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(RESEARCH ARTICLE)

The effect of growing medium type and growth regulators on the propagation of the ornamental plant *Alocasia reginula* 'Black Velvet' in a Greenhouse

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Abstract

Alocasia reginula 'Black Velvet' is an ornamental plant of the Araceae family characterized by dark green leaves with a velvety texture and prominent silver veins. Propagating *Alocasia* by dividing offshoots (split) does not yield a large number of uniform seedlings in a short period of time. This study aimed to determine the effects of growing media type and plant growth regulators, as well as their interaction, on the growth and shoot multiplication success of the ornamental plant *Alocasia reginula* 'Black Velvet' in a greenhouse. The study was conducted from July to November 2025 at the Sukamantri Experimental Garden Greenhouse, IPB University, using a two factor randomized block design with three replications. The first factor was the type of growing medium (cocopeat, raw rice husks, cocopeat + raw rice husks, and cocopeat + raw rice husks + hydroton). The second factor was the type of plant growth regulator (control, BA, GA_3, and BA + GA_3) at a concentration of 500 ppm. The results showed a significant interaction effect on the number of seedlings. The combination of cocopeat and BA + GA_3 produced the highest number of seedlings at 1.33. The type of cocopeat growing medium had a highly significant effect on the highest number of lateral shoots at 1.00 and the highest lateral shoot diameter. The BA + GA_3 plant growth regulator treatment had a significant effect on the number of lateral shoots. It was concluded that the combination of cocopeat medium and BA + GA_3 yielded the highest shoot multiplication.

Keywords: *Alocasia reginula*; Growing medium; Propagation; Plant growth regulators

1. Introduction

Alocasia reginula, widely known in the market as *Alocasia* 'Black Velvet,' is an ornamental plant in the Araceae family that is very popular among plant enthusiasts [6,7]. It is characterized by dark greenish-black leaves, prominent silver veins, and a velvety leaf surface, creating an attractive color contrast [1]. The high market demand for *Alocasia* ornamental plants with average exports reaching 16,9 thousand [1] stems requires propagation methods such as stem cuttings, tip cuttings, offshoot separation, and propagation via root tubers [1,7]. *Alocasia* has traditionally been propagated using the offshoot separation (Split) method [5]. This method does not yield a large number of seedlings in a short period because it can only be performed when the plant is mature and has physically produced offshoots [1]. The propagation of *Alocasia reginula* 'Black Velvet' is supported by the appropriate selection of organic growing media (cocopeat, raw rice husks, and hydroton) [1,8,9,16] and plant growth regulators (PGRs) Gibberellic Acid (GA_3) and Benzyladenine (BA) to induce the growth of more lateral shoots [3,7,10,11,13,14,15,17,18]. The main function of a greenhouse is to create a controlled environment for plant growth, reduce water evaporation, and increase the success rate of horticultural plant growth by protecting them from direct sunlight exposure, pests, and plant diseases [12].This study aims to analyze the effects of growing media type and plant growth regulators on the growth and multiplication success of *Alocasia reginula* 'Black Velvet' ornamental plant shoots in a greenhouse. This research can make a significant contribution to the science and practice of ornamental plant breeding, thereby improving the propagation success of *Alocasia reginula* 'Black Velvet' ornamental plants.

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2. Material and methods

The materials used in this study were *Alocasia reginula* 'Black Velvet' plants obtained from offshoot separation, raw rice husks, cocopeat, hydroton, the plant growth regulators benzyl adenine (BA) and GA_3, B1 fertilizer, AB mix, and insecticide. The equipment used in this study included 15 cm diameter plastic pots, a sprayer, gloves, a digital scale, a dropper, 100 ml beakers, stirring rods, a ruler, and a vernier caliper. This study was conducted from July 2025 to November 2025 at the Sukamantri Experimental Garden Greenhouse, Bogor Agricultural University, Jalan Kebun Kelapa, Sukamantri Village, Tamansari Subdistrict, Bogor Regency, West Java, at an elevation of 560 m above sea level.

