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The Effect of Shallot Extract and Amino Acids as Natural Plant Growth Regulators on Shoot Growth in Vanilla Cuttings (*Vanilla planifolia* Andrews)

Moch Dhimas Alif Fikri [1], Titien Fatimah [1], Ferril Muhammad Nur [1], Irma Wardati [1]

[1] Department of Agricultural Production, Politeknik Negeri Jember, Indonesia

* Correspondence: ferril.mn@polije.ac.id

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Abstract: Vanilla belongs to the Orchidaceae family and is a high-value plantation commodity. The significant domestic and global market potential for vanilla must be matched by optimizing production capacity through the provision of high-quality planting material. One approach to improving vanilla planting material involves the application of Plant Growth Regulators (PGRs). This research was conducted from June 1, 2025, to August 30, 2025, at the Field Laboratory and Soil Laboratory of the State Polytechnic of Jember, located at an elevation of 60 meters above sea level. The study employed a factorial Randomized Block Design (RBD) with two factors: the first factor comprised four levels, and the second factor comprised two levels. K0A0 = 0% shallot extract + no amino acid application, K0A1 = 0% shallot extract + amino acid application, K1A0 = 20% shallot extract + no amino acid application, K1A1 = 20% shallot extract + amino acid application, K2A0 = 50% shallot extract + no amino acid application, K2A1 = 50% shallot extract + amino acid application The application of shallot extract and amino acids as PGRs to promote shoot elongation in vanilla cuttings did not yield significant results at shallot extract concentrations of 20–30% per 100 ml of water. The best results regarding shoot elongation in vanilla cuttings were observed in the K2A1 treatment, which yielded the highest mean values across all treatments: 1.09 cm at 30 days after planting (DAP), 5.31 cm at 60 DAP, and 12.36 cm at 90 DAP.

Keywords: Amino acids, Plant Growth Regulators (PGR), Shallot extract, Vanilla shoots

1. Introduction

Vanilla (*Vanilla planifolia*) is a plant species belonging to the Orchidaceae family, sharing a taxonomic relationship with various types of orchids. This commodity holds a strategic position as a high-value agricultural product, given its widespread use as a raw material across the food, beverage, cosmetics, and pharmaceutical industries. The consistently rising demand for vanilla in the international market further strengthens its future economic development prospects (Maryana and Sholihah, 2026). In line with this trend, the global vanilla market value is estimated to reach approximately US$1.2 billion by 2025, while the domestic vanilla market is projected to experience an average annual growth rate of 5.99% during the 2024–2032 period (Pusdatin, 2024).

Vanilla production in Indonesia has shown an upward trend in recent years. According to the 2024 Vanilla Outlook (Pusdatin, 2024), production volume in 2023 was estimated at 1.53 thousand tons and is projected to rise to approximately 1.79 thousand tons by 2027, reflecting an average annual growth rate of 3.73%. This growth dynamic indicates that the significant opportunities in both domestic and global vanilla markets must be matched by optimizing production capacity through the implementation of more effective cultivation techniques. A fundamental strategy in supporting these efforts is the provision of high-quality planting material via vegetative propagation—specifically using cuttings—thereby ensuring greater consistency and quality in the resulting seedlings (Pusdatin, 2024).

Vegetative propagation using cuttings is more widely employed than generative propagation because the procedure is relatively simple, enables faster plant production, and preserves genetic characteristics identical to those of the parent plant (Nurholis, 2017). In vanilla nursery practices, the use of single-node cuttings serves as an efficient alternative for sourcing planting material. However, single-node cuttings still require a nursery phase to develop approximately 5–7 new nodes before they are ready for use. The primary limitation of this technique lies in the minimal reserve of assimilates stored within the cutting material, resulting in an initial growth rate that tends to be slower and suboptimal (Suteja and Dharma, 2016).

One approach with the potential to overcome these limitations is the application of Plant Growth Regulators (PGRs), particularly those derived from natural sources. Natural PGRs are considered more economical, readily available, and safer than synthetic PGRs (Nurlaeni and Surya, 2015). Shallot (*Allium cepa* L.) bulbs are a widely utilized source of natural PGRs because they contain rhizocaline and auxin compounds, which play a role in stimulating root system formation and development. Enhanced root development increases the plant's capacity to absorb water and nutrients, thereby supporting optimal seedling growth (Tarigan et al., 2017). The effectiveness of shallot extract as a natural PGR has also been demonstrated by Salsabila et al. (2021), who reported that applying shallot extract at concentrations of 80% and 90% significantly accelerated shoot emergence and increased root length in mini *Ixora* (*Soka mini*) cuttings.

The emergence of axillary or lateral buds in vanilla plants (*Vanilla planifolia*) is a key morphological parameter for evaluating the success of vegetative growth, particularly in plants propagated via stem cuttings. Bud initiation—the initial growth response—can be identified by distinct morphological characteristics. Newly developing buds typically exhibit a light green to yellowish-green hue due to chlorophyll levels still in the early stages of formation, creating a visual contrast against the mature, dark green stem cutting. Initially, the bud appears conical and pointed, encased in small protective scales. As growth progresses, the structure elongates and forms new nodes, followed by the differentiation of fleshy (succulent) simple leaves arranged in an alternating (distichous) pattern; this sequence indicates normal vegetative development (Kurnanto, 2007).

