

Effect of Different Potting Media on the Propagation and Early Growth of Three Bougainvillea Species from Stem Cuttings

Md. Tajkin Hasan

Daffodil International University

Rifat Hasan Rabbi

rabbir2301101012@diu.edu.bd

Daffodil International University <https://orcid.org/0009-0008-2109-1809>

Mohima Jannat

Daffodil International University

Md. Hasan Mahmud

Daffodil International University

Md. Rabby Hossen

Daffodil International University

Research Article

Keywords: Bougainvillea, potting media, vegetative propagation, stem cuttings, vermicompost, cocopeat

Posted Date: September 9th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10971773/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Additional Declarations: The authors declare no competing interests.

Abstract

Bougainvillea is among the most widely cultivated flowering ornamental shrubs in tropical and subtropical landscapes, yet nursery propagation is frequently constrained by inconsistent rooting media, resulting in variable sprouting, survival, and growth of stem cuttings. A factorial pot experiment was conducted to evaluate the effects of five potting media — sand (control, T1), sand:cocopeat (1:1, T2), sand:garden soil (1:1, T3), sand:garden soil:vermicompost (1:1:1, T4), and sand:cocopeat:farmyard manure (1:1:1, T5) — on the propagation performance of three Bougainvillea species, namely *Bougainvillea peruviana* (V1), *Bougainvillea spectabilis* Willd. (V2), and *Bougainvillea glabra* Choisy (V3). The experiment followed a completely randomised, two-factor factorial design comprising 15 species × medium combinations, each replicated five times (375 cuttings in total), and data were analysed by two-way analysis of variance (ANOVA) with Fisher's protected least significant difference (LSD) test at $P \leq 0.05$. Potting medium exerted a highly significant effect ($P < 0.01$) on all eight traits recorded — days to sprouting, sprouts per cutting, sprouting percentage, branches per cutting, survivability percentage, and fresh shoot, dry shoot, and fresh root biomass. The sand:garden soil:vermicompost mixture (T4) consistently produced the best performance, reducing days to sprouting by 34.2% and increasing survivability by 57.4%, fresh shoot biomass by 185.8%, and fresh root biomass by 205.0% relative to the sand control. Species also differed significantly for most traits ($P < 0.01$), with *B. glabra* sprouting 14.5% faster and producing 22.2% more shoot biomass than *B. spectabilis*. A significant species × medium interaction ($P < 0.05$) was detected only for days to sprouting, indicating that the relative ranking of media was largely consistent across species for most growth parameters. These findings demonstrate that amending sand with garden soil and vermicompost markedly improves the propagation efficiency of Bougainvillea cuttings and offers nursery growers a practical, low-cost medium formulation for commercial-scale multiplication.

1. Introduction

Bougainvillea (family Nyctaginaceae) is a thorny, vine-like ornamental shrub native to South America and now cultivated throughout the tropics and subtropics for its brilliantly coloured bracts and low maintenance requirements (Datta et al., 2021; Zhang et al., 2024). Commercial propagation of Bougainvillea relies almost exclusively on vegetative methods — principally semi-hardwood or hardwood stem cuttings — because seed propagation is unreliable and does not maintain cultivar or species trueness (Eed et al., 2015; Shrestha et al., 2023). The success of cutting propagation, however, is governed by a complex interplay of genotype, cutting physiology, and, critically, the physical and chemical properties of the rooting or potting medium used (Hartmann, 2002).

The potting medium influences cutting establishment through several interacting mechanisms: it determines the balance between water retention and aeration around the cut surface, buffers substrate temperature and pH, supplies mineral nutrients that sustain adventitious root and shoot development, and, in the case of organic amendments, may contribute growth-promoting microbial and biochemical activity (Fornes et al., 2013; Mendoza-Hernández et al., 2014). Sand, although widely used as an inert rooting medium for its excellent drainage, has negligible water- and nutrient-holding capacity and is frequently blended with organic or mineral amendments to improve cutting performance. Cocopeat (coconut coir dust) is valued for its high water-holding capacity and favourable air–water balance relative to peat (Abad et al., 2005), while farmyard manure (FYM) and vermicompost supply slow-release nutrients, improve cation exchange capacity, and can enhance microbial activity in the rhizosphere (Blouin et al., 2019).

Several independent trials have confirmed that potting/rooting medium composition significantly affects the sprouting, rooting, and survival of Bougainvillea cuttings. Eed et al. (2015) reported that a soil:sand (1:1) medium produced the tallest rooted *Bougainvillea spectabilis* plants under fibreglass-house conditions, while Shrestha et al. (2023) found that a sand:cocopeat (1:1) medium combined with a commercial rooting compound gave the highest sprouting percentage in *Bougainvillea glabra* cv. Double Red. More recently, Phule et al. (2024) demonstrated that amending soil and sand with farmyard manure and vermicompost significantly improved plant height, stem girth, branching, root weight, and survival of Bougainvillea hardwood cuttings compared with unamended media. These findings are consistent with broader evidence that vermicompost amendment reliably increases shoot and root biomass across a wide range of ornamental and horticultural species (Blouin et al., 2019; Fornes et al., 2013).

