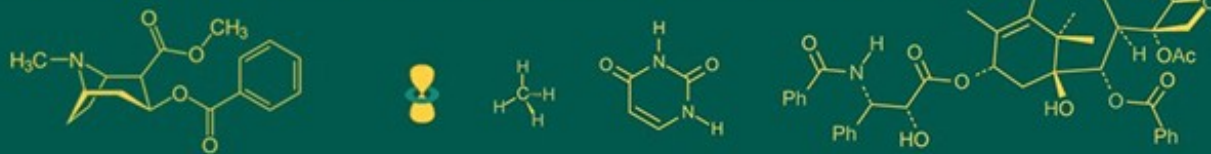


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Influence of auxin type and concentration on propagation responses of hardwood cuttings of bougainvillea 'Partha'

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ABSTRACT

A propagation experiment was conducted at Kolaghat, West Bengal, India, to evaluate the effects of three auxins—indole-3-acetic acid (IAA), indole-3-butyric acid (IBA) and naphthalene acetic acid (NAA)—each at 500, 1000 and 1500 ppm, on hardwood cuttings of bougainvillea 'Partha'. Ten treatments, including an untreated control, were arranged in a randomized block design with three replications and seven cuttings per treatment per replication. Auxin treatment markedly improved early bud and root initiation and subsequent vegetative and root development relative to the control. IAA at 1500 ppm produced the earliest bud initiation (7 days), whereas IAA at 1000 ppm produced the earliest root initiation (7 days). IBA at 1500 ppm recorded the highest number of leaves (21), roots (10.5) and mean root length (9.8 cm), while IBA at 1000 ppm produced the highest number of buds (3.5). The untreated control required 15 days for first bud initiation and 14 days for first rooting and had only 9 leaves, 2.4 buds, 5.6 roots and 1.4 cm mean root length. The results indicate that auxin response is trait-specific; IAA favoured rapid initiation, while IBA, particularly at 1500 ppm, promoted stronger post-initiation root and shoot development. IBA at 1500 ppm therefore appears promising for nursery multiplication of 'Partha', although confirmation across seasons and with rooting/survival percentage is warranted. Gopal Singh false

Keywords: *Bougainvillea*, Hardwood cutting, IAA, IBA, NAA, Vegetative propagation

Introduction

Bougainvillea is an important ornamental woody climber valued for its prolonged display of brightly coloured bracts and its adaptability to tropical and subtropical landscapes. Commercial multiplication depends largely on clonal propagation because vegetative methods preserve cultivar identity. Hardwood cuttings are inexpensive and suitable for nursery-scale multiplication, but rooting performance can vary with genotype, physiological condition, rooting environment and auxin treatment.

Auxins regulate adventitious root formation through effects on cell division, differentiation and root primordium development. Indole-3-butyric acid (IBA) is widely used for rooting woody cuttings because of its relative stability, while indole-3-acetic acid (IAA) and naphthalene acetic acid (NAA) can also modify sprouting and rooting responses. Earlier work in bougainvillea has shown substantial cultivar- and concentration-dependent responses to auxins. Singh (2012) [1] reported significant effects of IBA concentration and cultivar on sprouting and rooting, and Kumar *et al.* (2021) [2] observed differential responses of hardwood cuttings to IAA, IBA and NAA. More recent studies likewise demonstrate that rooting response depends on both auxin dose and propagation conditions (Qudoos *et al.*, 2024; Kumar *et al.*, 2026) [3, 4].

Information on the response of cultivar 'Partha' to different auxins is limited. The present investigation therefore compared IAA, IBA and NAA at three concentrations for their effects on the timing of bud and root initiation and on subsequent leaf, bud and root development in hardwood cuttings of bougainvillea 'Partha'.

