



## Growth enhancement of swartz orchid (*Cymbidium ensifolium* L.) after application liquid organic

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**Abstract.** *Cymbidium ensifolium* is a terrestrial orchid. The exploitation of orchids in nature causes extinction, so conservation efforts are needed. One of that efforts is ex-situ conservation. The cultivation process is adapted to natural conditions using natural materials. One organic fertilizer is liquid organic fertilizers based on coconut water and rice washing water. This research aims to study the effect of applying Liquid Organic Fertilizer/Pupuk Organik Cair (POC) made from coconut water and rice washing water with different concentrations for the growth of *Cymbidium ensifolium*. This study was conducted from November 2021 to February 2022 and was an experimental garden that used randomized block design with one factor, and the concentration of POC is 0%, 15%, and 30%. The method used is ex-situ, planting using polybags with soil medium:husk:husk hairy = 1:1:1 and mycorryza 5 gr. Result of ANOVA and DMRT analysis showed that POC from coconut water and rice-washing water had an effect on the growth of *Cymbidium ensifolium*. Concentration of 30% of liquid organic fertilizer is optimal for shoot length, length, and width of the leaf. The novelty of this research is the use combination of coconut water and rice washing water as the basic ingredients for making fertilizer.

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## INTRODUCTION

Ranges number of orchids in Indonesia from 6.000 species out of a total of 26.000 species worldwide (Irwanda *et al.* 2018). Orchids are ornamental plants that are in great demand because they have attractive flowers (Sucandra *et al.* 2015). One type of orchid that can be found in Indonesia is *Cymbidium ensifolium*. This type is land or terrestrial orchid that has a habitat in the open, either in a flat place, on a slope, or hill. The advantages possessed by *C. ensifolium* are that it has a large flower size with a yellow flower color and has a fragrant aroma (Li *et al.* 2015). The hallmark of the *C. ensifolium* orchid is its yellow flowers with red hues (Wang *et al.* 2011). The beauty of these orchids causes people to exploit them, which can threaten extinction.

Orchid plants, in their original condition use natural materials as planting media, one of which is leaf litter. The use of natural materials can support the process of preserving orchids by using them as fertilizers. Natural materials that can be found include livestock manure, rotting vegetables, straw, and so on (Marpaung 2017). Liquid Organic Fertilizer (POC) is a liquid fertilizer produced from natural ingredients. Provision of POC is made by spraying directly on all parts of the plant. Based on the form, organic fertilizers are divided

into two, namely solid and liquid organic fertilizers. Liquid organic fertilizer is a fertilizer produced from natural ingredients in liquid form.

The manufacture of liquid organic fertilizer is considered easy, inexpensive, and utilizes natural materials that exist in the environment. One of the natural ingredients that can be used as a base for liquid organic fertilizer is coconut water. Coconut water that is not used by the community can be used as a source of organic material for plants. The macronutrients contained in coconut water are N, P, K, Ca, and Mg, while the micronutrients are Fe and Cl (Priya and Ramaswamy 2014). Coconut water also contains natural hormones in the form of auxins and cytokinins that play a role in the process of cell division and shoot formation (Tiwery 2014). Another natural ingredient that can be used in the manufacture of liquid fertilizer is rice washing water. Rice washing water contains protein, phosphorus, and Vitamin B1, which play a role in plant metabolism (Wulandari *et al.* 2012). According to Mulyadi *et al.* (2013) POC based on coconut water contain C-organic 17,12%, N 3,09%, Phosphate 0,41% dan potassium 0,0066%. The other experiment from Sulfianti *et al.* (2021) said that POC with rice washing water contains N, P, and K.

This study refers to previous research, Tambunan (2018), that the provision of POC coconut water and tomato waste has an effect on increasing the growth and productivity of chili plants. Concentration POC 15% is the optimal concentration on the parameters of plant height and leaf number of chili plants. This research is expected to be a reference for other orchid species.

## **METHOD**

### **Location and Period of Research**

This research was conducted for three months, from November 2021 to February 2022 at Tembalang experimental garden, Semarang City.

### **Tools and Materials**

Tools used for this research are polybag, sprayer, ph meter paper, ruler, shovel, scissors, bucket, container POC, laptop, measuring cup, and object glass. The materials used in this study were mature *Cymbidium ensifolium* soil orchids, soil, and husks as media, Vitamin B1, coconut water, rice washing water, water, EM4, molase solution, and labels.

