



Effectiveness of Palm Sap (*Borassus flabellifer* L.) Concentrations on the Growth of *Dendrobium welirang* Orchids

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Abstract: This study aimed to evaluate the effectiveness of palm sap (*Borassus flabellifer* L.) as an organic plant growth regulator on the vegetative growth of *Dendrobium welirang* orchids. Palm sap contains natural sugars, minerals, and biologically active components that may serve as an organic plant growth regulator. The research was conducted at the Candi Orchid Greenhouse in Semarang from July to October 2024 using a Completely Randomized Design with four palm sap concentrations, namely 0, 100, 150, and 200 ml/l, each applied in five replications. Observed parameters included plant height and root length. Data were analyzed using One Way ANOVA at a 5% significance level, followed by the Duncan Multiple Range Test. The results showed that palm sap concentration significantly affected plant height with the growth observed in treatment P3 showing an average result of 12.01 cm. In contrast, root length was not significantly affected. These findings indicate that palm sap has potential as an environmentally friendly organic plant growth regulator to support vegetative growth of *Dendrobium welirang* orchids.

Keywords: *Dendrobium welirang*; palm sap; organic plant growth regulator; vegetative growth

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INTRODUCTION

Orchids are one of the most important decorative plant commodities with high economic and aesthetic value. They are commonly cultivated in tropical and subtropical countries, including Indonesia (Prayoga & Mustikarini, 2022). Indonesia is renowned as one of the major hubs of orchid biodiversity due to its ideal environmental conditions and abundant genetic resources (Rinaldi & Rita, 2020). Orchids belong to the family Orchidaceae and consist of 25,000 flowering plant species with 730 genera (Husain & Eraqui, 2023). Over the years, public interest in orchids has evolved beyond entertainment and conservation goals to commercial and international markets (Ambarwati et al., 2021). Among various orchid genera, *Dendrobium* is one of the most popular distinguished by its floral morphology and pigmentation. The magnificent *Dendrobium* flowers, with their different colors, shapes, and patterns, and their long lasting nature, make this plant of high aesthetic and economic worth (Fikien & Agustim, 2023).

One of the orchids with strong development potential is *Dendrobium welirang*, a hybrid resulting from a cross between *Dendrobium boonchoo gold* and *Dendrobium erlyna*. The advantages of *Dendrobium welirang* include its large yellow flowers and the number of florets, which can reach twelve to sixteen per inflorescence (Warisman et al., 2024). Although orchids have a high commercial value due to their extended lifespan, their slow vegetative growth frequently impedes their cultivation (Amalia et al., 2022). The primary obstacles in *Dendrobium* cultivation are the variety of growing media quality, specialized nutritional requirements, and vulnerability to climate change

and pest infestations (Widiastuti et al., 2024). These issues are further complicated in nursery or greenhouse systems, which necessitate meticulous environmental management, uniform seedling quality, and continuous microclimate regulation to achieve optimal growth and flowering.

With the increasing market demand for high quality orchids both domestically and internationally, the development of effective and environmentally friendly propagation techniques has become essential. Accelerating plant growth can be achieved through various cultivation engineering approaches, one of which is the application of Plant Growth Regulators (PGRs) (Amalia et al., 2022). One promising innovation is the use of organic-based Plant Growth Regulators, which are cheaper, more accessible, and more environmentally friendly compared to synthetic PGRs (Miftakhul et al., 2025). The use of natural materials with bioactive compounds has recently been developed (Nurdyansyah & Widyastuti, 2020). One potential local resource is palmyra sap (*Borassus flabellifer* L.), known to contain natural sugars, minerals, and bioactive compounds capable of stimulating plant growth (Saidi et al., 2018).