Despite this body of work, comparative information on how potting-medium responses vary across different Bougainvillea species propagated under identical conditions remains limited, and most published trials evaluate a single species or cultivar. Understanding whether the ranking of potting media is consistent across species — or whether species × medium interactions must be considered in nursery protocol design — has direct practical relevance for growers who propagate multiple Bougainvillea types within the same production cycle. The present study therefore evaluated the combined and interactive effects of five potting media (sand, sand:cocopeat, sand:garden soil, sand:garden soil:vermicompost, and sand:cocopeat:farmyard manure) on the sprouting, survival, and early vegetative growth of three Bougainvillea species — *B. peruviana*, *B. spectabilis* Willd., and *B. glabra* Choisy — grown from stem cuttings under a common factorial design, with the objective of identifying the medium formulation best suited for efficient, low-cost commercial propagation.

2. Materials and Methods

2.1. Experimental site and plant material

The experiment was conducted at Agricultural Field Laboratory-1 (Malta Bagan), Department of Agricultural Science, Daffodil International University, Dhaka, Bangladesh (23.875488° N, 90.327916° E), from February to May 2026, with final data recorded 60 days after planting. Propagation was carried out under polyhouse conditions with a mean air temperature of approximately 26°C and relative humidity of 85–90% throughout the trial. Three Bougainvillea species/taxa were used as propagation material: *Bougainvillea peruviana* (V1), *Bougainvillea spectabilis* Willd. (V2), and *Bougainvillea glabra* Choisy (V3). Stem cuttings were sourced from three-month-old stems of healthy, disease-free stock plants procured from a local commercial nursery. Uniform cuttings measuring 22.9 cm (9 inches) in length and 1.3 cm (0.5 inch) in diameter, bearing 4–5 nodes, were prepared and planted directly without any rooting-hormone treatment; all cuttings across the 15 species × medium combinations were therefore compared under hormone-free conditions.

2.2. Potting media and treatments

Five potting media (Treatment factor, five levels) were evaluated: T1 – sand only (control); T2 – sand:cocopeat (1:1, v/v); T3 – sand:garden soil (1:1, v/v); T4 – sand:garden soil:vermicompost (1:1:1, v/v); and T5 – sand:cocopeat:farmyard manure (FYM) (1:1:1, v/v). Each medium was combined factorially with the three Bougainvillea species/varieties (Variety factor, three levels), giving 15 species × medium treatment combinations. Substrate pH was monitored and maintained between 5.5 and 6.0 across all media throughout the trial; electrical conductivity and particle-size distribution of the substrate components were not measured in this study and are noted here as a limitation of the dataset rather than an omission to be filled in.

2.3. Experimental design and data recording

Treatments were arranged in a completely randomised, two-factor factorial design (3 species × 5 potting media), with each of the 15 combinations replicated five times. Each replicate consisted of five cuttings planted in the corresponding medium in 12.7 cm (5-inch) pots, giving 25 cuttings per species × medium combination and 375 cuttings in total. Irrigation was applied once daily. Continuous, cutting-level traits – days to sprouting, sprouts per cutting, branches per cutting, and fresh shoot, dry shoot, and fresh root biomass – were recorded on individual cuttings 60 days after planting and analysed with $n = 25$ per combination ($n = 75$ per medium pooled across species; $n = 125$ per species pooled across media). Sprouting percentage and survivability percentage were calculated on a per-replicate basis (proportion of the five cuttings in each replicate that sprouted or survived, respectively) and were therefore analysed with $n = 5$ replicates per combination ($n = 15$ per medium; $n = 25$ per species).

2.4. Statistical analysis

Data for each response variable were subjected to two-way analysis of variance (ANOVA) appropriate to a factorial design, partitioning total variation into Species (Variety, A), Potting Medium (B), the Species × Medium interaction (A × B), and residual error. Treatment means were compared using Fisher's protected least significant difference (LSD) test at $P \leq 0.05$ wherever the corresponding F-test was significant. Standard errors of the mean (SE), standard deviations (SD), and the coefficient of variation (CV%) were computed for each response variable. Statistical analyses were performed using IBM SPSS Statistics version 27 and R version 4.6.1 (IBM Corp., 2020; R Core Team, 2021).

3. Results and Discussion

3.1. Analysis of variance

Potting medium had a highly significant effect ($P < 0.01$) on all eight traits recorded, confirming that substrate composition was the dominant source of variation in this experiment (Table 1). Species identity also significantly affected six of the eight traits ($P < 0.01$) – days to sprouting, sprouts per cutting, branches per cutting, and fresh shoot, dry shoot, and fresh root biomass – but had no significant effect on sprouting percentage or survivability percentage ($P > 0.05$), indicating that once a cutting initiated growth, its probability of establishing successfully was governed primarily by the medium rather than by species. The species × medium interaction was significant only for days to sprouting ($P = 0.028$), while all other traits showed non-significant interactions, meaning that the relative ranking of potting media was broadly consistent across the three species for sprout number, branching, survivability, and biomass accumulation.

Table 1. Two-way analysis of variance (F-values) for the effect of Bougainvillea species (Variety, A), potting medium (B), and their interaction (A × B) on eight propagation and growth traits.

