# prosiding_the_effect_of_decomposer

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# The Effect Of Decomposer Microorganism Additions On The Natural Hydroponic Technology (Nht) Systems Of Pakchoy Growth

# The Effect Of Decomposer Microorganism Additions On The Natural Hydroponic Technology (Nht) Systems Of Pakchoy Growth

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**Abstract**. Nowadays there is a tendency of the people, especially the middle class and above, to choose vegetables with high quality and safe for body. Therefore, farmers are required to always innovate in terms of vegetable cultivation, so that the crops can compete and be accepted by the community. This study aims to determine the effect of the addition of decomposer microorganisms on the Natural Hydroponic Technology (NHT) system on the growth of Pakchoy plants. The study was conducted on May to July 2019 in the agricultural land of Ngesrep Balong Village, Limbangan District, Kendal Regency, Central Java. This study uses a completely randomized design (CRD) with one treatment factor, the type of decomposer microorganisms. The research data was taken through several measurement techniques and direct observation of objects. Data were taken three times on the 14th day, 21st day, and 28th day after planting. Data were then analyzed statistically with ANOVA (Analysys of Variance) at 95% confidence level and continued with LSD test. The analysis shows that the addition of decomposer microorganisms to the Natural Hydroponic Technology (NHT) system can increase the growth rate of Pakchoy plants. Decomposer microorganisms with trademarks ST (Sukses Tani) and EM-4 (Effective Microorganism-4) produce the same growth rate. Keywords: hydroponics, microorganisms, decomposers, Pakchoy

## 1. Introduction

Natural Hydroponic Technology (NHT) is one of the developments in hydroponic technology that aims to answer the farmers' needs in improving agricurtural bussiness. NHT is a hydroponic technology that uses the flow of natural springs, land slopes, and the decomposition of natural materials [1]. In the NHT model, water needs of cultivated plants are obtained from natural springs such as the rivers that are in higher places. The water can flow by itself towards hydroponic installations located in lower places caused by gravity. In addition, the nutrient requirements are obtained from the decomposition of organic material connected to the flow of water [2].

The source of organic material that will be broken down into nutrients for cultivation plants on the NHT system can be in the form of organic material placed in the composter tub. In addition, the NHT system can use fish pool wastewater that consists of fish food waste and feces as a source of plant nutrients. In the NHT, conditions composter or fish pools and hydroponic systems are made similar to the conditions of natural ecosystems [3].

The organic material decomposition process will occur naturally in every ecosystem, but the decomposition variations that depend on the amount and type of organic material, the number and type of decomposer microorganisms, and the environmental conditions in which the decomposition takes place. In the NHT system, a high decomposition rate is needed because it affects the availability of cultivated plants. If decomposition rate is low, it will cause nutrient deficiencies for the growth of cultivated plants.

To increase the rate of decomposition of organic matter on the NHT system, there are several factors that must be considered, such as the use of organic material which should be easily composed in sufficient quantities, the addition of decomposer microorganisms as decomposition agents for organic matter, and the regulating environmental conditions so that the performance of decomposer microorganisms can take place optimally.

The research aims to find out the effect of the addition decomposer microorganism on *Natural Hydroponic Technology* (NHT) system with water sources and organic matter in the form of fish pool water waste on the growth of pakchoy plants. The researcher hopes this research will be beneficial for the improvement of the NHT system in increasing vegetable production, and the development of science in general.

## 2. Methods

### 2.1. Time and Place of the Research
The research was conducted in Ngesrep Balong Village, Limbangan, Kendal Regency, Central Java. It was helm on June until August 2019 in the green house on the farmland.

### 2.2. Research Design
This reseach used Complete Randomized Design (CRD) with one treatment factor that is the addition of decomposer microorganisms with different trademarks. Organic material sources used were from the waste water of the tilapia pool which is flowed into the planting tub. Tilapia used are 5 cm in size with a stocking density of 100 fish/$m^2$ surface area. The addition of decomposer microorganisms treatment is carried out in a filter tub containing bioball. The treatment is as follows:
    P0  : Without adding decomposer microorganism (as the control)
    P1  : Adding decomposer microorganism with a trademark "Sukses Tani"
    P2  : Adding decomposer microorganism with a trademark "EM-4"
Each treatment above is done 3 times.