### **Media Preparation and Orchid Acclimatization**

The media used in this study were soil, husks, and roasted husks with a ratio of 1:1:1 with the addition of mycorrhizae 15 g/plant. The mixed media was then put into a polybag with a base diameter of 30 cm and a height of 30 cm. *Cymbidium ensifolium* orchid plants were pre-soaked in a Vitamin B1 solution for 3 hours to refresh the roots and relieve stress due to plant transfer. Orchid plants are then planted in polybags containing planting media.

### **Production of Liquid Organic Fertilizer**

First, 1 L of coconut water was prepared and then filtered to reduce debris. Next, the first 500 ml of filtered rice washing water is prepared in advance. Then the sugar solution is made by dissolving 100 g of granulated sugar with 250 ml of well water and heating it to boiling, and then cooled. Furthermore, coconut water, rice washing water, and sugar solution are put into the POC container. After that, two tablespoons of EM4 were added as a bioactivator, then the ingredients were mixed until evenly distributed. Next, clean water is added to the jerry can and then closed. The liquid organic fertilizer fermentation process is awaited until the fertilizer is ready to be used.

**Watering Liquid Organic Fertilizer**

POC was given 12 times for 3 months with concentrations of 0% (P0), 15% (P1), and 30% (P2). Giving POC is done by spraying evenly on all parts of the plant using a sprayer. The treatment of the given POC concentration is:

- a. 0% concentration : 1.000 ml of well water without giving POC
- b. 15% concentration : 150 ml of POC plus 850 ml of well water
- c. 30% concentration : 300 ml of POC plus 700 ml of well water

**Variable Measurement**

Observation of the number of new shoots and leaves is done by counting and recording the number of shoots and leaves that appear or form on the plant. The leaves that are counted are the leaves that are already open, while the new shoots are counted from the shoots that appear first. Observation of the length and width of leaves and shoots using a ruler. Measurement of leaf length was calculated from base to tip, while leaf width was measured by measuring the widest part of the leaf. Then the results are recorded in the logbook.

**Data Analysis Method**

The experimental design will be carried out using a Completely Randomized Design with a single factor in the form of liquid organic fertilizer concentration. The treatments in this study were three POC concentrations of 0% (control or P0), 15% (P1), and 30% (P2), each treatment was repeated six times to obtain 18 experimental units. The data obtained based on observations were analyzed using Analysis of Variances (ANOVA) or variance. Then if the treatment shows a significant effect, then the Duncan Multiple Range Test (DMRT) is continued with a 95% level of significance.

**RESULT AND DISCUSSION**

**Growth New Shoot of Orchid**

The results of the analysis of the variety of POC administration based on coconut water and rice washing water did not significantly affect the parameters of the number of new shoots, but Figure 1 shows that the concentration of 15% tends to induce more shoot formation than other treatments. The concentration of 15% stimulated the formation of new shoots, but the shoots that appeared were shorter than other concentrations. This was because the concentration of 15% stimulated cell differentiation but did not stimulate the elongation process. In POC, it is suspected that it is made from coconut water and rice washing water, it is suspected that it contains cytokinin hormones. The cytokinin hormone can help the emergence and growth of shoots. The role of cytokinins in shoots is also influenced by other hormones, namely auxin (Pranata *et al.* 2015).

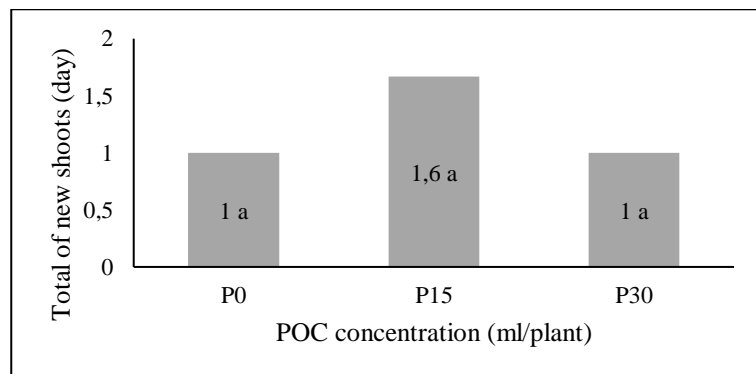


Figure 1 Number of shoots of *C. ensifolium* (92 HST) after being treated with various concentration of POC

