



Optimization of *Aloe vera* as a Natural Plant Growth Regulator to Enhance the Growth of *Dendrobium* Orchid 'Arif'

¹Imarotul Umamah, ²Endah Rita Sulistya Dewi, ³Praptining Rahayu

^{1,2,3}Department of Biology Education, Faculty of Mathematics Education, Natural Sciences, and Information Technology, Universitas PGRI Semarang, Indonesia.

*Corresponding Author e-mail: imarotulumamah@gmail.com

Received: January 2026; Revised: February 2026; Accepted: March 2026; Published: March 2026

Abstract: This study aimed to analyze the effects of different concentrations of *Aloe vera* as a natural plant growth regulator (PGR) on the growth of *Dendrobium* 'Arif' orchids. The observed parameters included root length, stem height, and shoot height as indicators of vegetative growth. The experiment employed a completely randomized design (CRD) with five treatments: a control (0%) and *Aloe vera* extract at concentrations of 1%, 3%, 5%, and 7%, each with three replicates. Data were analyzed using one-way ANOVA, followed by Tukey's HSD test at a 5% significance level. The results showed that *Aloe vera* had a significant effect on stem height ($F = 2.712$; $p = 0.043$) and root length ($F = 5.896$; $p = 0.001$), but no significant effect on shoot height ($F = 0.359$; $p = 0.836$). The 5% concentration produced the highest mean stem height (8.00 cm), exceeding that of the control (6.94 cm), 1% (6.89 cm), 3% (6.39 cm), and 7% (6.83 cm). For root length, the 5% concentration also yielded the highest value (8.98 cm), compared with 1% (7.76 cm), the control (6.40 cm), 7% (5.95 cm), and 3% (4.56 cm), and differed significantly according to Tukey's HSD test. The non-significant response in shoot height suggests differences in physiological sensitivity among plant organs, with roots and stems being more responsive to auxins and gibberellins present in *Aloe vera*. Overall, *Aloe vera* extract shows potential as a natural PGR to support the vegetative growth of *Dendrobium* orchids, particularly in root and stem development.

Keywords: *Aloe vera*; plant growth regulator/PGR; vegetative growth; *Dendrobium* orchid sp.

How to Cite: Umamah, I., Dewi, E. R. S., & Rahayu, P. (2026). Optimization of *Aloe vera* as a Natural Plant Growth Regulator to Enhance the Growth of *Dendrobium* Orchid 'Arif'. *Bioscientist: Jurnal Ilmiah Biologi*, 14(1), 239–248. <https://doi.org/10.33394/bioscientist.v14i1.19984>



<https://doi.org/10.33394/bioscientist.v14i1.19984>

Copyright© 2026, Umamah et al
This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) License.



INTRODUCTION

Indonesia is widely recognized as a country with rich natural orchid diversity. Its tropical climate is highly favorable for orchid growth and offers strong potential for the production of high-quality native orchids. The number of orchid species in Indonesia is estimated at 5,000–6,000 (Dewi et al., 2020). Among these, *Dendrobium* is one of the most economically valuable horticultural orchid commodities and is widely cultivated because of its aesthetic appeal and strong adaptability to diverse growing environments (Sulichantini & Primawati, 2024).

However, the successful cultivation of this orchid still faces constraints, particularly during the vegetative growth phase, which is relatively slower than that of many other ornamental plants (Maulana, Z. R., Djuhari, 2024). Therefore, efforts are needed to enhance growth hormone activity and optimize plant development, one of which is the application of plant growth regulators (PGRs) to stimulate physiological processes, especially stem elongation, root formation, and shoot development (Violita et al., 2022).

Although synthetic PGRs have proven effective, they tend to be more costly and may pose environmental risks when used excessively. For this reason, natural PGRs are increasingly being developed as a strategic alternative because they are safer and may reduce the risk of chemical residue accumulation in soil and plants (Wiryanata et al., 2025). One natural material with potential as a PGR is *Aloe vera*.

