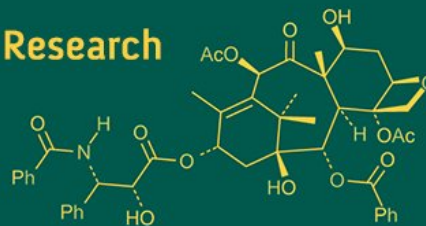
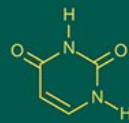


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Influence of IBA on root initiation in air layering of different litchi (*Litchi chinensis* sonn.) varieties under bastar plateau condition

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Abstract

The present investigation was carried out at the to study the effect of different concentrations of Indole-3-butyric acid (IBA) on air layering of litchi varieties. The experiment was laid out in Factorial Randomized Block Design with five varieties and four IBA levels. The results revealed significant variation among varieties and IBA levels for all growth and rooting parameters. Among varieties, Indira Litchi-1 and Indira Litchi-2 performed significantly better in terms of root initiation, root growth, shoot growth, and survival percentage. Among IBA levels, L4 (4000 ppm) recorded superior performance for all parameters, including minimum days to root initiation (18.76 days), maximum number of roots (10.15), root length (12.81 cm), fresh and dry weight of roots, and survival percentage (74.95%). The interaction effect was found significant for most parameters. The study concluded that 4000 ppm IBA is the most effective concentration for successful air layering in litchi under Bastar Plateau conditions.

Keywords: *Litchi*, air layering, IBA, rooting

Introduction

Litchi (*Litchi chinensis* Sonn.) is an important subtropical fruit crop widely cultivated for its high economic value. Air layering is the most common method of propagation; however, its success depends on rapid root formation and subsequent plant growth. The use of plant growth regulators like Indole-3-butyric acid (IBA) plays a crucial role in enhancing rooting and establishment. However, varietal differences and optimal IBA concentration are critical factors affecting propagation success. Therefore, the present study was undertaken to evaluate suitable IBA levels for different litchi varieties under Bastar Plateau conditions.

Material and Methods

The present experiment was conducted at litchi orchard of research cum instructional Farm, Jagdalpur, during the year 2024-25 unifrom vigorous, healthy and disease free plant of cultivar indira litchi-1, shahi, roce secented, china, indira litchi-2 were selected for air layering operation during month of mid- July and August after the onset of rains and maintained with uniform cultural practices as for air layering branch, 45-60 cm long and 2.5 cm thick was selected. Litch Layered branches were treated with four different concentrations of IBA i.e 1000ppm, 2000ppm, 3000ppm and 4000ppm of IBA. Stock solution of IBA were prepared by dissolving two grams of IBA in 500ml of water having a strength of 8000ppm of IBA. Experiment was laid out in Factorial Randomized Block Design (FRBD) with replications.

The girdled/exposed region was then covered with moistened soil and wrapped in a 10 × 10 cm piece of 200 gauge polyethylene film to prevent desiccation. A "sutli" string was used to securely tie both ends of the polythene. When the roots were apparent, the layers separated from the mother plants. Only when a significant number of roots had grown were the gootee or the air-layered branch cut off from the mother tree. The gootee was quickly placed in a nursery bed after being severed from the mother tree and the plastic sheet was taken off. After being planted in the nursery, the gootee received irrigation. Days to root appearance,

number of roots, root length, number of leaf, percentage survival, days to come leaf after detachment, fresh weight of shoot, dry weight of shoot, fresh weight of root, dry weight of root, relative growth rate and survival percentage on dry weight basis were among the parameters for which data were recorded. Each year's data was statistically analyzed using Factorial Randomized Block Design, year were worked out.

Results and Discussion

Days taken to root appearance

Minimum days were recorded in V₁ (18.80 days), which was at par with V₅ (18.92 days), while maximum in V₄ (23.83 days). Among IBA levels, L₄ (4000 ppm) recorded minimum days (18.76 days), significantly superior over L₁ (22.80 days). This clearly indicates that higher IBA concentration accelerates root initiation due to enhanced cell differentiation.

