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**THE EFFECT OF LIQUID ORGANIC FERTILIZER FERMENTED
FROM CABBAGE WASTE (*Brassica oleraceae* L. var . *Captitata*) ON
THE
GROWTH AND PRODUCTIVITY OF CHILI PEPPER PLANTS
(*Capsicum annuum* L var. *Longum*) AS THE REQUIREMENT
FOR A PRACTICAL OF PLANT PHYSIOLOGY COURSE**

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Abstract

The effect of liquid organic fertilizer fermented from cabbage waste (*Brassica oleraceae* L. var . *Captitata*) on the growth and productivity of chili pepper plants (*Capsicum annuum* L var . *Longum*) . The Thesis for Biology Education Study Program, Faculty of Teacher and Pedagogy, Mulawarman University. The current study is an experimental research adopting a Randomized Block Design (RDC). The current study aims at investigating the effect and the most effective concentrate of liquid organic fertilizer fermented from cabbage waste (*Brassica oleraceae* L. var . *Captitata*) on the growth and productivity of chili pepper plants (*Capsicum annuum* L var . *Longum*). The current study adopted a Randomized Block Design (RBD) with five treatments (including control variable), repeated in 5 times with 3 groups . The treatments are A₀ (control variable) , A₁ (100 ml) , A₂ (150 ml) , A₃ (200 ml) , and A₄ (250 ml) . The findings were analyzed with analysis of variance (ANOVA) and then

processed through the Least Significant Difference test (LSD) with the level of significance 5%. The results showed that the concentrate of liquid organic fertilizer fermented from cabbage waste revealed that $F_{\text{counting}} (3 .58) > F_{\text{tabel}} (3 .01)$ with the level of significance 5% and this means that H_0 is rejected while H_a is accepted . So, the treatment of liquid organic fertilizer fermented from cabbage waste has a significant effect on the growth and productivity of chili pepper plants. Given the treatment of liquid organic fertilizer around 100 ml, the average of highest chili pepper plants were 21.5cm. Given the treatment of liquid organic fertilizer around 150ml the average of highest chili pepper plants was 25.3cm. Given the treatment of liquid organic fertilizer around 200ml the average of highest chili pepper plants was 27.76 cm. While given the treatment of liquid organic fertilizer around 250ml the average of highest chili pepper plants was 42.24cm.

Keywords: Organic fertilizer, Cabbage waste, chili pepper

INTRODUCTION

Chili pepper are popular and needed in society around the world. This makes chili peppers as one of vegetable commodities that cannot left out by Indonesian society on their daily life. (Prajananta, 2002).

Chili peppers in Indonesia in the past few years ranked the top position among other 18 commercial vegetables cultivated in Indonesia (Rukmana, 2002) and in line with this, Prajnanta (2002) stated that chili peppers are one of top six vegetable commodities, mostly exported by

Indonesia in the past few years among onions, tomatoes, potatoes, cabbage, and cauliflower.

The production chili pepper plants in Samarinda in 2010 reached 121.3 ton and in 2011 reached 279 ton with the ratio of cultivation field around 30 hectare (BPS Samarinda, 2011). Starting from this data, it can be said that the production of chili peppers in Samarinda was increasing, though the production was still considered lower compared with production from other regions in Indonesia.

Chili peppers are seasonal fruit vegetable that is needed in any levels of society, as food flavor and oil for warming the body. Nevertheless, this fruit vegetable is more known as seasoning vegetable or cooking flavor. From its nutrition composition, chili peppers in fact contain high vitamins. Each 100 g of chili peppers contain vitamin A 470SI, vitamin C 180 mg, protein 1.0 g and fat 0.3 g. Furthermore, this seasoning vegetable contains *eteris* oil that brings the hot substance called *capsaicin*. This substance is the one that causes stomachache if consumed too much.

One of efforts that can be taken to increase and improve the growth and quality of chili pepper plants productivity is by fertilizing. Fertilizing is done to fulfill and increase useful substances required by plants from the soil, or in other words fertilizing is done to increase nutrients in the soil. The purpose of fertilizing is to increase the organic and non-organic nutrients needed in plants, to improve bad soil texture, and to improve the drainage and circulation of air in the soil, as well as to improve the physical and chemical components of soil so that they fit with the plant growth (Sarpian, 2003).

Fertilizer plays a role as a key for soil fertility, that it substitutes the nutrients that has already been absorbed by plants (Lingga and Marsono, 2004). It is needed for the life persistence and growth of plants. Fertilizer used to improve the quality of nutrients in the soil in fact is diverse. In term of process production, for instance, fertilizer is classified into two, organic and inorganic (synthesis) fertilizer . The use of fertilizer, pesticides, and other chemical substances in long term may kill the biota living in the soil, causing pests and disease resistance, as well as may change the composition of vitamins and minerals in some vegetable and fruit commodities. This phenomenon, if ignored in long term, will bear fatal effect to the continuity of life cycle. Furthermore, if the contaminated vegetable and fruits are

consumed by human being for long term, they may cause damage on our tissue even death.