This study used a two-factor randomized block design with the first factor being the type of growing medium (M_c = cocopeat, M_s = raw rice husks, M_g = cocopeat + raw rice husks, and M_h = cocopeat + raw rice husks + hydroton) with 4 levels, and the second factor being the type of plant growth regulator (Z_t = no plant growth regulator/control, Z_b = benzyl adenine (BA), Z_g = gibberellic acid (GA_3) growth regulator, and Z_k = BA + GA_3 growth regulator) at a concentration of 500 ppm. This study involved 16 treatment combinations; with 3 replicates, there were 48 experimental pots. The variables observed in this study included the number of lateral shoots, the length of lateral shoots, the diameter of lateral shoots, and the number of new seedlings.

2.1. Preparation of Growing Media

The growing media cocopeat, raw rice husks, and hydroton are sterilized by washing them twice, followed by soaking the media in a fungicide solution for 1 hour. The drained media are mixed in ratios of 1:1 and 1:1:1, then placed into pots.

2.2. Plant Material

Alocasia reginula 'Black Velvet' planting material for propagation was obtained from parent plants of *A. reginula* 'Black Velvet' produced via tissue culture by the PKHT IPB research team, which were then sorted to select suitable planting material. The selected *A. reginula* 'Black Velvet' plants were those with 2–3 leaves. The separated *A. reginula* 'Black Velvet' plants were then soaked in a B1 solution for 20 minutes, after which they were planted in 48 experimental pots already filled with growing medium according to the treatment.

2.3. Planting

Seedling planting was carried out in the morning in the prepared growing medium placed in the greenhouse. Prepare 48 pots containing a growing medium of cocopeat, raw rice husks, and hydroton in a 1:1:1 ratio.

2.4. Preparation of Plant Growth Regulator Solutions and Application of Treatments

Preparation of the solution began with the preparation of a 1000 ppm stock solution, followed by the preparation of 500 ppm GA_3 and BA solutions from the stock solution. Application of the plant growth regulators was carried out according to the treatment levels, using a concentration of 500 ppm GA_3 and BA, which were sprayed onto the stems, leaf axils, and leaves of the plants. Spraying was conducted two weeks after planting and repeated once a month using a sprayer.

2.5. Maintenance of Plant

Intensive maintenance includes applying AB mix fertilizer, watering, weeding, and controlling pests and diseases. AB mix fertilizer was applied at a rate of 100 ml per pot in the morning. Watering was performed routinely twice a week, with the volume adjusted based on the growing medium's condition when it had dried out slightly and its moisture level, using a sprayer. Weeding is done by manually pulling out weeds growing in the plant pots. Pest and disease control is carried out when symptoms of infestation appear, based on the type of pest or disease affecting the plants, by applying the insecticide Antracol 70 WP at a dose of 5 g/liter.

2.6. Observation Variables

2.6.1. Number of Lateral Shoots (unit)

The number of lateral shoots was counted every 2 weeks, starting 2 weeks after planting (WAP) until the day before harvest. Counting was performed manually, counting shoots emerging from the leaf axils on the main stem or secondary branches.

2.6.2. Length of lateral shoots (cm)

The length of lateral shoots was measured every 2 weeks starting 2 weeks after planting (WAP) until the day before harvest using a ruler placed precisely at the base of the lateral shoot where it emerges from or attaches to the main stem or an older branch extending to the tip of the shoot.

2.6.3. Lateral shoot diameter (mm)

The diameter of the lateral shoots is measured every 2 weeks from 2 weeks after planting (WAP) until the day before harvest using a vernier caliper by placing the lateral shoot between the two jaws of the vernier caliper.

2.6.4. Number of New Seedlings (unit)

The number of new seedlings resulting from propagation is determined by counting the number of lateral shoots that have grown and developed optimally, with at least one leaf, thereby meeting the criteria as seedlings for plant propagation.

