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Development of Quantity and Quality of Organic Granule Fertilizer Products in Home Industries

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ABSTRACT

This research is a development of previous research (2018) on the manufacture of granulated organic fertilizer. The purpose of this research is to make compost into organic fertilizer granules. To speed up composting, MOL is used. This study applied a factorial design with a factor of type of adhesive and a factor of the percentage of adhesive added. The adhesive consisted of 3 types, namely clay and molasses, while the comparison factor for the percentage of adhesive consists of 3 levels, namely 5%; 7.5% and 10%. Each treatment variation was replicated 5 times. The results showed that the bulk density was 0.4-0.6 g/cm3, the percentage of granule size was 70%-85%, water absorption was 29%-36% and the dispersion time was 13-22 hours. The levels of N = 3.48%-8.53%, P = 1.30%-2.03%, K = 0.03%-6.73% and C/N ratio = 12.92-20.45. Furthermore, it was concluded that the C/N ratio, N, P and K granules of organic fertilizer produced had met the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/Permentan/SR.140/10/2011.
Keywords: compost; granule organic fertilizer; granulator

INTRODUCTION

Granulated organic fertilizer is an organic fertilizer that is further processed to form granules. Granulated organic fertilizer is basically an organic fertilizer (compost) which is further processed so that it becomes granules or granules with the aim of making it easier for farmers to use [(1)]. In making compost, an inoculant is needed as a material to remodel microorganisms in the soil. Effective Microorganisms (EM) as biodecomposers are often used to ferment organic materials. Compost with cow dung activator and commercial organic fertilizer undergoes a longer decomposition process of 40 days, while EM4 works faster, which is about 20 days [(2)]. The longer the decomposition process, the lower the C/N ratio, the more opportunities for microorganisms to decompose the compost material. The greater the concentration of EM4, the greater the number of bacteria, so the material is decomposed more quickly by the bacteria [(3)].

The raw material for granulated organic fertilizer consists of 2 parts, namely the main raw material (80%-90%) in the form of compost and additional raw materials (10%-20%) as an adhesive, namely dolomite, natural phosphate, lime, xeolite, clay and molasses. The higher the percentage of adhesive material, the higher the value of bulk density, absorption, durability, and disintegration time of granulated organic fertilizer [(4)].

This study aims to design a granulator and its components, observe the process of processing waste into compost, then make granulated organic fertilizer.

METHODS

This experimental research was carried out by making compost into organic fertilizer granules, using a one-shot case study design, namely the research started from designing the granulator and its components, observing the process of processing waste into compost and then making organic fertilizer granules. More specifically, this study applies a factorial design with a factor of type of adhesive and a factor of the percentage of adhesive added.

The raw materials for granulated organic fertilizer are fertilizer/compost (biogas effluent, market waste, cow dung, chicken manure, husk charcoal, and wood sawdust). The adhesive consists of 3 types, namely clay, lime and tapioca flour; while the comparison factor of adhesive percentage consists of 3 levels, namely 5%; 7.5% and 10%. Each treatment variation was replicated 5 times. Furthermore, the resulting product is compared with the requirements according to the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/Permentan/Sr. 140/2011.

RESULTS

Compost as raw material for granulated organic fertilizer consists of 30% biogas effluent, 20% leaves, 10% cow dung, 10% chicken dung, and 30% husk charcoal). Next, a granular organic fertilizer machine is made which consists of a driving machine (5 PK) and a granulated organic fertilizer machine with a capacity of 0.45-0.9 kg/minute. The

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composting machine consists of a mechanic box suitcase which consists of two components, namely a driving machine (7 PK) and a box suitcase/garbage cutter. Compost as a granular organic fertilizer is processed in a granular organic fertilizer machine with the addition of clay adhesives, lime and tapioca flour. The advantages of compost compared to granulated or pellet fertilizer are that it does not generate dust, can prevent segregation, prevent plant overdose from sudden release of nutrients, and improve product appearance and packaging.

The results of the measurement of granular organic fertilizer parameters are: bulk density: 0.4-0.6 g/cm3, granule size percentage: 70%-85%, and dispersion time: 13 hours-22 hours. N content: 3.48%-8.53%, P: 1.30%-2.03%, K: 0.03%-6.73% and C/N ratio: 12.92-20.45.

