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Influence Concentration and Immersion Time, Substance Regulator Growth of IBA (Indole-3-Butyric Acid) Against Early Seedling Growth Cuttings, Plant Jasmine White (*Jasminum sambac*)

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Abstract
White jasmine (*Jasminum sambac* (L.) Aiton) is an ornamental plant of high economic value that requires access to quality, uniform seeds. Propagation through stem cuttings often faces challenges in root formation and initial growth. This study aims to analyze the effects of Indole-3-Butyric Acid (IBA) concentration and soaking time on the initial growth of white jasmine cuttings. The study employed a factorial completely randomized design with two factors: IBA concentration (0, 50, 100, and 150 parts per million) and soaking time (30, 60, and 90 minutes). The parameters observed included shoot emergence time, shoot length, number of leaves, number of primary roots, and root fresh weight. Data were analyzed using analysis of variance at a 5% significance level. The results showed a significant interaction between concentration and soaking time for all parameters. The combination of 100 ppm IBA with a 60-minute soaking time resulted in the fastest shoot emergence (11.27 days), the longest shoot length at eight weeks after planting (11.27 cm), the highest number of leaves (12.60), the greatest number of primary roots (12.52), and the largest fresh root weight (1.06 g). Treatments without growth regulators showed the lowest values for most parameters. Thus, a concentration of 100 ppm with a 60-minute soaking time was the most effective combination for enhancing the initial growth of white jasmine cuttings. Applying this treatment has the potential to improve seedling quality and uniformity, supporting the development of white jasmine cultivation.

Keywords: Auxin, Growth Vegetative, Nursery, Propagation Vegetative, Roots Adventitious

1. Introduction

Jasmine white (*Jasminum sambac* (L.) Aiton) is a tropical ornamental plant with significant economic and cultural importance in Indonesia. This plant is widely used as a raw material in the perfume and tea industries, as well as in cosmetics, decoration, and traditional ceremonies. Jasmine production in Indonesia is concentrated in Central Java Province, with Pemalang Regency among the main production centers. The high market demand for jasmine flowers requires a steady supply of high-quality, uniform seeds. In 2023, Indonesia successfully exported jasmine to various countries, achieving strong economic performance, with Central Java as the leading jasmine-producing province. In 2024, Central Java produced 14,275,777 kg of jasmine flowers, accounting for 86.18% of national production and making it the largest contributor to jasmine production in Indonesia (BPS, 2024). Pemalang Regency, as one of the key jasmine production centers in Central Java, contributed 4,825,052 kg to this total (Direktora Jendral Hortikultura, 2018).

Propagation of the jasmine white plant is generally done vegetatively through stem cuttings, because it is faster and more capable of maintaining the plant's characteristic genetics. This method is also appropriate for difficult plants that produce fruit and seeds; have fast seeds, experience a decline in viability, and for maintaining clones with

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characteristic superior genetics (Mariana, 2017). However, in practice, farmers still face obstacles at the stage of forming suboptimal root cuttings. The low percentage of life and growth, and the unexpected beginning, uniformity, and factor barriers in the provision of seedlings. This condition affects the quality and quantity of jasmine plant production in the field.

Study about application auxin in propagation vegetative jasmine white (*Jasminum sambac* (L.) W. Ait .) has reported previously, one of them was by Wulandari and Mukarlina (2013) which showed that administration of 75 ppm IBA increases quantity and weight root cuttings, while coconut water increases 60% growth title, with long soaking time cuttings set for 1 hour and without interaction real between factor treatment. Although no study has yet examined the effect of soaking time on IBA absorption by tissue cuttings. In physiological conditions, the duration of immersion potential determines the extent of IBA diffusion and accumulation in the network; the next step influences root formation and growth at the beginning of seed germination. Therefore that, research This test higher concentration of IBA area, namely 0, 50, 100, and 150 ppm, which are combined with soaking times of 30, 60, and 90 minutes in design factorial, use analyze the influence of each factor as well as the interaction to growth beginning seeds cuttings jasmine white so that obtained more information comprehensive about optimization technique IBA application in propagation vegetative .