Number of roots

Maximum number of roots was recorded in V₅ (9.53), followed by V₃ (9.16), while minimum in V₄ (7.13). Among IBA levels, L₄ (10.15) was significantly superior. Increased IBA concentration enhances root primordia formation

Root length

Maximum root length was recorded in V₅ (12.69 cm), followed by V₁ (12.44 cm). Among levels. L₄ (12.81 cm)

showed superior performance. The increase in root length with higher IBA concentration may be due to increased cell elongation.

Number of Leaves

The highest number of leaves V₅ (15.78) and V₁ (15.75) recorded maximum leaves at 90 days. Among IBA levels, L₄ (15.58) was significantly superior. This indicates better vegetative growth under higher IBA concentration.

Fresh weight of shoot

Maximum fresh weight (34.23 g) and dry weight (26.95 g) were recorded in V₅ and V₁ respectively. Among IBA levels, L₄ showed significantly higher values, indicating better biomass accumulation

Dry weight of shoot

Maximum dry weight of root (26.95 g) were recorded in V₅ and V₁ respectively. Among IBA levels, L₄ showed significantly higher values, indicating better biomass accumulation.

Relative growth rate

Maximum At 90 days, V₅ (2.79 mm mm⁻¹ month⁻¹) recorded growth rate, followed by V₁ (2.65 mm mm⁻¹ month⁻¹). Among IBA levels, L₄ (2.25 mm mm⁻¹ month⁻¹) was superior. This indicates enhanced physiological activity under higher IBA concentration.

Table 1: Effect of different concentration of IBA on air layering in litchi varieties on days taken to root appearance at 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Days taken to root Appearance	
Factor-A (Varieties)	90 Days
V ₁ (Indira litchi -2)	18.80
V ₂ (SHAHI)	22.10
V ₃ (ROSE SCENTED)	21.77
V ₄ (CHINA)	23.83
V ₅ (Indira litchi -1)	18.92
CD	0.23
Sem. ±	0.08
Factor-B (Level)	
L ₁ (1000ppm)	22.80
L ₂ (2000ppm)	21.85
L ₃ (3000ppm)	20.93
L ₄ (4000ppm)	18.76
CD	0.21
Sem. ±	0.07

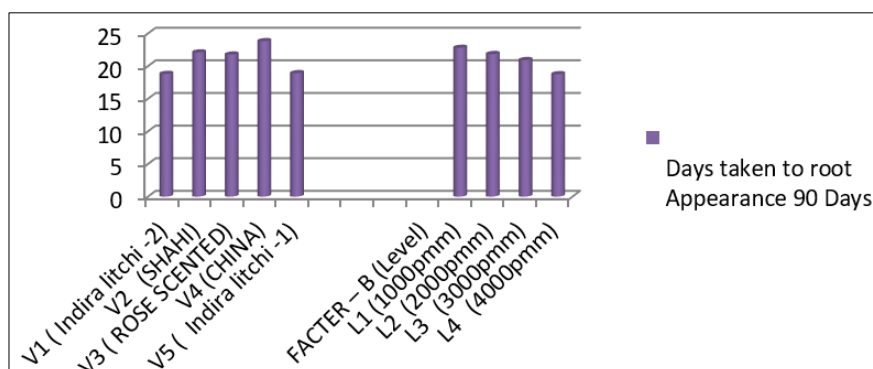


Fig 1: days taken to root appearance

The data presented in Table 1, the number of days required for root appearance in air layers was significantly influenced

by both litchi varieties and different concentrations of IBA. Among the varieties, Indira Litchi-2 (V₁) recorded the

earliest root initiation (18.80 days), followed closely by Indira Litchi-1 (V_5) (18.92 days). In contrast, China (V_4) required the maximum number of days for root appearance (23.83 days), while Shahi (V_2) and Rose Scented (V_3) showed intermediate values of 22.10 and 21.77 days, respectively. The significant varietal differences observed in rooting behavior may be attributed to inherent genetic variability, endogenous auxin levels, carbohydrate reserves, physiological maturity of shoots, and differences in tissue sensitivity to root-promoting hormones. The minimum number of days for root appearance was recorded with 4000 ppm IBA (L_4) (18.76 days), whereas the maximum duration was observed under 1000 ppm IBA (L_1) (22.80 days). The superior performance of Indira Litchi-2 and Indira Litchi-1, together with the application of 4000 ppm IBA, demonstrates their effectiveness in accelerating root initiation, thereby reducing the propagation period. These findings are in close agreement with earlier reports of Singh *et al.* (2017), Kumar *et al.* (2018) [7], Yadav *et al.* (2019) [11], Sharma and Singh (2012), [8] and Patel *et al.* (2021), who reported that higher concentrations of IBA significantly.