LC-MS/MS analysis has shown that Aloe vera contains key plant hormones such as Indole-3-acetic acid (IAA), Gibberellic Acid (GA), Abscisic Acid (ABA), and Salicylic Acid (SA), all of which are known to play important roles in growth regulation and plant tissue differentiation (Hakeem et al., 2025). In addition, Aloe vera contains a variety of essential nutrients, including enzymes, minerals, sugars, and fatty acids. The gel in aloe leaves consists of approximately 96% water and 4% solid matter, including around 75 bioactive compounds (Nasution et al., 2023). This composition suggests that Aloe vera may provide both nutritional support and physiological stimulation for plant growth.

Several studies have shown that the effectiveness of Aloe vera as a natural PGR varies depending on the concentration applied and the plant species tested. Research by (Srg & Hrp, 2023) demonstrated that a 10% aloe extract concentration accelerated branch growth, root proliferation, and stem elongation in peanut plants. Similar results were reported by (Kant, K., et al., 2025), who found significant improvements in root growth and shoot formation in *Rosa damascena* Mill. at the same concentration. In contrast, another study by (Zuyasna et al., 2024) reported an optimal response at a higher concentration (75%) in honey guava, particularly in terms of root elongation and significant increases in shoot and leaf number. These differences indicate that the effectiveness of Aloe vera is not universal, but rather depends on its concentration, the physiological characteristics of the plant, and the specific organ being observed.

Although numerous studies have examined the use of Aloe vera as a PGR in several horticultural crops, studies specifically evaluating the physiological response of *Dendrobium* spp. orchids to varying concentrations of Aloe vera, particularly at the organ level (roots, stems, and shoots) under *ex vitro* conditions, remain limited and have not yet shown a consistent pattern. Therefore, further research is needed to investigate how different concentrations of Aloe vera affect the growth of *Dendrobium* spp. orchids and to determine which plant organ exhibits the most optimal response. This issue forms the basis of the present study.

Based on this background, the present study aimed to analyze the effect of various concentrations of Aloe vera as a natural plant growth regulator on vegetative growth and to identify the plant organ showing the most optimal response in *Dendrobium* 'Arif' orchids. The selection of Aloe vera was based on its abundant availability and ease of cultivation within the community, whereas its utilization and scientific understanding of its potential benefits for plants remain limited.

METHOD

This study employed a quantitative experimental approach using a single-factor Completely Randomized Design (CRD). The experiment was conducted in the greenhouse of CV. Candi Orchid, Semarang City, Indonesia (approximately 86 m above sea level), from October 2025 to January 2026 under a tropical microclimate with an average temperature of 35°C. The independent variable was the concentration of *Aloe vera*-based plant growth regulator (PGR), while the dependent variables included root length, stem height, and shoot height. Five treatment levels were applied: a control without PGR (P0), and *Aloe vera* concentrations of 1% (P1), 3% (P2), 5% (P3), and 7% (P4). Each treatment was replicated three times, and observations were conducted over a period of three months to capture plant growth responses progressively.

The research subjects were *Dendrobium* 'Arif' orchids, a hybrid of *Dendrobium handojohardjo* × *Dendrobium nindii*, registered in the Royal Horticultural Society (RHS) Orchid Hybrid Register. The samples consisted of 6-month-old orchid seedlings with a

relatively uniform initial height of 5–10 cm. A total of 45 plants were used, derived from the combination of five treatments, three replications, and three observation times. Each plant was grown individually in a soft pot containing kadaka root medium (black moss), which provides good aeration and water-holding capacity. The equipment used in this study included a balance, seedling soft pots, measuring cylinders, spray bottles, a blender, and trays. The materials used included 6-month-old orchid seedlings, kadaka root planting medium, clean water, and *Aloe vera*.