Internal and external plant factors greatly influence the success of cuttings. Plant growth regulators (PGRs) of the auxin group are one way to increase root formation. Indole-3-Butyric Acid (IBA), or indole-3-butyric acid with the chemical formula $C_{12}H_{13}NO_2$, is a synthetic auxin that functions to stimulate cell division and differentiation, thereby accelerating adventitious root formation. The effectiveness of IBA is influenced by solution concentration and the time the cuttings are soaked before planting. Incorrect soaking concentration and duration can result in a suboptimal growth response.

Based on these problems, this study focused on testing the effect of IBA concentration and soaking duration on the initial growth of white jasmine cuttings. The research questions include: (1) how does IBA concentration affect the growth of cuttings; (2) how does soaking duration affect the growth of cuttings; and (3) is there an interaction between IBA concentration and soaking duration on the growth of white jasmine cuttings.

2. Material and Methods

2.1. Time and Place

The research was conducted from November 2025 to January 2026 on agricultural land in Kertosari Village, Ulujami District, Pemalang Regency, Central Java, with coordinates -6.8472218, 109.5597028, at an altitude of 3–5 meters above sea level. The research location has an average temperature of around 30 °C, rainfall of ±2,300 mm/year, air humidity of 55–95%, and muddy clay soil texture.

2.2. Tools and materials

The tools used include hoes, small shovels, sickles, pruning shears, buckets, measuring cups, Erlenmeyer flasks, watering cans, sprayers, meters, rulers, digital scales, and marker labels. The materials used include white jasmine stem cuttings (*Jasminum sambac* (L.) Aiton) with a shoot length of 20 centimeters, a diameter of 0.3–0.5 centimeters, and at least two buds; PGR Indole-3-Butyric Acid (IBA) in powder form; 70% alcohol; and distilled water (aquades).

2.3. Research Design

The study used a factorial design in a Completely Randomized Design (CRD) with two factors, namely IBA concentration and cutting immersion time. IBA concentration levels are 0 ppm, 50 ppm, 100 ppm, and 150 ppm. The immersion time consists of three levels: 30, 60, and 90 minutes. The combination of these two factors yielded 12 treatments, each repeated three times, for a total of 36 experimental units. Each experimental unit consisted of 7 cuttings with 5 plants as observation samples. The IBA solution was prepared by dissolving IBA powder with a few drops of 70% alcohol, then diluting it to 1 liter with distilled water, according to the treatment concentration: 0.05 g/liter for 50 ppm, 0.1 g/liter for 100 ppm, and 0.15 g/liter for 150 ppm. Observation data were analyzed using analysis of variance to determine the effects of each factor and its interactions.

2.4. Observation Parameters

1. Time of Emergence of Shoots

The time of emergence of shoots is recorded from the day of planting until the first shoots appear on each cutting. Data stated in unit days after planting (HST).

2. Shoot Length

The length of the shoot is measured from the base to the tip with a ruler and expressed in centimeters.

3. Amount Leaf

The number of leaves counted on the leaves that have fully bloomed on every plant sample.

4. Amount

The number of primary roots is counted at the end of the observation after the plant is carefully removed.

5. Wet Weight

The wet weight of the roots was measured immediately after the plants were removed and cleaned of any remaining soil.

2.5. Data analysis

Observation data were analyzed using analysis *of variance* (ANOVA) with a factorial design in a completely randomized design (CRD) to determine the effects of IBA concentration, soaking duration, and their interaction on each parameter. If there is a significant difference at the 5% significance level, further tests are carried out to compare the average treatment effects in accordance with the statistical procedures used in the study.

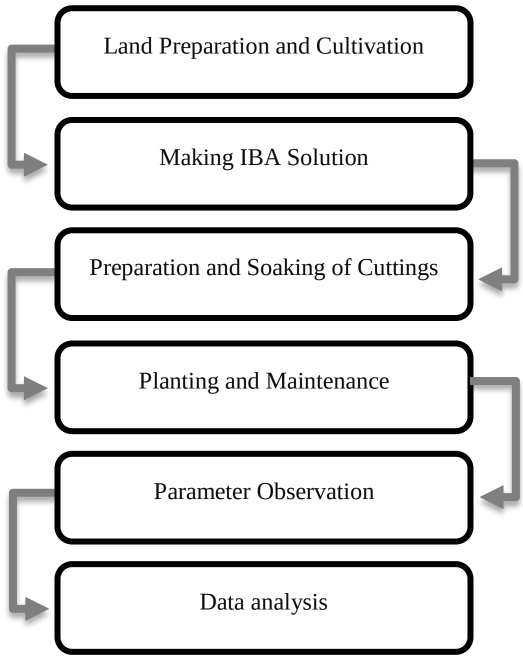

Figure 1. Research flow diagram.