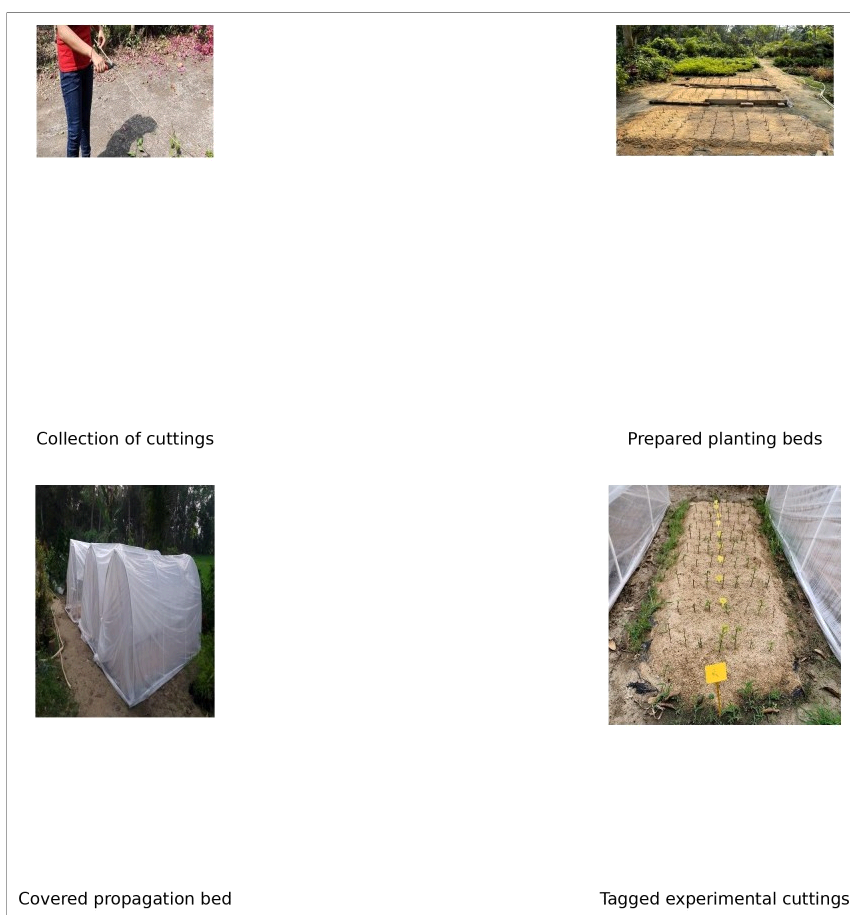
Material and methods

The experiment was conducted at Kolaghat, West Bengal, India, beginning on 22 March 2021. Hardwood cuttings of bougainvillea 'Partha' were used. The experiment comprised 10 treatments in a randomized block design with three replications. Each treatment contained seven cuttings per replication, giving 210 cuttings in total. Plant-to-plant spacing was 10 cm and the recorded plot length was 290 cm. The propagation beds were covered after planting and individual treatment units were tagged.

Table 1. Auxin treatments used for hardwood cuttings of bougainvillea 'Partha'.

Treatment	Auxin	Concentration (ppm)
T_1	IAA	500
T_2	IAA	1000
T_3	IAA	1500
T_4	IBA	500
T_5	IBA	1000
T_6	IBA	1500
T_7	NAA	500
T_8	NAA	1000
T_9	NAA	1500
T_{10}	Control	—

The observations available in the source dataset were days to first bud initiation, days to first root initiation, number of leaves per cutting, number of buds per cutting, number of roots per cutting and mean root length. Treatment means, standard error of mean (SEm) and critical difference (CD) at the 5% level were taken from the original randomized-block analysis. Because replication-level raw observations were not available in the supplied document, the statistical analysis was not recalculated.

**Plate 1.** Major steps in establishment of the hardwood-cutting experiment at the nursery.

Results and discussion

Auxin treatments altered both the onset of growth and the magnitude of subsequent shoot and root development (Table 2). First bud initiation ranged from 7 to 15 days. T_3 (IAA 1500 ppm) was earliest at 7 days, followed by T_7 and T_9 at 8 days, whereas the control required

15 days. With a reported CD (5%) of 2.30 days, the 8-day advantage of T_3 over the control was substantial. Root initiation was earliest under T_2 (IAA 1000 ppm; 7 days), followed by T_6 (IBA 1500 ppm; 8 days), compared with 14 days in the control (CD 5% = 2.06 days). These responses indicate that IAA was particularly effective for accelerating the initial developmental events in 'Partha'.

