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Utilization of Filter Cake and Waste of Soybean Extract in Making Casting Fertilizer

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ABSTRACT

A research of making casting fertilizer from blotong and soybean extract has been done. The purpose of the research is to know C / N and NPK of organic fertilizer using vermicompost method on earthworm *Lumbricus rubellus* which given blotong and soybean extract media. The treatments consist of a ratio of blotong and soybean extract continually; Fertilizer A 2:0 (Kg), fertilizer B 2:½ (Kg), fertilizer C 2:1 (Kg), fertilizer D 2:1½ (Kg) with three times repetitions. The experimental results show that the combination of media in fertilizer C has the best quality with the level of N 1.323%, P 2.076%, K 0.642% and C/N ratio 23.023.

Keywords: casting fertilizer, vermicompost, filter cake, soybean extract

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INTRODUCTION

Nowadays, environmental issues become one of the public attention centers. Environmental problems are often caused by untapped waste. Industry which is currently developing is one factor that increases the amount of waste volume. Sugar factory is one of the growing industries in Indonesia. One of them is Candi Sugar Factory located in Sidoarjo regency (East Java, Indonesia).

In processing the sugarcane, waste or byproducts are also produced such as, waste, blotong, and drops. Based on interviews between the researcher and one of the sugar factory employees, blotong is disposed in Watu Kosek Ngoro Mojokerto district and it is sold with the price 60.00 rupiahs / Kg. The composition of blotong consists of coir, wax and crude fat, crude protein, sugar, total ash, SiO₂, CaO, P₂O₅, and MgO [1]. Based on its composition, blotong has the potential to be used as organic fertilizer, because it contains of nutrients needed by the soil.

Organic fertilizer produced through the composting process with the help of earthworms is called as casting (worm's waste). Casting is a remnant of earthworm metabolism mixed with other materials with high nutrient content. So it is good to be used as fertilizer [2]. The role of earthworm in the process of making fertilizer is to accelerate the composting process along with microorganisms, so, it can produce more nutrients for plants. The earthworm used in this research is *Lumbricus rubellus* worm.

Other organic wastes that are available quite a lot and have not been utilized properly are soybean extract from the process of making soy essence. The nutrient content of soybean extract is high enough such as, crude protein 27.62%, crude fat 2.95%, BETN 52.66%, crude fiber 13.81% and 2.96%, Ca 0.09%, P 0.04 % [3]. Because of the sufficient nutritional content, this soybean waste is used as additional nutrients to *Lumbricus rubellus* worms.

Organic materials as earthworm's food also need to be paid attention its C/N ratio, material size, humidity and temperature [4]. In this research, casting fertilizer was made for 30 days by giving soybean extract every 3 days. Casting fertilizer which was formed was tested its levels of N, P, K and C/N. The best casting fertilizers are tested on mustard plants with observation parameters, including; Plant height, number of leaves, and leaf area.

MATERIALS AND METHODS

Some materials used in this research are: earthworms (*Lumbricus rubellus*), blotong, soybean extract, samples (fertilizer A, B, C and D), green seeds of best casting fertilizer, urea fertilizer, soil, and water. The tools which were used in this research are: tub with the size 30x26x10 cm, sacks, scissors, scales, shovels, gloves, vials, polybags, plasti

The process of making casting fertilizer

Lumbricus rubellus as many as 500 grams were inserted into 4 plastic tubs with the size 30x26x10 cm which filled of blotong and soybean extract with a ratio of 2:0 (Kg), 2:½ (Kg), 2:1 (Kg), 2:1½ (Kg). The composting process is done for 30 days until the material becomes crumb and small grain which is worm droppings found in it. Then the worms are separated from the casting and the casting fertilizer was dried. The casting fertilizer was tested for its qualities of N, P, K and C/N.

Application of best casting fertilizer on mustard plants

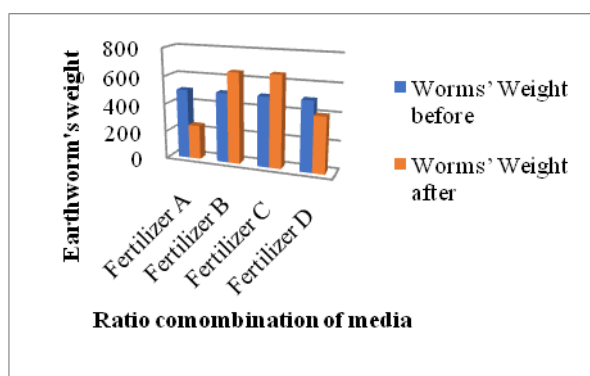
The applied casting fertilizer is the best casting fertilizer in stage I. It began with the provision of green mustard seeds and the soil processing for 2 weeks. After that, it transferred into polybags. In every 3 days, the height of plants and the number of leaves are observed and counted.

