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Effect of Bokashi Fertilizer on Increasing Soil Nutrients and Growth of Medicinal Plants

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ABSTRACT

The purpose of this study was to analyze the effect of bokashi (Cow) fertilizer on increasing soil nutrients and the growth of medicinal plants (Biopharmaca). The research method was a completely randomized design (CRD) with 3 treatments which were repeated 3 times. The type of bokashi fertilizer is cow dung, while the medicinal plants used are ginger and turmeric. Data analysis was performed using ANOVA (Analysis of variance) and 5% F test to determine the effect of treatment. The research findings showed that the application of organic matter bokashi cow dung succeeded in increasing soil nutrients consisting of H_2O, C-Organic, P_2O_5, K_2O, and CEC along with the increase in the concentration of bokashi. Giving bokashi cow dung had a significant effect on plant height, the number of leaves, and bulb weight of Biopharmaca plants at 30 DAP and 60 DAP measurements. It was concluded based on the results of the study that goat and cow dung bokashi can be used to increase soil nutrients such as KCl, C-Organic, N-Total, P_2O_5, K_2O, and CEC. Besides, bokashi fertilizer can also be used for the growth of biopharmaceutical plants where plant height, number of leaves, and bulb weight of medicinal plants are indicators used.

1. INTRODUCTION

Medicinal plants (Biopharmaca) are one of the non-timber forest products provided by nature. However, these medicinal plants are often not used because people generally think that medicinal plants have no economic value since they only look like shrubs or grass. In addition, not everyone knows the efficacy of these medicinal plants [1]. Some medicinal plants also have economic value where they are usually exported, such as noni, bitter, god's crown, ginger, and turmeric. The Central Statistics Agency (2020) noted that Parigi Moutong Regency is one of the regions producing biopharmaceutical plants in Central Sulawesi. Medicinal plants in the district are rhizome plants. The harvested area of biopharmaceuticals in Parigi Moutong Regency has increased from the harvested area of 9.21 Ha in 2018, increasing to 11.43 Ha in 2019.

The land is planted with plants such as Ginger (3.83 Ha), Galangal (2, 60 Ha), Sand Ginger (1.13 Ha), and Turmeric (3.86 Ha) [2]. Based on field observations and data from BPS (2020), it is known that the yield of medicinal plants (biopharmaceuticals) in 2019 in Tinombo District, Parigi Moutong Regency continues to increase. One of the reasons for this increase is the adequate soil quality so that the growth needs of medicinal plants (biopharmaceuticals) are met. However, this good soil condition tends to decline if it is not managed properly. Therefore, efforts to develop medicinal plant areas (biopharmaceuticals) in Tinombo Sub District, Parigi Moutong Regency should be carried out. The goal is to increase crop yields every year so that it can become an export product from Parigi Moutong Regency. The export of these plants will improve the economic conditions of farmers.

Previous research has shown that land in Tinombo District, Parigi Moutong Regency, Indonesia needs to be made efforts to improve land quality in order to develop plant potential and have an impact on improving the socio-economic status of farmers, especially medicinal plants (Biopharmaca) [3]. One of the efforts that can be done is by utilizing bokashi which is sourced from cow dung. This is the main choice for researchers because in this area every farmer has several cows and there are even cattle breeders so this can be used by medicinal plant farmers to use the waste from cow dung to be used as bokashi.

Bokashi is an organic fertilizer that is easy to make at home because this fertilizer is the result of fermentation of several organic materials such as straw, husks, rice bran, corn bran, wheat bran, rice husks, tofu dregs, coconut dregs, recycled waste, grass and animal waste [4]. These materials are fermented using an activator of microorganisms known as effective microorganisms (EM) to accelerate the fermentation process. The benefits of bokashi fertilizer are to restore soil fertility through improving soil properties (physical, chemical, or biological), accelerating and facilitating the absorption of N by plants, and preventing the emergence of nuisance plants [4].

This study aims to analyze the effect of bokashi (Cow) fertilizer on increasing soil nutrients and the growth of medicinal plants (Biopharmaca).