3. Results and Discussion

3.1. Time of Emergence of Shoots

The results of the analysis of variance showed that the interaction between IBA concentration and soaking duration significantly affected the time to shoot emergence. The average time to shoot emergence of white jasmine cuttings in the combination of IBA concentration and soaking duration is presented in Table 1.

Table 1 shows the fastest average shoot emergence time obtained with a 100 ppm IBA concentration (60 minutes), namely 11.27 days, while the treatment without IBA (0 ppm, 60 minutes) showed the slowest shoot emergence time, namely 18.67 days. Auxin is known to stimulate cell division and elongation, thereby accelerating shoot meristem activity (Javed and Gurdon, 2022). According to Vanneste *et al.* (2010), Auxin is the main signal that regulates plant growth and development. The gradient and distribution of auxin in tissues provide cellular instructions for developmental transitions, including the initiation and differentiation of vegetative organs. The accelerated response in shoot emergence time under the 100 ppm concentration treatment with a 60-minute immersion duration indicates that this combination creates physiological conditions that support shoot activity of meristematic tissue more effectively than other treatments.

3.2. Shoot Length

The results of the variation analysis showed that the combination of concentration and immersion duration in IBA PGR had a significant effect on the length of white jasmine cuttings at 5, 6, 7, and 8 WAP. The average shoot length of white jasmine cuttings due to the combination of concentration and duration of IBA PGR treatment is presented in Table 2.

Table 1. Average Time to Shoot Emergence (DAP) of Cuttings Plant Jasmine White In Combination Treatment Concentration and Immersion Time Substance Regulator Growing IBA

IBA PGR Concentration (ppm)	**Shoot Emergence Time (DAP)**		
	Soaking Time (minutes)		
	30 minutes	**60 minutes**	**90 minutes**
0 ppm	18.40 ± 0.60 c	18.67 ± 0.18 c	18.00 ± 0.07 c
50 ppm	17.67 ± 0.24 c	17.40 ± 0.31 c	17.47 ± 0.37 c
100 ppm	13.67 ± 0.35 b	11.27 ± 0.41 a	12.87 ± 0.07 ab
150 ppm	13.73 ± 0.18 b	13.00 ± 0.12 ab	12.00 ± 0.12 ab
BNJ 5%		2.12	

Description: The average number followed by the same letter at the same observation age shows no significant difference in the 5% BNJ test; HST: Days After Planting.

The average length of white jasmine cuttings (Table 2) resulting from the combination of IBA concentration and soaking treatment showed a significant effect. The combination of 100 ppm IBA and a soaking duration of 60 minutes resulted in longer average shoots than the other treatments, namely 3.37 cm at 5 WAP, 5.20 cm at 6 WAP, 8.40 cm at 7 WAP, and 11.27 cm at 8 WAP. Meanwhile, shorter shoot lengths were observed with the 0 ppm IBA concentration and a soaking duration of 30 minutes, namely 2.33 cm at 5 WAP; 3.43 cm at 6 WAP; 4.43 cm at 7 WAP, and 7.33 cm at 8 WAP. Auxin increases cell wall elasticity, making cells more easily elongated by turgor pressure. Firdausy et al. (2023) explain that IBA plays a role in stimulating vegetative growth through stimulation of division and elongation, supporting the growth of organs in plants.

Research by Yulianto et al. (2015) also reported that IBA administration led to increased shoot growth in vegetatively propagated plants. A concentration of 100 ppm is effective in stimulating white jasmine shoot growth. The increase in shoot length of ±1.62 cm at 60 minutes compared to 30 minutes indicates a significant increase in growth vigor. Arini (2024) explains that IBA administration increases the length of roots and accelerates the emergence of shoots. This shows that IBA is effective in stimulating root formation, which plays an important role in increasing the ability to absorb water and nutrients, supporting growth at the beginning of the vegetative phase.