The experimental procedure began with the preparation of seedlings and planting media, followed by the preparation of the natural PGR according to (Zuyasna et al., 2024). *Aloe vera* gel was blended to obtain a 100% natural solution, which was then diluted to the required concentrations. The 1% concentration was prepared by dissolving 10 mL of *Aloe vera* gel in water to a final volume of 1000 mL. The 3%, 5%, and 7% concentrations were prepared in the same manner using 30, 50, and 70 mL of gel, respectively, diluted to 1000 mL. The *Aloe vera* solution was applied by spraying approximately 50 mL per plant using a spray bottle. Application was carried out twice a week, every Monday and Thursday, between 07:00 and 08:00 WIB, by spraying evenly onto the leaves, particularly the abaxial surface, as well as onto the planting medium.

Measurements were performed regularly according to the plant organ being observed. Plant height was measured from the base to the tip of the stem using a ruler at 15-day intervals. Shoot height was measured in the same manner and at the same interval. In contrast, root length was measured from the base to the root tip once every month using a ruler. The different observation intervals were adjusted to the growth characteristics of each plant organ. Data were analyzed using one-way ANOVA at a 5% significance level ($\alpha = 0.05$) with IBM SPSS Statistics 25 software. Prior to the main analysis, the data were tested for normality using the Shapiro-Wilk test and for homogeneity of variance using Levene's test. When significant differences were detected ($p < 0.05$), the analysis was followed by Tukey's HSD test to identify the treatment with the most significant effect.

RESULTS AND DISCUSSION

Stem Height

Stem height was measured to evaluate the vegetative growth response of *Dendrobium* 'Arif' orchids to the application of *Aloe vera* extract at different concentrations. *Aloe vera* gel is known to contain Gibberellic Acid (GA) at approximately ± 1.55 ng/mL and Indole-3-Acetic Acid (IAA) at approximately ± 4.32 ng/mL, both of which are involved in cell elongation processes (Hakeem et al., 2025). This composition indicates that *Aloe vera* gel has potential as a natural plant growth regulator capable of influencing vegetative plant growth. Analysis of variance showed that the treatments had a significant effect on stem height. The ANOVA results are presented in Table 1.

Table 1. ANOVA results at the 5% significance level for stem height measurement

Group	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.744	4	3.186	2.712	0.043
Within Groups	47.000	40	1.175		
Total	59.744	44			

The one-way ANOVA results showed that the application of *Aloe vera* at different concentrations significantly affected the stem height of *Dendrobium* 'Arif' orchids ($F = 2.712$; $p = 0.043$) at the 5% significance level ($\alpha = 0.05$). A significance value of <0.05 indicates differences in stem height growth responses among treatments. This suggests that the phytohormone content in *Aloe vera* at these concentrations falls within an optimal range for stimulating stem cell elongation. To identify differences among treatments, the analysis was followed by Tukey's HSD test, as presented in Figure 1.

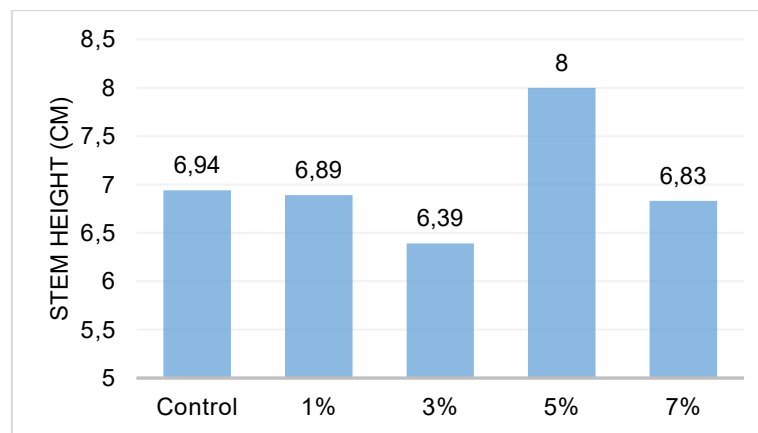


Figure 1. Mean stem height

The Tukey HSD test revealed two homogeneous groups at the 5% significance level. The 5% concentration produced the highest mean stem height (8.00 cm) and differed significantly from the 3% concentration, which had the lowest mean value (6.389 cm). This indicates that the application of 5% *Aloe vera* was more effective in increasing stem height than the 3% treatment. Meanwhile, the 1% concentration (6.89 cm), 7% concentration (6.83 cm), and control treatment (6.94 cm) belonged to the same group and were not significantly different. This pattern suggests the presence of an optimum concentration for supporting growth hormone activity, in which the balance of auxin and gibberellin at a particular concentration is more effective in stimulating stem elongation.