Source of Variation	Days to Sprouting	Sprouts per Cutting	Sprouting (%)†	Branches per Cutting	Survivability (%)†	Fresh Shoot Biomass (g)	Dry Shoot Biomass (g)	Fresh Root Biomass (g)
Variety (A) (df = 2)	81.09**	15.97**	0.72ns	35.98**	1.33ns	36.70**	24.37**	28.50**
Potting Media (B) (df = 4)	230.48**	65.84**	11.17**	199.29**	8.74**	328.71**	222.80**	311.58**
A × B (df = 8)	2.18*	0.92ns	0.95ns	1.75ns	0.51ns	0.97ns	1.16ns	0.53ns
CV (%)	9.68	36.54	13.47	22.30	21.90	18.62	22.27	20.06

† Sprouting (%) and Survivability (%) were computed and analysed on a per-replicate basis ($n = 5$ replicates per combination; error df = 60), whereas the remaining traits were analysed on individual cuttings ($n = 25$ per combination; error df = 360). ns = not significant ($P > 0.05$); * = significant at $P \leq 0.05$; ** = significant at $P \leq 0.01$. CV = coefficient of variation of the residual error for each trait.

3.2. Effect of potting medium on sprouting, survival, and growth (pooled across species)

Pooled across the three species, potting medium produced very large differences in propagation performance (Table 2, Figs. 1–3). The sand:garden soil:vermicompost medium (T4) gave the best performance for every trait measured: cuttings sprouted fastest (14.4 days, 34.2% faster than the sand control), produced the most sprouts (4.08 per cutting) and branches (5.03 per cutting), achieved the highest sprouting percentage (98.7%) and survivability (98.7%, a 57.4% improvement over the control), and accumulated the greatest fresh shoot biomass (15.29 g, +185.8%), dry shoot biomass (4.07 g, +179.8%), and fresh root biomass (8.35 g, +205.0%) relative to sand alone. The sand:cocopeat:FYM medium (T5) ranked second overall, followed by sand:cocopeat (T2), sand:garden soil (T3), and finally the sand-only control (T1), which performed poorest across all eight traits.

Table 2a. Mean performance of three Bougainvillea species (pooled across potting media) for eight propagation and growth traits.

Species	Days to Sprouting	Sprouts per Cutting	Sprouting (%)†	Branches per Cutting	Survivability (%)†	Fresh Shoot Biomass (g)	Dry Shoot Biomass (g)	Fresh Root Biomass (g)
V1 <i>B. peruviana</i>	17.63	2.91	88.00	3.54	82.40	9.99	2.68	5.52
V2 <i>B. spectabilis</i>	19.01	2.53	86.40	3.03	76.80	9.16	2.47	5.02
V3 <i>B. glabra</i>	16.26	3.29	90.40	3.86	84.80	11.19	3.00	6.08
LSD ($P \leq 0.05$)	0.42	0.26	6.73	0.19	10.08	0.47	0.15	0.28

Values are treatment means ($n = 125$ for continuous traits; $n = 25$ for the two percentage traits, pooled across the five potting media). LSD = least significant difference at $P \leq 0.05$; a difference between two species means for a given trait that exceeds the tabulated LSD is statistically significant.

Table 2b. Mean performance of five potting media (pooled across the three *Bougainvillea* species) for eight propagation and growth traits.

Potting Medium	Days to Sprouting	Sprouts per Cutting	Sprouting (%)†	Branches per Cutting	Survivability (%)†	Fresh Shoot Biomass (g)	Dry Shoot Biomass (g)	Fresh Root Biomass (g)
T1 Sand (Control)	21.94	1.51	72.00	1.80	62.67	5.35	1.46	2.74
T2 Sand:Cocopeat (1:1)	16.57	2.97	92.00	3.63	82.67	10.09	2.69	5.62
T3 Sand:Garden Soil (1:1)	19.35	2.44	85.33	2.71	74.67	7.41	2.01	3.95
T4 Sand:Soil:Vermicompost (1:1:1)	14.44	4.08	98.67	5.03	98.67	15.29	4.07	8.35
T5 Sand:Cocopeat:FYM (1:1:1)	15.89	3.55	93.33	4.23	88.00	12.45	3.36	7.03
LSD ($P \leq 0.05$)	0.55	0.34	8.68	0.25	13.01	0.60	0.19	0.36

Values are treatment means ($n = 75$ for continuous traits; $n = 15$ for the two percentage traits, pooled across the three species). LSD = least significant difference at $P \leq 0.05$; a difference between two medium means for a given trait that exceeds the tabulated LSD is statistically significant. T1 = Sand (control); T2 = Sand:Cocopeat (1:1); T3 = Sand:Garden Soil (1:1); T4 = Sand:Garden Soil:Vermicompost (1:1:1); T5 = Sand:Cocopeat:Farmyard Manure (1:1:1).

The superiority of the vermicompost-amended medium is consistent with previous reports on *Bougainvillea* and other woody ornamentals. Phule et al. (2024) similarly found that a soil–sand medium enriched with FYM and vermicompost significantly improved plant height, stem girth, branch number, leaf area, root weight, and survival of *Bougainvillea* hardwood cuttings compared with unamended media, while the meta-analysis of Blouin et al. (2019) confirmed that vermicompost amendment reliably increases both shoot and root biomass across a broad range of species, with especially strong effects when combined with a coarse, well-aerated base substrate. In the present study, the physical contribution of sand to aeration and drainage, combined with the nutrient-buffering and moisture-retention properties supplied by garden soil and vermicompost, likely created a more favourable balance between oxygen availability at the cut base and sustained moisture and nutrient supply – two conditions widely recognised as critical for adventitious root initiation (Hartmann, 2002; Lin et al., 2024).

