



Effect of Giving Tofu Dregs Bokashi on Phosphate Dynamics in Ultisols

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ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 7 No. 1, June 2022
URL: <https://doi.org/10.31327/atj.v7i1.1718>

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Abstract

Ultisols are soil types that are poor in nutrients, one of which is element P, where this nutrient is needed by plants in large quantities. In Ultisols, P nutrients are bound by Al, so the availability of P nutrients for plants is low. Giving organic matter is one way to speed up the process of soil amelioration. Tofu waste is organic waste that contains nutrients and can be used as organic fertilizer that can help improve soil nutrients. Tofu dregs contain organic N, P, K, Ca, Mg, and C which have the potential to increase soil fertility. This study aims to determine the effect of tofu pulp bokashi application on the dynamics of phosphate in Ultisols soil and to obtain the best dose of tofu pulp bokashi on the availability of phosphate in Ultisols soil. The method used in this study was a 1-factor Completely Randomized Design (CRD) with 6 (six) levels of treatment with 3 (three) replications in order to obtain 18 experimental units. Treatment P0 was without giving bokashi, P1 was P fertilizer 200 kg.ha⁻¹, P2 was bokashi tofu dregs 12 t.ha⁻¹, P3 was bokashi tofu dregs 24 t.ha⁻¹, P4 was bokashi tofu dregs 12 t.ha⁻¹ and fertilizer P 200 kg.ha⁻¹, P5 namely bokashi tofu dregs 24 t.ha⁻¹ + fertilizer P 200 kg.ha⁻¹. The results of this study showed that the administration of tofu dregs bokashi had a significant effect and the best dose was obtained for increasing pH and available P by giving bokashi tofu dregs 24 t.ha⁻¹ and P fertilizer 200 kg.ha⁻¹. The best dose to reduce Al-dd is by giving bokashi tofu dregs 24 t.ha⁻¹ and P fertilizer 200 kg.ha⁻¹

Keywords: P205, phosphorous, Al-dd, compost, waste tofu

A. Introduction

One of the materials that can be used as raw material for making bokashi fertilizer is tofu waste, both solid and liquid waste. The waste produced by the tofu factory in the form of soybean husks, dregs, and tofu water can still be used as useful products. In the tofu processing process, waste will be produced in the form of tofu dregs which if not handled immediately can cause an unpleasant odor (Ridayanti, 2011). Tofu pulp contains 43.8% protein, 0.9% fat, 6% crude fiber, calcium 0.32%, phosphorus 0.67%, magnesium 32.3 mg/kg and other ingredients. Tofu dregs which is still fresh cannot be used directly as organic fertilizer. For utilizing tofu dregs, which can be used as a basic material for fertilizers organic in the form of compost (Krisman, 2016). Tofu dregs contain organic N, P, K, Ca, Mg, and C which have the potential to increase soil fertility. The elements contained in organic fertilizer tofu waste are very good plays an important role in growth that plays a role in the formation or growth of the vegetative parts of plants, such as leaves, stems and roots, important in the formation of leaf green matter in the process of photosynthesis, and increase microorganisms in the soil (Sunarsih F., Yetty H dan, Aseptianova, 2018). Under these conditions, the provision of bokashi tofu dregs can increase the organic matter content of the soil and play a role in improving the physical, chemical, and biological properties of the soil, especially in terms of the availability of nutrients for plants.

Soil that is poor in nutrients is Ultisols, especially nutrient P, this nutrient is needed by plants in large quantities. In Ultisols, P nutrients are bound by Al, so the availability of P nutrients for plants is low. The addition of organic matter to the soil is one of the corrective actions for Ultisols. According to Tan (2010), the addition of organic matter is one of the efforts that can be used to overcome nutrient problems in the soil. Organic materials in the decomposition process will release organic acids that can bind Al and form complex compounds, so that Al becomes insoluble. The organic material that can be applied to Ultisols soil is tofu pulp bokashi. Due to the limited information about application of tofu bokashi to the Ultisols, it needs more study to investigate the effect of its application to the soil chemical reaction. Therefore, this study aims to determine the effect of tofu dregs bokashi application on changes in phosphate in Ultisols.