RESULT AND DISCUSSION

The process of making casting fertilizer

Earthworms are inserted into a plastic container which already contains of media, after the observation for 2 days; the earthworm does not leave the media. So it is declared that it is feasible for the earthworm cultivation. The weight of earthworms has increased during the composting process [5], as shown in Figure 1.

Figure 1: The differences of worm's weight between before and after composting process



The picture above shows that the weight of the worm in fertilizer B and C have increased. However, in the A and D fertilizers, the weight of the worms has decreased. It is because in the fertilizer A there is no additional organic material (excessive soybean extract) which causes the death of the worm due to the decrease of aeration on the media.

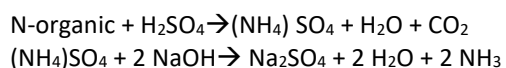
Once there is worm's waste (casting) in the media, the worms are moved from Casting. There are not only casting found in media, but also worm's eggs. The presence of eggs can interfere with the planting process, so the fertilizer must be dried. The quality of fertilizer produced was tested in order to know its N, P, K and C/N levels, as shown in Figure 2. The feed given to the worm will determine the quantity and quality of the casting fertilizer [6].

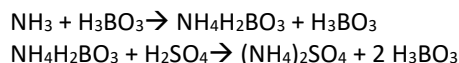
Figure 2: Casting Fertilizer



A. Total nitrogen content

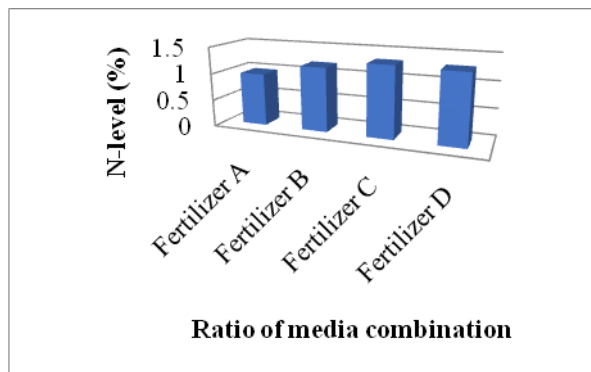
Nitrogen is needed by plants at a growth stage, especially vegetative growth [7]. N-level assay used is kjeldahl method covering stage of destruction, distillation, and titration. The principle of determining protein content according to the kjeldahl method is nitrogen in the sample was hydrolyzed with sulfuric acid to form ammonium sulfate compounds. Nitrates with salicylic acid form ammonium compounds. Ammonium compound in an alkaline atmosphere was distilled, and then it saved in a solution of boric acid. The sulfuric acid solution was titrated until green turns pink [8], as in the following reaction:





The content of nitrogen nutrient can be seen in Figure 3.

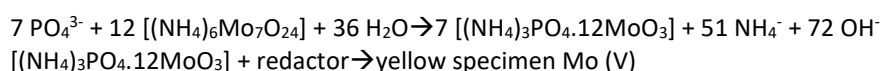
Figure 3: Data of nitrogen content of casting fertilizer



Standard of organic fertilizer quality according to Regulation of Agriculture Minister no. 28 of 2009 states that total nitrogen content up to a maximum of 6%. All media combinations show that it is accordance with the N total standard. Nitrogen nutrient content in casting fertilizer each combination looks different, but tends to increase. Fertilizer A with a combination of 2 Kg blotong medium without the addition of soybean extract has the lowest N content of 0.98%. It is because of unfermented blotong which makes earthworms difficult to consume it. B and C fertilizers have high N levels; this is because the worms in the fertilizer fed with the fermented soybean waste so as to facilitate the worms to consume them. Compared with fertilizer C, the mass of soybean extract contained in the B fertilizer is less than the fertilizer C. During the vermicompost process, the N content comes from the mucus fluid, the nitrogenous enzyme and the growth hormone [9].

