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THE EFFECT OF BOKASHI OF SHALLOT STRAW FERTILIZER TO THE GROWTH AND YIELD OF SHALLOT (Allium ascalonicum L.*) CV. BIMA*

PENGARUH PUPUK ORGANIK BOKASHI BRANGKASAN BAWANG MERAH TERHADAP PERRTUMBUHAN DAN HASIL BAWANG MERAH (*Allium ascalonicum* L.) KULTIVAR BIMA

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ABSTRACT

Shallot waste, in the form of stover, is often a problem at shallot marketing locations. To overcome this problem, stover can be further processed into bokashi compost. This study examines the effect of bokashi compost doses on shallot plants. The experiment was conducted in Silihasih Village, Babakan District, Cirebon Regency, from August to October 2021. A randomized complete block design (RCBD) was used to test the effect of shallot bokashi doses (0, 10, 20, 30, 40, 50, and 60 t ha^{-1}) on shallot growth and yields. The observed growth variables were plant height, number of leaves and shoots per clump, root volume, shoot-to-root ratio, and plant growth rate. The observed yield components and yield variables were bulb diameter, fresh bulb weight per clump and per plot, and dry bulb weight per clump and per plot. The statistical analysis used was analysis of variance with post hoc Duncan's Multiple Range Test. The results showed that shallot stover bokashi can increase shallot growth and yield. Shallot stover bokashi of 20 and 60 t ha^{-1} produced higher dry weight of bulbs per plot than other treatments, namely 3.22 and 3.16 t plot^{-1}.

ABSTRAK

Limbah bawang merah, berupa brangkasan, seringkali menjadi masalah di lokasi pemasaran bawang merah. Untuk mengatasi permasalahan tersebut, brangkasan dapat diproses lebih lanjut menjadi kompos bokashi. Penelitian ini mengkaji pengaruh dosis kompos bokashi terhadap tanaman bawang merah. Percobaan dilakukan di Desa Silihasih, Kecamatan Babakan, Kabupaten Cirebon mulai Agustus sampai Oktober 2021. Rancangan acak kelompok (RAK) digunakan untuk menguji pengaruh dosis bokashi bawang merah (0, 10, 20, 30, 40, 50, dan 60 t ha^{-1}) terhadap variabel pertumbuhan, variabel hasil, dan hasil bawang merah. Variabel pertumbuhan yang diamati tinggi tanaman, jumlah daun dan anakan per rumpun, volume akar, rasio pucuk akar, dan laju pertumbuhan tanaman. Variabel komponen hasil dan hasil yang diamati diameter umbi, bobot umbi segar per rumpun dan per petak, serta bobot umbi kering per rumpun dan per petak.Analisis statistik yang digunakan adalah analisis varians dengan post hoc Uji Jarak Berganda Duncan. Hasil penelitian menunjukkan bokashi brangkasan bawang merah dapat meningkatkan pertumbuhan dan hasil bawang merah. Bokashi brangkasan bawang merah 20 dan 60 t ha^{-1} menghasilkan bobot kering umbi per petak yang lebih tinggi dibanding perlakuan lainnya, yaitu 3,22 dan 3,16 t petak^{-1}.

KATA KUNCI:

Bawang merah, bima, brangkasan, bokashi

1. INTRODUCTION

Shallot is a horticultural commodity with high economic value. Its important function as a cooking spice makes shallots a commodity that is difficult to replace by others (Kustiari, 2018). In the Cirebon region, West Java, shallots are cultivated intensively and are capital-intensive. Farmers use artificial fertilizers and pesticides over recommended doses, for fear of crop failure (Bahar, 2016). This excessive use of fertilizers causes land quality to decrease (Hakim and Anandari, 2019).

The addition of organic material is an alternative to solving the problem of decreasing land quality (Bahrudin *et al*., 2019; Lasmini *et al*., 2018). Organic materials that are often used are compost. Compost is nutrient-rich material as a result of the decomposition of organic materials, including agricultural waste. Agricultural waste that can be used to make compost includes shallot stover. Shallot stover is shallot leaves that are thrown away when traders want to sell their shallots. Farmers harvest shallots, including all parts of the plant, and then sell them after drying them without removing the dried leaves. However, shallot sellers will sell shallots in granular form that have been cleaned of dry leaves.

Bokashi is a technique for making compost by adding effective microorganisms commonly known as EM4 (Ginting, 2019). With this bokashi technique, the composting process can be accelerated from 3 months to only 3 weeks (Olle, 2021). The resulting compost has better quality than conventional composting (Azhar Abdul Razak et al., 2024). The materials used to make bokashi are very diverse, such as straw (Muliarta *et al*., 2019), soybean stover (Cahaya *et al*., 2021), coffee peel (Tumangger *et al*., 2017), fruit peel (Masulili *et al*., 2023), and fresh leaves (Frona *et al*., 2016). Apart from the materials used, the type of decomposer used also affects the composting speed and quality of the bokashi compost (Muliarta *et al*., 2019).