The strong performance of the sand:cocopeat medium (T2), which ranked second or third for most traits and outperformed both the sand-only control and the sand:garden soil medium, is consistent with the favourable air–water relationships reported for coconut coir dust relative to mineral soil (Abad et al., 2005). Cocopeat combines a comparatively high water-holding capacity with good porosity, reducing the risk of both desiccation and waterlogging around the cut surface, and similar sand:cocopeat formulations have previously supported high sprouting percentages in *Bougainvillea* (Shrestha et al., 2023). By contrast, the sand:garden soil medium (T3), lacking both the aeration benefits of sand alone and the nutrient or water-buffering benefits of organic amendment, consistently underperformed relative to T2, T4, and T5, suggesting that garden soil alone is a comparatively poor substrate component unless supplemented with organic matter such as vermicompost.

3.3. Species differences in propagation performance

Averaged across all five potting media, *Bougainvillea glabra* (V3) consistently outperformed *B. spectabilis* (V2), sprouting 14.5% faster, producing 30.1% more sprouts per cutting, 27.2% more branches per cutting, 22.2% more fresh shoot biomass, and 21.1% more fresh root biomass (Table 2a). *Bougainvillea peruviana* (V1) was generally intermediate between the two, though it did not differ significantly from *B. glabra* in sprouting percentage or survivability, both of which were statistically unaffected by species identity (Table 1). These interspecific differences most likely reflect inherent physiological variation in stored carbohydrate reserves, cambial activity, and endogenous auxin dynamics among the three taxa, which are known to strongly influence the rate and success of adventitious rooting in woody cuttings (Frick & Strader, 2018; Hartmann, 2002; Hu & Hu, 2025; Strader, 2015). Because species significantly affected six of eight traits but did not significantly interact with medium for any trait except days to sprouting, the practical implication for nurseries propagating multiple *Bougainvillea* types is that a single, well-formulated medium – such as the sand:garden soil:vermicompost mixture identified here – can be applied across species without substantially altering its relative advantage, simplifying propagation-bed management.

3.4. Species × medium interaction for days to sprouting

Days to sprouting was the only trait for which the species × medium interaction was statistically significant ($P = 0.028$; Table 1), and the combination means and Fisher's LSD letter groupings (Table 3, Fig. 1) illustrate why. Across all three species, T4 (sand:garden soil:vermicompost) produced the fastest sprouting, ranging from 13.49 days in *B. glabra* to 15.29 days in *B. spectabilis*, while T1 (sand control) was consistently the slowest, ranging from 20.39 days in *B. glabra* to 23.41 days in *B. spectabilis*. However, the magnitude of the gap between the fastest and slowest media differed among species: the T1–T4 difference was largest in *B. spectabilis* (8.12 days) and smallest in *B. glabra* (6.90 days), indicating that *B. spectabilis* cuttings were comparatively more sensitive to medium quality for this trait, which is the statistical basis of the significant interaction. For all other traits, the absence of a significant interaction (Table 1) confirms that medium rankings were essentially parallel across species, and the letter groupings in Table 3 show the same overall pattern – T4 and T5 sharing the top-performing letter classes, T1 anchoring the lowest classes, and T2 and T3 occupying intermediate positions – for every species evaluated.

Table 3. Species × potting-medium interaction means for eight propagation and growth traits of Bougainvillea, with Fisher's protected LSD ($P \leq 0.05$) significance letter groupings.

Species	Potting Medium	Days to Sprouting	Sprouts per Cutting	Sprouting (%)†	Branches per Cutting	Survivability (%)†	Fresh Shoot Biomass (g)	Dry Shoot Biomass (g)	Fresh Root Biomass (g)
<i>B. peruviana</i>	Sand (Control)	22.01b	1.24no	64.00no	1.84mn	56.00klmn	4.78no	1.34n	2.81mn
	Sand:Cocopeat	16.62ghi	3.16efg	96.00abcd	3.96ef	88.00abcde	9.75h	2.55h	5.61gh
	Sand:Garden Soil	19.21e	2.52hij	88.00abcdefgh	2.80ijk	80.00abcdefgh	7.48jk	2.01jk	3.95jk
	Sand:Soil:Vermicompost	14.53klmn	4.16ab	100.00a	5.12ab	100.00a	15.70ab	4.26a	8.26b
	Sand:Cocopeat:FYM	15.79ij	3.48de	92.00abcdef	4.00e	88.00abcdef	12.26e	3.27e	6.94e
<i>B. spectabilis</i>	Sand (Control)	23.41a	1.28n	72.00klmn	1.40o	56.00klmno	4.87n	1.31no	2.36no
	Sand:Cocopeat	18.33ef	2.44hijk	88.00abcdefghi	2.96i	80.00abcdefghi	9.15hi	2.44hi	5.06hi
	Sand:Garden Soil	21.29bc	2.12ijkl	84.00defghijk	2.40kl	68.00efghijklm	6.48kl	1.77kl	3.49kl
	Sand:Soil:Vermicompost	15.29jk	3.80abcd	100.00ab	4.60cd	96.00abc	13.93c	3.74c	7.65bc
	Sand:Cocopeat:FYM	16.75gh	3.00efgh	88.00abcdefghij	3.80efgh	84.00abcdefg	11.38ef	3.09efg	6.55ef
<i>B. glabra</i>	Sand (Control)	20.39cd	2.00jklm	80.00fghijklm	2.16lm	76.00cdefghijk	6.39lm	1.72klm	3.04lm
	Sand:Cocopeat	14.77klm	3.32def	92.00abcdefg	3.96efg	80.00abcdefghij	11.35efg	3.09ef	6.19fg
	Sand:Garden Soil	17.54fg	2.68ghi	84.00defghijkl	2.92ij	76.00cdefghijkl	8.28ij	2.24hij	4.42j
	Sand:Soil:Vermicompost	13.49o	4.28a	96.00abcde	5.36a	100.00ab	16.23a	4.23ab	9.15a
	Sand:Cocopeat:FYM	15.13jkl	4.16abc	100.00abc	4.88bc	92.00abcd	13.70cd	3.73cd	7.60cd