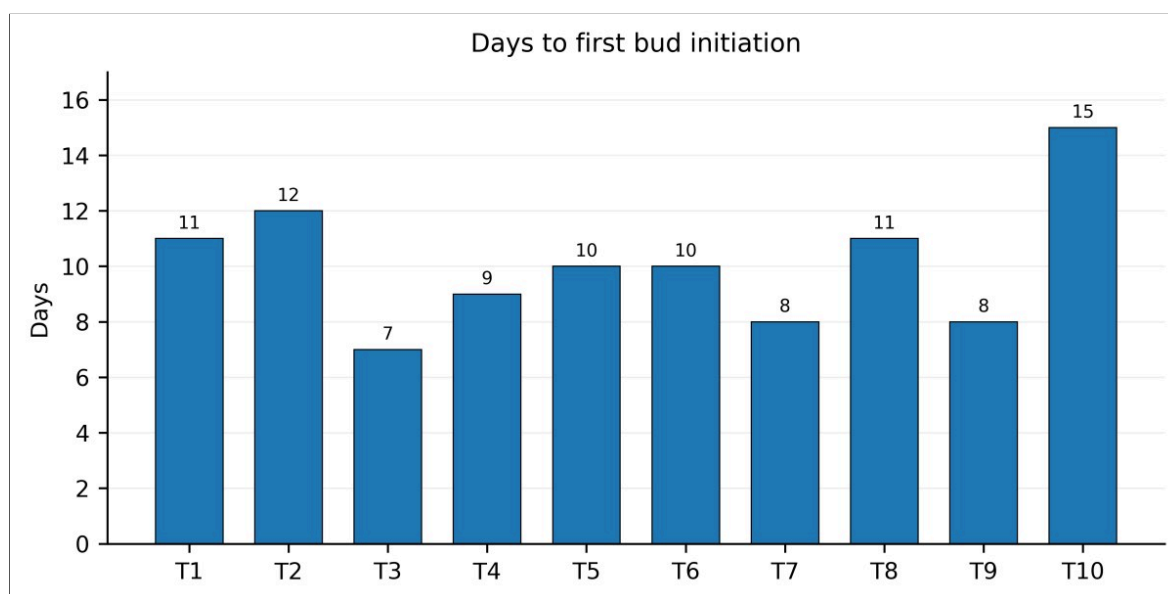


Figure 1. Days to first bud initiation in hardwood cuttings of bougainvillea 'Partha'.