The increase in stem height at the 5% concentration indicates that auxin plays a role in stimulating cell elongation through receptor activation at the plasma membrane, followed by translocation from the shoot apex to the elongation zone, thereby supporting stem growth (Srg & Hrp, 2023). This process is reinforced by the role of gibberellin, which acts through two main mechanisms: enhancing auxin activity in cell elongation and stimulating the synthesis of α -amylase, an enzyme that hydrolyzes starch into simple sugars. The resulting increase in glucose concentration raises cellular osmotic pressure, facilitating water uptake and promoting optimal cell expansion and elongation (Gresiyanti & Rahayu, 2023).

The synergy between auxin and gibberellin enables stem growth to proceed more optimally at balanced concentrations, as explained by (Permatasari et al., 2016), who reported that the interaction of these two hormones contributes to increased cell size. However, increasing the concentration beyond 5% did not produce a better response. This may be attributed to hormonal imbalance or inhibitory effects at higher concentrations, resulting in suboptimal growth responses.

These results are consistent with previous findings by (Ei Ei et al., 2025), who reported that the application of various plant extracts, including *Aloe vera* at a 5% concentration, increased plant height by 33–68% in tomato, cucumber, and lettuce,

with a relatively stable response pattern. Compared with that study, the increase in stem height in *Dendrobium* 'Arif' orchids was lower and less consistent across all concentrations. This difference confirms that the effectiveness of *Aloe vera* as a natural plant growth regulator is specific to plant species and environmental conditions. Therefore, the present study indicates that, in *Dendrobium* 'Arif' orchids, a 5% concentration represents the optimum level for supporting stem growth.

Root Length

Roots are essential plant organs that function to anchor the plant and maintain its stability. In addition, roots serve as the primary structures responsible for absorbing water and nutrients from the growing medium, which are then utilized to support plant growth and development (Yahya et al., 2024). Because roots are highly sensitive to nutrient availability, root length is considered a representative indicator for assessing plant physiological responses to plant growth regulator treatments. To support these descriptive findings, statistical analysis was conducted to test the effect of treatments on root length. The ANOVA results are presented in Table 2.

Table 2. ANOVA results at the 5% significance level for root length measurement

Group	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	103.870	4	25.968	5.896	0.001
Within Groups	176.182	40	4.405		
Total	280.052	44			

The one-way ANOVA results showed that the application of different concentrations of *Aloe vera* significantly affected the root length of *Dendrobium* 'Arif' orchids ($F = 5.896$; $\text{Sig.} = 0.001$; $p < 0.05$). A significance value of <0.05 indicates differences in root growth responses among treatments. The 5% concentration showed the highest effectiveness in increasing root length, indicating that the phytohormone content in *Aloe vera* at this concentration was able to stimulate root cell elongation optimally. To determine which treatment had the most optimal effect, the analysis was followed by Tukey's HSD test, as presented in Figure 2.

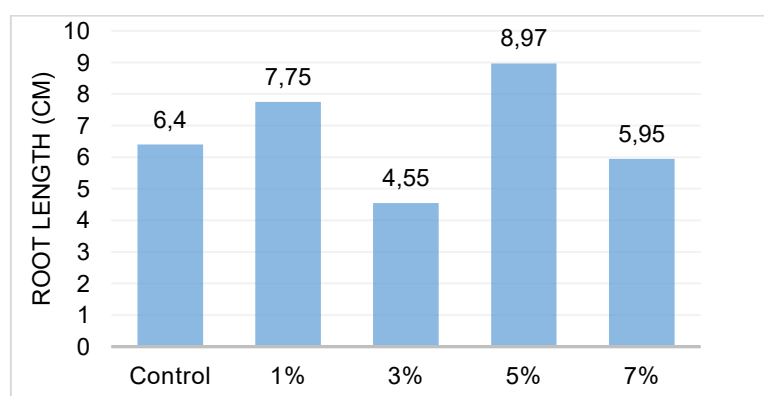


Figure 2. Mean root length

The post hoc test showed that the 5% concentration produced the highest mean root length (8.978 cm) and formed a separate subset, indicating a significant difference compared with treatments with lower mean values, particularly the 3% concentration, which showed the lowest average (4.556 cm). Meanwhile, the control treatment (6.400 cm), 1% concentration (7.756 cm), and 7% concentration (5.950 cm) were included in