Table 1. Results of chemical measurements of granulated organic fertilizer (POG) for parameters C/N, N, P and K

No	Sample	Levels								Requirement: N+P+K ≤4%
		N	Mean	P_2O_5	Mean	K_2O	Mean	C/N ratio	Mean	
1	Tapioca flour 5%	4.73	4.46	2.03	1.83	1.91	0.9	19.64		8.67
2	Tapioca flour 7.5%	4.57		2.03		0.74		20.45		7.34
3	Tapioca flour 10%	4.08		1.43		0.05		25.21		5.56
4	Clay 5%	5.85	5.48	1.57	1.45	0.83	0.33	17.83		8.25
5	Clay 7.5%	5.52		1.47		0.14		18.7		7.13
6	Clay 10%	5.07		1.31		0.03		21.42		6.41
7	Chalk 5%	8.53	6.03	2.03	1.77	6.73	5.54	11.29		17.28
8	Chalk 7.5%	6.08		1.98		6		15.58		14.06
9	Chalk 10%	3.48		1.3		3.9		12.92		8.68

DISCUSSION

Sources of organic waste from the research site are grass, sengon leaves, manga, umbrella tiara and other shrubs. Other raw materials are also used, namely: cow dung, chicken manure and husk ash. These materials are ground with a mechanical cutting box coper until smooth (≤ 2 cm) and ready to be made into compost with the composition of organic waste (10% biogas effluent, 10% market waste/leaf, 30% cow dung, 30% chicken manure, charcoal). husk 15%, and saw wood 5%). The supporting material used is dolomite drops/sugar; rice bran and EM4. Composting is carried out for 20-30 days, then processed into organic fertilizer granules at the Magetan Environmental Health Study Program campus, Health Polytechnic of the Ministry of Health Surabaya.

The use of adhesive materials is described as follows:

Clay

Wayan, et al. [4], reported that clay with a percentage of 11% was the most optimal treatment for the manufacture of granulated organic fertilizer. Granulated organic fertilizer with clay adhesive has a higher bulk density value than granulated organic fertilizer with molasses adhesive. This is because clay has a strong adhesion so that the particles making up the granules are denser, so that there are fewer air voids. The results also showed that the higher the percentage of adhesive material, the higher the bulk density, durability, and dispersion time of granulated organic fertilizer.

The results of another study on the concentration of clay adhesives for the manufacture of organic fertilizer granules from CPO mill effluent showed that from variations of clay adhesives 5%, 10%, 15%, and 20% by assessing the bulk density, the percentage of granule size (2-5 mm), durability value, water absorption value, dispersal time; The best quality of granulated organic fertilizer is on 20% clay adhesive [5].

Chalk

Lime commonly used for agriculture is called kaptan. The addition of lime is usually used to increase soil pH, especially in acid-reacting soils. Kaptan can be used to increase the pH of organic fertilizers, especially if the ingredients are acidic.

Tapioca flour

Granule or pellet fertilizer does not generate dust, can prevent segregation, prevent plant overdose from sudden release of nutrients, and improve product appearance and packaging. Organic compost and adhesives to be made into granules are filtered first to get fine and uniform particles. After getting the smooth material, then the raw materials and adhesive materials are mixed according to a predetermined percentage [4].

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Granulated organic fertilizer is an organic fertilizer which is further processed by mixing the main raw materials with additional raw materials/fillers, granulating, drying, cooling and filtering processes; to form a grain or granule. To improve the quality of granulated organic fertilizers, especially in terms of the abundance of functional microbes, granulated organic fertilizers are usually enriched with the addition of biological fertilizers. Currently, many organic fertilizers are further processed into granule organic fertilizers with the aim of making it easier to use and increasing efficiency. However, it should be noted that the process of making granule organic fertilizer must go through a drying process using a rotary dryer with a high temperature, which can kill functional microbes that naturally exist in granule organic fertilizer or other organic fertilizers that become raw materials for granule organic fertilizer, so that the population of functional microbes will decrease drastically. After that, the functional microbial population in the granule organic fertilizer was enriched again by adding biological fertilizer [(1)].