Bokashi is known to have a good influence on soil structure (Manhounou et al., 2024; Phooi *et al*., 2022), quickly releases nutrients, and can control several pests and soil-borne diseases *(Bócoli et al*., 2020). The use of bokashi has been proven to suppress the attack of stem rot disease caused by *Sclerotium rolfsii* on soybean plants (Gusnawaty *et al*., 2020). The use of bokashi can reduce the use of inorganic fertilizers (Indriani and Eliyatiningsih, 2021) thereby reducing farming costs. On post-mine sandpits soil, the provision of 9 t ha^{-1} of *Thitonia diversifolia* bokashi can increase soil porosity and permeability as well as increase the diameter of the bulbs and the weight of the shallots (Hidayat *et al*., 2024). In true shallot seed, 2.5 kg m^{-2} of bokashi gave results that were not significantly different from 5.0 kg m^{-2} (Zulfahmi *et al*., 2023).Shallot stovers are not widely used as sources of organic materials for making bokashi. Bokashi shallot stovers can be an alternative organic fertilizer for shallot cultivation. It is hoped that by using shallot stover bokashi, the growth, and yield of shallots will increase because the soil quality will be better. This study aimed to determine the effect of shallot bokashi dosage on the growth and yield of the shallot cv. Bima Brebes. This cultivar was chosen because it is most widely cultivated in the Cirebon region and its surroundings.

2. MATERIALS AND METHOD

2.1. Location, Time, and Materials

The experimental location is in Silih Asih Village, Pabedilan District, Cirebon Regency. The experiment runs from October to December 2021. The materials used were shallot bulb cv Bima, shallot stover, manure, rice fine bran, rice husk charcoal, EM4, sugar, and other materials that support this research.

2.2. Experimental Design

The research was designed in a randomized complete block design. The treatment was the dose of shallot stover bokashi with seven treatment levels, namely: 0, 10, 20, 30, 40, 50, and 60 tons ha^{-1}. All treatments were repeated four times, resulting in 28 experimental units.

2.3. Experimental Procedure

The first stage in this study was the manufacture of shallot stover bokashi referring to Cahaya *et al*. (2021). The materials used were 90 kg of shallot stover, 10 kg of goat manure, 20 kg of rice husk charcoal, 10 kg of rice bran, 50 g of brown sugar, 200 mL of EM4 solution. and 10 L of water. The shallot stover was finely chopped then mixed with goat manure, rice husk charcoal, and rice bran. Brown sugar was dissolved in water and mixed with EM4. The EM4 solution was poured onto the shallot stover mixture and stirred evenly. The mixture was then covered with a tarpaulin and fermented for 14 days. Every three days the mixture was turned over to lower the temperature. After 14 days the bokashi was ripe with the characteristics of being brown and having a fresh aroma. Bokashi is ready to use.

Soil tillage is done twice by hoeing. The first tillage is done 14 days before planting to loosen the soil and control weeds. The second tillage is done 7 days before planting. In the second tillage, a trial plot is made of 1 m x 1.5 m, and as many as 28 plots are made. Bokashi application is also carried out during the second l and processing by sprinkling it on the soil's surface and stirring it with a hoe. The dose of bokashi depend on the treatment. Planting is done by placing a seed in the hole and then covering it with soil. The plant spacing used is 15 cm x 20 cm. Seeds are replanted 7 days after planting (DAP). Plant maintenance is carried out according to that carried out by local farmers. Harvesting is done at 45 DAP by uprooting the entire plant.

Observations were made on the following variables: plant height, number of leaves per clump, number of tillers per clump, root volume, and root shoot ratio at 45 days after planting. A relative growth rate was calculated at 35-45 days after planting. The observed yield components were bulb diameter, fresh bulb weight per clump and plot, and dry bulb weight per clump and plot.

2.4. Data Analysis

Analysis of variance is used to analyze experimental data, and the Duncan Multiple Range Test is then applied at the 5% level.

3. RESULTS AND METHODS

3.1 Soil and Bokashi Analysis

The results of the analysis of shallot stover bokashi showed a C/N ratio of 13, pH (H_2O) 8.2 and pH (KCl) t of 7.8 ,, N-total 1.38% (high), P_2O_5 0.84% (medium), K_2O 2 .08% (very high), SiO_2 (coarse silica) 28.0%, N-NH_4 0.05%, N-NO_3 0.21%, CaO 12.04% (very high), MgO 0.91 (high), S 0.32%, Na 0.33%, Fe 11968 ppm, Mn 434 ppm (medium), Cu 16 ppm, Zn 88 ppm, B 35 ppm (medium), and Al 10.772 ppm.