Within each column, means followed by the same letter are not significantly different according to Fisher's protected LSD test ($P \leq 0.05$). Column order: Days to Sprouting, Sprouts per Cutting, Sprouting (%), Branches per Cutting, Survivability (%), Fresh Shoot Biomass (g), Dry Shoot Biomass (g), Fresh Root Biomass (g). Sprouting (%) and Survivability (%) significance letters derive from the treatment-level LSD applied to replicate-level percentages ($n = 5$); all other traits derive from the cutting-level LSD ($n = 25$).

3.5. Graphical comparison of media performance

Figures 1–3 summarise the media and species effects graphically. Figure 1 depicts the species × medium interaction for days to sprouting, visually confirming the pattern of a consistently faster response to T4 and T5 across all three species, with the steepest slope (largest medium-driven change) observed in *B. spectabilis*. Figure 2 compares fresh shoot, dry shoot, and fresh root biomass across the five media pooled across species, illustrating the approximately three-fold biomass advantage of T4 over the sand control. Figure 3 presents sprouting and survivability percentages by medium, highlighting that T4 was the only medium to achieve both parameters above 95%.

3.6. Practical implications for nursery production

From a commercial nursery perspective, the sand:garden soil:vermicompost medium (T4) offers a compelling combination of speed (fastest sprouting), reliability (highest and most uniform sprouting and survivability across all three species), and vigour (greatest shoot and root biomass), and is composed of low-cost, locally available materials in a simple 1:1:1 ratio. Where vermicompost is unavailable or costly, the sand:cocopeat:FYM medium (T5) represents a viable second-choice formulation, also outperforming the unamended sand control and the sand:garden soil medium on every trait recorded. Conversely, the widespread nursery practice of propagating cuttings directly in sand or in a simple sand:garden soil mixture appears sub-optimal: both media produced

markedly slower sprouting, lower survivability, and reduced biomass accumulation relative to the organically amended treatments, which is consistent with the broader literature showing that unamended mineral substrates generally lack the nutrient and moisture-buffering capacity required to sustain rapid adventitious root and shoot development in woody ornamental cuttings (Fornes et al., 2013; Hartmann, 2002).

4. Conclusion

Potting medium was the dominant factor governing the sprouting, survival, and growth of Bougainvillea stem cuttings, significantly affecting all eight traits evaluated, while species identity significantly influenced sprouting speed, branching, and biomass accumulation but not sprouting or survival percentage. A sand:garden soil:vermicompost mixture (1:1:1) consistently produced the fastest sprouting and the highest survivability, sprout number, branching, and shoot/root biomass across all three Bougainvillea species tested, and is recommended as a practical, low-cost medium for commercial nursery propagation. A sand:cocopeat:farmyard manure mixture (1:1:1) offers a viable alternative where vermicompost is unavailable. Because the species × medium interaction was significant only for days to sprouting, nurseries multiplying several Bougainvillea species can generally adopt a single optimised medium without substantial loss of efficiency across taxa, although species-specific fine-tuning may still be warranted to minimise sprouting delays in slower-responding types such as *B. spectabilis*. As all cuttings in this trial were propagated without rooting-hormone treatment under polyhouse conditions at Daffodil International University, future work should extend this factorial framework to include rooting-hormone treatments (e.g., IBA), characterise the physicochemical properties of the component substrates, and evaluate longer-term field performance after transplanting.

Declarations

Funding

This research received no external funding.

Acknowledgements

The authors gratefully acknowledge the teachers of the Department of Agricultural Science, Daffodil International University, for their guidance and for providing the opportunity to conduct this research. The authors also thank the staff of the Agricultural Field Laboratory-1 (Malta Bagan) for their assistance during the propagation trial.