Table 2: Effect of different concentration of IBA on air layering in litchi varieties on number of roots at 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Number of roots	
Factor-A	90Days
V_1 (Indira litchi -2)	8.83
V_2 (SHAHI)	8.13
V_3 (ROSE SCENTED)	9.16
V_4 (CHINA)	7.13
V_5 (Indira litchi -1)	9.53
CD	0.27
Sem. $\pm$	0.09
Factor - B	
L_1 (1000pmm)	6.89
L_2 (2000pmm)	8.11
L_3 (3000pmm)	9.07
L_4 (4000pmm)	10.15
CD	0.24
Sem. $\pm$	0.08

The number of roots was significantly influenced by both litchi varieties and IBA concentrations. Among the varieties, Indira Litchi-1 (V_5) produced the maximum number of roots (9.53), followed by Rose Scented (V_3) (9.16), whereas China (V_4) recorded the minimum (7.13). These differences may be attributed to genetic variability, endogenous hormone balance, and the differential rooting potential of the varieties. The highest number of roots was observed with 4000 ppm IBA (L_4) (10.15), while the lowest was recorded with 1000 ppm (L_1) (6.89). The promotive effect of higher IBA concentration may be due to its ability to stimulate cell division, increase cambial activity, and accelerate the initiation and development of adventitious roots. These findings indicate that the application of 4000

ppm IBA is most effective for improving rooting in litchi air layering.

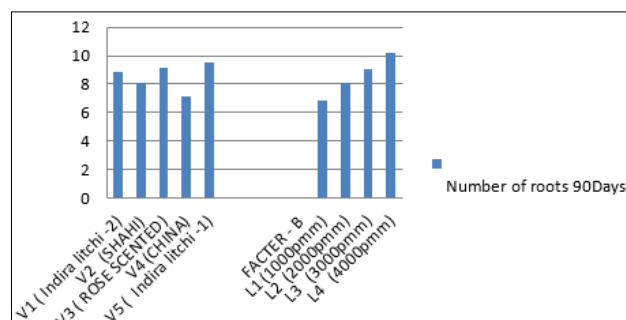


Fig 2: Number of roots

The promotive effect of higher IBA concentration may be due to its ability to stimulate cell division, increase cambial activity, and accelerate the initiation and development of adventitious roots. These findings indicate that the application of 4000 ppm IBA is most effective for improving rooting in litchi air layering. Similar observations have also been reported by Singh *et al.* (2017), Kumar *et al.* (2018) [7], Yadav *et al.* (2019) [11], Sharma and Singh (2012) [8], and Patel *et al.* (2021), who observed that increasing IBA concentrations significantly.

Table 3: Effect of different concentration of IBA on air layering in varieties on roots length (cm) at 30, 60 and 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Root length (cm)			
Factor - A	30days	60days	90days
V_1 (Indira litchi -2)	9.27	11.13	12.44
V_2 (SHAHI)	6.30	9.88	11.09
V_3 (ROSE SCENTED)	8.12	10.74	12.19
V_4 (CHINA)	5.84	8.92	10.15
V_5 (Indira litchi -1)	10.10	11.49	12.69
CD	0.20	0.44	0.42
Sem. $\pm$	0.07	0.15	0.14
Factor - B			
L_1 (1000pmm)	6.42	9.48	10.42
L_2 (2000pmm)	7.26	10.26	11.44
L_3 (3000pmm)	8.56	10.64	12.18
L_4 (4000pmm)	9.45	11.35	12.81
CD	0.18	0.39	0.37
Sem. $\pm$	0.06	0.13	0.13

Among various IBA treatments, maximum total length (12.69 cm) was recorded with application of 4000ppm IBA, the varieties, Indira Litchi-1 (V_5) recorded the maximum root length at all observation stages (10.10, 11.49, and 12.69 cm at 30, 60, and 90 days, respectively), followed by Indira Litchi-2 (V_1), whereas China (V_4) produced the shortest roots. The superior performance of Indira Litchi-1 may be attributed to its better genetic potential, efficient carbohydrate translocation, and favorable endogenous hormonal balance, which promote root elongation.