Palmyra sap (*Borassus flabellifer* L.) is derived from the juice of the palmyra (lontar) tree and contains various organic substances and natural sugars that are believed to influence plant growth. Sugar is the primary source of energy in cellular respiration, producing the ATP required for metabolism, cell division, and tissue formation, as well as providing a carbon framework for the synthesis of plant structural compounds (Jeandet et al., 2022). Fresh lontar sap, known as nira, contains approximately 10.93% total sugar and 0.96% reducing sugar (Saidi et al., 2018). In addition to sugars, palmyra sap also contains minerals per 100 g, including Mg (640 mg), Ca (433.3 mg), K (236.7 mg), Mn (12.85 mg), Zn (12.74 mg), and Fe (11.5 mg), and it exhibits electrolyte properties (Ashfarina et al., 2020). Potassium (K) regulates osmotic pressure and maintains cell turgor, thereby supporting cell expansion and plant growth, while also controlling stomatal movement to enhance CO₂ uptake and reduce water loss (Zhu et al., 2025). Calcium (Ca) contributes to cell division and elongation by stabilizing cell walls and membranes, whereas Magnesium (Mg), as the central component of chlorophyll, is essential for efficient photosynthesis (Adriaje, 2025). In addition, micronutrients such as zinc (Zn) and manganese (Mn) function as enzyme cofactors involved in metabolic, hormonal, and redox processes that collectively support optimal plant growth and development (Nandal & Solanki, 2021). These components not only make palmyra sap a natural energy source for humans, but also potentially support plant physiology, including photosynthesis and cell division. The wide distribution of palmyra trees across Central Java, East Java, and East Nusa Tenggara (Suwatiningsih et al., 2024) indicates that this material is abundant and can be sustainably utilized to support local agriculture.

Despite its high commercial value, the cultivation of *Dendrobium* is constrained by relatively slow vegetative growth (Nissa et al., 2023) and high nutrient requirements, which can delay flowering and reduce production efficiency. The use of synthetic plant growth regulators (PGRs) face limitations due to high production and application costs as well as environmental damage risks such as toxicity (Chittora, 2023), thereby increasing the need for affordable and environmentally friendly organic alternatives to support sustainable orchid cultivation.

This study examines the use of palmyra sap (*Borassus flabellifer* L.) as a natural plant growth regulator for *Dendrobium welirang* orchids, considering its content of natural sugars and minerals that have been reported to support plant. The effectiveness of different palmyra sap concentrations was evaluated to determine the most responsive concentration in promoting vegetative growth, using plant height

(Amalia et al., 2022) and root length (Sari et al., 2024) as growth indicators. The results of the study are expected to enhance vegetative growth while improving the quality of the flowers produced, thereby supporting environmentally friendly orchid cultivation practices and providing practical recommendations for farmers.

METHOD

This study was carried out from July to October 2024 at CV. Candi Orchid's greenhouse in Karanganyar Gunung, Candisari District, Semarang City, Indonesia at an elevation of 86 meters above sea level, using a Completely Randomized Design with four palm sap concentrations, namely 0, 100, 150, and 200 ml/L, each applied in five replications. The greenhouse climate provided ideal circumstances for *Dendrobium* growth.

The study began by preparing 20 pots of *Dendrobium welirang* orchid seedlings aged approximately 6–8 months, kadaka root growing medium, water, and palm sap water in various concentrations. The plants are individually placed in plastic pots with fern roots (kadaka) due to their superior capacity to retain water and nutrients (Maulana et al., 2024). This study used instruments included a sprayer, measuring cup, soft pot, ruler, stationery, and smartphone. Subsequently, treatments were applied to the plants twice a week, specifically every Monday and Thursday at 3-4 pm.

The plant growth regulator was prepared by diluting palmyra sap with water according to the treatment concentrations of 0, 100, 150, and 200 mL/L, with the 0 mL/L treatment serving as the control using water only. Each solution was diluted to a total volume of 1 L and applied by spraying onto the growing media. Plant growth observations were conducted every 15 days for 90 days using a ruler.

The observed parameters were plant height and root length. Plant height was measured from the base of the stem to the tip of the tallest leaf, while root length was measured from the base of the stem to the tip of the longest root visible above the growing medium. All measurements were taken every 15 days during the 90-day experimental period. Data were analyzed using One Way ANOVA with IBM SPSS Statistics 27, followed by DMRT at a 5% significance level when significant differences were detected ($p < 0.05$) (Amalia et al., 2022). Prior to analysis, data normality and homogeneity were tested using the Shapiro–Wilk and Levene tests, respectively.

RESULTS AND DISCUSSION

The results presented below show the effects of various palmyra sap concentrations on the vegetative growth of *Dendrobium welirang*.

Table 1. Descriptive statistics of plant height and root length of *Dendrobium welirang* orchids treated with different palm sap concentrations.