Author Contributions (CRediT)

MTH: Conceptualization, Methodology, Investigation. **RHR:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Supervision. **MJ:** Investigation, Writing – review & editing. **MHM:** Investigation, Writing – review & editing. **MRH:** Investigation, Writing – review & editing.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The raw experimental data, replicate-level summaries, treatment means, ANOVA, and LSD outputs generated and analysed during this study are available from the corresponding author on reasonable request.

References

1. Abad, M., Fornes, F., Carrión, C., Noguera, V., Noguera, P., Maquieira, Á., & Puchades, R. (2005). Physical Properties of Various Coconut Coir Dusts Compared to Peat. *HortScience*, 40(7), 2138–2144. <https://doi.org/10.21273/HORTSCI.40.7.2138>
2. Blouin, M., Barrere, J., Meyer, N., Lartigue, S., Barot, S., & Mathieu, J. (2019). Vermicompost significantly affects plant growth. A meta-analysis. *Agronomy for Sustainable Development*, 39(4), 34. <https://doi.org/10.1007/s13593-019-0579-x>
3. Datta, S. K., Jayanthi, R., & Janakiram, T. (2021). Bougainvillea. In S. K. Datta & Y. C. Gupta (Eds.), *Floriculture and Ornamental Plants* (pp. 1–34). Springer Singapore. https://doi.org/10.1007/978-981-15-1554-5_2-1
4. Eed, A. M., Albana'a, B., & Almaqtari, S. (2015). The effect of growing media and stem cutting type on rooting and growth of Bougainvillea spectabilis plants. *University of Aden Journal of Natural and Applied Sciences*, 19(1), 141–147. <https://doi.org/10.47372/uajnas.2015.n1.a12>
5. Fornes, F., Mendoza-Hernandez, D., & Belda, R. M. (2013). Compost versus vermicompost as substrate constituents for rooting shrub cuttings. *Spanish Journal of Agricultural Research*, 11(2), 518–528. <https://doi.org/10.5424/sjar/2013112-3304>
6. Frick, E. M., & Strader, L. C. (2018). Roles for IBA-derived auxin in plant development. *Journal of Experimental Botany*, 69(2), 169–177. <https://doi.org/10.1093/jxb/erx298>
7. Hartmann, H. T. (2002). *Hartmann and Kester's Plant Propagation: Principles and Practices*. Prentice Hall. <https://books.google.com.bd/books?id=SNtXAAAAYAAJ>

8. Hu, D., & Hu, L. (2025). Effects of Exogenous IBA on Cutting Propagation in Different Cutting Types of *Bougainvillea spectabilis* 'Yunnan Purple.' *Horticulturae*, 11(12), 1496. <https://doi.org/10.3390/horticulturae11121496>
9. IBM Corp. (2020). *IBM SPSS Statistics for Windows (Version 27.0) [Computer software]*. (Version 27.0) [Computer software]. IBM Corp.
10. Lin, H., Xu, J., Wu, K., Gong, C., Jie, Y., Yang, B., & Chen, J. (2024). An Efficient Method for the Propagation of *Bougainvillea glabra* 'New River' (Nyctaginaceae) from In Vitro Stem Segments. *Forests*, 15(3), 519. <https://doi.org/10.3390/f15030519>
11. Mendoza-Hernández, D., Fornes, F., & Belda, R. M. (2014). Compost and vermicompost of horticultural waste as substrates for cutting rooting and growth of rosemary. *Scientia Horticulturae*, 178, 192–202. <https://doi.org/10.1016/j.scienta.2014.08.024>
12. Phule, S. S., Khanvilkar, M. H., Kulkarni, M. M., Dalvi, N. V., Dhopavkar, R. V., & Pawar, P. R. (2024). Effect of Various Potting Media on the Growth and Root Development of *Bougainvillea* (*Bougainvillea* spp.) Cuttings. *Asian Research Journal of Agriculture*, 17(4), 226–232. <https://doi.org/10.9734/arja/2024/v17i4518>
13. R Core Team. (2021). *R: A language and environment for statistical computing*. (Version 4.6.1) [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
14. Shrestha, J., Bhandari, N., Baral, S., Marahatta, S. P., & Pun, U. (2023). Effect of rooting hormones and media on vegetative propagation of *Bougainvillea*. *Ornamental Horticulture*, 29(3), 397–406. <https://doi.org/10.1590/2447-536x.v29i3.2637>
15. Strader, L. (2015). CAREER: Roles for Indole-3-butyric Acid in Plant Development. *NSF Award*, 14, 53750.
16. Zhang, D., Xue, Y., Feng, N., Bai, J., Ma, D., Sheng, Q., Cao, F., & Zhu, Z. (2024). Physiological Responses and Salt Tolerance Evaluation of Different Varieties of *Bougainvillea* under Salt Stress. *Plants*, 13(17), 2409. <https://doi.org/10.3390/plants13172409>

