which might have increased the growth of branches to greater extend and produce more number of branches. This might have attributed significant increase in the number of branches in media containing soil + sand + FYM + vermicompost (1:1:1:1). Similar results were also reported by Monika et al. [10] for chrysanthemum in vermicompost + FYM + garden soil (2:1:1) and Minj et al. [6] in bougainvillea.

Number of leaves: The number of leaves (Table 1) was significantly maximum in treatment T_8 (51.67) which was at par with T_6 (50.60) and T_7 (49.80). While minimum number of leaves recorded in treatment T_1 (39.73). Number of leaves is mainly influenced by environmental conditions, nutrients present in the growing media. The media with high organic matter content increases the water and nutrient holding capacity of the medium also high N content resulting in the vegetative growth of the plant [11]. Physical and chemical activity in the media might be resulted in increase in rate of photosynthesis of the cuttings which triggered the maximum number of leaves. In present investigation soil + sand + FYM + vermicompost has favoured the maximum number of leaves. Similar results were observed by Marasini and Khanal [12] in soil + FYM (1:1) media for bougainvillea, Kumar et al.[13] for pomegranate in soil + sand + FYM media, Kapre et al. [14] for cape jasmine in soil + FYM + ricehusk (1:1:1).

Total leaf area (cm^2): There was a significant variation among all the treatments and the maximum total leaf area (587.64 cm^2) (Table 1) was noted in the treatment T_8 (soil + sand + FYM + vermicompost). The minimum total leaf area (219.50 cm^2) was found in the treatment T_1 (soil) at end of the experiment. The combination of soil, sand, FYM and vermicompost may create synergisticeffects, enhancing plant growth and leaf development. Leaf area is important factor for growth and development of plant through photosynthesis activities. Maximum leaf area noted in soil + sand + FYM + vermicompost. It might be due to vermicompost improves leaf expansion and increase chlorophyll contents [15] it results leaves produced more quantity of enzymes which accelerate cell division and expansion of leaf. Similar findings were reported by Arunesh et al. [16] in coirpith + vermicompost + FYM + garden soil media (1:1:1:1) for gerbera, Bendre [17] for bush pepper in cocopeat + soil + rice husk + compost (1:1:1:1) media combination.

Survival percentage: The statistically maximum per cent survival of plants (Table 2) in treatment T_8 (88.33) (soil + sand + FYM + vermicompost) which was at par with T_6 (86.67), T_7 (85.00), T_4 (81.67) and T_5 (83.33).While lowest per cent sprouting observed in treatment T_1 (75.00). In present investigation media combination i.e. soil + sand + FYM + vermicompost (1:1:1:1) might have provide physical conditions and sufficient nutrients to cuttings particularly for better metabolic and physiological activities along with better development of root system. Maximum number of roots with higher length and thickness absorb more nutrients and water from the soil and resulted in maximum percentage of survival [18]. The results are in conformity with the findings of Rahman et al. [19] in silt for bougainvillea, Mehmood et al. [9] in soil + FYM + compost (1:1:1) for fig cutting, Singh et al. [3]

Root length: The root length was significantly influenced by different potting media treatments. The highest root length (Table 2) (32.23 cm) was recorded in the treatment T_3 (soil + sand + rice husk) which is at par with treatment T_5 (29.80 cm), T_7 (29.60 cm), T8 (29.40 cm) T_6 (29.30 cm) and T_4 (29.03 cm). The lowest root length observed in treatment T_1 (20.33 cm). Among various media soil + sand + rice husk showed maximum root length. It might be due to good aeration, drainage and high porosity in media combination which leads to proper gas exchange by maintaining sufficient oxygen supply to the roots. Simultaneously removal of respiratory CO_2 helped in root elongation [20]. Similar results were obtained by Marasini and Khanal [12] for bougainvillea in sand and FYM media, Mehmood et al. [9] in FYM for fig cuttings, Minj et al. [6] for bougainvillea in soil +sand + cocopeat media.