### 2.3. Research Variables
a. Independent Variable : The research independent variable is adding decomposer microorganism
b. Dependent Variable : The research dependent variable is the growth of pakchoy plant production.
    The growth and production variables that is observed are as follows:
    1) The Height of Plants
    2) The number of leaves
    3) The Wet Weight of Plants

### 2.4. Method of Data Collection.
The research data needed is taken from the measurement techniques and direct observation of objects. The measurement and production of plants are taken by measuring, counting, and weighing objects according to the observed variables. A water quality data as supporting data is taken after pool water waste passes through a filter bath that has been given the addition of decomposer microorganisms. Data collection on the growth and production of plants, as well as water quality data is carried out on day-28 after planting.

### 2.5. Data Analysis
The quantitative data obtained will be analyzed statistically with ANOVA (Analysys of Variance) with a 95% confidence level and continued with the LSD test (Least Significant Difference). Besides using Anova, the data will be analyzed qualitatively.

### 3. Results and discussion

The quality of pool water waste as a source of pakchoy plant nutrients is measured after pool water waste passes through the filter tub which has been added with decomposer microorganisms. The quality of pool water waste consist of ammonia, nitrites, and nitrates in can be seen in Table 1.

Table 1. Ammonia, Nitrite, and Water Nitrate levels in the NHT System (Day-28 after planting) with the Addition of Different Decomposer Microorganisms

| Treatment | Ammonia (mg/L) | Nitrit (mg/L) | Nitrat (mg/L) |
|---|---|---|---|
| Control | 0,25 | 15,78 | 42,2 |
| Sukses Tani | 0,26 | 10,68 | 45,2 |
| EM-4 | 0,25 | 13,98 | 44,8 |

Ammonia in pool water waste comes from the decomposition of organic material in the form of metabolic waste and leftover food that is not consumed. In general, the ammonia released by fish through the osmoregulation process ranges from 80-90%. Meanwhile, the ammonia released through faeces ranges from 10-20%. In addition, ammonia in water comes in two forms, namely $NH_4^+$ and $NH_3$ ions. Unionized free ammonia ($NH_3$) is toxic to aquatic organisms [4].

Ammonia waste level in fish pool after passing through the filter is relatively low, ranging from 0.25 to 0.26 mg/L. The low ammonia level is caused by the nitrification process when pool water waste has passed through the filter. In the process of nitrification, ammonia is converted to nitrite by the bacterium Nitrosomonas. The addition of probiotics containing Nitrosomonas can reduce the concentration of ammonia in fish pool water. [5]. Pool water waste which was given several types of probiotics can reduce ammonia levels up to 0.188-0.267 mg/L. Low ammonia levels indicate that the process of converting ammonia to nitrite runs smoothly [6].

Nitrite is the result of oxidation of ammonia through the process of nitrification by the bacterium Nitrosomonas. Nitrites are toxic to organisms and cannot be used by plants [7]. Nitrite level in pool water waste that has passed through the filter is very high, which is around 10.68-15.78 mg/L. The high level of nitrite is caused by the accumulation of ammonia in pool water waste successfully remodeled by the bacteria Nitrosomonas into nitrite [8].

Nitrite will be oxidized by bacteria Nitrobacter to nitrate immediately in the process of nitrification. In this research, the highest nitrite level was in the control treatment, followed by treatment with the addition of EM-4 trademark decomposer microorganisms and the nitrite level from the addition of Sukses Tani trademark decomposer microorganisms was lower. Meanwhile, the highest nitrate level was found in the treatment with the addition of Sukses Tani decomposer microorganism. After finding the highest level nitrate, the addition of EM-4 trademark decomposer microorganisms was added and the lowest was in the control treatment.

The level difference between nitrite and nitrate is caused by the results of the control treatment, the conversion of nitrites to nitrates in the nitrification process is only carried out by bacteria that are naturally present without any additions so that the process of converting nitrites to nitrates is not optimal. Meanwhile, converting nitrites to nitrates can be increased by using the treatment with the addition of EM-4 and Sukses Tani decomposer microorganisms.

Pool water waste which is given several types of probiotics can reduce nitrite levels and increase nitrate levels. The nitrification process will cause a reduction of ammonia levels in water, while nitrate levels will increase. Nitrification process fails, the ammonia or nitrite levels in the water will increase.

The quality of pool water waste analyzed is based on phosphate levels, dissolved oxygen (DO), and biochemical oxygen demand (BOD). Based on the results of the study were obtained that levels of phosphate, DO, and BOD of pool water waste that had passed through the filter tube in all treatments were in normal conditions. The detail about levels of phosphate, DO, and BOD of pool water waste is presented in Table 2.