Organic fertilizer is fertilizer that is made from organic or natural substances. Based on its structure, organic fertilizer is divided into solid organic fertilizer and liquid organic fertilizer. Some organic fertilizer are processed in industry, for example, flour made of animal blood, bones or made of fishes. The result of interviews from the grocery sellers in Segiri Traditional Market on 7th October 2013 revealed that the volume of cabbage waste was abundant. In average there was 20 ton more or less of cabbage per day. From that total, around 5-7% or 1-1.5 ton was left as waste. The cabbage waste usually used to be piled at temporary place by means of open dumping and is not transported per day. The too longer dumping may trigger pollution since sulfide acid and ammonia gas produced from the decayed waste may result in pungent scents coming from decayed waste, as well as may become place that incubates disease.

To overcome the too longer waste dumping, it has been done some ways of treating the vegetable waste, for instance, it can be used as major ingredients in producing fertilizer or compost. However, not all types of vegetable waste are suitable for making fertilizer or compost. Commonly, the solid vegetable waste that is suitable for making fertilizer or compost is the one that contains much fiber, not the ones that contain much water. Vegetable like cabbage contains too much water that it is not suitable for making fertilizer or compost. Cabbage contains around 90% of water.

One of alternatives in bio approach that can be applied in overcoming the vegetable waste containing too much water is the technology of fermentation. Liquid nutrients in the soil have very soft texture that they are easily absorbed by plants, including leaves and stems.

This study investigates how the process of vegetable waste fermentation is, especially the vegetable that contains too much water. The technology of cabbage waste fermentation can decrease the impact of environmental pollution and reduce the use of chemical fertilizer that has been known to cause field degradation. Based on the explanation above, the writer tried to conduct research for investigating the effect of using liquid organic fertilizer made of cabbage waste (*Brassica oleraceae* L. var . *Capitata*) on the growth and productivity of chili pepper plants (*Capsicum annum* L var . *Longum*).

METHOD AND SAMPLING

The research method adopted in this study is experimental research with Randomized Block Design (RDB). Experimental design aims at investigating the cause-effect relationship, that is by exposing one or more experimental groups as well as one or more control groups.

Variable And The Definition Of Research Operational

The variables in this study:

- a) The independent variable of the current study is liquid organic fertilizer, that is obtained from the fermentation of cabbage waste (*Brassica oleraceae* L. var. *Capitata*) fermented for 3 weeks until the liquid is ready to be used.
- b) The dependent variable is the growth of chili pepper plants, especially the height of plants (cm), the numbers of leaves, and the production of fruits on the 14th, 21st, and 28th day after planting.

The definition of operational:

- a) The appropriate liquid organic fertilizer is signaled by the transformation of color into brownish and the scent is not pungent.
- b) The parameter used in measuring the variables is the increase in plants' heights, numbers of leaves, and fruit production. The data was collected on the 14th, 21st, and 28th day after planting.
- c) The fruit production was calculated from the numbers of fruits per plant and then the totals from all plants are summed up.

Population and Sample

1) Population of the study

The population of this study is all of chili pepper plants (*Capsicum annuum* L var. *Longum*) that has been planted.

2) Sample

The sample of this study is 25 seedlings of chili pepper plants (*Capsicum annuum* L var. *Longum*)

Data Collecting Technique

The data collecting technique conducted in this study is:

- 1) The height of plants (cm): the length of main stem from the soil surface to the edges of leaves was measured.
- 2) The numbers of leaves: the numbers of leaves per plant were calculated and then total from all plants were summed up.

- 3) The numbers of fruits per plant: the numbers of leaves per plant were calculated and the total from all plants were summed up.

Research Design

This study was constructed with Randomized Block Design (RDB) that consists of five treatments including control variable with different concentrates of fluid organic fertilizer given to each experimental treatment. Each treatment was repeated in 5 times as follow:

A₀: without liquid organic fertilizer

A₁: treated with liquid organic fertilizer around 100ml

A₂: treated with liquid organic fertilizer around 150ml

A₃: with liquid organic fertilizer around 200ml

A₄: with liquid organic fertilizer around 250ml

Data Analysis Technique

The data that had been collected from observation and calculation then were analyzed with variance analysis (ANAVA). If the analysis result shows significant difference then it will be followed by least significant difference test with the level of significance 5 %.

