

USING CHLORELLA PYRENOIDOSA FERTILIZER FOR CONTROLLING SOIL ACIDITY IN MELON CULTIVATION

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ABSTRACT

Most of the agricultural lands in Indonesia are in the same condition, which is the decrease in soil fertility. Continuous supply of chemical fertilizers causes soil to become nutrient poor, microbial diversity poor, hardened, and not loose. Besides this soil damage is also characterized by acidic soil pH. Soil acidification can cause a decrease in crop yields. This study aims to determine the effect of *Chlorella pyrenoidosa* microalgae in recovery soil acidity and its effect on rice crop productivity. This research involved laboratory analysis and field analysis. Laboratory analysis was conducted by treating acidic soil using 3 types of treatment, namely treatment using lime, treatment using urea chemical fertilizer, and treatment using Chloten fertilizer (*Chlorella pyrenoidosa*). Based on the laboratory scale analysis conducted the best results in recovery soil acidity are Chloten fertilizer (*Chlorella pyrenoidosa*) because it improves soil pH from acid (4,5) to neutral pH (7) which is the optimal pH for soil.

Keywords : Critical land, Soil Acidity, Chloten, *Chlorella pyrenoidosa*, Microalgae Fertilizer, Crops Productivity.

INTRODUCTION

Most of the agricultural lands in Indonesia are in the same condition, which is the decrease in soil fertility. The reduction in land fertility is largely due to the use of chemical fertilizers and intensive cultivation systems that have been carried out for decades without being interspersed with organic fertilizers. The supply of chemical fertilizers that are ongoing and the absence of regular addition of organic matter has caused agricultural soils to be nutrient poor, microbial diversity poor, hardened, and not loose. As a result of declining land fertility is a decrease in agricultural productivity (Wahyono, 2010). One characteristic of soil damage on agricultural land is soil acidification. Acidic soil pH is largely due to excessive application of fertilizers. Acidification causes loss of alkaline cations, increased aluminum saturation and decreased yields (Goulding, 2016). The best pH for soil is the range of neutral pH numbers (7) because at a neutral pH most macro and micro nutrients can be absorbed optimally by plants. Therefore, it is one of the most appropriate methods for increasing the availability of soil nutrients and optimizing the absorption of nutrients by plants so that yields are increased is by recovery of soil pH (Miransari, 2013).

Because land is the main resource in agriculture, the destruction of land will have an impact on agriculture. Agriculture is an important sector for national food security which must always be preserved. Therefore, if the critical land is left damaged and does not get an improvement, it will threaten national food security. The low national food security will directly affect the vulnerability of the national security conditions of the Indonesian nation (Nurpita, Wihastuti, & Andjani, 2018).

Melon is a plant native from Africa. Melons were developed in Indonesia in the 1980s in Cisarua (Bogor) and Kalianda (Lampung) by PT. Jaka Utama Lampung. Melon plants also spread to several areas in Indonesia such as Sukabumi, Ngawi (East Java), Madiun, Ponorogo, and other areas (Prajnanta, 2003). Melons require a neutral pH of 5-7 to grow and have high productivity. Therefore, the effect of several methods of increasing pH carried out in this study needs to be implemented, which is expected so that melon farmers get the best method in regulating soil pH so as to increase their productivity. This research's aims to increase the productivity of planting melons in the Klaten area and as an effort to bioremediation of the soil so that it can lead to more environmentally friendly organic agriculture and plantations.

Microorganisms as biofertilizer can help to provide nitrogen in the soil (*Rhizobium*, *Azospirillum*, and *Azetobacter*), Phosphate (phosphate solvents bacteria, ectomycorrhizae, and mycorrhizae vesicular arbuscular), and trigger the decomposition process of organic matter (cellulose breaker and effective microorganism) (Rahmawati 2006).

MATERIALS AND METHODS

Lab Scale Analysis

To Prove The Ability of Microalgae *Chlorella* Ability on Recovery Soil Acidity, that is need lab scale analysis. This research was conducted on April 2020 until August 2020 in the Sidowayah fields, Polanharjo, Klaten. The materials used in this study were with no additional acidity treatment as control, lime, urea chemical fertilizer and Chloten (100% *Chlorella pyrenoidosa*). While the tool used is a soil pH meter. The study was conducted on the same land with an initial pH of 4.5 using 3 different treatments including urea chemical fertilizer, lime, Chloten (*Chlorella pyrenoidosa*), and 1 control (no treatment).

The Differences Analysis was Performed on Field Scale Prior to Challenging The Result/Productivity of Treated Rice Field by Microalgae Fertilizer (*Chlorella pyrenoidosa*). The most optimal results in soil improvement from lab scale analysis were used for field scale analysis. This research was conducted on 650 m² fields in Sidowayah, Polanharjo, Klaten. The material used in this study was Chloten (100% *Chlorella pyrenoidosa*) and the tool used was a sprayer. Chloten treatment is carried out during the initial tillage process by splashing and during the treatment period the plants are sprayed every two weeks until the harvest period. Calculation of crop yields is calculated by dividing the amount of rice production with the area of agricultural land.

$$\text{Melon Productivity} = \frac{\text{Total Weight (kg)}}{\text{Area (m}^2\text{)}}$$

The experiment was arranged in factorial randomized block design with four combinations of variables and six replications, thus there were 24 experimental plots. The melons plants in the land got three treatments and one with no treatments as a control based on the plot. Then observed every twice a month until harvest time. Parameters observed is the pH of the soil that from three points in every plots. Data of Analysis of Variance (ANOVA) and means comparison was computed by spss software. Honest real difference test at 0.05 level was used to analyze significant differences in different treatments with probability 5%.