In addition to the role of auxin, cytokinins are also needed in the process of shoot formation. Coconut water, used as the basic ingredient of POC contains cytokinins that stimulate cell differentiation, which will then form budding candidates to form new shoots. Based on research by Meyuliana *et al.* (2022), it was shown that POC with coconut water and tomato water contained hormones IAA (0,0039%), GA3 (0,0018%), and cytokinins (0,0018%). Then coconut water also contains growth hormones, namely kinetin (0,0053%) and zeatin (0,0019%). Cytokinins are contained in coconut water because it is the endosperm, where the cells are still actively dividing. Cytokinins synthesized in roots will be translocated to parts that undergo cell division (Hastuti *et al.* 2016).

### Growth Shoot Length of Orchid

Analysis of variance that giving POC did not significantly affect the parameters of new shoot length. The elongation of shoots is influenced by the presence of the hormone auxin. DMRT test showed that 30% and 0% POC were significantly different from 15% POC. But 30% is not significantly different from 0%. This was presumably because the addition of POC, which was thought to contain exogenous auxin, was able to assist the endogenous auxin of *C. ensifolium* in the process of bud expansion. The amount of endogenous hormones in plants varies. Auxin hormone has an effect on cell division and elongation in plant tissue (Srimaulinda *et al.* 2021).

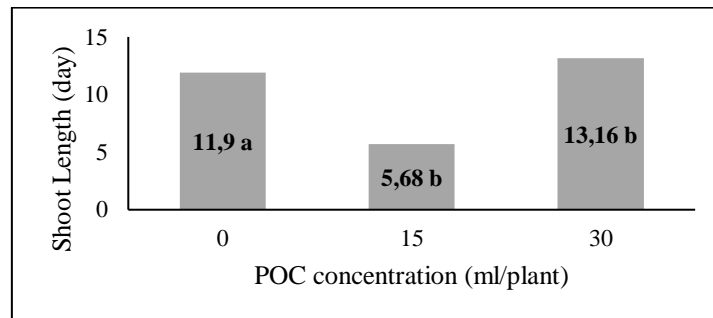


Figure 2 Shoot length of *C. ensifolium* (92 HST) after being treated with various concentrations of POC

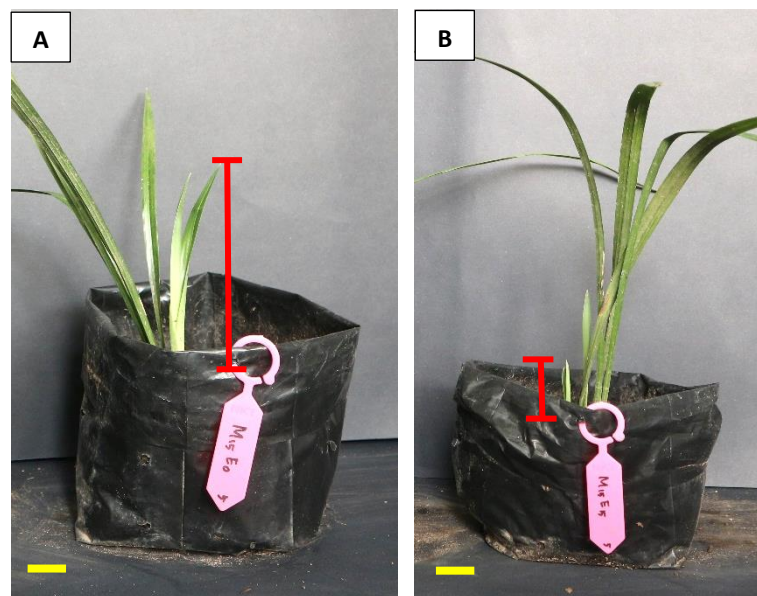


Figure 3 Differences in shoot height based on the emergence of *C. ensifolium* shoots (32 HST) after being given; POC treatment: concentration A: 0%, B: 15%; Description: red bar (shoot height), yellow bar (3 cm scale)

Figure 2 shows the longest shoot at P2 while the shortest shoot at P1. However in Figure 3, there is a difference in yield between control and 15% POC treatment, this is influenced by the time of emergence of shoots. On the 8<sup>th</sup> day, new shoots appeared at P0 and P2, then on the 16<sup>th</sup> day, new shoots appeared at P1. This caused P1 to have a lower shoot length than the control and P2. The time of shoot emergence is influenced by the hormone cytokinin in the process of cell division and elongation so it stimulates shoot growth (Delcheh 2014). Auxin hormone plays a role in meristem cell division so that it can stimulate elongation (Pamungkas and Yoga 2020). This is supported by Pratama and Nilahayati's research (2018) that the addition of coconut water has an effect on stimulating the addition of Cymbidium shoot height.