Table 2. Phosphate, DO, and BOD levels of the water in the NHT System (Day-28 after planting) with the Addition of Different Decomposer Microorganisms

| Treatment | Phosphat (mg/L) | DO (mg/L) | BOD (mg/L) |
|---|---|---|---|
| Controll | 7,68 | 5,2 | 3,5 |
| Sukses Tani | 8,34 | 5,6 | 3,9 |
| EM-4 | 8,58 | 6,6 | 4,4 |

The process of decomposition of organic material in pool water waste will provide nutrients for cultivated plants indirectly. After that, the nutrients will be absorbed and utilized by plants to grow and thrive. the plant growth can be measured by increasing plant height, number of leaves, and wet weight of plants. The height plant growth, number of leaves, and heavy wet plants can be used as an indicator of nutrient installation by plants. The detail of pakchoy plant growth data in this study can be seen in Table 3.

Table 3. The Height Plants, the Number of Leaved, and Wet Weight Pakchoy of each treatment in day 28 after planting

| Treatments | Height (cm) | The Number of Leaves | Wet Weight (gram) |
|---|---|---|---|
| Control | $21,30^a$ | $18,33^a$ | $93,07^a$ |
| Sukses Tani | $27,47^b$ | $18,67^a$ | $120,77^b$ |
| EM-4 | $26,50^b$ | $18,67^a$ | $116,50^b$ |

Note: the numbers accompanied by the same notation in the same column show no significant difference at the 95% test level.

The results of the study showed that there is a difference between the control treatment and the treatment of the addition of decomposer microorganisms to pakchoy growth. In the control treatment, pakchoy plants showed the lowest growth. Meanwhile, the treatment with the addition of decomposer microorganisms of the trademark Sukses Tani and EM-4 showed the same growth and higher than the control treatment.

Pakchoy can be given the addition of decomposer microorganisms treatments can grow better than pakchoy that was not given the addition of decomposer microorganisms. It shows that the availability of pakchoy nutrients with the addition of decomposer microorganisms is available in sufficient quantities for its growth. Meanwhile, pakchoy growth is not optimal because of the availability of nutrients in pakchoy which is not given additional decomposer microorganisms is insufficient.

The availability of nutrients for pakchoy plants caused by wastewater from Tilapia fish culture contains a lot of organic materials, including leftovers that are not consumed, fish dung, and additional food waste in the form of green leaves. This organic material contains nutrients for plant growth. Fish dung contains ammonia while the remaining food additives in the form of green leaves contain lots of carbohydrates and minerals [9]. In fish pool water wastes there are many humus and feed residues that contain a lot of N, P, and K and other minerals in quite high amounts. These elements are nutrients that are needed for plant growth. Besides that, these nutrients are nutrients that are not yet available to plants because they are still in the form of organic compounds, so they cannot be absorbed by plants [10].

Organic materials in fish pool water waste must be decomposed to produce inorganic nutrients available to plants. The decomposition of organic material will produce macro nutrients such as $NH_4^+$, $NO_3^-$, $PO_4$, K, Ca, Mg, and SO4, as well as other micronutrients. Amino which is a waste of leftover food and fish metabolism results will undergo nitrification. In this section, the rest of the fish's food and feces are converted by the Nitrosomonas bacteria into nitrites. Furthermore, nitrite will be oxidized by bacteria Nitrobacter to produce nitrate as nutrients in plants [11].

In NHT system, a high rate of decomposition of organic material is needed because the availability of nutrients for cultivatied plants is very dependent on it. If the decomposition rate is low, the crop will lack nutrients. Meanwhile, If the decomposition rate is high, the nutrient requirements of the cultivated plant will be fulfilled.

The process of decomposition of organic material in pool water waste has basically taken place naturally. Besides that, the number of species and the number of individual decomposer microorganisms in the natural control treatment is insufficient to maximally decompose organic matter in pool water waste. Thus the available nutrients needed for cultivating plants cannot be fulfilled at all. That is evidenced by the growth and production of cultivated plants that are not optimal.

During treatment with the addition of decomposing microorganisms from Sukses Tani and EM-4 trademarks, the rate of decomposition of organic matter is higher because the number of species and the number of individual decomposer microorganisms is greater than control treatments. It affects nutrients that are needed by cultivated plants are also available in sufficient quantities. It is proven by the optimal growth and production of cultivated plants. The addition of probiotics in fish pools can increase nitrate levels which are essential nutrients needed in large quantities for plant growth and production.

## 4. Conclusion
Based on the result of the research, it can be concluded that the addition of decomposers microorganisms with the Natural Hydroponic Technology (NHT) system, water sources, and organic matter in the form of fish pool water waste can increase the growth and production of pakchoy plants. The researcher hopes this research could be useful for improving the NHT system in increasing vegetable production, and developing science in general.

## Acknowledgement

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