2.7. Data Analysis

The observation data were analyzed using analysis of variance (ANOVA) according to a randomized block design. If an interaction occurred between the type of growing medium and the plant growth regulator, the mean values of the combination treatments were further tested using Duncan's multiple range test at the 5% significance level. If the interaction was not significant, the mean values of the variables due to the effects of the single factors type of growing medium and plant growth regulator were tested using the Least Significant Difference (LSD) test at the 5% level.

3. Results and discussion

3.1. Number of Lateral Shoots

The number of lateral shoots showed a highly significant effect in Table 1 for the single factor of growing medium type (M). The number of lateral shoots was highest in the cocopeat treatment (M_c) with an average of 1.00 shoots, and lowest in the raw rice husk treatment (M_s) and the cocopeat + raw rice husk + hydroton growing medium (M_h) treatments, both with an average of 0.08 shoots (Table 2). The cocopeat treatment (M_c) produced 11.5% more lateral shoots compared to the raw rice husk treatment (M_s) and the cocopeat + raw rice husk + hydroton growing medium (M_h) treatments, which both had an average of 0.08 shoots. The number of lateral shoots in Table 1 for the different plant growth regulator (Z) treatments showed a significant effect. The number of lateral shoots was highest in the BA + GA_3 plant growth regulator treatment (Z_k) with an average of 0.75 shoots and lowest in the control treatment (Z_t) with an average of 0.17 shoots, representing a 77.33% decrease (Table 2). Benzyladenine (BA), as a class of cytokinins, plays a role in breaking apical dominance by inhibiting auxin transport, thereby stimulating cell division activity in the lateral meristems of the stem to form new growth points [10]. Additionally, the application of Gibberellic Acid (GA_3) accelerates the transition of bud eyes from the dormant phase to the active phase to enhance cell elongation activity through energy reserves, consequently increasing the number of shoots that successfully emerge simultaneously [1].

Table 1 Significance of the effects of growing medium type (M), plant growth regulator type (Z), and their interaction (MxZ) on all study variables

No	Variable	Treatment		
		M	Z	M x Z
1	Number of lateral shoots (unit)	**	*	ns
2	Length of lateral shoots (cm)	*	*	ns
3	Lateral shoot diameter (mm)	**	ns	ns
4	Number of new seedlings (unit)	**	**	*

Notes : Ns : non significant effect (P ≥ 0,05); *: significant effect (P < 0,05); ** : highly significant (p < 0,01); M : Growing medium; Z : Growth regulator

3.2. Lateral Shoot Length

Lateral shoot length showed a significant effect in Table 1 for the single factor of growing medium type (M). Lateral shoot length was highest in the cocopeat growing medium treatment (M_c) with an average of 1.24 cm and lowest in the raw rice husk growing medium treatment (M_s) with an average of 0.24 cm, representing an 80.65% decrease in yield (Table 2). The length of lateral shoots in Table 1 for the different plant growth regulator (Z) treatments showed a significant effect. Lateral shoot length was highest in the GA_3 plant growth regulator treatment (Z_g) with an average of 1.56 cm and lowest in the BA + GA_3 plant growth regulator treatment (Z_k) with an average of 0.16 cm, representing an 82.69% decrease (Table 2).

Table 2 Effect of growing medium type (M) and plant growth regulator type (Z) treatments on the number of lateral shoots, lateral shoot length, and lateral shoot diameter