Table 2. Average Shoot Length (cm) of White Jasmine Cuttings in Combinations of IBA Plant Growth Regulator Concentration and Soaking Time

Age (MST)	IBA PGR Concentration (ppm)	Shoot Length (cm)		
		Soaking Time (minutes)		
		30 minutes	60 minutes	90 minutes
5	0 ppm	2.33 ± 0.09 a	2.33 ± 0.07 a	2.40 ± 0.23 a
	50 ppm	2.40 ± 0.06 a	2.53 ± 0.18 ab	2.87 ± 0.13 ab
	100 ppm	2.80 ± 0.12 ab	3.37 ± 0.09 b	2.73 ± 0.18 ab
	150 ppm	2.73 ± 0.13 ab	3.00 ± 0.12 ab	2.87 ± 0.07 ab
	BNJ 5%		0.94	
6	0 ppm	3.43 ± 0.09 a	3.53 ± 0.24 a	3.47 ± 0.18 a
	50 ppm	3.73 ± 0.18 ab	3.87 ± 0.07 ab	3.80 ± 0.12 ab
	100 ppm	4.07 ± 0.07 ab	5.20 ± 0.12 b	4.47 ± 0.07 b
	150 ppm	4.20 ± 0.12 ab	4.20 ± 0.12 ab	4.73 ± 0.07 b
	BNJ 5%		0.93	
7	0 ppm	4.43 ± 0.12 a	4.53 ± 0.07 ab	4.87 ± 0.07 ab
	50 ppm	5.20 ± 0.12 b	5.33 ± 0.07 b	5.33 ± 0.18 b
	100 ppm	7.13 ± 0.07 c	8.40 ± 0.12 d	7.20 ± 0.07 c
	150 ppm	7.93 ± 0.12 d	7.93 ± 0.07 d	8.33 ± 0.07 d
	BNJ 5%		0.71	
8	0 ppm	7.33 ± 0.07 a	7.73 ± 0.07 ab	7.60 ± 0.12 ab
	50 ppm	8.33 ± 0.07 b	8.80 ± 0.12 bc	9.33 ± 0.07 c
	100 ppm	10.40 ± 0.12 d	11.27 ± 0.07 e	10.00 ± 0.13 cd
	150 ppm	10.67 ± 0.12 de	10.40 ± 0.00 d	10.47 ± 0.24 de
	BNJ 5%		0.68	

Description: The average number followed by the same letter at the same observation age shows no significant difference in the 5% BNJ test; MST: Weeks After Planting.

3.3. Number of Leaves

The results of the variation analysis showed that the combination of IBA concentration and soaking duration treatments significantly affected the number of leaves of white jasmine cuttings at 5, 6, 7, and 8 days after planting. The average number of leaves of white jasmine cuttings in the combination of IBA concentration and soaking duration treatments is presented in Table 3.

Table 3 shows that the combination of concentration and duration of immersion in IBA PGR has a significant effect on the number of leaves on white jasmine cuttings at the ages of 5, 6, 7, and 8 WAP. The largest average number of leaves on white jasmine cuttings was achieved in the combination of 100 ppm IBA concentration and 60 minutes immersion time, namely 4.93 leaves at the age of 5 WAP, 7.53 leaves at the age of 6 WAP, 10.53 leaves at the age of 7 WAP, and 12.60 leaves at the age of 8 WAP. Meanwhile, the number of leaves with a lower value was found in the combination of 0 ppm IBA PGR concentration treatment with a 30-minute immersion duration, namely 4.00 leaves at the age of 5 WAP, 6.00 leaves at the age of 6 WAP, 8.07 leaves at the age of 7 WAP, and 9.73 leaves at the age of 8 WAP.

An optimal root system supports more efficient water and nutrient absorption, thereby accelerating the formation of vegetative organs. Taiz et al. (2015) explain that the relationship between root and shoot growth is mutually influential, as roots provide the nutrients needed for the formation of new tissue in the upper part of the plant.

Apriliani et al. (2015) stated that IBA has a role in stimulating activity in division cells in meristematic tissue, which accelerates bud formation and has implications for the formation of more leaves faster; the next one increases the capacity for photosynthesis in plants. With increasing leaf area and quantity, energy utilization and nutrient absorption become more efficient, supporting vegetative growth. Furthermore, Asmaini et al. (2021) explained that the concentration and duration of soaking in plant growth regulators significantly determine the success of vegetative organ formation in cuttings. The improved root system resulting from IBA treatment also supports optimal water and nutrient absorption, thereby accelerating photosynthesis and increasing leaf formation.

