The Effect of Volcanic Ash Addition to the Chemical Quality of Excreta Organic Fertilizer

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ABSTRACT

This research aims to know the effect addition of volcanic ash to the chemical quality of excreta organic fertilizer. This study consists of five treatments, the first treatment 0%(T0) addition of volcanic ash as control, the second treatment 5%(T1), the third treatment 10%(T2), the fourth treatment 15%(T3), and the fifth treatment 20%(T4). Parameters that were observed covering the chemical quality are temperature of composting, N total, P total, K total. The data were tested analysis variance of completely randomized design of one way anova, and the mean differences were analyzed with Duncan's New Multiple Range Test (DMRT). The results showed that the addition of volcanic ash on the treatments was not significally different to the control (T0) of N total. The contents of N total that contained in organic fertilizer on the addition of 0, 5, 10, 15, and 20% volcanic ash were 0.81, 0.71, 0.89, 1.02, and 0.52%, respectively. Treatment T1 and T4 gave significally different ($P<0.05$) to the control (T0) of P total. The P total that contained in organic fertilizer on the addition of 0, 5, 10, 15, and 20% volcanic ash was 1.52, 1.01, 1.48, 1.45, and 0.8%, respectively. Treatment T1 and T4 gave significally different ($P<0.05$) to the control (T0) of K total. The contents of K total that contained in organic fertilizer on the addition of 0, 5, 10, 15, and 20% volcanic ash were respectively 1.56, 1.18, 1.64, 1.53, and 0.82%. The dose addition of volcanic ash in treatment 10% (T2) and 15% (T3) was the best improved the chemical quality of organic fertilizer.

Keywords: Organic fertilizer, Excreta, Volcanic ash, Chemical quality

INTRODUCTION

Organic fertilizer is more effective than chemical fertilizer and becomes an important issue (Zai et al., 2008) in many country that majority of land. By the 2010, the accumulated volcanic ash was still being a problem to the area around the Merapi Mountain. There is no utilizing of volcanic ash in the farm village. Lack of information about the content of volcanic ash makes the farmer letting the volcanic ash on the ground without treatment. Volanic ash was contained organic matter that needed by plant to grow, and it can make farm field fertile. Metin et al. (2010), stated that volcanic ash has a pH value of 7.8, brown of color, 274000 ppm of CaCO3, 40 ppm of phospor (P), and 248 ppm of Potassium (K). The fertile soil, around the Merapi Mountain, could be applied to the other place (soil) through a medium. The organic fertilizer could be a medium with addition of volcanic ash, so it can be expected to fertile the plant and soil.

In the other side, poultry industry is developing due to the necessary of human for meat and egg. The booming poultry industry in this country makes the waste more released from the livestock. The excreta recently becomes a waste with nothing solving, so that it was

buried on the ground and became an air pollution. For long time accumulaed, many organic matters of excreta make the soil to be fertile naturaly. Excreta was recommended to being a fertilizer and improved soil fertility with content 4530 ppm of P, 20660 ppm of K, 250 ppm of Ca, and C/N ratio of 8.73 (Zai et al., 2008). The purpose of this research was to know the effect addition of volcanic ash to the chemical quality of excreta organic fertilizer.

MATERIALS AND METHODS

Excreta and volcanic ash collection. The excreta of laying chicken was collected from the cage of Charoen Pokhpand in Sleman, Yogyakarta. The excreta that was used is 4 days old and 60% of water content. Volcanic ash used in composting organic fertilizer was taken from Gendol river, Merapi Mountain slope, Yogyakarta.

Composting organic fertilizer. The excreta and volcanic ash were mixed with the other materials with various kind treatments of addition volcanic ash, that is T0: 0%, T1: 5%, T2: 10%, T3: 15%, T4: 20% and every treatment is respectively needed excreta 90%, 85%, 80%, 75%, 70%. The mixed materials were fermented for 35 days and aeration were carried out every 5 days. Organic fertilizer was composted in Turi, Sleman, Yogyakarta.

Chemical analysis. The temperature of composting the organic fertilizer was measured by putting the termometer into the pile of compost. Just wait for 30 seconds, and then pull out the termometer. Temperature measurement was carried out every 3 days. The N total was determined by taking 5 g sample of organic fertilizer, and then mixed sample with 20 ml H_2SO_4 and puted into destruction tube. Sample will be destructed for an hour and if the color of sample becomes clearly, the destruction stoped. The P total was measured by oxidation with HNO_3 and $HClO_4$. The first extract was puted into beaker glass, added by distilled water and diluted 10 times. The sample for P total was measured by spectrophotoeter UV-1601 PC Shimadzu and recorded to the results. The K total was measured by wet oxidation with HNO_3 and $HClO_4$. The sample for K total was measured using flamephotometer.

Statistic. The data were tested by analysis variance and mean differences were continued analyzed by Duncan's Mutiple Range Test (DMRT) methods.

