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Effectiveness of Eco Enzyme for Inducing Flower Growth in *Dendrobium Sonia-ersakul* Orchids

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Abstract: Orchid plants are ornamental plants with various shapes, colors, and sizes, exhibiting unique characteristics that make them a special attraction for enthusiasts of ornamental plants. Among them is the Dendrobium orchid, which belongs to the genus of orchids known for its diverse types and beauty. Enhancing the growth and quality of *Dendrobium Sonia-ersakul orchid flower*s can be achieved through proper fertilization. The fertilizer in this research is derived from liquid organic fertilizer, *Eco Enzyme*. This research aims to assess the impact of *Eco Enzyme* on the induction of flowering growth in *Dendrobium orchids*. This research was carried out at CV Candi Orchid, 17 Bukit Unggul Raya Street, Semarang, over three months, from May to July 2023. The research design employed in this research is the two-tailed t-test research method, which includes a control group and an experimental group treated with 0.2% Eco Enzyme. There were two combinations, with each treatment comprising six replicates. The measured variables included the number of roots, root length, buds, and panicles. The outcomes indicated that the application of *Eco Enzyme* led to a significant increase in the number of panicles compared to the control group. However, no significant differences were observed in root length, the number of new roots, or the number of buds when *Eco Enzyme* was applied.

Keywords: *Dendrobium* Orchid; Eco Enzyme; Flowering Induction.

Introduction

In Indonesia, there are approximately 5,000 species of orchids. *Orchid* plants belong to the *Orchidaceae* family, and they have been widely recognized by the general public for a long time as ornamental plants and cut flowers [1]. Orchid plants are globally renowned and appreciated. In their native environments, these plants thrive as epiphytes, anchoring their roots onto other plants. Orchids are cultivated for their exquisite flowers and are commonly grown globally in tropical and subtropical regions [2]. Indonesia can produce quality orchid plants because the climate in Indonesia is suitable for the growing conditions or cultivation of orchids. Many orchid species, such as *Dendrobium*, *Vanda*, *Phalaenopsis*, *Cattleya*, *Oncidium*, *Rananthera*, *Aranda*, and *Cymbidium*, are commercially cultivated. Many people's favorite orchid is the Dendrobium orchid because of its extraordinary bloom colour [3].

As one of the orchid genera, Dendrobium showcases significant diversity in its species and aesthetic appeal. Dendrobium orchids exhibit a wide array of colours, including pure white, combinations of white and purple, and vibrant yellow, with remarkable variations in hue and intensity. Furthermore, hybrid Dendrobium orchids yield even more captivating colour variations, with crosses leading to intriguing and distinctive colour patterns in Dendrobium orchids. One example of Dendrobium orchid crossing is *Dendrobium sonia-ersakul* orchid.

Dendrobium Sonia orchid, which results from a hybridization between *Dendrobium caesar* and *Dendrobium tomie* drake [4], represents a captivating hybrid orchid. This crossbreeding was conducted to amalgamate the advantageous traits of both hybrid orchids. *Dendrobium caesar* possesses distinct characteristics, while *Dendrobium tomie* drake imparts additional attributes that can augment the overall beauty and resilience of the plant. In Thailand, *Dendrobium hybrids* are prevalent orchid varieties in the potted ornamentals and cut flower industries. One type, *Dendrobium Sonia*, is famous for having bright flower colours. The plant can continuously produce flowers yearly, with at least six flowers in each flowering period [5].

In pursuing high-quality and prolific orchid plants, it is crucial to recognize that multiple factors exert significant influence. As Herliana's research [6] indicates, the quality of orchid plants, including Dendrobium, is shaped by genetics, hormonal factors, nutritional conditions, and environmental temperature. Dendrobium orchids grow slowly, requiring special attention to stimulate their growth. Although flowering of orchid plants can occur without applying fertilizers, it can hurt flower quality. Therefore, orchid plants need good nutritional care, and a lack of nutrients can inhibit their growth and development. Adding nutrients to orchid plants is done by applying fertilizer.

Fertilization plays a pivotal role in promoting orchid flowering. The proper application of fertilizer can expedite the flowering cycle of these plants. The fertilizer utilized for orchid plants is *Eco Enzyme*. *Eco Enzyme* is an organic fertilizer to reduce the use of inorganic fertilizers that can cause environmental pollution. *Eco Enzyme* is an effort made to spur the induction of growth and flowering of Dendrobium orchid plants.