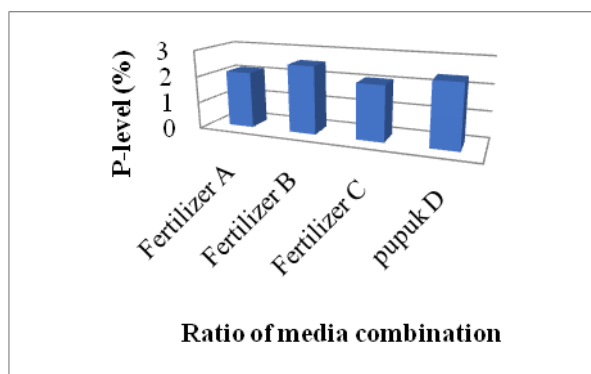
B. Total phosphoric content

Phosphoric nutrient elements are needed for early growth in stimulating plant roots that are useful to support the establishment of plant and the absorption of nutrient from planting media. P-level assay used in this research is UV-Vis spectrophotometer method at 420 nm wavelength by following SNI 2803-2012. The principle is that dissolved orthophosphates are reacted with ammonium molibdovanadat forming a yellow molybdovanadic acid compound of phosphoric acid [10]. Here's the reaction:



Phosphorus content of all treatments can be seen in Figure 4.

Figure 4: Data of phosphorus content of casting fertilizer



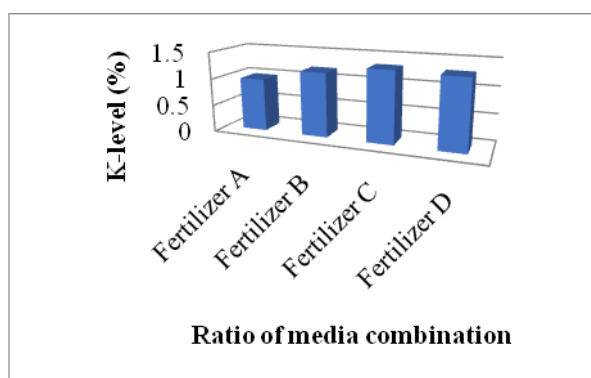
The standard quality of organic fertilizer according to Regulation of Agriculture Minister No.28 year 2009 states that total phosphorus content as P_2O_5 maximum as much as 6%. All media combinations show it is accordance with P standard. In principle, earthworms will consume organic material according to their weight in a day. Therefore, the combination of B fertilizer causes the worms more easily to process organic materials. High P levels is caused by the earthworms not only consume the extract of soybean waste, but also consume blotong that has P_2O_5 content. From enzymes and microorganisms activity in digestive tract of earthworms which process organic material, the material will be excreted by microorganisms through the worms' excretion [11]. According to Fig. 4, the concentration of P in each combination indicates that the results are not significantly different; this is because the mass of blotong on all containers are the same i.e. 2 Kg.

C. Total potassium content

The potassium nutrient is absorbed in the plant in K^+ form. Potassium plays a role in metabolic processes, respiratory photosynthesis, helping the process of stomata activity in opening and closing, expanding root growth, increasing plant resistance to pest and disease attacks [12]. Test of N content used in this research is kjeldahl method. The K level assay used in this research is atomic absorption spectrophotometer (AAS) method. The principle of the AAS method is the absorption of light by atoms.

The nutrient content of potassium produced can be seen in Figure 5.

Figure 5: Data of potassium content of casting fertilizer



Standard of organic fertilizer quality according to Regulation of Agriculture Minister no. 28 year 2009, it is stated that total potassium content maximum as K_2O as much as 6%. All the media combinations show that it is accordance with the total K standard. Earthworms together with microorganisms help the process of mineralizing organic waste to produce K [13]. K nutrient content in casting is the result of organic material decomposition. According to Fig. 5, the K content of each combination indicates a small inclination. This is because the media used contains low levels of potassium.

D. C/N Ratio

C/N ratio is one of important factors in the composting process. Nutrients are bonded to the carbon chain; so long carbon chains are cut. So that, the C/N ratio is absorbed by the plant [14]. The C/N ratio of all treatments can be seen in Figure 6.

Standard of organic fertilizer quality according to Regulation Agriculture Minister no. 28 of 2009 states that the C/N ratio is between 15-25. Based on the C/N ratio shown in Figure 6, it can be seen that the presence of high organic material decomposition activity on media C and D is indicated by C / N which is accordance with the standards compared to other media. This is because the rate of decomposition of organic material by earthworms on media C and D is higher than other media, in other words earthworms on this media consume more extract soybean waste than other media. Fertilizers A and B have high C/N results, due to the availability of less soybean extract than the combination of media in fertilizers C and D.

Application of best casting fertilizer on mustard plants

Based on C/N data in Figure 6, it can be concluded that the combination of media in fertilizer C is the best compared with urea fertilizer and without fertilizer. All variations indicate the growth of mustard plants. However, the growth of mustard plant is based on high parameters, number of leaves and leaf area which appear different it can be seen in Figure 7, 8 and 9.