RESULTS AND DISCUSSION

Temperature of composting. The observation temperatures of excreta organic fertilizer on five treatments are presented in Figure 1. The highest average temperature, on three replication of five treatments (T0, T1, T2, T3, T4) based on observation of composting temperature of organic fertilizer for 35 days, was between the second day and fifth day that was 60^0C. This temperature showed that the composting temperature was in thermophile phase after two days of composting process. The existing microbes on this phase were thermophilic microbes those lived in temperature between 45^0C to 70^0C (Canganella and Wiegel, 2014). The quickly increasing temperature on the early days of composting process was due to the high of microbial activity (Haynes and Zhou, 2016) in degradating the substance containing nitrogen (N) in the form of ammonium (NH_4^+) that contained in excreta. The temperature of composting decreased at the 8th day and continuously decreased day by day until the 35th day. After a week of composting, started by the 8th day, decreasing temperature reached 40^0C degrees, and this condition was the mesophyll phase lasted for a week. The five treatments temperature, the latest temperature at the day of harvesting the fertilizer (day 35th), were respectively 32.7^0C, 32.3^0C, 32.3^0C, 32^0C, and 30.2^0C (Fig. 1). Organic material that was decomposted could produce a heat exoterm (Haynes and Zhou, 2016). Nitrification process, the forming of ammonium to be nitrite (NO^{-2}) and nitrate (NO^{-3})

by nitrifying microbes, is producing a heat exoterm. The more the ammonium content in excreta, the higher the temperature released.

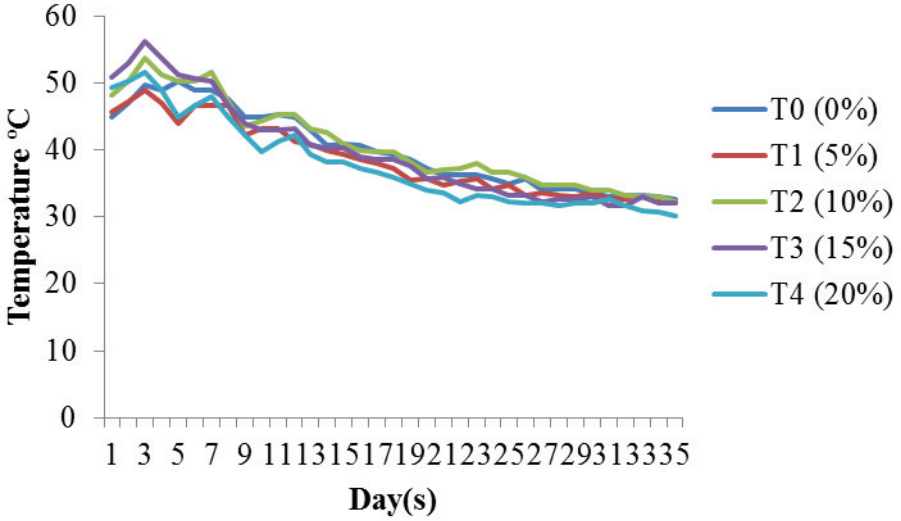

Figure 1. The temperature of composting organic fertilizer on five treatment for 35 days

The high temperature in composting a fertilizer is usefull to kill the phatogen microbes that could decreased the quality of organic fertilizer. Tiquia *et al.* (2002) stated that thermophilic temperature was capable to destroy the coliform bacteria and other phatogens with temperature above 55^0C.

Nitrogen (N) total contained in organic fertilizer. Contents of N total in excreta organic fertilizer on each different treatment are presented in Figure 2. Based on the result of the analysis N total, the contents of N total on five treatments T0, T1, T2, T3, and T4 were respectively 0.81%, 0.71%, 0.89%, 1.02%, and 0.52%.

The lowest content of N total that was 0.52% carried out of three replication was in T4 with 20% additional of volcanic ash. The highest content of N total was in T3 contained 1.02% of nitrogen in 100kg fertilizer. N total with addition of volcanic ash on four treatments (T1, T2, T3, T4) was not significantly different effect ($P>0.05$) compared to the control (0.81%) at last the composting of organic fertilizer. T3 treatment has given a significantly different effect ($P<0.05$) compared to T4. Dried excreta has the concentration of N total of 6.00% (60000 ppm) (Tagoe *et al.,* 2008). In T4 treatment, the content of N total was the lowest because the amount of excreta used in composting was the least and occured evaporation of NH_3. Gericke *et al,* (2012) stated that the high temperatures caused the evaporation and reduce NH_3 resulted in a change of -0.04% of ammonium-N/kg.

Phosphor (P) total contained in organic fertilizer. The result of chemical test of P total contained in organic fertilizer composted for 35 days on each different treatment is presented in Figure 2. The average content of three replication of P total in organic fertilizer with addition of volcanic ash on T0, T1, T2, T3, T4 was respectively 1.52%, 1.01%, 1.48%, 1.45%, and 0.8%. The lowest content of P total was 0.8% in T4 and the highest was 1.52% in T0. The mineral content that contained in volcanic ash was adequate enough.