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Eco Enzyme is a product generated through anaerobic fermentation, which includes fruits, vegetables, sugar, and water. It is a brown organic solution with low acidity and emits a distinct aroma during fermentation. [7]. *Eco Enzyme*'s innovation is the work of Dr Rasukon Poompanvong from Thailand, who transforms unused waste organic kitchen materials into eco-friendly enzymes with significant benefits.

The production of *Eco Enzyme* from organic fruit peel waste has gained popularity and widespread development due to its perceived practicality, cost-effectiveness, and environmentally friendly nature [8]. The *Eco Enzyme* manufacturing process entails mixing vegetable and fruit waste with the addition of water and palm sugar in a ratio of 3:1:10, followed by anaerobic fermentation over three months [9]. The resulting liquid extract contains nitrate (NO3), which can be utilized as a nitrogen source to fulfill the nutrient needs of plants.

Eco Enzyme comprises a range of *vital enzymes* that promote plant growth. Furthermore, *Eco Enzyme* contains active components, including enzymes, microorganisms, and amino acids, which stimulate plant growth. According to Larasati's research [10], using *Eco Enzyme* can contribute to meeting the nutrient needs of plants through the fermentation of organic waste. One example is the enzyme amylase, which is crucial in breaking down amylum contained in plant seeds. This process provides energy in the form of ATP during the germination phase.

The protease enzyme found in *Eco Enzyme* can break down intricate amino acids, which plants can subsequently assimilate to facilitate their growth. Meanwhile, the lipase enzyme in *Eco Enzyme* is responsible for breaking fats into fatty acids or glycerol within plant seeds. This glycerol is an energy source through fat metabolism during germination until the plant progresses into a more intricate form [11]. Furthermore, liquid organic fertilizers like Eco Enzyme are preferred because they contain enzymes such as lipase, trypsin, and amylase, which can inhibit pathogens. Additionally, it contains acetic acid (H3COOH), a component capable of eliminating bacteria and viruses.

Plants require nutrients for their growth and development processes and cannot produce nutrients autonomously. Instead, plants acquire nutrients through their roots by absorbing water and capturing carbon dioxide through their stomata. Nevertheless, the stomata will close when the plant encounters water scarcity conditions. Since photosynthesis is linked to the water transport activity within the plant and a reduction in the flow of carbon dioxide, it becomes inhibited when the stomata close or constrict. According to Burhan's statement [12], the composition of planting media can provide nutrients and nutrients to plants. *Eco-enzyme* treatment will be given to *Dendrobium sonia-ersakul* orchid plants to prove the effectiveness of *Eco-enzyme* on the induction of growth and flowering of *Dendrobium sonia-ersakul* orchid plants. This research is intended to determine the efficacy of using *Eco Enzyme* for the induction of growth and flowering of Dendrobium orchids.

Research Methods

The research was carried out over three months, from May to July 2023. The study was conducted at CV Candi Orchid, 17 Bukit Unggul Raya Street, Semarang, where the average air temperature ranged from 27°C to 32°C.

Tools and Materials

The equipment comprised 12 *soft pots* with a 1.7-inch volume, 12 pieces of wire, 12 pieces of rope, one handheld sprayer, one white marker, one stirring rod, 1 measuring cup, one ruler, one thermometer, one scale, and two trays.

The research materials employed consisted of 12 Dendrobium orchid plants aged eight months since acclimatization or bottle opening, one container of Eco Enzyme, 1.8 kg of *kadaka* roots (150 grams x 12 pieces), 1 measuring cup, and 6 liters of distilled water.

Procedure

1. Dendrobium orchid plant preparation

a. Once all the tools and materials are prepared, place a small *kadaka* root into the soft pot.
b. Retrieve 8-month-old *Dendrobium Sonia-ersakul* (ESK) orchid seedlings, which have been acclimated. Carefully remove the seedlings from the net pot, gently unravel their roots, and cleanse them slightly from any residual medium.
c. Take the kadaka roots and affix them to the origins of the Dendrobium Sonia-ersakul orchids, ensuring a snug fit (each pot should contain 150 grams of kadaka roots). Subsequently, position the orchid in the soft pot and compact the *kadaka* roots to create a firm medium.
d. Label each pot with the corresponding treatment name, such as Eco Enzyme 1, Control 1, and so on.
e. Arrange them on the tray once all 12 plants have been transplanted into the soft pots.
f. Position the plants in an environment with a temperature ranging from 27-32°C. If the temperature exceeds this range, utilize a fan and install a shade cloth to maintain a stable temperature.
g. Watering should be performed twice using a water hose until the orchid plants are adequately moistened.