Figure 6: Data C/N ratio of casting fertilizer

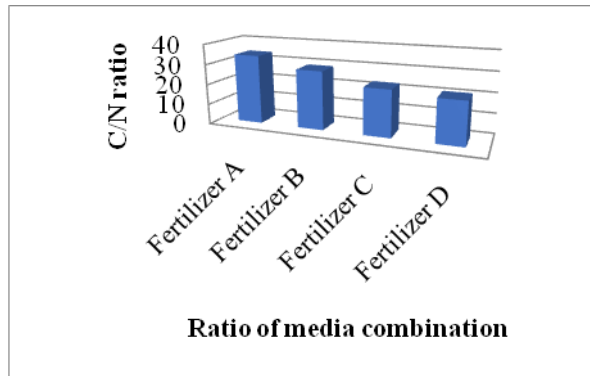


Figure 7: High saw plant

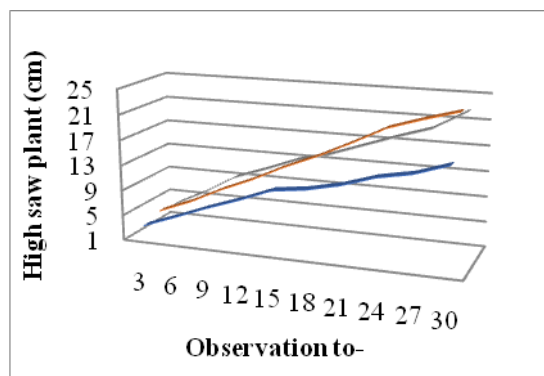


Figure 8: Number of mustard leaf

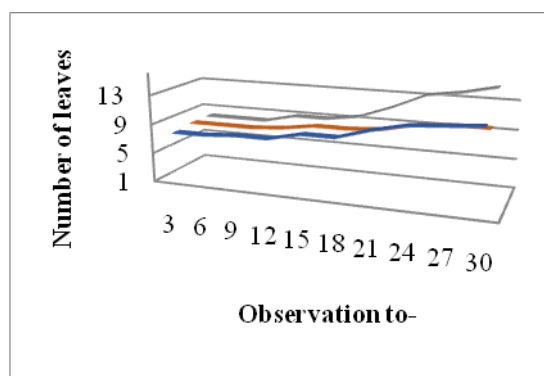


Figure 9: Mustard leaf area

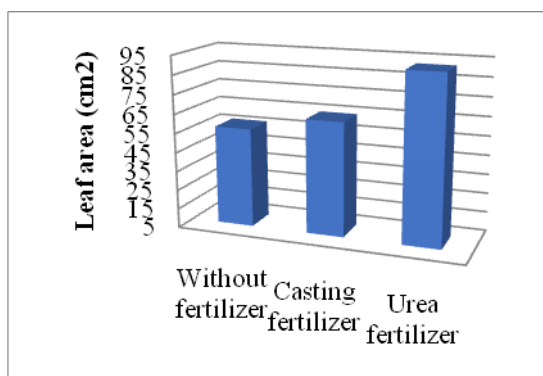
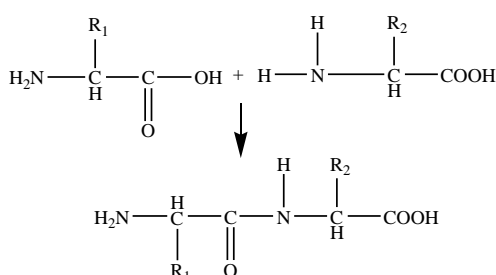


Figure 10: Reaction of protein form



Based on the Figure 7, 8 and 9, the treatment of mustard greens without fertilizers provides the lowest growth on the mustard greens height, leaf number and leaf area. It can be seen that the casting fertilizer gives a higher impact on the mustard plant. This is due to casting fertilizer given to mustard plants has a fairly high P levels of 2.076%.

Based on the parameter of leaf number and leaf area, the growth of mustard plant using casting fertilizer is slightly slower compared to urea fertilizer. This is because urea fertilizer is a type of single inorganic fertilizer which only contains of element N. The N content of urea fertilizer is suitable for the growth of mustard plant, while the casting fertilizer has low N level which is 1.323%. Nitrogen compounds are used to form amino acids that are converted into proteins which described in the following reactions:

Therefore nitrogen is needed for plants in relatively large quantities, especially during the vegetative growth period [7].

CONCLUSION

The quality of casting fertilizer which resulted from the combination of blotong media and soybean extract is fertilizer C with a ratio of 2:1 (Kg) which has N levels of 1.323%, P 2.076%, K 0.642% and C / N ratio of 23.023. Casting fertilizer C give an impact on height of mustard greens which is better than the variations without fertilizers and urea fertilizers, but it gives less leaf growth and less leaf area.

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