FINDINGS AND DISCUSSION

The growth and productivity of chili pepper plants (*Capsicum annuum* L var . *Longum*) on the 14th, 21st, and 28th day after the planting period were measured by the parameter of plants' height , numbers of leaves, and numbers of fruits. It was identified that the effect of liquid organic fertilizer fermented from cabbage waste (*Brassica oleraceae* L. var . *Captitata*) has significant effect on the growth and productivity of chili pepper plants and this can be read on the tables above. Based on the analysis of variance analysis the height growth of chili pepper plants on the 14th, 21st, 28th day after planting, it was revealed that the treatment of liquid organic fertilizer fermented from cabbage waste has a significant effect in terms of height increase. This can be summed up since the F_{counting} is higher than the F_{table} in all parameters which had been observed. The treatment A₄ (250ml) had significant effect on the growth of the chili pepper plants (*Capsicum annuum* L var . *Longum*) with the average of highest plants was 40.70cm.

On the 14th, 21st, and 28th day after planting the liquid organic fertilizer had a significant effect to all treatments. The significance of the

treatment might happen since the plants were in the vegetative phase. Wahyudi (2012) proposed that vegetative phase is the phase that really determines the productivity. At this phase, all of the growth energy is used for the growth of root, stem and leaves. In addition, Kurnia (2004) pointed out that initial phase ranges from 0-10 days after planting, vegetative phase on 11-45 days, and generative phase on 45-60 days.

The calculation of chili pepper leaves (*Capsicum annuum* L var . *Longum*) was done on the 14th ,21st , and 28th day. The findings of the study obtained on the 14th day revealed that the highest numbers of leaves resulted from the treatment A₄ (250ml), that is 19.60 leaves and the lowest numbers of leaves resulted from the treatment A₀ (control variable), that is 7.80 leaves. After tested with the least significant difference test with the level of significance 5%, it was revealed that the results from A₂(200ml), A₃ (150ml) and A₄ (100ml) were significantly different with the result from A₀ (control variable). As Hardjodinomo (2000) proposed that iron mineral plays an important role in producing green leaves. The lack of iron substance may cause the leave color to become pale. These phosphor and iron minerals in fact cause the rapid growth of leaves on chili pepper plants, increase the numbers, and make them greener and fresher.

Based on analysis of variance (ANAVA), the effect of liquid organic fertilizer fermented from cabbage waste(*Brassica oleraceae* L. var . *Captitata*) shows significant role on the numbers of chili pepper fruits (*Capsicum annuum* L var . *Longum*). The result showed that each treatment given to chili pepper plants at treatment A₄ (250ml) is: the average numbers of leaves per plant was 158.46, while for A₀ (variable control) the average numbers of leaves per plant was 68.2. This happened since the nutrients in the soil are not sufficient as required by the plants, meanwhile the treatment of liquid organic fertilizer fermented from cabbage waste can increase the numbers of fruits since the liquid organic fertilizer plays the role as *catalyst* which can maximize either macro or micro nutrients in the soil.

The result of the study showed that the liquid organic fertilizer fermented from cabbage waste plays significant role to the numbers of chili pepper fruits per plant, to illustrate, the treatment A₄ (250ml) resulted in highest numbers of fruits, 158.46. This occurred since liquid organic fertilizer help encouraging the growth of flowers and the plenty numbers of flowers will produce more fruits which means more production. While A₀

(variable control) produced least fruits, 68.2. The significant effect on the numbers of fruit might also occur since the plants absorbed very sufficient nutrients for producing fruits, where in the period growth of flowering and producing fruit, the chilly plants need phosphor (P). This is in line with the findings from Lingga (2006) who stated that phosphor plays a role as nutrients producing certain protein, supporting assimilation and respiration, and accelerating the process of flowering, ripening seed and fruit. As proposed by Novizan (2004), Phosphor encourages the process of producing flowers, fruit, and seed even it can accelerate the process of fruit ripening. Cabbage waste itself contains phosphor (P) around 26 mg.

CONCLUSION

Based on the current study of the effect of liquid organic fertilizer fermented from cabbage waste (*Brassica oleraceae* L. var. *Capitata*) on the growth and productivity of chili pepper plants (*Capsicum annuum* L var. *Longum*), it can be concluded that:

- 1) The treatment of liquid organic fertilizer fermented from cabbage waste has significant difference of effect to the chili pepper plants. This can be concluded as follow:
 - a. The treatment of liquid organic fertilizer fermented from cabbage waste has significant effect to the growth of chili pepper plants' height.
 - b. The treatment of liquid organic fertilizer fermented from cabbage waste has significant effect to the numbers of leaves on chili pepper plants.
- 2) Based on the result of the study it was found that the most effective concentrate of liquid organic fertilizers fermented from cabbage waste (*Brassica oleraceae* L. var. *Capitata*) for chili pepper plants' growth (*Capsicum annuum* L var. *Longum*) is 250ml.

SUGGESTIONS

Based on the result of the study that has been conducted, it is recommended that::

- 1) It is recommended that society use liquid organic fertilizer by making use of cabbage waste.

- 2) It is recommended that chilly farmers use liquid organic fertilizer fermented from cabbage waste around 250ml as fertilizer, to gain better crop production
- 3) It is recommended that other researchers investigate further study concerning the effect of liquid organic fertilizer fermented from cabbage waste on other plants

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