DISCUSSIONS

Lab Scale Analysis

Lab scale analysis is the step to prove the ability of microalgae chlorella ability on recover soil acidity. The results of the Chloten (*Chlorella pyrenoidosa*) in lab scale analysis of soil acidity using 3 types of treatment and 1 control are in Table 1 below :

Tabel 1. The ability of microalgae chlorella ability on recover soil acidity

	pH Obsrv 1	pH Obsrv 2	pH Obsrv 3	pH Obsrv 4	pH Obsrv 5	pH Obsrv 6	pH Obsrv 7
Control	6.23	6.17	6.28	6.13	5.93	5.86	5.78
Urea	6.54	8.98	5.73	5.83	5.96	5.83	5.81
Lime	6.54	6.98	5.89	5.71	5.63	5.62	5.56
Chlorella	6.36	6.93	6.87	6.91	6.99	6.87	6.83

Lab scale analysis for recovery soil acidity by using 3 different treatment types was obtained in Table 1. The first treatment was using urea, the second treatment using Lime, the third treatment using Chloten, and one control without treatment. Based on the graph shown in Figure 1 it can be seen that from each treatment different effects on soil pH. The treatment of using lime on acid soil turned out to have a significant effect on pH changes. On the first day of lime treatment it was found that the initial pH of 6.5 changed to pH 9. However, on the third observation there was a drastic decrease in pH which was entering number 5. The number 5 lasted until the harvest time. If seen in the graph, it can be seen that the treatment of limestone soils is quite high and unstable.

Lime has been used by the Romans 2000 years ago to compensate for acidity on agricultural land and has been practiced for centuries (Goulding, 2016). Lime is effective for increasing soil pH by increasing the supply of Ca^{2+} which has dissolved with NO_3^- , but it turns out the reaction of lime in the soil causes CO_2 release. $\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$

In addition, although lime on acid soils is an effective practice to stabilize soil organic matter content, increase the level of nutrient mineralization, and increase plant growth, it turns out this has a negative impact on microbes and earthworms (Palmu & Hedlund, 2017). In contrast to the lime treatment, for treatment using urea chemical fertilizer it can be seen from Figure 1 that the change in pH occur until it reaches a neutral number (pH 7) in observation 2 even the graph shown tends to fluctuate and pH decreases on the 3rd observation day. In addition, it can also be seen from the graph that the soil pH treated with chemical fertilizers also decreased pH under control, reaching number 5. The instability and decrease in soil pH using urea chemical fertilizer is the most important cause of acidification of land on agricultural land is the provision of ammonium and ureabased fertilizers (Goulding, 2016). Urea applied to the soil will cause a hydrolysis reaction. $\text{CO}(\text{NH}_2)_2 + \text{H}^+ + 2\text{H}_2\text{O} \rightarrow 2\text{NH}_4^+ + \text{HCO}_3^-$ (Jones, *et. al*, 2007).

After the hydrolysis process occurs to produce ammonium salts, the nitrification process then causes acidification of the soil. $\text{NH}_4^+ + 2\text{O}_2 \rightarrow \text{NO}_3^- + 2\text{H}^+ + \text{H}_2\text{O}$. There is no acidification process when all N in urea is used by plants. Acidification only occurs when urea is converted to NH_4^+ , NH_4^+ undergoes a process of nitrification and dissolved NO_3 (Goulding, 2016).

Soil acidification is a major problem in modern agricultural systems and is an important factor affecting soil microbial communities and soil health. Soil acidification is one of the main factors of the disease caused by lack of nutrient uptake of plants and caused by

bacteria transmitted by soil. Acidic soil conditions (under 7), support the pathogen growth of *Ralstonia solanaceum* (the cause of bacterial wilt) and suppress the growth and activity of the antagonist bacteria *Pseudomonas fluorescens* (a bacterium that has been widely used to control pathogens, especially bacterial wilt) (Li, et al., 2017).

Whereas for the treatment using Chloten (*Chlorella pyrenoidosa*) has the effect of increasing the pH that is not striking at the beginning of the treatment, but Chloten recovered the soil pH consistently and tends to rise until it reaches a neutral pH (7). Soil reaction (soil pH) in neutral numbers is the optimal pH for the soil. This is because soil pH has a large influence on nutrient availability, nutrient uptake, and ion toxicity to plants. Most of the land cultivated for crop production should be at a neutral pH, slightly acidic, and slightly alkaline (6-8) (Lauchli & Grattan, 2012). If the soil pH is too acidic, aluminum, iron, manganese, copper, and zinc it becomes a dissolved form and in certain quantities can be toxic to plants. However, if the soil pH is too alkaline, the solubility of these ions will be very low so that the plant becomes deficient in the intake of these ions (iron, copper, manganese, zinc). Whereas if the pH is neutral, these ions will form inert oxides and hydroxides and the toxicity will decrease. In addition, neutral soil pH is the most suitable condition for bacterial growth (Allaway, 1957).

CONCLUSIONS

Chloten fertilizer (*Chlorella pyrenoidosa*) can recovery soil acidity from acidic pH to neutral pH (7) which is the optimal pH for the soil. The ability of Chloten to recovery soil pH has an effect on the field analysis in rice crops field in Sidowayah, Polanharjo, Klaten

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