Organic compost fertilizer and adhesive materials to be made into granules are sieved first to obtain fine and uniform particles. After getting the smooth material, then the raw materials and adhesive materials are mixed according to a predetermined percentage. The next process is granulation which is repeated three times for each treatment. The granulation speed depends on the granulator machine. After the granulation process is complete, the next step is drying by drying directly in the sun. Drying continues until the water content of the material (granules) is 9%-12% [(4)].

One of the important factors in the manufacture of granules is the adhesive. Adhesive serves to glue the material to be made granules. Clay has a strong adhesion. The smaller granule particle size will increase the density value because the smaller particle size will fill the space or gap between the particles. Thus, the mass of the resulting granules becomes larger than the larger sized granules [(5)].

In addition, the adhesive can be in the form of molasses, which is one of the by-products of a sugar factory which has about 30% sucrose and about 25% reducing sugar, in the form of glucose and fructose [(6)]. Molasses can still be processed into several other products such as liquid sugar, food flavoring (MSG), alcohol and dry yeast for bread, single protein, animal feed, citric acid and acetic acid alcoho. So far, the fermentation medium that is often used for alginate production by both A. vinelandii and P. aerugionosa bacteria is synthetic media. Molasses is a by-product of the sugar industry which contains nitrogen compounds, trace elements and a fairly high sugar content, especially the sucrose content of around 34% and the total carbon content of about 37%.

The results showed that the greater the molasses content, the greater the compressive strength, impact resistance and density value of the sample. However, the higher the molasses content, the more difficult it is for the sample to disintegrate in water. The content of molasses is found in the content of 50% molasses [(6)].

The results of the study to form granules used adhesives of tapioca flour, clay, and gum arabica with 5% each. Analysis of moisture content and dispersion time were tested to determine the effectiveness of the adhesive. Biofertilizer (a substance used as soil fertilizer) in the form of granules with tapioca flour adhesive has a faster dispersion time so it is more effective to use than clay and gum arabica. After drying, tapioca flour adhesive has the highest moisture content of 20.6% [(7)].

Research shows that clay with a percentage of 11% is the most optimal treatment for the manufacture of granulated organic fertilizer. The results also showed that the higher the percentage of adhesive material, the higher the bulk density, durability, and dispersion time of granule organic fertilizer. The results of the variance test showed that the adhesive material had a significant effect on the percentage value of granule size (2-5mm) and dispersion time, but had no significant effect on the value of kamba density, water absorption, and durability [(4)].

Granular organic fertilizer from 3 adhesive formulas in this study measured the chemical parameters C, N, P, K and C/N ratio with reference to SNI/2004 and Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/2011 with the following results:

Nitrogen (N)

The use of adhesives either clay, lime or tapioca flour will make a difference in N in granulated fertilizer. Different types and concentrations of adhesives produce different N. The largest amount of N was in lime adhesive (5%) which was 8.53% and the smallest was 4.08% in the use of tapioca flour adhesive (10%).

There is an indication that the more adhesive is added (5-10%), the lower the N of the three adhesives, namely tapioca flour: 4.46%, clay: 5.48% and lime: 6.03%. This shows that the lime adhesive contributes the greatest total N.

Granular organic fertilizer which was given molasses adhesive had a higher N average than clay adhesive. Molasses contains high sucrose which contains organic C which is needed for the decomposition process in compost. N in granule organic fertilizer ranged from 5.1% - 6.1% [(8)]. This condition is still below the lime

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adhesive (8.53%). Oktaviana [9] reported that the use of cow dung, chicken manure in a ratio (1:3:1) without using adhesive produced a maximum of 2.73% N.

In the manufacture of compost as raw material for granule organic fertilizer, there is a breakdown of carbohydrates in the form of hemicellulose into CO_2 and H_2O or CH_4 and H_3, proteins will decompose into amides and amino acids which are then converted into NH_3, CO_2 and H_2O. Mineral nutrients from organic compounds break down into inorganic materials available in the form of ions, namely NH_4, NO_2 and NO_3 ions [10].