a group that did not differ significantly. Overall, the 5% concentration was the most effective treatment for increasing root length. This indicates that the phytohormone content in *Aloe vera* at this concentration was at an optimal level to stimulate root cell elongation.

These findings suggest that the effectiveness of the 5% concentration is associated with the mechanism of action of the phytohormones contained in *Aloe vera*, particularly in stimulating root cell elongation. Auxin induces cells to release hydrogen ions into the cell wall, thereby lowering pH and increasing cell wall flexibility, which ultimately triggers root cell elongation (Darojat et al., 2016). In agreement with this, auxin in *Aloe vera* contributes to root formation by stimulating meristematic cell division at the root tip and accelerating cell elongation, enabling roots to grow longer (Maisyarah, 2024). In addition, gibberellin in *Aloe vera* supports root growth by increasing cell elongation, thereby accelerating longitudinal root growth (Mudaningrat & Nada, 2021). The synergy between these two hormones allows root growth to proceed more optimally at balanced concentrations.

This finding indicates that root system development plays an important role in supporting vegetative plant growth, as explained by (Agustin et al., 2016), who stated that optimally developed roots enhance the plant's ability to absorb water and nutrients, which are subsequently used to support photosynthesis in the leaves. The products of photosynthesis then become energy sources for root growth and other vegetative organs, creating a mutually supportive relationship among plant organs.

Compared with other plant species, the increase in root length observed in this study was relatively low at each concentration. In rose (*Rosa damascena*), the application of 10% *Aloe vera* was reported to significantly increase root length and root number, with a relatively stable response approaching the effectiveness of synthetic plant growth regulators (Kant et al., 2025). A similar pattern was also reported by (Bahgat et al., 2023) in *Hibiscus sabdariffa*, where foliar application of *Aloe vera* extract acted as a biostimulant that not only stimulated root growth but also enhanced plant physiological activity, including photosynthesis, nutrient uptake, and metabolic efficiency, more consistently.

The differences in root growth responses are related to the physiological characteristics of orchids as epiphytic plants, which possess specialized adaptive mechanisms for obtaining water and nutrients (Gao et al., 2025). The growing medium for orchids differs from that of terrestrial plants; orchids do not grow in soil and depend heavily on air humidity and surrounding organic sources, making water and nutrient availability more limited and fluctuating. This indicates that the response to *Aloe vera* as a plant growth regulator is specific to the plant species and the organ being observed. In the present study, roots exhibited higher sensitivity than the other organs. Thus, this study contributes to identifying that a relatively low concentration (5%) is sufficient to optimize root growth in *Dendrobium* orchids, with the potential to improve the efficiency of natural plant growth regulator use in cultivation practices.

Shoot Height

Shoot height was measured to evaluate the growth response of the vegetative organs of *Dendrobium* 'Arif' orchids to the application of *Aloe vera* extract at different concentrations. In general, shoot height varied among treatments, but it did not exhibit a clear increasing pattern as observed for root length and stem height. Some concentrations showed relatively higher values, but the differences were not consistent. Variations in shoot height among treatments were then statistically analyzed using ANOVA at the 5% significance level, as presented in Table 3.