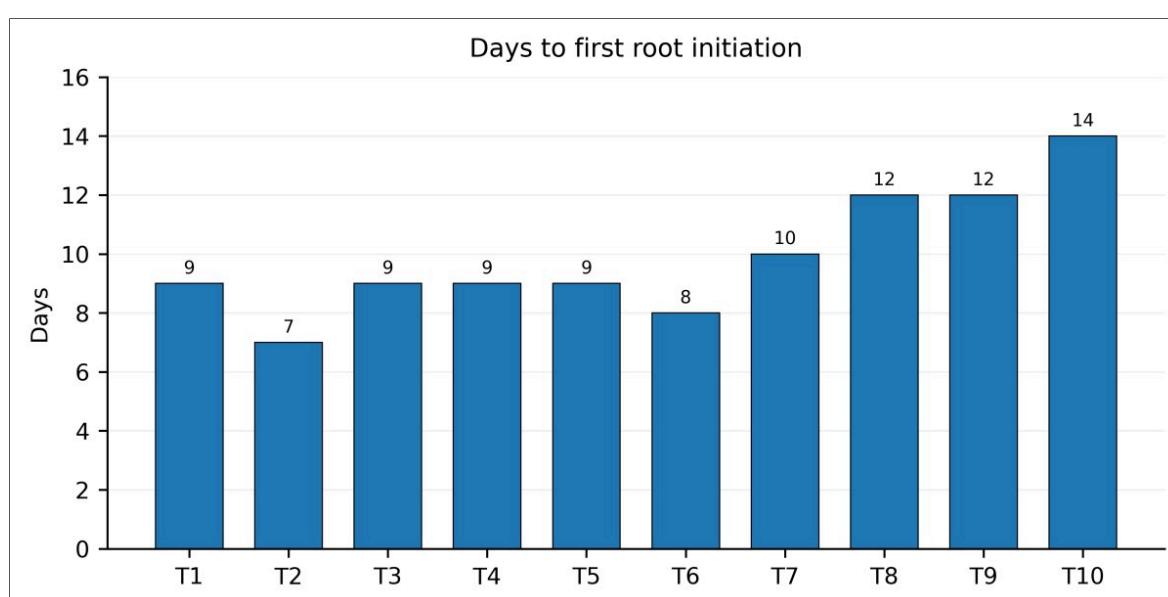


Figure 2. Days to first root initiation in hardwood cuttings of bougainvillea 'Partha'.

Post-initiation growth showed a different pattern. The maximum leaf number was recorded in T_6 (IBA 1500 ppm; 21 leaves per cutting), closely followed by T_4 and T_5 (20 leaves), while the control produced only 9 leaves. The reported CD (5%) was 3.47, indicating a clear improvement of the higher-performing IBA treatments over the control.

Bud number varied from 2.4 in the control to 3.5 under T_5 (IBA 1000 ppm); the difference exceeded the reported CD of 0.29. The superior vegetative growth under IBA may reflect improved root-system development and consequently greater capacity for water and nutrient acquisition.

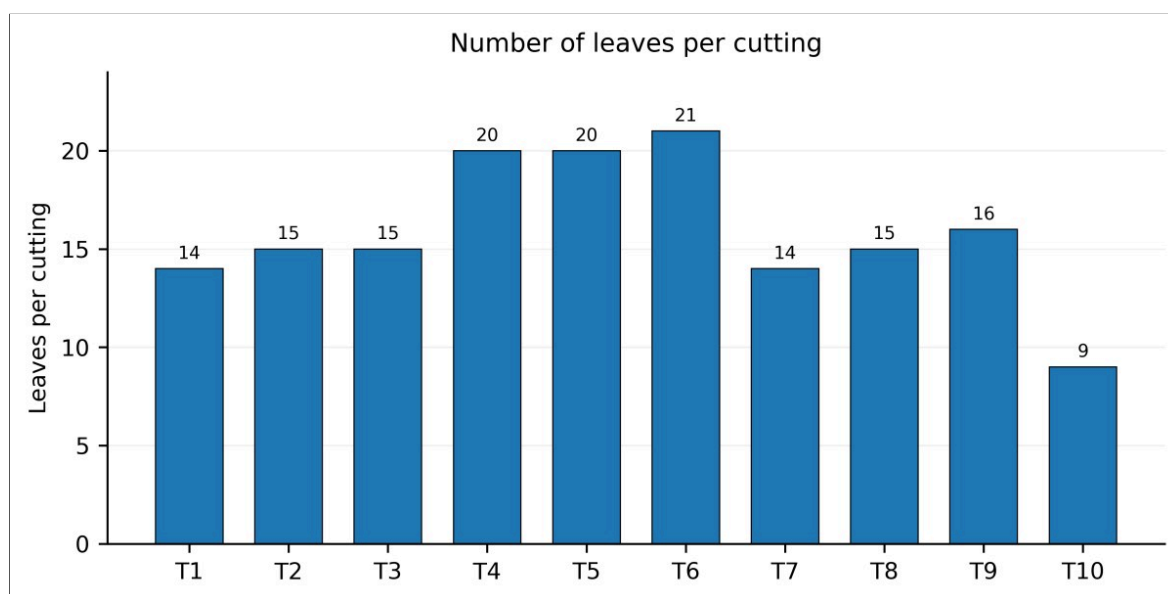


Figure 3. Number of leaves per cutting as affected by auxin treatment.