Treatment	Number of Lateral Shoots (unit)	Lateral Shoot Length (cm)	Lateral Shoot Diameter (mm)
Type of Growing Medium (M)			
M_c	1,00 (1,39) a	1,24 (1,55) a	1,50 (1,59) a
M_s	0,08 (1,03) b	0,24 (1,44) b	0,10 (1,43) b
M_g	0,75 (1,30) a	1,09 (1,54) a	1,26 (1,57) a
M_h	0,08 (1,03) b	0,26 (1,44) b	0,19 (1,44) b
LSD 5%	0,16	0,09	0,07
Type of Growth Regulator (Z)			
Z_t	0,17 (1,07) b	0,27 (1,45) b	0,31 (1,45) b
Z_b	0,50 (1,21) ab	0,92 (1,52) ab	0,90 (1,52) ab
Z_g	0,50 (1,21) ab	1,56 (1,57) a	0,97 (1,53) a
Z_k	0,75 (1,27) a	0,16 (1,44) b	0,86 (1,52) b
LSD 5%	0,16	0,09	0,07

Note: Numbers followed by the same letter indicate no significant difference based on the least significant difference (LSD) test at the 5% level, and numbers in parentheses represent transformed values.

3.3. Lateral Shoot Diameter

Lateral shoot diameter showed a highly significant effect in Table 1 for the single factor of growing medium type (M). Lateral shoot diameter was highest in the cocopeat growing medium treatment (M_c) with a mean of 1.50 mm and lowest in the raw rice husk growing medium treatment (M_s) with a mean of 0.10 mm, representing a 93.33% decrease (Table 2). Lateral shoot diameter showed no significant effect in Table 1 for the plant growth regulator (Z) treatments. Lateral shoot diameter was highest in the GA_3 plant growth regulator treatment (Z_g) with an average of 0.97 mm, and lowest in the control treatment/without plant growth regulator (Z_t) with an average of 0.31 mm, resulting in a 68.04% decrease in yield (Table 2).

The physical properties of cocopeat are capable of maintaining a balance between moisture and aeration in the media, ensuring proper root system development and optimal water and nutrient absorption, which consequently increases cell division processes in lateral shoots [2]. The success of lateral shoot length and lateral shoot diameter is supported by GA_3, which plays a primary role in stimulating cell elongation through the loosening of cell walls, allowing for rapid cell enlargement due to increased turgor pressure [17].

3.4. Number of New Seedlings

The number of new seedlings showed a significant effect of the interaction between the treatment of growing medium type (M) and plant growth regulator type (Z). The number of new seedlings was highest in the treatment combining cocopeat growing medium and the plant growth regulators BA + GA_3 (M_cZ_k), with an average of 1.33 seedlings a 33.00% increase compared to the treatment using cocopeat growing medium and the plant growth regulator BA (M_cZ_b), the treatment of cocopeat growing medium and the plant growth regulator GA_3 (M_cZ_g), and the treatment of cocopeat + raw rice husk growing medium and the plant growth regulator BA (M_gZ_b), all of which had the same average of 1.00 seedlings, indicating no significant difference.The number of new seedlings showed the lowest results in the treatments

M_cZ_t, M_sZ_t, M_sZ_b, M_sZ_g, M_sZ_k, M_hZ_t, M_hZ_b, M_hZ_g, and M_hZ_k, all with an average value of 0.00 (Table 3). Cocopeat growing medium can increase the success of seedling growth due to its characteristics as a growing medium capable of strongly binding and retaining water, thereby maintaining moisture around the root zone [2]. Apart from the growing media, the hormone Benzyladenine (BA) plays a role in the process of cell division and the formation of plant bud eyes [4], while Gibberellic Acid (GA_3) plays a role in accelerating cell elongation, shoot growth, stem elongation, leaf growth, and accelerating the vegetative growth of plants [17,18].

Table 3 Interaction between Differences in Growing Media Type (M) and Growth Regulator Type (Z) on the Number of New Seedlings

Treatment	Z_t	Z_b	Z_g	Z_k
M_c	0,00 (1,00) c	1,00 (1,41) ab	1,00 (1,41) ab	1,33 (1,52) a
M_s	0,00 (1,00) c	0,00 (1,00) c	0,00 (1,00) c	0,00 (1,00) c
M_g	0,33 (1,14) c	1,00 (1,41) ab	0,67 (1,28) bc	0,67 (1,28) bc
M_h	0,00 (1,00) c	0,00 (1,00) c	0,00 (1,00) c	0,00 (1,00) c

Note: Numbers followed by the same letter indicate no significant difference based on Duncan's multiple range test at the 5% level, and numbers in parentheses represent transformed values.