**Effect POC Dosage on Number of Orchid Leaves**

Based on the analysis of variance, the POC administration had no significant effect on the number of new leaves with a significance value of 0,64 (greater than 0,05). Figure 4 shows that POC administration has no effect, but can still produce the highest number of leaves at a concentration of 15%. This is possible because the addition of exogenous hormones from POC can stimulate endogenous hormones thereby increasing the number of leaves. The concentration was 30% lower than the control because the higher the POC concentration, the more inhibition the process of new leaf formation would be.

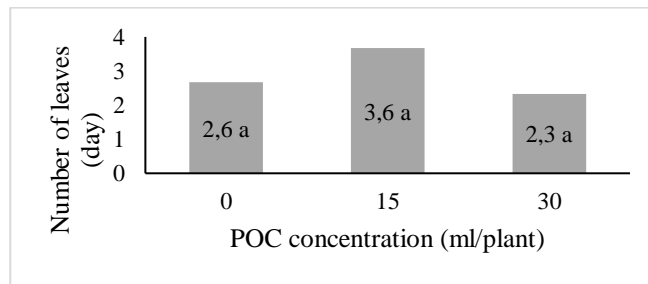


Figure 4 Number of leaves of *C. ensifolium* (92 HST) after being treated with various concentrations of POC

Rice washing water in POC is thought to contain nitrogen (N) which has an effect on leaf formation, but the results of this study did not affect the number of new leaves. Wulandari *et al.* (2012) stated that rice washing water contains protein, phosphorus, and Vitamin B1, which play a role in plant metabolism. Nitrogen is an element that affects leaf growth because it is related to the photosynthesis process (Munar *et al.* 2018).

New leaves are counted when the leaf primordia begin to open the first leaf blade. In this study, it is suspected that POC contains cytokinin and auxin hormones. Desy *et al.* (2021) stated that a higher number of cytokinins than auxin would stimulate cell division in leaves and shoots. Cytokinins play a role in cell division in leaf primordia so it will increase the number of leaves on shoots. In addition, cytokinins function in the process of cell expansion in new leaves and inhibit leaf aging. The application of cytokinins results in an increase in the photosynthesis process so that the results of photosynthesis will be used in metabolic processes and cell division (Li and Xu 2014).

**Effect POC Dosage on Orchid Leaf Length and Width**

The variance results showed that POC administration had a significant effect on the length and width of the new leaves. DMRT analysis on the leaf length parameter with a concentration of 30% was significantly different with a concentration of 0% and 15%, while the leaf width parameter with a concentration of 0% was significantly different with 15% and 30%. Figure 5 shows the longest leaf at P2 and the shortest leaf at P0. The widest leaves were obtained at treatment P2, and the lowest yield was at P0. This is because exogenous hormones affect the process of cell expansion in leaves. The N content in rice washing water contained in POC also affects leaf formation (Wijiyanti *et al.* 2019).

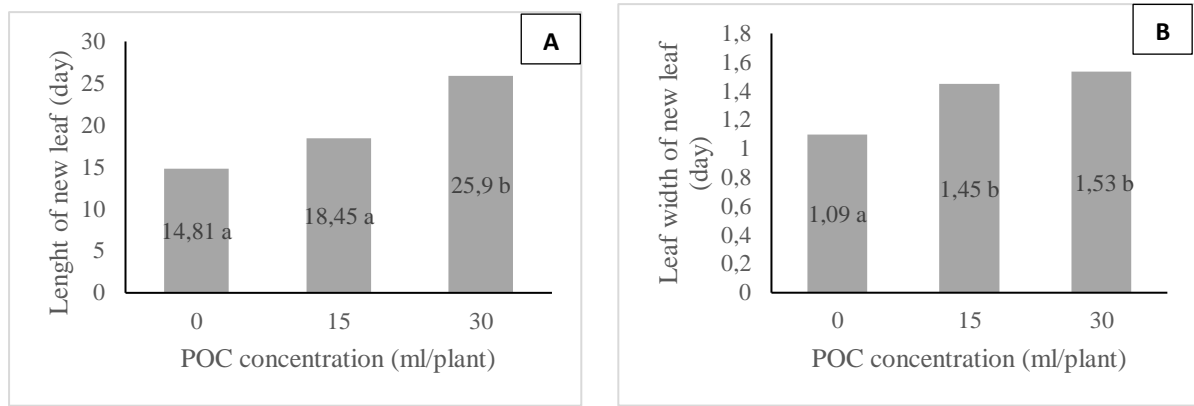


Figure 5 Length (A) and leaf width (B) of *C. ensifolium* (92 HST) after being treated with various concentration POC