3.4. Number of Primary Roots (fruit)

The results of the analysis of variance showed a significant interaction between IBA concentration and soaking duration in the PGR treatment on the number of roots of white jasmine cuttings. The average number of roots resulting from the combination of IBA concentration and soaking duration is presented in Table 4.

Table 3. Average Number of Leaves (strands) of White Jasmine Plant Cuttings in Combination of IBA Plant Growth Regulator Concentration and Soaking Time Treatments

Age (MST)	IBA PGR Concentration (ppm)	Number of leaves (blades)		
		Soaking Time (minutes)		
		30 minutes	60 minutes	90 minutes
5	0 ppm	4.00 ± 0.12 a	4.13 ± 0.13 ab	4.20 ± 0.23 ab
	50 ppm	4.13 ± 0.18 ab	4.13 ± 0.07 ab	4.27 ± 0.13 ab
	100 ppm	4.13 ± 0.07 ab	4.93 ± 0.07 b	4.13 ± 0.07 ab
	150 ppm	4.27 ± 0.07 ab	4.33 ± 0.18 ab	4.33 ± 0.07 ab
	BNJ 5%		0.91	
6	0 ppm	6.00 ± 0.12 a	6.20 ± 0.20 ab	6.20 ± 0.12 ab
	50 ppm	6.27 ± 0.07 ab	6.27 ± 0.18 ab	6.27 ± 0.07 ab
	100 ppm	6.80 ± 0.12 ab	7.53 ± 0.07 b	6.93 ± 0.07 b
	150 ppm	6.73 ± 0.07 ab	6.87 ± 0.13 b	7.00 ± 0.12 b
	BNJ 5%		0.83	
7	0 ppm	8.07 ± 0.07 a	8.20 ± 0.00 a	8.27 ± 0.13 a
	50 ppm	8.60 ± 0.12 ab	8.67 ± 0.18 ab	8.73 ± 0.18 ab
	100 ppm	9.40 ± 0.12 b	10.53 ± 0.24 c	10.00 ± 0.12 bc
	150 ppm	10.07 ± 0.07 bc	10.13 ± 0.13 bc	10.40 ± 0.12c
	BNJ 5%		0.97	
8	0 ppm	9.73 ± 0.37 a	10.20 ± 0.00 ab	10.27 ± 0.13 ab
	50 ppm	10.60 ± 0.12 ab	10.67 ± 0.18 ab	10.73 ± 0.18 ab
	100 ppm	11.40 ± 0.12 b	12.60 ± 0.20 b	12.00 ± 0.12 b
	150 ppm	12.07 ± 0.07 b	12.13 ± 0.13 b	12.40 ± 0.12 b
	BNJ 5%		1.20	

Description: The average number followed by the same letter at the same observation age shows no significant difference in the 5% BNJ test; MST: Weeks After Planting.

Table 4. Average Number of Primary Roots (fruit) of White Jasmine Plant Cuttings in Combination of IBA Plant Growth Regulator Concentration and Soaking Time Treatments

IBA PGR Concentration (ppm)	Amount Primary Root (fruit)		
	Soaking Time (minutes)		
	30 minutes	60 minutes	90 minutes
0 ppm	6.53 ± 0.66 a	5.52 ± 0.39 a	5.95 ± 0.33 a
50 ppm	5.62 ± 0.50 a	6.80 ± 0.12 a	7.78 ± 0.78 ab
100 ppm	6.25 ± 0.38 a	12.52 ± 1.28 b	8.83 ± 0.60 ab
150 ppm	9.90 ± 0.35 ab	10.00 ± 1.15 ab	8.57 ± 0.92 ab
BNJ 5%		5.10	

Note: Mean figures followed by the same letter indicate no significant difference in the 5% BNJ test.

Table 4 shows that the combination of concentration treatment with the duration of IBA PGR soaking gave a significant difference in the number of roots of white jasmine cuttings. The average number of roots from white jasmine cuttings was the highest among the treatment combinations, with 12.52 pieces from the IBA PGR concentration of 100 ppm and a soaking duration of 60 minutes. It was not significantly different from the IBA PGR concentration treatment of 50 ppm with a soaking duration of 90 minutes, or from the IBA PGR concentration treatment of 150 ppm at various soaking durations.