The success of propagation in Figure 1 for the treatment combining cocopeat growing medium and the growth regulators BA + GA_3 (M_cZ_k) indicates that the cocopeat medium is capable of providing an ideal physical environment due to its high porosity and good water holding capacity, which supports the action of the plant growth regulators (PGRs) benzyladenine (BA) and gibberellic acid (GA_3) in stimulating cell division in meristematic tissues, thereby promoting the growth of shoots into new seedlings [2,4,13,15,18].

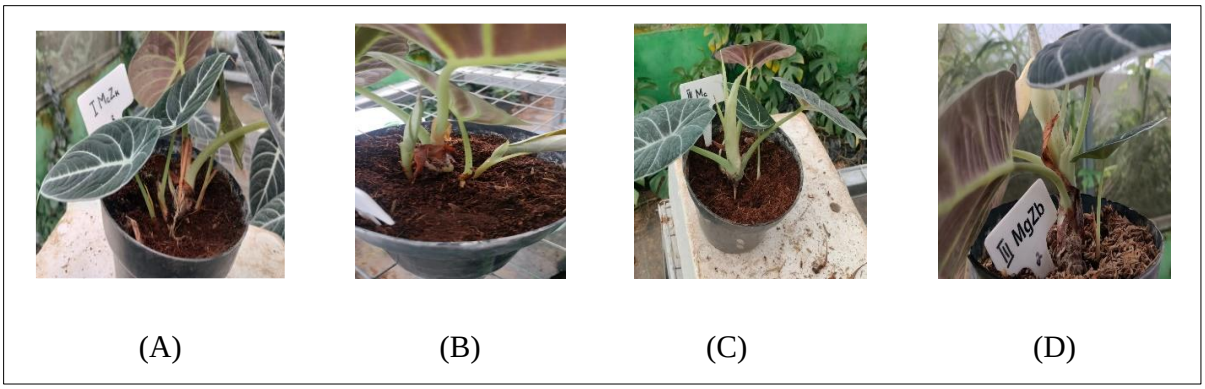

Figure 1 Number of new seedlings at the M_cZ_k (A); M_cZ_b (B); M_gZ_g (C); and M_gZ_b (C) treatment levels

4. Conclusion

- The type of growing medium has a very significant effect on the growth and shoot multiplication of the ornamental plant *Alocasia reginula* 'Black Velvet'. The growing medium consisting of cocopeat produced the highest number of lateral shoots (1.00) and the largest lateral shoot diameter (1.50 mm).
- The type of growth regulator had a significant effect on the growth and shoot multiplication of the ornamental plant *Alocasia reginula* 'Black Velvet'. The treatment combining the growth regulators benzyladenine (BA) and gibberellic acid (GA_3) produced the highest number of lateral shoots (0.75) compared to the control without growth regulators (0.17). The gibberellic acid (GA_3) treatment produced the longest lateral shoots (1.56 cm).
- There was a significant interaction between the type of growing medium and the type of plant growth regulator on the success of shoot propagation of the ornamental plant *Alocasia reginula* 'Black Velvet'. The combination of cocopeat as the growing medium and the plant growth regulator treatment of Benzyladenine (BA) + Gibberellic Acid (GA_3) produced the highest number of new seedlings, at 1.33.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors hereby declare that this manuscript does not have any conflict of interest.

Statement of ethical approval

The authors certify that this submission is original work and is not under review at any other publication.

Statement of informed consent

The authors declare that informed consent was obtained from all individual participants included in the study. All work utilized in this study was fully cited and referenced.

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