2. Stages of Making Treatment Materials

Preparation of *Eco Enzyme* solution:

a. Prepare undiluted *Eco Enzyme*
b. Take *Eco Enzyme* using an injection of 2 ml
c. Take 1000 ml or 1 liter of water using a measuring cup. Add 2 ml of *Eco Enzyme* to the measuring cup and stir using a stirrer.
d. Put the *Eco Enzyme* solution in a plant spray bottle and label it using a marker.

3. Stages of Application

The Eco Enzyme solution is applied once a week, every Thursday afternoon, from 15:00 to 17:00 WIB (Western Indonesian Time). The solution is evenly sprayed onto the plant media and roots using a spray bottle, ensuring thorough wetting.

4. Data Analysis

This research is experimental; the data were analyzed comparatively using statistical tests, namely the *two-tailed* t-test with the treatment factor 0.2% *Eco Enzyme*. *The* treatment was done six times. *The* parameters observed included the number of roots, root length, shoots, and panicles.

Results and Discussion

Significant differences were observed in the application of *Eco Enzyme* concerning the stimulation of growth and flowering in *Dendrobium Sonia-ersakul* orchids. The results of the analysis of variance for root length, the number of new roots, the number of buds, and the number of flower panicles are as follows:

Plant Root Length (cm)

Based on the collected data, it is evident that the root length of *Dendrobium Sonia-ersakul* orchid plants treated with Eco Enzyme is significantly longer compared to the control group (without treatment) (Table 1). In the size of the roots of *Dendrobium sonia-ersakul* orchid plants with the application of *Eco Enzyme* and control (without treatment) using the *two-tail* t-test method, the results obtained are H0 (there is no significant difference in the application of *Eco Enzyme* and not fertilized on vegetative growth) (Table 2).

Table 1. Root length of Dendrobium orchid plants

No.	Control (cm)	*Eco Enzyme* (cm)
1.	1.4	3
2.	2.5	5
3.	1.8	4.3
4.	2	2.2
5.	2	6
6.	2.5	3

Table 2. A t-test assessed the efficacy of *Eco Enzyme* application on root length growth in Dendrobium Sonia-ersakul orchid plants.

	Control	*Eco Enzyme*
Mean	2.03	3.92
Variance	0.18	2.06
Observations	6	6
Hypothesized Mean Difference	0	
Df	6	
t Stat	-3.08	
P(T<=t) two-tail	0.02	
t Critical two-tail	2.45	

Including *Eco Enzyme* in the research revealed no significant difference in the root length of *Dendrobium orchid* plants. It suggests that the *Eco Enzyme* application remains inadequate in meeting the nutritional requirements of nutrients in *Dendrobium Sonia-ersakul orchid* plants. Although the results of the *two-tail* test showed no difference from the control, other materials may support vegetative and generative growth in the root length of *Dendrobium orchid* plants. Based on his research outcomes, Prabekti [13] proposed that *Eco Enzyme* contains organic acids capable of exerting positive stimulatory effects on plants. These organic acids are believed to stimulate and enhance cell membrane permeability, thereby promoting the growth of plant roots. In addition, *Eco Enzyme* also plays a role in producing phytohormones such as auxin, gibberellin, and cytokinin. These phytohormones are essential in enhancing plant growth in vegetative and generative aspects.

Tahmidina and Sitawati [14] asserted that *Eco Enzyme* comprises protease, amylase, and lipase enzymes capable of stimulating plant biocatalytic activities. The described mechanism of action of *Eco Enzyme* is susceptible to alteration based on nitrogen availability within the plant. Nitrogen is identified as an essential element that contributes to the formation of amino acids, a process necessary for plant growth, and there is a relationship between the presence of nitrogen and the mechanism of plant response to *Eco Enzyme.* Therefore, the nitrogen content present in *Eco Enzyme* can affect the length of plant roots. The higher the nitrate content in the plant, the more protein is produced, thus spurring plant growth.

Ginting et al. [15] demonstrated the significant role of nitrogen in supporting the photosynthesis process, subsequently influencing plant root length. They further emphasized that the activity of protease enzymes can affect the presence of nitrogen in soil. These enzymes are believed to facilitate nitrogen mineralization, a process in which organic nitrogen is converted into simpler forms that plants can absorb. This. Therefore, it is necessary to avoid adverse effects that may affect the ability of plants to increase nitrogen uptake. According to Blinnik [16], this is important because nitrogen plays a crucial role in producing fats, proteins, and other organic compounds. Increased nitrogen uptake, particularly during the plant's vegetative phase, is essential to meet nutrient requirements. This research highlights that plant biomass increases as nitrogen uptake increases, creating conditions favoring optimal plant growth and development.