B. Methodology

1. Research Methods

The study was carried out in July – October 2021. This study was arranged in a Completely Randomized Design (CRD) with 1 (one) factor with 6 (six) levels of treatment with 3 (three) replications therefore consist of 18 experimental units. The treatments in this study were P0 = Control (without giving bokashi), P1 = Fertilizer P 200 kg.ha⁻¹, P2 = Bokashi tofu dregs 12 t.ha⁻¹, P3 = Bokashi tofu dregs 24 t.ha⁻¹, P4 = Bokashi tofu dregs 12 t.ha⁻¹ and fertilizer P 200 kg.ha⁻¹, P5 = Bokashi tofu dregs 24 t.ha⁻¹ + fertilizer P 200 kg.ha⁻¹.

A total of 5 kg of Ultisols soil from Banjarbaru Region, South Kalimantan, was sieved with a 2 mm diameter then put into polybags. Then, tofu dregs bokashi was added which was made with a mixture of 70 kg of fresh tofu dreg, 10 kg bran, 1 kg brown sugar, and 150 ml EM-4 which was composted for 21 days. The soil was incubated for 2 weeks and observed for pH, Al-dd, P205 every week. The soil chemical properties before incubation were pH 5.3, available P 12.25 mg.100g⁻¹, and exchangeable-Al 0.94 mg.100g⁻¹. All the soil chemical analysis based on Balai Penelitian Tanah (2009).

2. Data Analysis

The data obtained were analyzed for variance analysis of variance (ANOVA) and further test using Duncan Multiple Range Test (DMRT) with 95% confidence level.

C. Result

1. Soil pH

Giving bokashi tofu dregs showed an increase in soil pH from the observations of weeks I to II, both pH H₂O (actual) and pH KCl (potential), although based on statistical tests it did not show a significant difference between treatments.

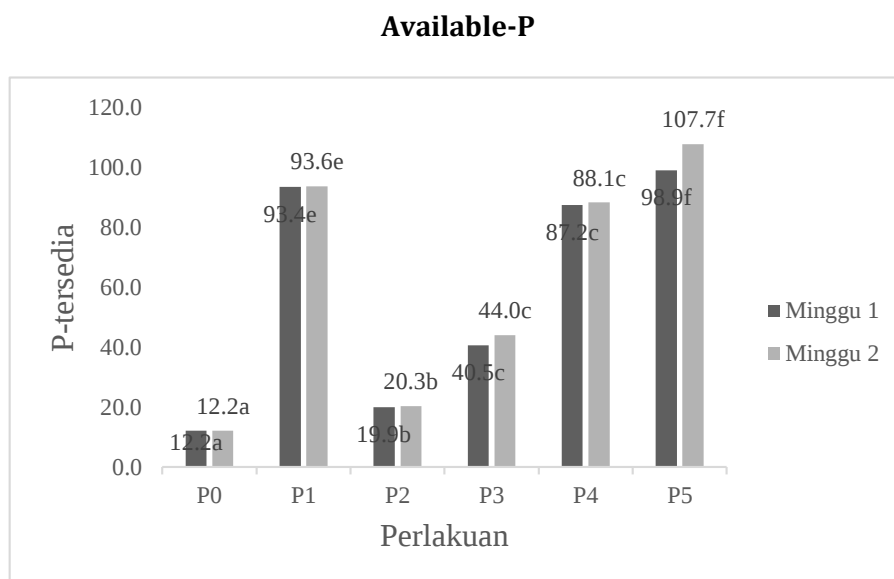
Table 1. Soil pH 1-2 weeks

Treatment	pH H ₂ O		pH KCl	
	1	2	1	2
P0	5.3a	5.3a	3.7a	3.7a
P1	5.1a	5.2a	3.9ab	4.0ab
P2	5.7a	5.8a	3.8a	3.8a
P3	5.6a	5.7a	4.3cd	4.5c
P4	5.2a	5.3a	4.1bc	4.3bc
P5	5.6a	5.6a	4.6d	4.6c