Table 3. ANOVA results at the 5% significance level for shoot height measurement

Group	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.800	4	2.200	0.359	0.836
Within Groups	245.000	40	6.125		
Total	253.800	44			

In contrast to stem height and root length, shoot height showed that the application of *Aloe vera* at various concentrations did not have a significant effect on shoot height ($p > 0.05$). This result confirms that the response of plant organs to natural plant growth regulators is not uniform. The finding indicates that shoot growth in *Dendrobium* 'Arif' orchids is influenced more strongly by endogenous hormonal balance, particularly the interaction between auxin and cytokinin, than by the external addition of growth regulators.

Physiologically, shoot growth is highly dependent on the balance between auxin and cytokinin, in which the ratio of these two hormones determines meristem activation and shoot formation. As explained by (Cammarata et al., 2023), auxin dominance can inhibit shoot growth, whereas increased cytokinin promotes shoot initiation; therefore, the balance between the two is a key factor in regulating shoot growth.

In addition to hormonal factors, shoot growth rate is also influenced by external factors such as temperature and humidity (Sudartini et al., 2020). The ideal humidity for orchid growth ranges from 60–80% (Najikh et al., 2018). These conditions must remain stable, not excessively high at night and not too low during the day, to ensure optimal plant physiological processes. During the observation period, the plants were exposed to the rainy season, characterized by high humidity and limited light intensity. These conditions may have suppressed the rate of photosynthesis and caused the plants to allocate more resources to physiological adaptation rather than maximizing vegetative growth.

Compared with other studies, the shoot growth response in the present study was relatively limited. (Zuyasna et al., 2024) reported that the application of 75% *Aloe vera* in honey guava consistently increased shoot number and shoot length under significantly different treatment conditions. This difference in results confirms that the effectiveness of *Aloe vera* depends not only on its hormone content, but also on the complex interaction between internal and external plant factors.

Overall, this study provides new information regarding the application of *Aloe vera* as a natural plant growth regulator in *Dendrobium* 'Arif' orchids, showing that the treatment was more effective in stimulating root and stem growth than shoot growth. Unlike previous studies reporting a general increase in plant growth, the present findings indicate that the effectiveness of natural plant growth regulators is specific to particular plant organs, especially roots and stems. These findings highlight the importance of an organ-based approach in the application of natural plant growth regulators and provide a scientific basis for determining more efficient and targeted concentrations in orchid cultivation practices.

CONCLUSION

The application of *Aloe vera* as a natural plant growth regulator (PGR) was shown to enhance root length and stem height in *Dendrobium* 'Arif' orchids, although it did not have a significant effect on shoot height. A concentration of 5% produced the most favorable growth response, particularly in root development. These findings indicate that the effectiveness of natural PGRs is organ-specific, highlighting the importance of

selecting an appropriate concentration to optimize plant growth. The variation in response further suggests that each organ exhibits different hormonal sensitivities, with roots and stems being more responsive to auxins and gibberellins than shoots. Overall, this study confirms the potential of *Aloe vera* as a natural PGR for promoting vegetative growth in orchids, especially in roots and stems, while also supporting its use as a more environmentally friendly alternative in plant cultivation practices.

RECOMMENDATION

Further research should focus specifically on shoot height by considering the balance between auxin and cytokinin hormones, as well as the influence of environmental conditions, in order to obtain a more comprehensive understanding of shoot growth responses to the application of natural PGRs.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to CV. Candi Orchid, Semarang City, for granting permission, providing facilities, and offering full support throughout the implementation of this study. The greenhouse facilities, availability of plant samples, and technical assistance greatly contributed to the smooth execution of the research process, from the preparation stage to data collection. The constructive collaboration and strong support from CV. Candi Orchid also played an important role in ensuring the successful achievement of the research objectives.