Figures

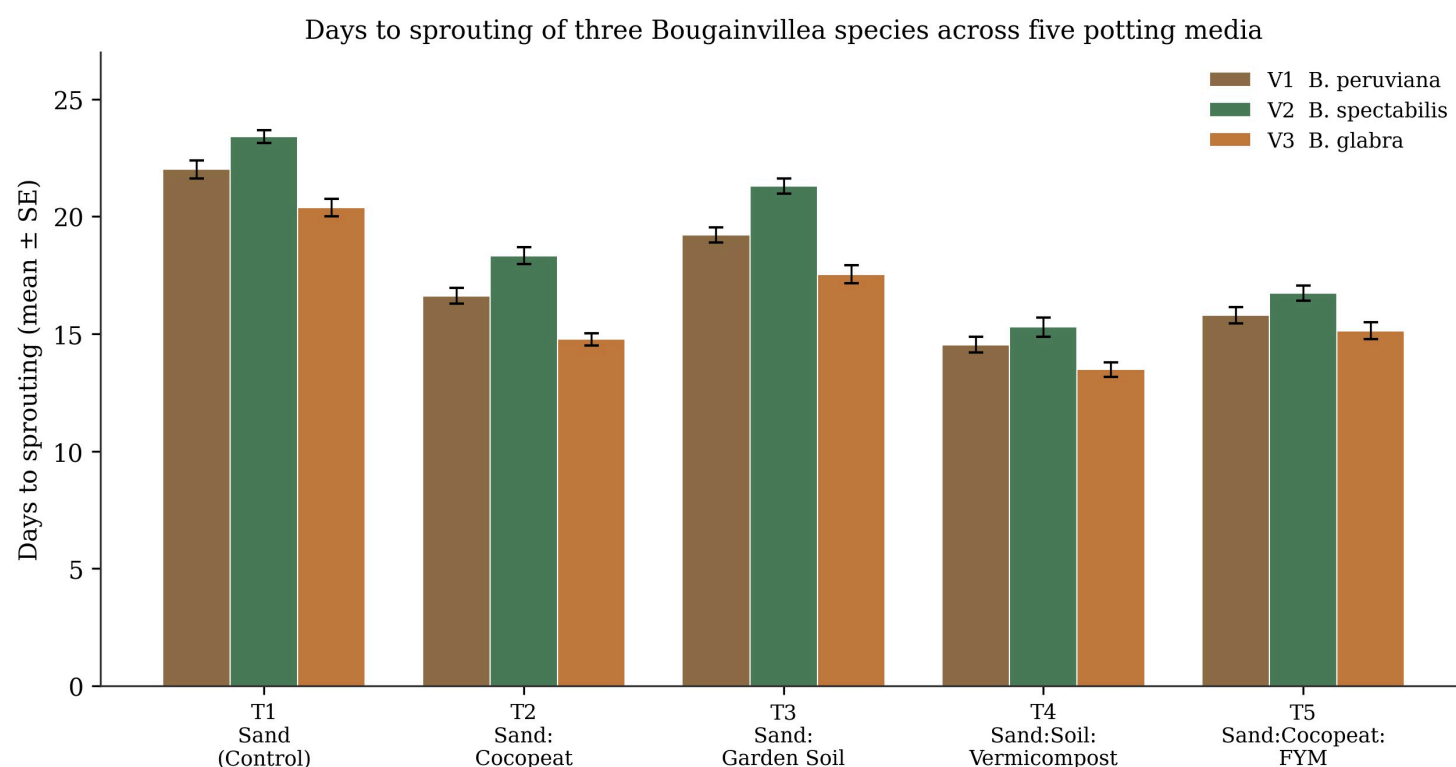


Figure 1

Days to sprouting (mean $\pm$ SE) of three *Bougainvillea* species across five potting media, illustrating the significant species $\times$ medium interaction ($P = 0.028$).

Shoot and root biomass of Bougainvillea cuttings under five potting media (pooled across species)