Treatments	Plant Height (cm) \pm SD	Root Length (cm) \pm SD
P0	8,78 \pm 1,08	3,65 \pm 0,29
P1	11,34 \pm 0,91	3,93 \pm 0,53
P2	11,49 \pm 0,77	4,05 \pm 0,95
P3	12,01 \pm 1,88	5,10 \pm 1,41

Plant Height

The application of palmyra sap significantly increased the plant height of *Dendrobium welirang*, indicating that the nutrients contained in the sap supported vegetative growth processes. Palmyra sap is known to contain essential macro and micronutrients, including potassium, calcium, and magnesium, which play important physiological roles in plant growth. Potassium regulates the distribution of

photosynthesis products and maintains cellular water balance, thereby supporting stem elongation (Sari et al., 2024). Calcium strengthens cell walls and supports the growth of young tissues, enabling the stem to grow taller. Nitrogen (N) and magnesium (Mg) play important roles in chlorophyll formation, which enhances photosynthetic activity, allowing assimilates to be used for stem growth (Paiman, 2022).

The results of the ANOVA test at a 5% significance level for the plant height measurements of *Dendrobium welirang* in this study are presented in Table 2.

Table 2. ANOVA test results at a 5% significance level on plant height measurements.

	Sum of Square	df	Mean Square	F	Sig.
Between groups	31.285	3	10.428	6.772	0.04
Within groups	24.639	16	1.540		
Total	55.924	19			



Figure 1. Plant height measurement

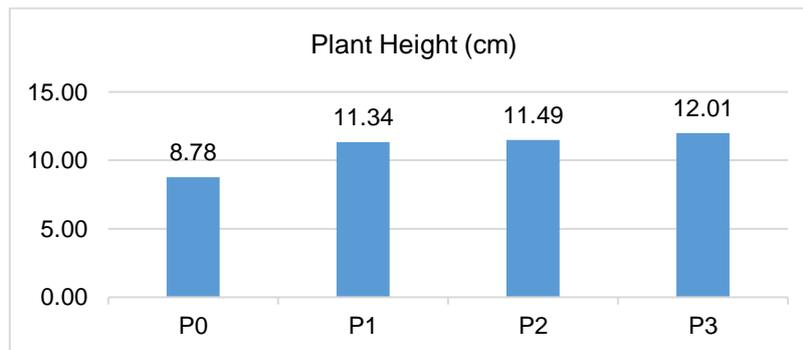


Figure 2. Average plant height diagram

The One Way ANOVA test results in Table 2 showed that there were significant differences in plant height among the treatments, indicating the need for further analysis to determine which treatment had the most favorable effect on plant height growth. Based on the ANOVA results in Table 2, a significance value of 0.04 (<0.05) was obtained, indicating that the application of palmyra sap was effective in increasing the plant height of *Dendrobium welirang* orchids. This means that the various concentrations of palmyra sap were able to induce significant differences in growth among the treatments.

The results of the Duncan test for the plant height measurements of *Dendrobium welirang* in this study are presented in Table 3.

Table 3. Duncan Test results on plant height measurements

Treatment	N	Subset for alpha = 0.05	
		1	2
P0	5	8.7820	
P1	5		11.3420
P2	5		11.4900
P3	5		12.0080
Sig.		1.000	0.434

The results of the Duncan test in Table 3 show that treatment P3 (200 mL/L) produced higher average plant height than the control (P0), and these three treatments were included in the same subset, indicating no significant differences among them. Although treatment P3 showed the highest mean plant height, this value was not significantly different from those of P1 and P2. This result indicates that the application of palmyra sap generally promotes vegetative growth of *Dendrobium welirang*, particularly plant height, compared to plants without palmyra sap application.

The increased plant height observed in palmyra sap treatments may be related to the presence of bioactive compounds and mineral nutrients such as potassium (K), magnesium (Mg), and calcium (Ca), which support cell division, stem elongation, and photosynthetic activity. Potassium contributes to osmotic regulation and assimilate translocation, while magnesium plays a key role in chlorophyll formation, thereby enhancing photosynthesis (Ashfarina et al., 2020). Increased photosynthetic activity allows greater assimilate production to support vegetative growth (Saputri et al., 2025). In addition, natural sugars in palmyra sap may serve as an additional energy source for plant metabolic processes.

These findings are consistent with previous studies reporting that liquid organic fertilizers and natural plant growth regulators can enhance the vegetative growth of *Dendrobium* orchids (Sholiha et al., 2024). Similarly, the application of natural plant growth regulators has been shown to accelerate the growth of orchid seedlings (Amalia et al., 2022). The higher plant height observed in palmyra sap treatments compared to the control indicates that the additional nutrients and organic compounds provided by the sap support vegetative growth processes. Although treatment P3 showed the highest mean plant height, its effect was not significantly different from those of P1 and P2, suggesting that all palmyra sap concentrations tested were able to support plant height development. The lower growth observed in the control treatment reflects the absence of supplemental nutrients and bioactive compounds, which may limit vegetative growth in *Dendrobium welirang*.