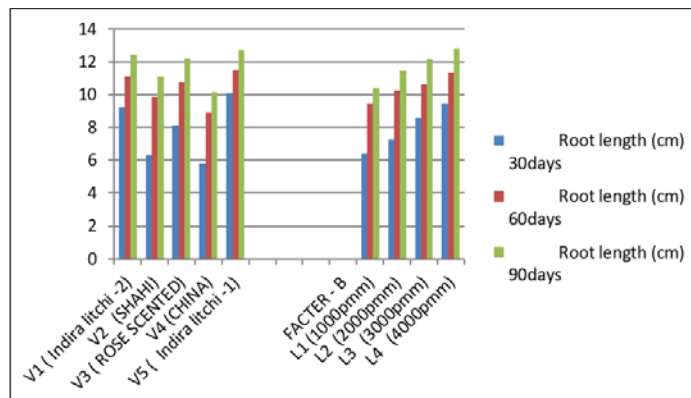


Fig 3: Root length

IBA concentration significantly influenced root length, with 4000 ppm (L₄) producing the longest roots (9.45, 11.35, and 12.81 cm at 30, 60, and 90 days, respectively). Root length increased consistently with increasing IBA concentration, while the shortest roots were observed under 1000 ppm (L₁). Similar results have also been reported by Singh *et al.* (2017), Kumar *et al.* (2018) [7], Yadav *et al.* (2019) [11], who observed significantly greater root length in litchi air layers treated with higher concentrations of IBA.

Table 4: Effect of different concentration of IBA on air layering in varieties on number of leaves at 30, 60 and 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Number of leaves			
Factor - A	30 Days	60 Days	90 Days
V ₁ (Indira litchi -2)	13.38	14.84	15.75
V ₂ (SHAHI)	12.62	13.26	13.86
V ₃ (ROSE SCENTED)	12.72	13.27	13.95
V ₄ (CHINA)	11.13	12.09	13.06
V ₅ (Indira litchi -1)	13.56	15.01	15.78
CD	0.39	0.23	0.37
Sem. ±	0.13	0.08	0.13
Factor - B			
L ₁ (1000ppm)	11.32	12.06	13.34
L ₂ (2000ppm)	12.26	12.98	14.17
L ₃ (3000ppm)	13.14	14.20	14.84
L ₄ (4000ppm)	14.02	14.63	15.58
CD	0.34	0.21	0.33
Sem. ±	0.12	0.07	0.11

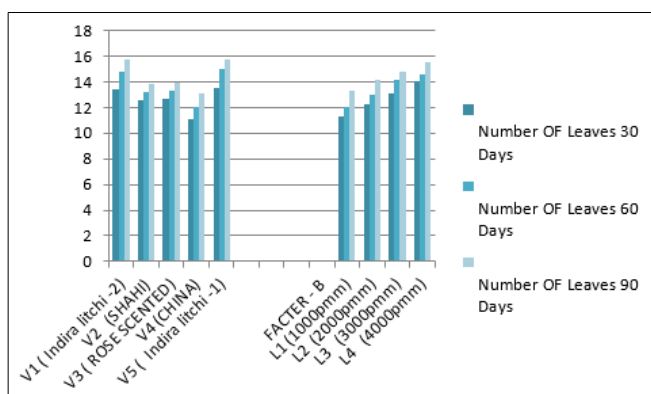


Fig 4: Number of leave

Among the varieties, Indira Litchi-1 (V₅) produced the highest number of leaves (13.56, 15.01, and 15.78 at 30, 60, and 90 days, respectively), closely followed by Indira Litchi-2 (V₁), whereas China (V₄) recorded the lowest

values. The superior leaf production in Indira Litchi-1 may be attributed to its better genetic potential, enhanced rooting ability, and efficient nutrient uptake, which promoted vigorous shoot growth.

IBA concentration significantly influenced leaf production, with 4000 ppm (L₄) recording the maximum number of leaves (14.02, 14.63, and 15.58 at 30, 60, and 90 days, respectively), while 1000 ppm (L₁) produced the minimum. The increase in leaf number with higher IBA concentration may be due to improved root development, greater absorption of water and nutrients, and enhanced physiological activity, resulting in better vegetative growth. Similar findings have also been reported by Kumar *et al.* (2018), [7] Yadav *et al.* (2019) [11], Sharma and Singh (2012) [8], and Patel *et al.* (2021), Improving vegetative establishment and overall quality of rooted litchi air layers.