REFERENCES

- Agustin, A. D., Riniarti, M., & D. (2016). Pemanfaatan Limbah Serbuk Gergaji dan Arang Sekam Padi sebagai Media Sapih untuk Cempaka Kuning (*Michelia Champaca*). *Jurnal Sylva Lestari*, 2(3), 49–58. <https://doi.org/10.23960/jsl3249-58>
- Bahgat, A.-R., Dahab, A. A., Elhakem, A., Gururani, M. A., & El-Serafy, R. S. (2023). *Integrated Action of Rhizobacteria with Aloe vera and Moringa Leaf Extracts Improves Defense Mechanisms in Hibiscus sabdariffa L . Cultivated in Saline Soil*. *MDPI Journal*, 12(21). <https://doi.org/10.3390/plants12213684>
- Cammarata, J., Roeder, A. H. K., & Scanlon, M. J. (2023). *The ratio of auxin to cytokinin controls leaf development and meristem initiation in Physcomitrium patens*. *Journal of Experimental Botany*, 74(21), 6541–6550. <https://doi.org/10.1093/jxb/erad299>
- Darojat, M. K., Resmisari, R. S., & Nasichuddin, A. (2016). Pengaruh Konsentrasi dan Lama Perendaman Ekstrak Bawang Merah (*Allium cepa L .*) terhadap Viabilitas Benih Kakao (*Theobroma cacao L .*). *Jurnal Penelitian*, 7(1), 6.
- Ei Ei, Park, H. H., & Kuk, Y. I. (2025). *Growth Promotion and Secondary Metabolites of Vegetables by Spraying Soil with Psidium guajava , Aloe vera , Allium sativum and Medicago sativa Extracts at Various Stages of Growth*. *MDPI Journal*, 14(237). <https://doi.org/10.3390/plants14020237>
- Gao, T.-Y., Zhang, W., & Zhang, S.-B. (2025). *Differentiation in water adaptation strategy between epiphytic and terrestrial species of Cymbidium , Orchidaceae*. *AoB PLANTS*, 17(4), 1–8. <https://doi.org/10.1093/aobpla/plaf030>
- Gresiyanti, D. M., & Rahayu, Y. S. (2023). *The Effectiveness of Various Natural PGR Combination on Seed Germination, Growth and Yield of Red Chili (Capsicum annum L .)*. *LenteraBio:Berkala Ilmiah Biologi*, 12(3), 307–316. <https://doi.org/10.26740/lenterabio.v12n3.p307-316>