Root-system quality was most strongly enhanced by IBA. T_6 (IBA 1500 ppm) recorded 10.5 roots per cutting and a mean root length of 9.8 cm, compared with 5.6 roots and 1.4 cm in the control. T_4 and T_5 also produced more than 10 roots per cutting with mean root lengths above 9 cm. The reported CD (5%) values were 1.39 roots and 2.44 cm for root length. These findings are consistent with the estab-

lished role of IBA in adventitious rooting of bougainvillea. Singh (2012) [1] documented improved rooting responses to IBA in several bougainvillea cultivars, while Kumar *et al.* (2021) [2] reported strong root growth under IBA in 'Manila Red'. Variation among published optimum concentrations emphasizes that auxin requirement is geno-type- and environment-dependent rather than universal.

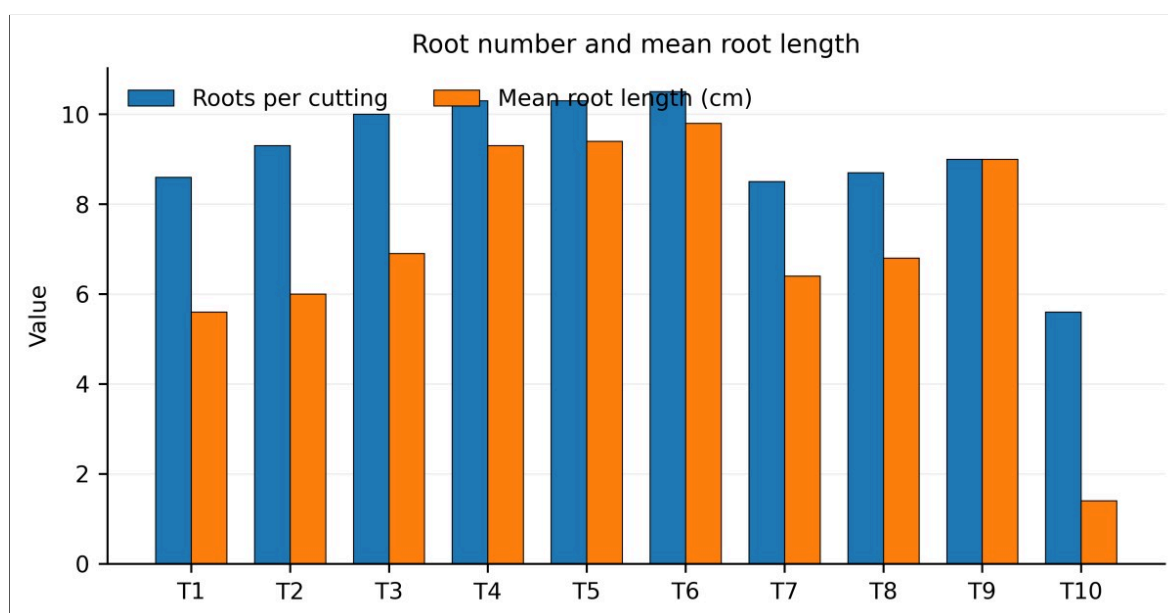


Figure 4. Root number and mean root length of hardwood cuttings under different auxin treatments.