2. METHOD

2.1 Research type

The type of this research is an experimental research design using a completely randomized design (CRD) with 3 treatments which were repeated 3 times. CRD is a design with several treatments arranged randomly for all experimental

units. The advantages of using CRD are: (1). The experimental design plan is easier, (2). Statistical analysis of experimental subjects is very simple, (3). Flexibility in the use of the number of treatments and the number of replications. The type of bokashi fertilizer used was cow manure. The types of medicinal plants used were ginger and turmeric.

2.2 Time and research site

The research was carried out from March 2021 to November 2021. The research took place in the experimental field of the Faculty of Agriculture Tadulako University using soil samples from Tinombo Sub District, Parigi Moutong Regency. The size of the site used for the experiment is 15×25 meters.

The study used a split-plot design. As the main plot, the dose of soil ameliorant was given to each medical plant (TO) (Table 1).

Table 1. Dosage and medicinal plants

Distribution Dose (D)	Medicinal Plants (TO)	
	Ginger (TO I)	Turmeric (TO II)
D1	0 ton ha^{-1}	0 ton ha^{-1}
D2	10 ton ha^{-1}	10 ton ha^{-1}
D3	20 ton ha^{-1}	20 ton ha^{-1}

First Factor Bokashi Cow Manure With 3 Treatment Doses: (1). D1 0 ton/ha equivalent to 0 g bokashi/8kg soil/polybag; (2) D2 Dosage 10 tons/ha equivalent to 26 g bokashi/8kg soil/polybag; (3) D3 Dosage 20 tons/ha equivalent to 52 g bokashi/8kg soil/polybag. The second factor is the type of biopharmaceutical plant with 2 types, namely: Ginger and Turmeric (Table 1). It is hoped that giving 10 kg/ha it can have an effect on improving the physical and chemical properties of the soil so that indicator plants can show better results than without Bokasi fertilizer (D1) and Bokasi D3 is expected to have a growth effect due to improving the physical and chemical properties of the soil. maximum growth of average growth.

As a sub-plot, one type of organic soil enhancer is cow manure. Each experiment was repeated 3 times. The materials used in this study were EM4, sugar, washing water, fine bran, sawdust, delomite, market waste, cow manure, rice water, and whole and incomplete soil samples taken from each experimental unit. The methods and steps for soil improvement: 1) Land preparation; 2) Bokasi fertilizer; 3) Basic Fertilizer; 4) Water for watering; 5) Temporary Protection before environmental adaptation; 6) Weed Weeding.

The parameters observed in the observation of the growth of medicinal plants were plant height, number of leaves, and weight of bulbs.

2.3 Data analysis

Data analysis was performed using ANOVA (Analysis of variance) and a 5% F test to determine the effect of treatment. ANOVA test is a special form of statistical analysis used in experimental research. ANOVA is used as an analytical tool to test research hypotheses which assess whether there is a difference in means between groups.

3. RESULTS & DISCUSSION

3.1 Effect of bokashi (Cow) fertilizer on increasing soil nutrients

Table 2 shows that the H_2O content was higher in the soil treated with cow dung bokashi, 7.24 – 7.28 with concentrations of 20 tons/ha and 30 tons/ha. The C-Organic content (%) was higher in the soil given bokashi cow dung, 1.05% with a concentration of 30 tons/ha. The content of K2O (mg/100g) was also found to be higher at a concentration of 30 tons/ha, namely 49.23 mg/100. Figure 1 shows that the plant height of ginger and turmeric was higher in groups 2 and 3 at the 60 DAP measurement. In addition, the results of the One Way Anova test showed that bokashi with a concentration of 30 tons/ha had better plant height than the other groups.

Figure 2 shows that the number of leaves of ginger and turmeric plants was more in groups 2 and 3 at 60 DAP measurements. Meanwhile, the One Way Anova test showed that bokashi with a concentration of 30 tons/ha had more plant leaves than the other groups.

Figure 3 shows that the heavier ginger and turmeric root weights were found in group 1 at 60 DAP measurements. One Way Anova test showed that bokashi with a concentration of 30 tons/ha had a heavier plant bulb weight than the other groups.