Notes: Numbers followed by the same letter show that they are not significantly different based on the 5% DMRT test. P0 = Control, P1 = P 200 kg.ha⁻¹ fertilizer, P2 = bokashi 12 t.ha⁻¹, P3 = bokashi 24 t.ha⁻¹, P4 = bokashi 12 t.ha⁻¹ and P 200 kg fertilizer. ha⁻¹, P5= bokashi 24 t.ha⁻¹ + fertilizer P 200 kg.ha⁻¹.

2. Available-P

Giving tofu dregs bokashi was able to increase available P than without tofu dregs bokashi administration (P2 & P3 VS P0). The combination of bokashi tofu dregs at a dose of 24 t.ha⁻¹ + P fertilizer 200 kg.ha⁻¹ was also able to increase the available P of the soil compared to the application of P fertilizer alone.

**Figure 1. P-tersedia 1-2 weeks**

Notes: Numbers followed by the same letter show that they are not significantly different based on the 5% DMRT test. P0 = Control, P1 = P 200 kg. ha⁻¹ fertilizer, P2 = bokashi 12 t.ha⁻¹, P3 = bokashi 24 t.ha⁻¹, P4 = bokashi 12 t.ha⁻¹ and P 200 kg fertilizer. ha⁻¹, P5= bokashi 24 t.ha⁻¹ + fertilizer P 200 kg.ha⁻¹.

3. Exchangeable-Al

Giving bokashi tofu dregs was able to reduce Al-dd at week II compared to control. The combination of bokashi tofu waste 24 t.ha⁻¹ with P 200 kg.ha⁻¹ fertilizer showed the lowest Al solubility. The application of P 200 kg.ha⁻¹ fertilizer can also reduce soil Al-dd.

Exchangeable-Al

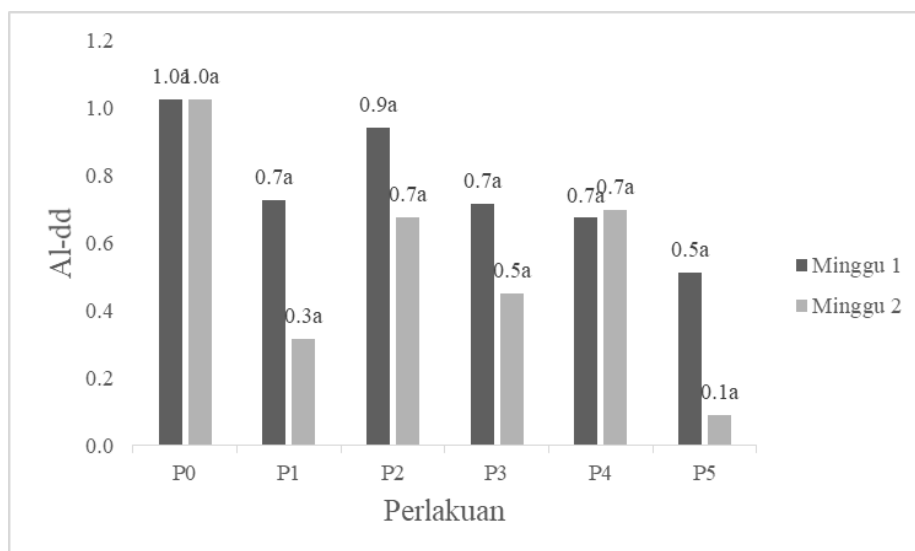


Figure 3. Al-dd 1-2 weeks

Notes: Numbers followed by the same letter show that they are not significantly different based on the 5% DMRT test. P0 = Control, P1 = P 200 kg.ha⁻¹ fertilizer, P2 = bokashi 12 t.ha⁻¹, P3 = bokashi 24 t.ha⁻¹, P4 = bokashi 12 t.ha⁻¹ and P 200 kg fertilizer. ha⁻¹, P5= bokashi 24 t.ha⁻¹ + fertilizer P 200 kg.ha⁻¹.