The root elongation growth process suggests that the elongation of root length is also affected by the element zinc (Zn), which is synthesized at the plant's root tip and subsequently transported through the xylem to various plant organs, thereby stimulating the process of cell division. The role of Zn in promoting cell division is evident, especially in root growth, focused on the root meristem. Root meristem activity is responsible for the formation of elongated roots, which leads to the development of a more extensive and robust root system in plants [17].

Number of New Roots

In the data collected, the number of new *Dendrobium sonia-ersakul* orchid plants with *Eco Enzyme* is higher than that of the control (without treatment) (Table 3). While the number of new roots that grow on *Dendrobium sonia-ersakul* orchid plants with *Eco Enzyme* and control (no treatment) using the *two-tail* t-test method shows the result of H0 (there is no significant difference between *Eco Enzyme* and no fertilizer on vegetative growth) (Table 4).

Table 3. Number of new roots of *Dendrobium* orchid plants

No.	Control	*Eco Enzyme*
1.	8	12
2.	24	7
3.	15	19
4.	12	24
5.	11	13
6.	12	16

Table 4. The t-test evaluates the effectiveness of *Eco Enzyme* application on the growth of new roots in *Dendrobium Sonia-ersakul* orchid plants.

	Control	*Eco Enzyme*
Mean	13.67	15.17
Variance	30.67	34.97
Observations	6	6
Hypothesized Mean Difference	0	
Df	10	
t Stat	-0.45	
P(T<=t) two-tail	0.66	
t Critical two-tail	2.23	

The analysis results indicated that the impact of *Eco Enzyme* did not yield any significant difference in the number of new roots of Dendrobium orchid plants. Generally, *Eco Enzyme* treatment resulted in the most favorable growth in the number of new roots, although it was not significantly different from the control. Although the results of this analysis also contain bacteria that act as decomposing agents of organic matter, the results of the study show that there is no difference between *Eco Enzyme* treatment and control on the growth of the number of new roots of *Dendrobium Sonia-ersakul* orchid plants [18].

Eco Enzyme, serving as a source of nutrient supply, including nitrogen, plays a pivotal role in promoting plant growth. The addition of nitrogen to plants is well-recognized for its capacity to stimulate the growth of organs involved in the photosynthesis process. Novianto [19] emphasized that nitrate, the nitrogen nutrient in Eco Enzyme liquid organic fertilizer, significantly contributes to plants' growth and development.

The significance of nutrient supply for plants, particularly nitrogen, is evident in its support of metabolic processes and protein synthesis. As indicated by Novianto, the availability and equilibrium of nutrients can also enhance plant metabolic processes, subsequently enhancing plant growth and development, especially in forming new rootlets. Thus, understanding the role of liquid organic fertilizers, such as *Eco Enzyme*, in providing nutrients and supporting plant growth processes offers essential insights for optimal plant nutrition management [20]. However, the nutrients provided by the *Eco Enzyme* treatment for the number of root lengths have not fulfilled the nutrients orchid plants need.

Number of Buds

Based on the collected data, it can be observed that the *Dendrobium Sonia-ersakul* orchid plants treated with *Eco Enzyme* application exhibited a higher number of newly grown roots compared to the control group (Figure 5).

Table 5. Number of buds of *Dendrobium sonia-ersakul* orchid plants

No.	Control	*Eco Enzyme*
1.	1	0
2.	0	0
3.	1	1
4.	2	2
5.	2	0
6.	1	1

Including *Eco Enzyme* in the research yielded a similar number of shoots to the control, indicating that *Eco Enzyme* elicited a comparable growth response. According to the results of the analysis, Eco Enzyme resulted in superior growth, though not significantly different from the control. However, it is most likely that Eco *Enzyme* contains other ingredients that help plants' vegetative and generative growth. According to Ardiansyah et al. [21], bacteria such as *Pseudomonas sp., Yersinia sp., richoderma viride*, and *Aspergillus niger* are found *in Eco Enzyme*, as well as various biocatalyst enzymes such as lipase, protease, and amylase [22]. Plant growth is facilitated by the enzyme amylase, particularly during the early vegetative stage. The hormone gibberellin, crucial for supporting plant growth and cell division, can be produced more efficiently in the presence of the amylase enzyme [23].