- Hakeem, M. K., Marafa, M., Elangovan, S. K., Saeed, E. E., Mishra, A. K., Hazzouri, K. M., Shah, I., & Amiri, K. M. A. (2025). *Innovative determination of phytohormones in Aloe vera*. *Frontiers*, January, 1–10. <https://doi.org/10.3389/fchem.2024.1490639>
- Kant, K., Gupta, S., Kaur, N., Jindal, P., & Ali, A. (2025). *Effect of Aloe vera Extract on the Cultivation Practices of Rosa damascena Mill*. *Environment and Ecology*, 43(March), 239–244. <https://doi.org/10.60151/envec/YTZV4304>
- Maisyarah, R. (2024). Respon Penggunaan ZPT Organik Ekstrak Bawang Merah, Ekstrak Lidah Buaya Dan Ekstrak Tauge dalam Merangsang Pertumbuhan Vegetatif Setek pada Tanaman Jambu Biji Merah (*Psidium Guajava L.*) [Universitas Islam Negeri Sumatera Utara]. http://repository.uinsu.ac.id/22966/1/Cover_Skripsi.pdf
- Maulana, Z. R., Djuhari, & S. (2024). Respon Pertumbuhan Anggrek *Dendrobium Sp* Kompot terhadap Berbagai Media dan Konsentrasi Nutrisi. *Jurnal Agronisma*, 12(1), 270–286. <https://jim.unisma.ac.id/index.php/AGRNM/article/view/25176>
- Mudaningrat, A Nada, S. (2021). Pengaruh Konsentrasi Zat Pengatur Tumbuh dalam Kandungan Air Kelapa terhadap Pertumbuhan Tanaman Jahe (*Zingiber Officinale*) dan Tanaman Kencur (*Kaempferia Galanga L.*). 1–9. <https://proceedings.unnes.ac.id/semnasbiologi/article/view/750/659>
- Najikh, R. A., Ichsan, M. H. H., & Kurniawan, W. (2018). Monitoring Kelembaban, Suhu, Intensitas Cahaya pada Tanaman Anggrek Menggunakan ESP8266 dan Arduino Nano. *Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer*, 2(11), 4607–4612. <https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/3021>
- Nasution, W. R., Batubara, P. R. H., Sigalingging, D. M., & Hasibuan, L. H. (2023). *Utilization of Aloe Vera (Aloe Vera) as a Natural ZPT Alternative for the Growth of Rose Plant Roots*. *Bioedunis Journal*, 02(01), 34–38. <https://doi.org/10.24952/bioedunis.v2i1.8214>
- Permatasari, D. A., Rahayu, Y. S., & Ratnasari, E. (2016). Pengaruh Pemberian Hormon Giberelin terhadap Pertumbuhan Buah secara Partenokarpi pada Tanaman Tomat Varitas Tombatu F1. *LenteraBio:Berkala Ilmiah Biologi*, 5(1), 25–31. <https://ejournal.unesa.ac.id/index.php/lenterabio/article/view/14559>
- Srg, R. J., & Hrp, R. S. (2023). Pengaruh Ekstra Lidah Buaya (*Aloe vera*) sebagai ZPT Alami untuk Pertumbuhan Tanaman Kacang Tanah (*Arachis hypogaea*). *Jurnal Agroplasma*, 10(2), 31–43. <https://doi.org/10.36987/agroplasma.v10i2.5103>
- Sudartini, T., Kurniati, F., & Lisnawati, A. N. (2020). Efektivitas Air Cucian Beras dan Air Rendaman Cangkang Telur pada Bibit Anggrek *Dendrobium*. *Jurnal AGRO*, 7(1), 82–91. <https://doi.org/10.15575/1676>
- Sulichantini, E. D., & Primawati, A. Q. (2024). Respon Pertumbuhan Bibit Anggrek *Dendrobium (Dendrobium Ira Veronica)* Terhadap Penambahan Pupuk Daun dan Pupuk Organik Pada Komposisi Pemupukan. *Jurnal Agroteknologi Tropika Lembab*, 6(2), 45–53. <https://e-journals.unmul.ac.id/index.php/agro/article/view/14057>
- Sulistya Dewi, E. R., Nugroho, A. S., & Ulfah, M. (2020). *Types of Epiphytic Orchids and Host Plants on Ungaran Mountain Limbangan Kendal Central Java and its Potential as Orchid Conservation Area*. *International Journal of Conservation Science*, 11(1), 117–124. https://ijcs.ro/public/IJCS-20-11_Dewi.pdf
- Violita, S. U., Podesta, F., Kesumawati, N., Hayati, R., Harini, R., & U. (2022). Pengaruh Pemberian Zat Pengatur Tumbuh dan Pupuk Organik Cair terhadap Pertumbuhan Tanaman Anggrek *Dendrobium Sp*. *Jurnal Agriculture*, 17(1), 46–57. <https://doi.org/10.36085/agrotek.v17i1.3594>

- Wiryanata, I. W. G., Parmila, I. P., Prabawa, P. S., Suwardike, P., & Suarsana, M., Agroteknologi, P. S., & Sakti, U. P. (2025). Optimalisasi Kelompok Tani Ternak dalam Pengelolaan Limbah Urin Sapi sebagai Biourin dan ZPT Alami di Desa Bulian. *Jurnal Jnana Karya*, 06(1).
<https://ejournal.unipas.ac.id/index.php/JK/article/view/2489>
- Yahya, M. Z., Susiyanti., Yenny, R. F., & Laila, A. (2024). Optimasi Konsentrasi Air Kelapa dan Ekstrak Lidah Buaya untuk Pertumbuhan Setek Jambu Air Var. Citra (*Syzygium Aqueum*). *Agroteksos*, 34(3), 1109–1124.
<https://doi.org/10.29303/agroteksos.v34i3.1306>
- Zuyasna, Berutu, H. B., & N. (2024). *Effect of Aloe vera as Natural Growth Regulator Concentration on the Growth of Two Varieties of Honey Guava (Syzygium aqueum L.) Cuttings.* *Jurnal Agrium*,
<https://doi.org/10.29103/agrium.v21i4.19984>