Table 5: Effect of different concentration of IBA on air layering in varieties on fresh weight of shoot at 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

fresh weight of shoot (gm)	
Factor - A	90 Days
V ₁ (Indira litchi -2)	33.31
V ₂ (SHAHI)	30.23
V ₃ (ROSE SCENTED)	32.09
V ₄ (CHINA)	26.48
V ₅ (Indira litchi -1)	34.23
CD	0.30
Sem. ±	0.10
Factor - B	
L ₁ (1000ppm)	29.08
L ₂ (2000ppm)	30.80
L ₃ (3000ppm)	32.02
L ₄ (4000ppm)	33.17
CD	0.27
Sem. ±	0.09

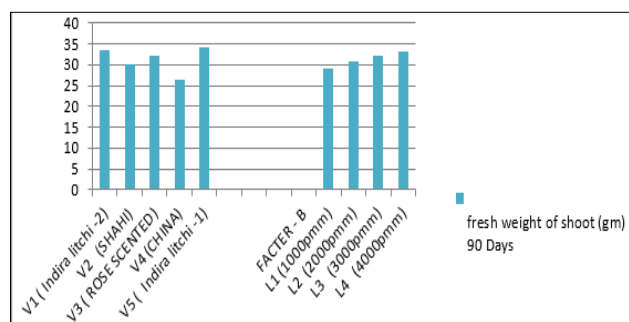


Fig 5: fresh weight of shoot

Fresh shoot weight was significantly influenced by both litchi varieties and IBA concentrations. Among the varieties, Indira Litchi-1 (V_5) recorded the highest fresh shoot weight (34.23 gm), followed by Indira Litchi-2 (V_1) (33.31 gm), whereas China (V_4) produced the lowest value (26.48 gm). The superior shoot biomass in Indira Litchi-1 may be attributed to its higher rooting efficiency, better nutrient uptake, and greater photosynthetic capacity, resulting in enhanced vegetative growth. The highest fresh shoot weight was recorded with 4000 ppm IBA (L_4) (33.17 gm), while the lowest was observed with 1000 ppm (L_1) (29.08 gm). Similar findings have been reported by Singh *et al.* (2017), and Patel *et al.* (2021), who observed that higher concentrations of IBA significantly.

Table 6: Effect of different concentration of IBA on air layering in varieties on Dry weight of shoot at 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Dry weight of shoot (gm)	
Factor-A (Varieties)	90 Day
V_1 (Indira litchi -2)	26.95
V_2 (SHAHI)	25.33
V_3 (ROSE SCENTED)	26.04
V_4 (CHINA)	16.20
V_5 (Indira litchi -1)	26.10
CD	0.24
Sem. $\pm$	0.08
Factor-B (Level)	
L_1 (1000ppm)	22.64
L_2 (2000ppm)	23.66
L_3 (3000ppm)	24.59
L_4 (4000ppm)	25.60
CD	0.21
Sem. $\pm$	0.07

Dry shoot weight was significantly affected by both litchi varieties and IBA concentrations. Among the varieties, Indira Litchi-2 (V_1) recorded the highest dry shoot weight (26.95 g), followed closely by Indira Litchi-1 (V_5) (26.10 g) and Rose Scented (V_3) (26.04 g), whereas China (V_4) produced the lowest value (16.20 g). The higher dry matter accumulation in these varieties may be attributed to their superior rooting ability, efficient nutrient uptake, and greater photosynthetic efficiency, which enhanced biomass production. IBA concentration significantly increased dry shoot weight, with 4000 ppm IBA (L_4) recording the highest value (25.60 g), while the lowest was observed at 1000 ppm (L_1) (22.64 g). The improvement in dry matter production at higher IBA concentrations may be due to enhanced root