D. Discussion

According to research by Danial M, Taufieq NAS, dan Sanusi W. (2008), the change of soil pH was caused by the low acidity level of tofu pulp bokashi so that when soil with a low pH is mixed with bokashi tofu pulp with a high pH, it causes a neutral pH or alkaline pH. Thus, the tofu dregs bokashi has sufficient potential to reduce the acidity of Ultisols soil so that the soil becomes suitable soil for growing plants. Changes in soil pH are also caused by the nutrient content in the soil and its availability is quite fast. Provision of nutrients from bokashi tofu dregs is sufficient in providing the needs of the soil. Solid organic fertilizer has slow release properties, meaning that the nutrients in the fertilizer will be released slowly and continuously over a certain period of time. This shows that the pH of the soil will increase slowly over a certain period of time until a neutral pH is reached. The addition of organic matter can increase the pH value of the soil, because organic matter has the ability to bind Al³⁺ metal, so that the Al³⁺ hydrolysis reaction does not occur, where from the Al³⁺ hydrolysis reaction 3 H⁺ ions are produced which can acidify the soil (Nariratih I, Danamik M M B, Sitanggang G., 2013).

The application of tofu dregs bokashi can increase available-P significantly, this is due to the effect of increasing pH and decreasing soil Al-dd. According to Adiningsih, S. and Rochayati (1988), stated that organic matter applied to the soil can increase the availability of phosphorus and soil pH. According to Tan (1991), this significant change occurred due to the presence of Al which still binds P and causes P to be unavailable. Phosphorus becomes difficult to dissolve in the soil so that P is difficult to be available, this happens because of high amounts of Fe and Al oxide clays, especially highly weathered soils such as Ultisols and Oxisols in the tropics, the clay reacts quickly with Phosphorus to form a series of Phosphorus hydroxy difficult to dissolve. The increased availability of P in the soil was thought to be due to the addition of organic matter, namely bokashi tofu waste. According to Hakim, N. M. Y. Nyakpa., A. M. Lubis., S. G. Nugroho., M. R. Saul., M. Diha., G. B. Hong., dan H. H. Bailey (1986), the effect of organic matter on P availability can be directly through mineralization or indirectly by assisting the release of fixed P. This is reinforced by Fox TR, Commerford NB, McFee WW. (1990), which states that the decomposition products of organic matter in the form of organic acids can form chelation bonds with Al and Fe ions, thereby reducing the solubility of Al and Fe ions, thereby increasing the availability of P is increasing. The increase in available-P soil due to the provision of tofu dregs bokashi is still in the low category according to the soil characteristics criteria by the soil research center (2009).

The increase in available P in the soil was due to the tofu dregs bokashi composed of organic matter capable of producing organic acids that could bind metals such as Al and Fe so that P binding was reduced and made available in the soil.

The decrease in Al-dd on Ultisols that was applied to bokashi tofu dregs occurred due to a chemical reaction between tofu dregs and the soil, this also had an effect due to an increase in pH. According to Siregar (2017), in his research, he stated that organic matter applied to the soil produces organic acids that can chelate free Al^{3+} in the soil, so that the exchangeable Al^{3+} decreases. There is a relationship between Al-dd on pH and P-available soil, namely with an increase in soil pH, Al-dd will decrease so that P-available increases. The results showed that there was a decrease in Al-dd levels and an increase in P-available soil after adding tofu dregs bokashi. This generally occurs because of the decomposition process which then produces humic and fulvic acids so that the bound P can be released. Organic matter added to the soil through the decomposition process will produce a lot of organic acids containing phenolic acid and carboxylic acid derivatives (Wahjudin, 2006).

E. Conclusion

Bokashi tofu dregs can increase soil P availability and soil pH. In addition, tofu dregs bokashi was able to lower Al-dd so that P was more available.

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