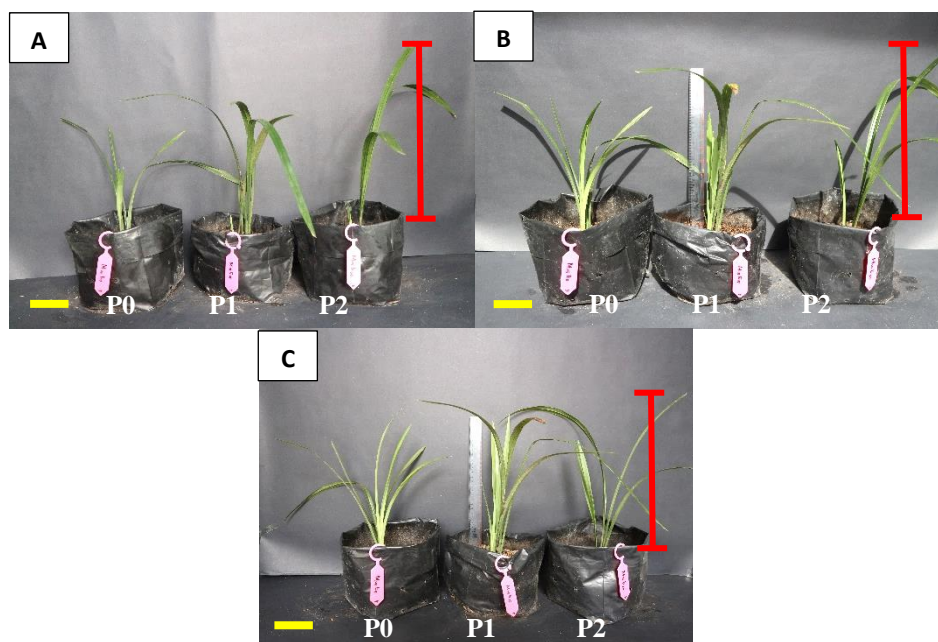


Figure 6 Differences in leaf length of *C. ensifolium* with POC treatment of coconut water and rice washing water at: (A) 40 HST, (B) 68 HST, (C) 92 HST (concentration P1, P2, P3); Description: Red bar (leaf length), yellow bar (5 cm scale)

Figure 6 shows that the application of POC with a higher concentration can produce longer and wider leaf sizes. The results of this study suggest that the N content affects the formation of endogenous cytokinins. Then the hormone will affect plant growth which is indicated by the length, width, and number of leaves. This is due to the nitrogen content contained in POC, which can help leaf growth (Nuraida *et al.* 2021). Nitrogen is obtained from the protein breakdown process in coconut water and rice washing water assisted by microorganisms from EM4 (Fadilah *et al.* 2020). Nitrogen is a component that makes up proteins and enzymes as an essential plant compound. High nitrogen content can stimulate the process of leaf elongation due to the addition of cells (Ayuningtyas 2020).

Making POC through a fermentation process that aims to break down complex compounds into simpler ones so that plants easily absorb them. The organic matter contained in the fertilizer is decomposed by microbes resulting from the addition of EM4 as a starter. The fermentation process is carried out anaerobically. Research conducted by Wijiyanti *et al.* (2019) showed that the best incubation period for making POCs was 15 days. Nutrient content in fertilizers, especially nitrogen elements, reaches maximum yields on the 15<sup>th</sup> day, so optimal fertilizer yields will spur plant growth.

## CONCLUSION

The application of liquid organic fertilizer (POC) based on coconut water and rice washing water has an effect on increasing the growth of *Cymbidium ensifolium* orchids on the parameters of new shoot length, length, and width of new leaves. However, it did not affect the number of shoots and the number of new leaves. Thirty percent POC concentration is the optimal concentration that can increase leaf length and width.

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