2. Materials and Methods

Subsection

This research was conducted from June 1, 2025, to August 30, 2025, at the Field Laboratory and Soil Laboratory of the State Polytechnic of Jember. The research site was located at an elevation of 60 meters above sea level.

Research materials and tools

The tools utilized in this research included a budding knife, sieve, bucket, machete, crowbar, hoe, small shovel, watering can, measuring tape, scissors, graduated cylinder, blender, filtering cloth, writing materials, and tubs to support all stages of the research activities.

The research materials consisted of vanilla vines (as the source of planting material), shallot bulbs, water, polybags, topsoil, burnt rice husks, goat manure, Furadan, Dithane M-45, label paper, transparent plastic, binding wire, Basiscrop Amino Acid, bamboo, and shade netting; these served variously as growing media, treatment agents, or supporting supplies throughout the research process.

Method

The study was designed using a factorial Randomized Block Design (RBD), with blocking based on the node position on the cuttings (first, second, third, and fourth nodes). Two factors were involved: the first factor comprised four levels, and the second factor comprised two levels, as follows:

Factor 1: Shallot extract concentration

K0 = 0% shallot extract concentration (0 ml + 100 ml water)

K1 = 20% shallot extract concentration (20 ml + 80 ml water)

K2 = 50% shallot extract concentration (50 ml + 50 ml water)

Factor 2: Amino acid application

P0 = No amino acid application P1 = Amino acid application (2.5 ml/liter water)

The study involved eight treatment combinations, as follows:

K0A0 = 0% shallot extract + No amino acid application

K0A1 = 0% shallot extract + Amino acid application

K1A0 = 20% shallot extract + No amino acid application

K1A1 = 20% shallot extract + Amino acid application

K2A0 = 50% shallot extract + No amino acid application

K2A1 = 50% shallot extract + Amino acid application

This resulted in six treatment combinations, each replicated four times, yielding a total of 24 experimental units. Each replication unit consisted of four cuttings, resulting in a total of 96 cutting samples. The mathematical model for the Randomized Block Design (RBD) used is as follows:

$$Y_{ijk} = \mu + \tau_i + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \varepsilon_{ijk}$$

Where:

Y_{ijk} : Observed value for factor α at level j and factor β at level k in block i

μ : Overall mean τ_i : Effect of block i

α_j : Effect of factor α treatment at level j

β_k : Effect of factor β treatment at level k

$(\alpha\beta)_{jk}$: Interaction effect between factor α at level j and factor β at level k

ε_{ijk} : Error effect associated with block i, factor α at level j, and factor β at level k

Observation parameters

The research data were analyzed using analysis of variance (ANOVA). If a significant effect was found, a post-hoc test using Honestly Significant Difference (HSD) at the 5% level was conducted. Shoot length was observed when the cuttings were 30, 60, and 90 days after planting (DAP). Measurements were taken from the shoot's growth point to its tip using a ruler.

3. Results and Discussion

Research on the effect of applying natural plant growth regulators (PGRs)—specifically shallot extract and amino acids—on the growth of vanilla (*Vanilla planifolia* Andrews) cuttings was conducted by evaluating shoot length parameters. Shoot length was monitored to assess the growth response of the seedlings to the applied treatments. Based on the observations and data analysis from the study, the results are as follows:

Table 1. Summary of observations on the effect of applying plant growth regulators (shallot extract and amino acids) on the growth of vanilla (*Vanilla planifolia* Andrews) cuttings.

Parameter	**Age (DAT)**	**F-Statistic**			**F-Tabel**		**KK**
		K	A	KxA	5%	1%	
Shoot Length	30	0,66ns	1,05ns	1,49ns			140
	60	0,43ns	2,04ns	1,43ns			107
	90	**0,38ns**	**1,29ns**	**1,55ns**	**K = 3,07**	**K = 4,87**	**90**

Observations of the shoot length parameter were conducted periodically three times during the study period: at 30, 60, and 90 days after planting (DAP). Based on the analysis of variance results presented in Table 4.1, neither the shallot extract concentration treatment (K), the amino acid application (A), nor the interaction between these two factors (K×A) had a significant effect on the increase in shoot length of vanilla cuttings at any of the observation times—namely 30, 60, and 90 DAP.