The gibberellin hormone is a plant growth regulator that collaborates synergistically with other plant regulators. Furthermore, gibberellin is a hormone that also stimulates shoot elongation. The interaction between the gibberellin hormone and specific treatments can induce the synthesis of auxin hormone. This auxin content plays a role in the bud formation process and, in conjunction with the gibberellin hormone, enhances cell division efficiency, expediting bud formation. In ecological enzymes, amylase (α-amylase) catalyzes the hydrolysis of amylose glycosides to produce glucose. The mechanism of action of amylase is divided into two stages. The first stage is characterized by the rapid and random breakdown of amylose into maltose and maltotriose, followed by a significant decrease in viscosity. In the second stage, alpha-amylase breaks down amylose molecules into glucose and maltose as end products, not randomly. Amylase breaks down amylopectin molecules into glucose, maltose, and dextrins [24].

Heryanto also asserted that amylase generates glucose that circulates throughout plant tissues, acting as a food supply for the plant before being converted into energy. This energy supports plant growth and development and influences plant height, particularly during the budding of Dendrobium orchid plants. However, the *Eco Enzyme's enzyme does not fulfill* the nutrients in *Dendrobium sonia-ersakul* orchid plants. Therefore, the control produced more buds than the 0.2% *Eco Enzyme* treatment.

Number of panicles

Based on the collected data, it can be observed that *Dendrobium Sonia-ersakul* orchid plants treated with *Eco Enzyme* application exhibited a more significant number of panicles compared to the control group (Table 6).

Including *Eco Enzyme* in the research revealed that the *Eco Enzyme* treatment resulted in more panicles. The protease enzyme present in *Eco Enzyme* serves the purpose

of breaking down complex amino acids. This aligns with Abdul's statement [25] that plants can catalyze amino acids but require substantial energy and rely on other elements such as carbon, oxygen, hydrogen, and nitrogen through intricate biochemical processes. The function of nitrogen (N) in plants involves cell formation, and its presence is crucial when plants enter the vegetative phase. *On the other hand, Eco Enzyme* contains protease, amylase, and lipase activators that can break down proteins, amylum, and lipids.

Table 6. Number of panicles of *Dendrobium sonia-ersakul* orchid plants

No.	Control	*Eco Enzyme*
1.	0	1
2.	1	2
3.	0	0
4.	0	0
5.	1	1
6.	0	0

Applying Eco Enzyme to Dendrobium Sonia-ersakul orchids can supply amino acids through the degradation facilitated by protease enzymes without requiring substantial energy expenditure. Conversely, amylase enzymes play a role in breaking down starch and glycogen found in plant seeds, where these substances serve as food reserves and store energy in the form of ATP. In Mondal's opinion [26], in carbohydrate metabolism, amylase enzymes are essential in hydrolyzing the glycosidic bonds in starch.

Furthermore, the lipase *enzyme* in Eco Enzyme breaks down fats within plant seeds into fatty acids or glycerol. The resulting fatty acids serve as an energy source through fat meta. The plant then utilizes this energy during germination until it becomes more complex. According to Sholeha and Agustini [27], lipase catalyzes the hydrolysis of triglycerides into glycerol and free fatty acids.

The application of *Eco Enzyme* has been demonstrated to enhance the growth and flowering of Dendrobium orchid plants, attributed to the higher content of *Eco Enzyme* containing enzymes such as proteolytic, maltase, and amylase—these enzymes converting starch compounds stored as food in the endosperm into glucose compounds. As an energy source, glucose is essential to maintain plant growth. Thus, *Eco Enzyme* treatment on orchid plants showed more panicles than the control group.

The outcomes from the conducted research indicate that the treatment yielding the highest results is in terms of the variable 'number of panicles.' This variable exhibits the most favorable growth, although the difference is minimal compared to the control treatment. Conversely, the variables of 'root length,' 'number of roots,' and 'number of buds' displayed responses that did not significantly differ from the control. This is attributed to the fact that *kadaka* roots contain organic nutrients essential for mycorrhiza as supplementary nutrients, and the kadaka root medium may not efficiently absorb nutrients, unlike the soil's optimal absorption of *Eco Enzyme* nutrients. As per Herlia, orchid plants can adapt to diverse types of growth media. The critical factors in the growth of these plants are adequate watering and proper fertilization. Planting media for orchids functions as a source of nutrients and a place for roots to attach, maintain moisture, and store water.

Conclusion

Based on the research's outcomes, it can be concluded that the application of *Eco Enzyme* leads to a significant increase in the number of panicles compared to the control group. However, the application of *Eco Enzyme* did not result in a substantial increase in root length, the number of new roots, or the number of buds.

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