Nitrogen is one of the important parameters that must be present in compost, because nitrogen is needed to make up 1%-4% of dry matter (hard parts) of plants, such as stems, bark, and seeds. Nitrogen is taken from the soil in the form of nitrate (NO_3^-) or ammonium (NH_4^+), or in combination with carbohydrate metabolism compounds in plants in the form of amino acids and proteins. Nitrogen is also available in compost and manure in small amounts [11].

Phosphorus (P_2O_5)

The results showed that the phosphorus content (P205) ranged from 1.30%-2.03% for tapioca flour, clay and lime adhesives. The more use of each adhesive material (5%-10%), the lower the phosphorus content. The type of adhesive with the most phosphorus is tapioca flour. The greater the C/N ratio, the greater the phosphorus.

P is an important element in compost, because this element is the main nutrient for plant growth. The content of P elements is higher with the occurrence of weathering of composted organic matter. At the ripening stage the microorganisms will die and the P content in the microorganisms will mix in the compost material which will directly increase the phosphorus content (P_2O_5) in the compost. Phosphorus in plants functions in the formation of flowers, fruit and seeds, and accelerates fruit ripening. The quality of Granule Organic Fertilizer is influenced by the composting method, the quality of organic matter, temperature and the activity of microorganisms that decompose organic matter.

Potassium (K_2O)

The results showed that the highest potassium was produced from lime adhesive (5.54%), and this still met the requirements of SNI/2004, which was at least 0.20%. Thus, it can be concluded that if you want a large potassium (K_2O) content, it is necessary to use 5% lime adhesive instead of 10%. The biogas effluent in the compost which still contains EM increases the ripening process and potassium (K_2O). An increase in potassium is followed by a decrease in the C/N ratio. This indicates the activity of microorganisms that use potassium as a catalyst in the fermentation process.

C/N ratio

The results showed that the C/N ratio ranged from 13.26% to 21.77%, which means it still meets the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/2011 concerning the standard for granulated organic fertilizer, which is 15%-25%. C/N ratio is the ratio between carbohydrates (C) and nitrogen (N). From the results of this study the average C/N ratio of the use of tapioca flour adhesive = 21.77; clay = 19.15 and lime = 13.26. This shows that the C/N ratio of lime has not met the requirements but seen from the results of the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/2011 that the minimum N+P+K content is 4%, this figure still meets the requirements and even in this study the average score reached 13.34% more than clay adhesives and tapioca flour. The greater the lime adhesive (10%), the smaller the C/N ratio.

C/N ratio exceeding 20 indicates incompletely C oxidized to carbon dioxide (CO_2) and nitrogen is eliminated. This indicates an effective role of microorganisms in biogas effluent on compost maturation. The greater the concentration of EM4, the C/N ratio will decrease [13]. This is reinforced by the results of previous studies that the greater the concentration of EM4, the faster the decrease in the C/N ratio and the shorter the compost maturation time. This is due to the greater the concentration of EM4, the number of bacteria that break down the material is increasing so that the material is decomposed faster by the bacteria [3].

The C/N ratio gives an idea of whether or not the material is easily weathered, the level of maturity of the organic matter or the mobility of N in the soil. Soil with stable organic matter generally has a C/N ratio of about 10. Element C is used as energy for the life of microorganisms and element N is used for protein synthesis. If the C/N ratio is too high, the microbes will lack N for protein synthesis so that decomposition is slow.

Generally, the main problem in composting is at a high C/N ratio, especially if the main material is a material that contains a high wood content (saw wood residue, twigs, pulp, etc.). The given organic material generally has a high C/N ratio, therefore it is necessary to carry out a composting process that aims to reduce the C/N ratio. The process of decomposition of organic matter with a high C/N ratio will have an adverse effect on plants because it can reduce the availability of other nutrients, such as nitrogen available in the soil. The high

C/N organic matter causes competition between plants and microbes, so that plants will experience a decrease in nitrogen supply.

CONCLUSION

Based on the results of the study, it was concluded that granular organic fertilizer had been produced that met the requirements in the applicable regulations in agricultural regulations.

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