Fresh weight of root: The statistically maximum fresh weight of root (Table 2) (14.33 g) was obtained in treatment T_8 (soil + sand + FYM + vermicompost) which was at par with treatment T_6 (14.23 g) (soil + sand + FYM + rice husk) and T_7 (13.73 g) (soil + sand + FYM + cocopeat). The lowest fresh weight of root observed in treatment T_1 (6.13 g). In present investigation, it was found that soil + sand + FYM + vermicompost noted maximum fresh weight of roots. According to Chattergee and Choudhari [21] adequate drainage, constant moisture and nutrient supply in media helps in more accumulation of energy in roots which leads to enhance root growth. Hence, it may clear that more number of roots directly correlated with root fresh weight. Similar results were obtained by Singh et al. [3] for bougainvillea in sand + cocopeat + perlite (1:1:1), Akshay et al. [22] for black pepper in soil+ sand + FYM + vermicompost (1:1:1:1).

Dry weight of root: The dry weight of root was influenced by effect of different potting media treatments (Table 2). The maximum dry weight of root (5.97 g) was obtained in treatment T_8 (soil + sand + FYM + vermicompost) which was at par with treatment T_6 (5.83 g) (soil + sand + FYM + rice husk) and T_7 (5.30 g) (soil + sand + FYM + cocopeat). The lowest fresh weight of root observed in treatment T_1 (2.20 g). In present investigation, it was found that soil + sand + FYM + vermicompost noted maximum dry weight of roots. Might be due to adequate drainage, constant moisture and nutrient supply through media helps in more accumulation of energy in roots which leads to enhance root growth [21] and also, helps in increasing number of roots which resulted more root weight. Similar results were obtained by Kumar et al. [13] for pomegranate in soil + sand + vermicopost (1:1:1), Singh et al. [2] for mulberry in vermicompost rooting media.

Table 1. Effect of different potting media on growth parameters of bougainvillea cuttings at 180 days after cutting

Treatments	Plant height (cm)	Stem girth (mm)	Number of branches	Number of leaves	Total leaf area (cm^2)
T_1	40.60	10.73	2.27	39.73	219.50
T_2	45.13	11.49	3.00	42.80	293.47
T_3	41.09	10.77	2.67	40.13	244.85
T_4	46.55	11.40	2.80	42.87	289.56
T_5	47.97	11.46	2.93	47.20	348.50
T_6	51.43	11.67	3.40	50.60	543.83
T_7	50.94	11.41	3.33	49.80	450.35
T_8	56.76	11.81	3.47	51.67	587.64
Mean	**47.56**	**11.34**	**2.98**	**45.60**	**372.21**
Range	**40.60-56.76**	**10.73-11.81**	**2.27-3.47**	**39.73-51.67**	**219.50-587.64**
'F' test	**SIG**	**SIG**	**SIG**	**SIG**	**SIG**
S.Em. ±	**1.11**	**0.13**	**0.09**	**1.13**	**19.61**
C.D. at 5 %	**3.37**	**0.39**	**0.27**	**3.41**	**59.47**

Table 2. Effect of different potting media on survival percentage and rooting parameters of bougainvillea cuttings at 180 days after cutting

Treatments	Survival percentage	Root length (cm)	Fresh weight of root (g)	Dry weight of root(g)
T_1	75.00	20.33	6.13	2.20
T_2	80.00	23.83	6.72	2.60
T_3	76.67	32.23	7.27	2.57
T_4	81.67	29.03	9.30	3.03
T_5	83.33	29.80	9.47	3.19
T_6	86.67	29.30	14.23	5.83
T_7	85.00	29.60	13.73	5.30
T_8	88.33	29.40	14.33	5.97
Mean	**82.08**	**27.94**	**10.15**	**3.84**
Range	**75.00-88.33**	**20.33-32.23**	**6.13-14.33**	**2.20-5.97**
'F' test	**SIG**	**SIG**	**SIG**	**SIG**
S.Em. ±	**2.28**	**1.82**	**0.60**	**0.27**
C.D. at 5 %	**6.92**	**5.51**	**1.81**	**0.83**

4. CONCLUSION

Among the different treatments, T_8 (soil + sand + FYM + vermicompost) (1:1:1:1) treatment recorded the maximum plant height, stem girth, number of branches, number of leaves, leaf area, survival percentage, fresh and dry weight of root. Thus, on the basis of results obtained in above investigation, it can be concluded that combination of soil + sand + FYM + vermicompost gives best results for better growth performance of bougainvillea.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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