Root Length

The observations showed that palmyra sap application did not result in a significant difference in the root length of *Dendrobium welirang* orchids. The results of the ANOVA test at a 5% significance level for the root length measurements of *Dendrobium welirang* in this study are presented in Table 4.

Table 4. ANOVA test results at 5% significance level on root length measurements

	Sum of Square	df	Mean Square	F	Sig.
Between groups	6.077	3	2.026	2.497	0.097
Within groups	12.981	16	0.811		
Total	19.057	19			



Figure 3. Root length measurement

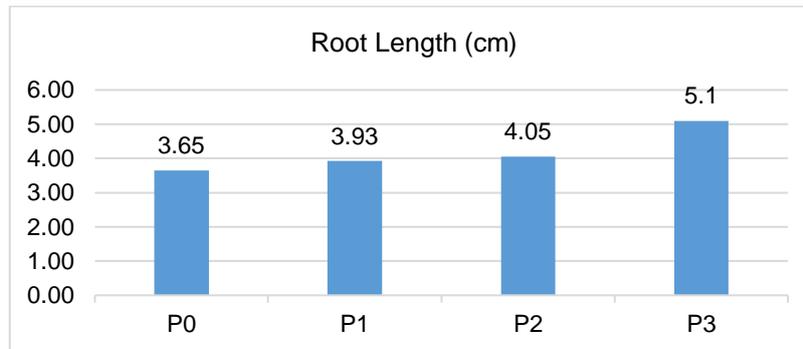


Figure 4. Average root length diagram

The One Way ANOVA test indicated a significance value of 0.097 (>0.05), confirming that different palmyra sap concentrations had no statistically significant effect on this parameter. Descriptively, treatment P3 showed the highest mean root length, followed by P2, P1, and the control (P0). However, these differences were not statistically significant.

The non-significant effect of the treatments on root length may be attributed to several factors. First, root growth tends to be more strongly influenced by the growing media, aeration, and moisture conditions than by the concentration of nutrients applied. The fern root (kadaka) medium used in this study was already adequate for supporting root development (Herastuti & Kawuryan, 2021), so the additional nutrients from palmyra sap did not produce noticeable differences among treatments. Furthermore, during the vegetative growth phase, *Dendrobium* orchids tend to allocate more resources to shoot and leaf development rather than root elongation.

Although not statistically significant, treatment P3 observed at palmyra sap concentrations may be related to the nutrient composition of the sap. Minerals such as calcium and potassium are involved in root cell division, while magnesium and iron support energy metabolism required for root tissue development (Ashfarina et al., 2020). In addition, the natural sugar content in palmyra sap may function as a carbon source that supports root cell respiration and the formation of new tissues. Micronutrients such as zinc and iron also contribute to enzyme activity and protein synthesis associated with root tip development.

These results are consistent with the findings of Sari *et al.* (Sari et al., 2024), who reported that application significantly enhanced shoot growth but did not influence root length in *Dendrobium*. Furthermore, natural materials containing sugars and minerals have been reported to stimulate microbial activity in the rhizosphere, which may improve nutrient availability and root system health over longer application periods (Miftakhul et al., 2025). Therefore, although the effects of palmyra sap on root length were not statistically significant in this study, a concentration of 200 mL/L application

may contribute to improved root environment and nutrient absorption efficiency when applied continuously.

CONCLUSION

This study showed that palmyra sap application significantly affected the plant height of *Dendrobium welirang* orchids, as indicated by the One Way ANOVA results. All palmyra sap treatments resulted in higher plant height compared to the control, with the highest mean value observed at a concentration of 200 mL/L, although no significant differences were found among the palmyra sap concentrations tested. In contrast, palmyra sap application did not significantly influence root length during the observation period, despite a positive descriptive trend at higher concentrations. Overall, these findings indicate that palmyra sap has potential as an environmentally friendly organic plant growth regulator to support the vegetative growth of *Dendrobium welirang* orchids.

REKOMENDATION

The effects of palmyra sap during both the vegetative and generative phases should be investigated further, especially with regard to the development and quality of *Dendrobium welirang* orchid blooms. To confirm these results and broaden the application of siwalan sap as a natural growth regulator, testing at more varied concentrations and on different kinds of orchids is also required.

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