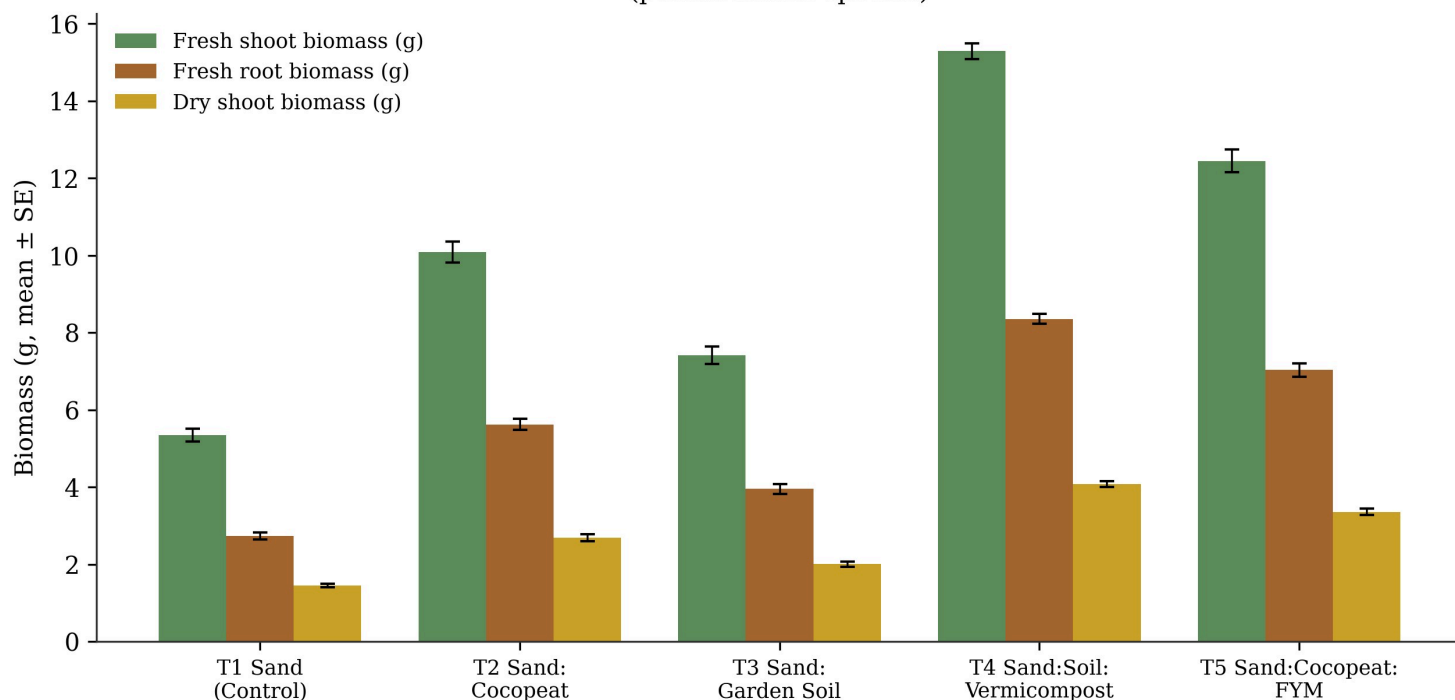


Figure 2

Fresh shoot, dry shoot, and fresh root biomass (mean $\pm$ SE) of Bougainvillea cuttings under five potting media, pooled across the three species.

Sprouting and survivability percentage of Bougainvillea cuttings under five potting media (pooled across species)

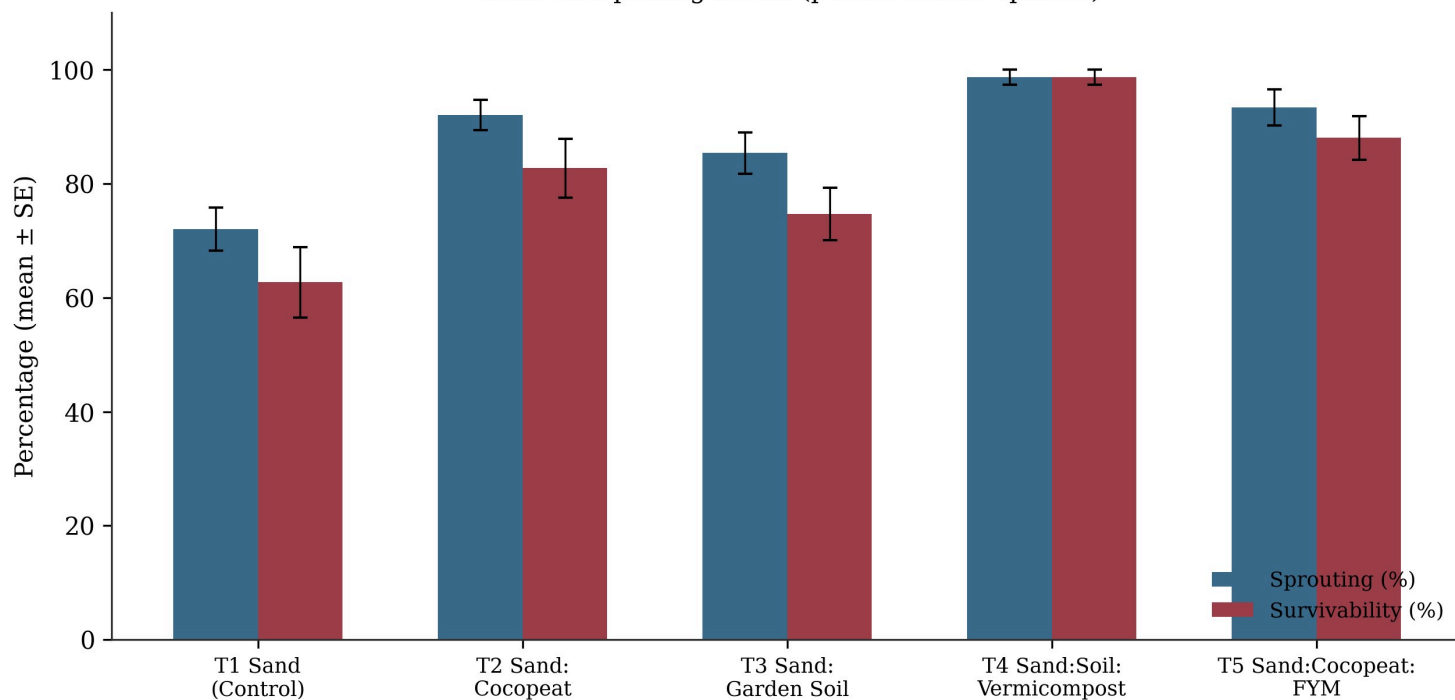


Figure 3

Sprouting percentage and survivability percentage (mean $\pm$ SE) of Bougainvillea cuttings under five potting media, pooled across the three species.