P total with addition of volcanic ash on treatment T2 and T3 was not significantly different effect (P>0.05) compared to the control (1.52%) (Fig. 2) in organic fertilizer with addition of 10% and 15% of volcanic ash respectively. The content of P total in T2 and T3 has given a significantly different effect (P<0.05) compared to T1 and T4. In T4 treatment, the P total has the lowest concentration because the content of P total in volcanic ash was the least only 40 ppm (0.004%) (Metin *et al.,* 2010), the addition 20% of volcanic ash decreased the P total in organic fertilizer. Dried excreta has the concentration of P total of 4470 ppm (0.44%) (Tagoe *et al.,* 2008). Anda and Sarwani (2012) stated that other nutrient that was P in form of P_2O_5 contained in fresh Merapi volcanic ash was potential nutrient with concentration of 5.99% equal to 59900 ppm.

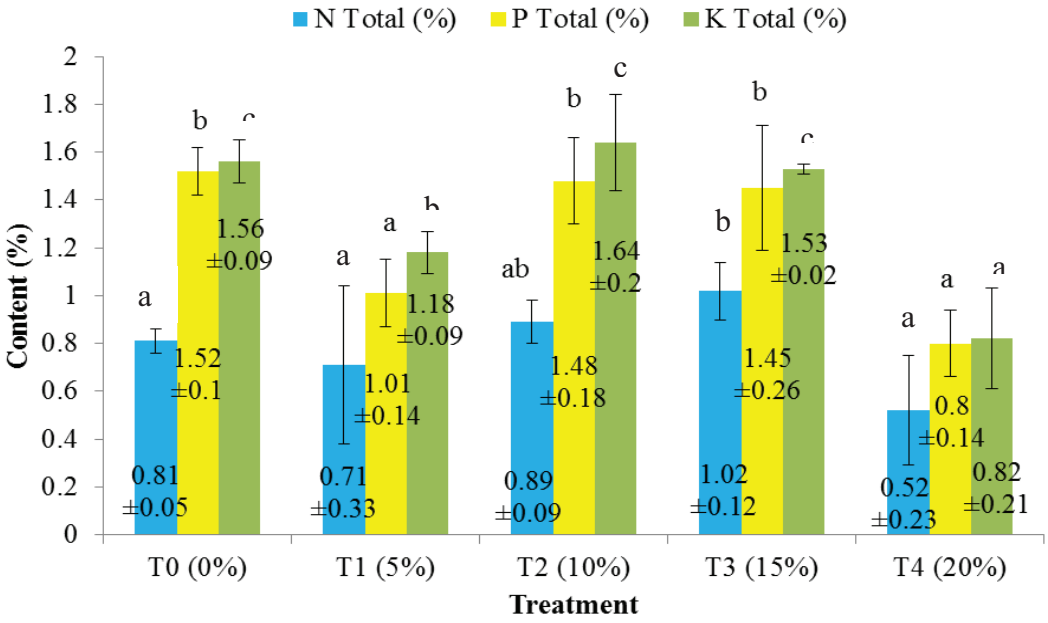

Figure 2. Nitrogen (N), Phosphor (P), Potassium (K) total after 35 days composting on five treatment in excreta organic fertilizer

Nitrogen (N), Phosphor (P), Potassium (K), means followed by the same letter are not significantly different at (P<0.05).

Potassium (K) total contained in organic fertilizer. The result of K total contained in organic fertilizer on each different treatment is presented in Figure 2. The average content of K total by three replication on five treatment was respectively 1.56%, 1.18%, 1.64%, 1.53%, dan 0.82%. Previous study by Anda and Sarwani (2012) stated that the mineralogical composition of K in form of K_2O contained in fresh Merapi volcanic ash was observed of 9.68% equal to 96800 ppm.

K total with addition of volcanic ash on treatment T1 and T4 gave a significantly different effect (P<0.05) compared to the control (1.56%), although the concentration of T1 and T4 was lower than T0 (Fig. 2). The content of K total in T2 and T3 has given a significantly different effect (P<0.05) compared to T1 and T4, but T2 and T3 was not a significantly different effect (P>0.05) compared to T0 during the end composting of organic fertilizer. T2 treatment has the higest concentration of K total because the composition of excreta and volcanic ash used in composting was balance and appropriate, so that the contribution of K total from excreta and volcanic ash improved the K total in organic fertilizer. Dried excreta has the concentration of K total of 2300 ppm (Tagoe *et al.,* 2008) to

20660 ppm (Zai *et al.,* 2008). Jifeng *et al,* (2017) stated that organic fertilizer from the chicken manure has the potassium (K) content of 2.99% equal to 29900 ppm.

CONCLUSIONS

Based on the research that has been done is concluded that the addition of volcanic ash in dosage of 10% can improve the chemical quality, especially for improvement potassium (K) total content.

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