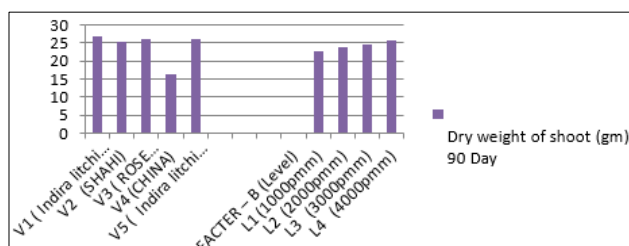


Fig 6: Dry weight of shoot

Development, efficient translocation of assimilates, and increased metabolic activity, resulting in greater accumulation of structural biomass. These findings indicate that 4000 ppm IBA is the most effective concentration for

improving dry shoot growth. Similar results have also been reported by Yadav *et al.* (2019) [11], Sharma and Singh (2012) [8], and Patel *et al.* (2021), who observed that higher concentrations of IBA significantly increased shoot dry weight and vegetative biomass in litchi propagated through air layering.

Table 7: Effect of different concentration of IBA on air layering in varieties on relative growth rate ($\text{mm mm}^{-1} \text{month}^{-1}$) at 30, 60 and 90 days after air layers of litchi (*Litchi chinensis* Sonn.)

Relative growth rate ($\text{mm mm}^{-1} \text{month}^{-1}$)			
Factor - A	30 Day	60 Day	90 Day
V_1 (Indira litchi -2)	1.50	1.66	2.65
V_2 (SHAHI)	1.40	1.46	1.71
V_3 (ROSE SCENTED)	1.47	1.50	1.77
V_4 (CHINA)	1.14	1.26	1.35
V_5 (Indira litchi -1)	1.53	1.69	2.79
CD	0.07	0.06	0.09
Sem. $\pm$	0.02	0.01	0.02
Factor - B			
L_1 (1000ppm)	0.67	0.99	1.79
L_2 (2000ppm)	1.49	1.54	1.98
L_3 (3000ppm)	1.72	1.74	2.20
L_4 (4000ppm)	1.75	1.78	2.25
CD	0.08	0.01	0.04
Sem. $\pm$	0.06	0.05	0.08

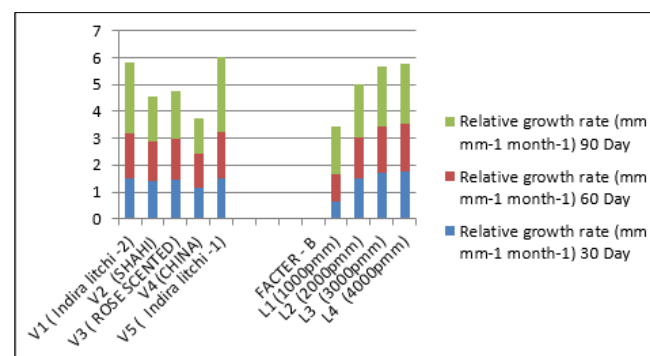


Fig 7: Relative growth rate

The air-layer raised by the application of IBA 4000ppm gave significantly higher Relative growth rate ($2.79 \text{ mm mm}^{-1} \text{month}^{-1}$). Among the varieties, Indira Litchi-1 (V_5) recorded the highest RGR (1.53, 1.69, and $2.79 \text{ mm mm}^{-1} \text{month}^{-1}$ at 30, 60, and 90 days, respectively), closely followed by Indira Litchi-2 (V_1), whereas China (V_4) exhibited the lowest values. The superior growth performance of Indira Litchi-1 may be attributed to its better genetic potential, efficient root development, and greater assimilate accumulation, IBA concentration significantly enhanced RGR, with 4000 ppm (L_4) producing the highest values (1.75, 1.78, and $2.25 \text{ mm mm}^{-1} \text{month}^{-1}$), while 1000 ppm (L_1) recorded the lowest. These findings demonstrate that 4000 ppm IBA is the most effective concentration for promoting vigorous growth in litchi air layers. Similar findings have been reported by Singh *et al.* (2017), Kumar *et al.* (2018) [7], Yadav *et al.* (2019) [11], Sharma and Singh (2012) [8], and Patel *et al.* (2021), who observed that higher concentrations of IBA significantly.

Conclusion

Based on the present investigation, it can be concluded that Indira Litchi-1 and Indira Litchi-2 are the most suitable

varieties for air layering Application of IBA @ 4000 ppm significantly improves rooting, growth, and survival. Higher IBA concentration enhances overall propagation success in litchi air-layering.

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