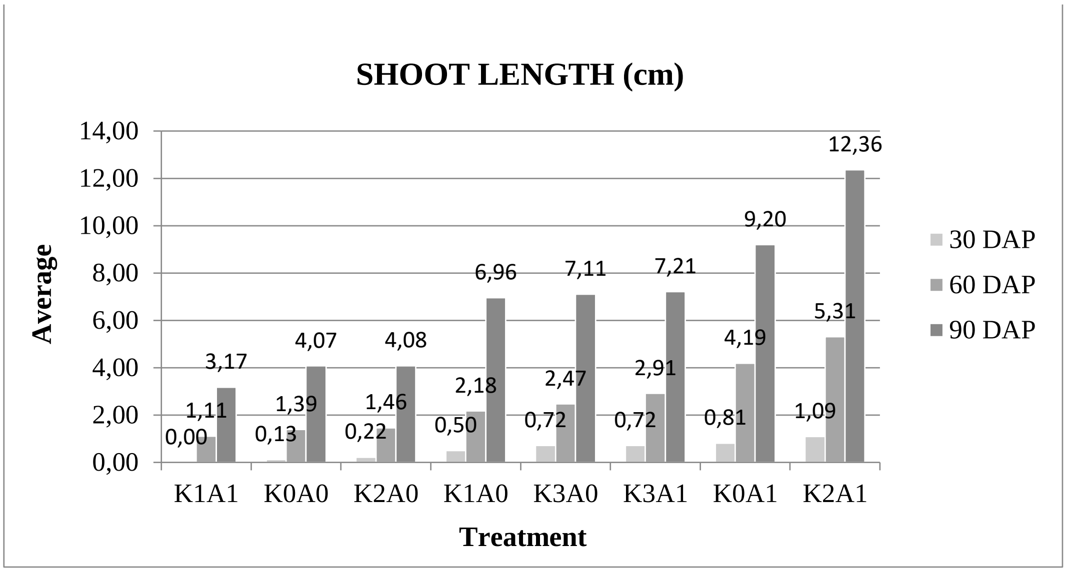

Figure 1. Bar chart of vanilla seedling shoot length

The research results indicate that there were no significant differences in shoot length development among the various samples and treatments, as shown in the diagram above. The lowest average growth was observed in the K1A1 treatment—which involved no application of shallot extract or amino acids and served as the control. The average shoot length development for the K1A1 treatment across the three observation periods was 0 cm at 30 days after planting (DAP), 1.11 cm at 60 DAP, and 3.17 cm at 90 DAP; these figures were consistently the lowest among all treatments. The treatment with the highest average growth was K2A1, involving the application of 50% shallot extract and amino acids. The K2A1 treatment yielded the highest averages across all groups: 1.09 cm at 30 DAP, 5.31 cm at 60 DAP, and 12.36 cm at 90 DAP. Although the treatments did not produce statistically significant differences, the application of shallot extract and amino acids at the highest concentration still resulted in the greatest average growth.

The lack of a significant effect of shallot extract application on the shoot elongation of vanilla cuttings is likely attributable to sufficient levels of endogenous auxin already present within the cutting tissues; consequently, auxin supplementation from the shallot extract—acting as an exogenous hormone source—failed to trigger a substantial increase in shoot growth. According to Sofwan et al. (2018), the indole-3-acetic acid (IAA) content in shallots plays a role in stimulating root system formation and development; however, the effectiveness of natural plant growth regulators (PGRs) is heavily influenced by the suitability of the applied concentration and the plant's physiological status at the time of treatment. Consistent with this view, Upreti and Sharma (2016) noted that the physiological activity of PGRs is optimized at relatively low concentrations, provided there is a balance between endogenous and exogenous hormones within the plant tissues. It is hypothesized that the concentration of shallot extract used in this study did not reach a level capable of effectively modulating hormonal activity, thereby failing to produce a statistically significant increase in the shoot length of the vanilla cuttings.

The amino acid (A) treatment also did not show a significant effect on the shoot elongation of vanilla cuttings throughout the observation period. This condition is thought to be related to the tendency for the nitrogen contained in the amino acids to be utilized for supporting root system formation and the development of basic vegetative tissues, meaning nutrient allocation was not yet optimally directed toward shoot elongation. Amino acids function to support plant growth by providing the macro- and micronutrients required for metabolic processes. However, the resulting growth response is not determined solely by amino acid availability; it is also influenced by environmental factors—such as light intensity and growing medium conditions—that play a role in optimizing the plant's physiological activities. Nurholis (2017) explains that vanilla propagation via cuttings requires a relatively long growth phase to produce approximately 5–7 new nodes. Therefore, the observation period of only 90 days after planting (DAP) is considered insufficient to reveal statistically significant differences in shoot elongation among the treatment levels.

4. Conclusions

The application of shallot extract and amino acids as plant growth regulators (PGRs) to promote shoot elongation in vanilla cuttings—specifically at shallot extract concentrations of 20–30% per 100 ml of water—did not yield significant results. Among the treatments tested, the K2A1 treatment produced the best results for shoot elongation, achieving the highest mean values: 1.09 cm at 30 days after planting (DAP), 5.31 cm at 60 DAP, and 12.36 cm at 90 DAP. The lack of significant results is likely because the natural PGR content in the 20–30% shallot extract was insufficient to stimulate shoot elongation, and because, during this developmental phase, PGR activity tends to prioritize root formation over shoot development. Recommendations for future research include carefully considering the growth stages of vanilla cuttings when applying PGRs, adjusting dosage levels, selecting high-quality shallot raw materials, and employing appropriate application methods.

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Conflicts of Interest: The authors declare no conflict of interest.