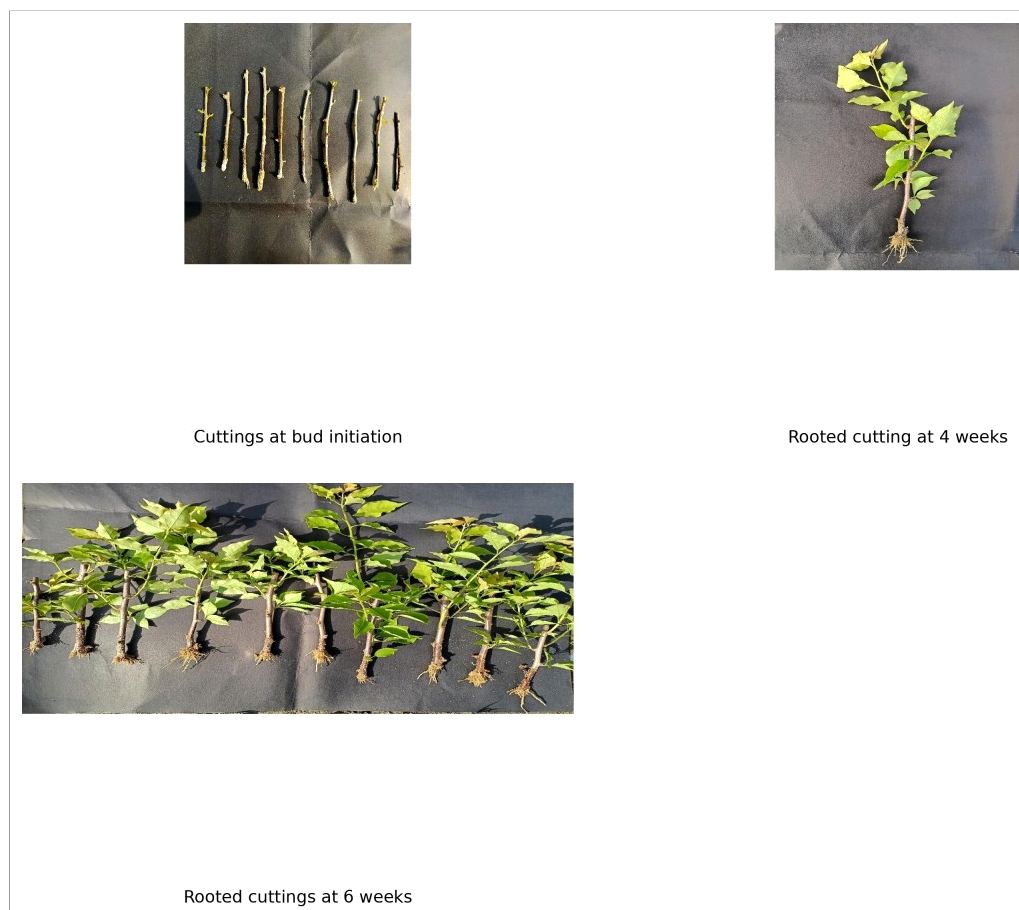


Plate 2. Representative developmental stages and root formation in experimental bougainvillea cuttings.

Table 2. Effect of auxin treatments on propagation responses of hardwood cuttings.

Trt.	Bud init. (days)	Root init. (days)	Leaves (no.)	Buds (no.)	Roots (no.)	Root length (cm)
T_1	11	9	14	3	8.6	5.6
T_2	12	7	15	3.1	9.3	6
T_3	7	9	15	3.3	10	6.9
T_4	9	9	20	3.3	10.3	9.3
T_5	10	9	20	3.5	10.3	9.4
T_6	10	8	21	3.3	10.5	9.8
T_7	8	10	14	3	8.5	6.4
T_8	11	12	15	3.2	8.7	6.8
T_9	8	12	16	3.1	9	9
T_{10}	15	14	9	2.4	5.6	1.4
SEm	0.77	0.71	1.20	0.10	0.48	0.84
CD (5%)	2.30	2.06	3.47	0.29	1.39	2.44

Conclusion

The study demonstrates distinct auxin-specific responses in hardwood cuttings of bougainvillea 'Partha'. IAA at 1500 ppm accelerated bud initiation and IAA at 1000 ppm accelerated root initiation, whereas IBA at 1500 ppm gave the strongest overall root and leaf development. On the basis of the measured traits, IBA at 1500 ppm is a promising treatment for nursery propagation where a well-developed root system is the principal objective. Future validation should include rooting and survival percentages, shoot length and biomass,

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