The organic material used in this study was cow dung bokashi. The findings showed that increasing the concentration of cow dung bokashi was able to increase soil nutrients. The utilization of organic matter aims to fertilize the soil. Compost is a rich source of macro and micronutrients that play a role in supplying nutrients for plant growth and improving soil structure and fertility [5]. Organic fertilizer in the form of compost is a suitable source of nutrients to increase soil fertility [6]. The application of organic matter (bokashi) can improve soil structure so that the soil becomes easier to cultivate where the capacity to hold water also increases. In this case, the ability of the soil to provide water will result in more water retention and better soil permeability [7, 8]. Bokashi can reduce permeability on coarse-textured soils and increase permeability on very soft-textured soils [9].

Table 2. Effects of bokashi fertilizer on soil nutrients, BS (Bokashi)

No	Sample Code	pH (1:2.5)		C-Organic (%)	N-Total (%)	P_2O_5 (mg/100g)	K_2O (mg/100g)	KTK (cmol (+) kg^{-1})
		H_2O	KCl	Walkley & Black	Kjedhal	Extract HCl 25%	Extract HCl 25%	Extract HCl 25%
	Distribution of Cow Dung Bokashi							
1	BS 0 (Control)	6.91	6.87	0.85	0.11	50.29	38.14	17.66
2	BS 1 (10 Ton/Ha)	7.21	7.17	0.90	0.13	54.30	40.74	22.02
3	BS 2 (20 Ton/Ha)	7.27	7.01	0.92	0.14	55.18	42.27	22.50
4	BS 3 (30 Ton/Ha)	7.28	6.91	1.05	0.17	55.27	49.24	22.72

Giving bokashi fertilizer from cow dung is one way to overcome the lack of nutrients and organic matter in the soil so that it can support the growth of medicinal plants, in this case, ginger and turmeric. The growth indicator used to measure the effectiveness of the treatment given is plant height [10]. The results of observations made every day showed an increase in the height of biopharmaceutical plants 60 DAP for all treatments. Plant production is influenced by vegetative growth [11]. The most important nutrient in plant vegetative growth which is characterized by leaf growth is nitrogen [12]. Nitrogen plays a role in stimulating the vegetative growth of plants as a whole, especially the growth of roots, stems, and leaves [13].

Several studies indicate the use of Bokashi of cow manure, namely: bokashi of cow manure treatment at dose of 3 t ha^{-1} combined with NPK inorganic fertilizer application of 200 kg ha^{-1} can reduce the evaporation rate and soil temperature fluctuation, and also increase the yield of shall [7], the addition of cow dung as the organic fertilizer as much as 1 ton/ha to the soil could cause an increase in the yield of grain by 0.097 ton/ha [14], the treatment of 15 t ha^{-1} cow manure accompanied by 225 kg ha^{-1} N-fertilizer gives a highest plant height than the other treatments and providing bokashi cow manure can increase the fruit length per plant, which is higher and significantly different compared to the control [15].

The increase in the size of the plant body as a whole is the result of the increase in the size of the plant organ parts due to the increase in cell tissue produced by the increase in cell size. These physiological processes are influenced by environmental factors such as sunlight, soil, wind, and weather. Planting media, in this case, tailings, also greatly affect plant growth in terms of nutrient availability, water availability, media weakness (affecting oxygen availability), and root movement and penetration. Plants at a young age tend to show rapid upward growth (vertical) where the diameter growth will be met if the needs of photosynthesis for respiration, leaf change, and root change have been met.

The growth of the number and size of leaves is influenced by the availability of nutrients. The number of leaves that increase in plants is due to the adequate supply of nutrients in the plant [16]. The availability of nutrients in sufficient and balanced quantities will encourage the process of cell division, enlargement, and elongation to take place properly so that plant organs will grow faster [17]. Giving cow dung bokashi adequate and appropriate doses can contribute C-Organic, N, P_2O_5, K_2O, and CEC nutrients. Plants that are adequately supplied with N will form leaves that have wider strands with a higher chlorophyll content so that plants can produce sufficient carbohydrates or assimilate to support plant vegetative growth [18]. Bokashi cow dung is more quickly absorbed by plants [19, 20].