The root formation process begins with cell division and callus formation, which then develops into root primordia. The tissue's auxin concentration strongly influences this process. These results are also supported by Abdel-Rahman (2020), who shows that applying IBA at 100 ppm provides the best rooting response in ornamental plant cuttings, with a higher root percentage than at other concentrations, and significantly improves root growth characteristics. He also stated that the appropriate IBA concentration can increase the number of roots and the quality of the root system in plant cuttings. Thus, a concentration of 100 ppm can be considered optimal for stimulating primary root formation in white jasmine cuttings.

Meanwhile, the lowest average number of roots was observed in the IBA PGR concentration treatment of 0 ppm with a soaking duration of 60 minutes, namely 5.52 pieces. It was not significantly different from the IBA PGR concentration treatments of 0 ppm at soaking durations of

30 and 90 minutes, 50 ppm at soaking durations of 30 and 60 minutes, and 100 ppm at a soaking duration of 30 minutes.

According to Li et al. (2018), the increase in root number and length at 100-150 ppm indicates that IBA effectively induces pericycle cell division and differentiation into root primordia, and accelerates the initiation and elongation phases of adventitious roots. Research by Danu et al. (2015) also reported that administering 100 ppm IBA significantly increased root number in forestry cuttings compared with the control.

3.5. Root Wet Weight

The results of the analysis of variance showed a significant interaction between IBA concentration and soaking duration in the PGR treatment on the fresh root weight of white jasmine cuttings. The average fresh root weight resulting from the combination of IBA concentration and soaking duration is presented in Table 4.5.

Table 5. Average Fresh Root Weight (g) of White Jasmine Plant Cuttings in Combination of IBA Plant Growth Regulator Concentration and Soaking Time Treatments

IBA PGR Concentration (ppm)	Heavy Wet Root (g)		
	Soaking Time (minutes)		
	30 minutes	60 minutes	90 minutes
0 ppm	0.13 ± 0.03 a	0.09 ± 0.01 a	0.15 ± 0.01 a
50 ppm	0.18 ± 0.01 ab	0.19 ± 0.04 ab	0.23 ± 0.02 ab
100 ppm	0.32 ± 0.07 ab	1.06 ± 0.09 c	0.57 ± 0.02 b
150 ppm	0.47 ± 0.03 b	0.39 ± 0.08 ab	0.41 ± 0.04 ab
BNJ 5%		0.32	

Note: Mean figures followed by the same letter indicate no significant difference in the 5% BNJ test.

Figure 2. Comparison of Root Yields Between Treatment Combinations

Table 5 shows that the combination of IBA concentration and soaking duration significantly affected the wet weight of white jasmine cuttings. The average wet weight of white jasmine cuttings, which was the highest among all treatment combinations, was observed with an IBA concentration of 100 ppm and a soaking duration of 60 minutes, namely 1.06 g.

Increasing the number and length of roots will directly increase root biomass. This is in line with research by Wulandari & Mukarlina (2013), where IBA treatment increased heavy dry root as an indicator of biomass. In addition, Yang et al. (2025) explained that auxin plays a role in regulating root growth and enhancing nutrient absorption efficiency. A more developed root system means the plant has a greater capacity for optimal water and nutrient absorption, thus supporting overall vegetative growth. Meanwhile, the average root wet weight was lower, namely in the IBA PGR concentration treatment of 0 ppm with a 60-minute immersion duration, at 0.09 g. Also, the root wet weight at the 0 ppm concentration was relatively low at all immersion durations and did not differ significantly across immersion times. Hariani et al. (2018) explained that the appropriate duration of IBA application increases the formation of vascular tissue and strengthens root structure, thereby significantly increasing dry weight.

4. Conclusion

Based on the research results, there is an interaction between the concentration of 100 ppm IBA PGR and a soaking time of 60 minutes, which provides the most optimal results for the initial growth of white jasmine cuttings, especially in terms of shoot emergence time, shoot length, number of leaves, number of primary roots, and root wet weight. The use of IBA is recommended for vegetative propagation of white jasmine because it effectively increases the quality of initial seedling growth by improving the rooting system and growth rate. Optimal concentration and immersion duration can serve as technical guidelines to produce uniform, vigorous seedlings with high growth potential. The implementation of the IBA application should be accompanied by proper management of planting media, humidity, and the quality of the cutting material used to maximize growth response and increase production efficiency.

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