Lack or excess of nutrients will adversely affect plant growth. The effect of inappropriate fertilizer application, including the application of fertilizer with a concentration that is too high, causes plants to become stressed so that the physiological process of plants is disrupted [21]. Nutrients absorbed by plants will be utilized for various metabolic processes that will maintain plant physiological functions. Whether or not the physiological activity of plants is determined by the dry weight of the plant. Dry weight is a measure of growth and development that reflects the accumulation of organic compounds that have been successfully synthesized by plants. The dry weight of the plant is the result of the accumulation of carbohydrates which is the result of photosynthesis. Furthermore, it can be said that if the physiological processes that occur in plants run well and are supported by the application of efficient fertilization, the dry weight of the plant will also increase. The application of bokashi fertilizer has a significant effect on plant growth and fruit weight compared to the use of other animal manure fertilizers [4]. Microorganisms and organic compounds in bokashi fertilizer have an effect on increasing nutrients so that they support plant growth [4]. The application of bokashi livestock could potentially reduce the use of inorganic fertilizers while maintaining higher yield [22] and application of irrigation duration 0.5 - 1 hour and addition of organic fertilizer 15 t.ha^{-1} could increase soil moisture so it can growth, yields, and quality of shallot [23].

3.2 Effect of bokashi fertilizer (Cow) on the growth of medicinal plants (Biopharmaca)

Ginger and Turmeric Plant Height (cm) at 60 DAP Measurement:

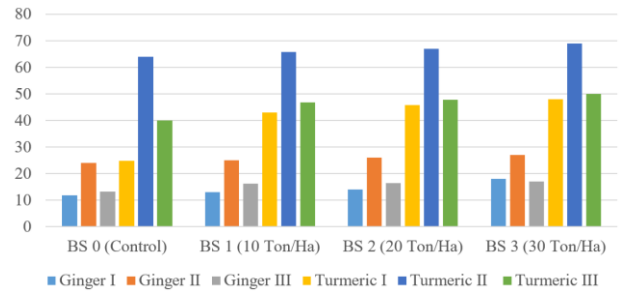

Figure 1. Effect of bokashi fertilizer (Cow) on ginger and turmeric plant height (cm)

3.3 The number of ginger and turmeric's leaves plants (strands)

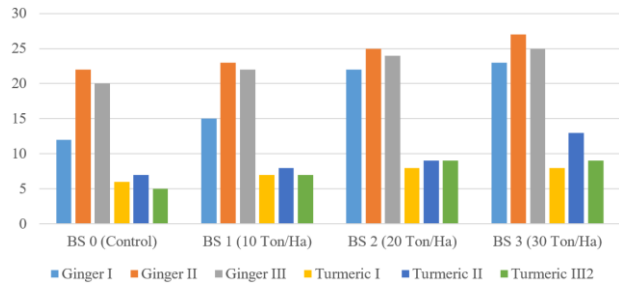

Figure 2. Effect of bokashi fertilizer (Cow) on the number of leaves of ginger and turmeric plants (strands)

3.4 Weight of ginger and turmeric bulbs (Gram)

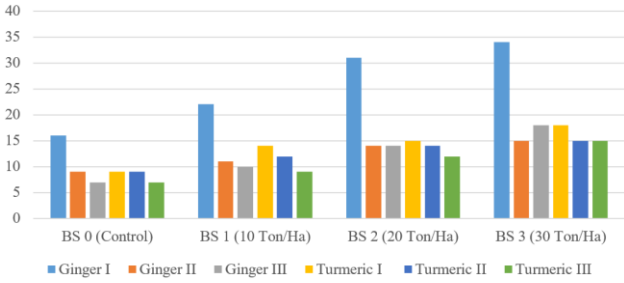

Figure 3. Effect of bokashi fertilizer (Cow) on weight of ginger and turmeric plant bulbs (gram)

4. CONCLUSIONS

The application of organic matter bokashi cow dung was found to be able to increase soil nutrients such as KCl, C-Organic, N-Total, P_2O_5, K_2O, and CEC along with the increase in the concentration of bokashi in cow dung. Giving bokashi cow dung had a significant effect on plant height, the number of leaves, and the weight of bulbs of Biopharmaca plants at 60 DAP measurements.

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