The soil analysis showed that the experimental site had a soil pH of 6.0 (slightly acidic), with an organic matter content of 1.24 (low), N-total 0.14% (low), P_2O_5 90.8 ppm (high), K_2O 219 ppm (high), Ca 25.18 cmol(+)/kg (moderate), Mg 8.16 cmol(+)/kg (high), Na 0.16 cmol(+)/kg (low), and a cation exchange capacity of 37.00 cmol/kg. The experimental land contained sand (23%), dust (49%), and clay (28%), so that the soil texture was sandy clay dust.

3.2. Growth Variables

The results of variance analysis show that bokashi significantly affects plant height, number of leaves per clump, root volume, shoot-to-root ratio, and plant growth rate, but not the number of leaves per clump (data not shown). Plant height, number of tillers per hill, and root volume in the bokashi treatment differed significantly from the control (0 tons ha^{-1}). Increasing the bokashi dose to 30 tons ha^{-1} increased these three variables, but subsequent increases in the dose did not have a different effect (Table 1).

The results of other research show that bokashi (Dilli Novianto and Alwi Husen, 2021; Efendi, 2010) and cow manure (Hakim and Anandari, 2019) do not significantly affect shallot growth but have a significantly effects on shallot yield. Bokashi Tithonia significantly affects K uptake, plant dry weight, and shallot bulb weight (Putra *et al*., 2013). Bokashi soybean stover significantly affects the growth and yield variables of shallot plants (Cahaya et al., 2021). The results of this study indicate that bokashi derived from various materials can increase the growth and yield of shallots both through growth variables and directly to yield. Pereira *et al*. (2022) showed that bokashi derived from different materials has the same physical properties, but the nutrient content is different.

Bokashi shallot stover increased the number of tillers but not the number of leaves. The number of tillers in the bokashi treatment was greater than that in the treatment without bokashi. Both plant height and number of tillers increase with the bokashi dose, up to 30 t ha^{-1}. The addition of bokashi dose did not increase plant height and number of tillers. In terms of root volume, application of bokashi increased it, but root volume was not significantly different across bokashi doses. The results of this study are different from the results of previous research, where a bokashi dose of taro leaves of 10 t ha^{-1} produced a greater number of leaves compared to other doses (Asie *et al*., 2020). Bokashi application can increase soil fertility because it can increase organic carbon in the soil and increase the activity of N and P-fixing bacteria (Lasmini *et al*., 2018).

Table 1. Growth variable of shallots given different doses of shallot stover bokashi.

Treatment	Plant height (cm)	Number of leaves per clump	Number of tillers per clump	Root volume (mL)
0 tons ha^{-1}	33.89 d	24.20	6.05 c	0.75 b
10 tons ha^{-1}	35.63 cd	27.30	7.58 abc	2.25 a
20 tons ha^{-1}	38.63 bc	28.75	7.05 bc	2.25 a
30 tons ha^{-1}	42.45 a	33.40	8.85 a	1.00 ab
40 tons ha^{-1}	39.50 ab	27.40	8.15 ab	1.00 ab
50 tons ha^{-1}	41.80 ab	33.23	8.03 ab	2.25 a
60 tons ha^{-1}	42.64 a	34.03	8.50 ab	1.50 ab

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range tests at the 5% level.

Table 2. Shoot-root ratio and plant growth rate are given different doses of shallot stover bokashi.

Treatment	Shoot-to-root ratio	Plant growth rate at 35-45 DAP (g day^{-1})
0 tons ha^{-1}	126.07 a	0.45 ab
10 tons ha^{-1}	220.37 abc	1.33 c
20 tons ha^{-1}	174.31 ab	0.40 a
30 tons ha^{-1}	233.04 abc	0.40 a
40 tons ha^{-1}	190.41 abc	0.33 a
50 tons ha^{-1}	328.95 c	045 ab
60 tons ha^{-1}	366.65 c	1.03 bc

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range tests at the 5% level.

Bokashi application significantly increased the shoot-to-root ratio (Table 2). The nutrients provided by bokashi are used more to support the growth of the plant's top compared to the roots. so that the shoot-to-root ratio increases in line with the bokashi dose. Shallots have shallow fibrous roots. The shallot bulb is the base of the leaf that undergoes modification as a food reserve tissue. Shallot stems are small discs at the base of the bulb. Therefore, the root part is smaller than the leek part. The addition of organic carbon to the rhizosphere serves as a source of energy for microorganisms, which in turn provides nutrients for plants (Husen *et al*., 2021).

Plant growth rate (35-45 DAP) was significantly affected by the bokashi dose (Table 2). The growth rate in the 10 t ha^{-1} bokashi dose treatment was significantly higher than in the no-bokashi treatment, but was the same as 60 t ha^{-1}. This indicates that the provision of 10 t ha^{-1} bokashi was sufficient to increase the plant growth rate. At a dose of 20-50 tons ha^{-1}, the growth rate did not differ significantly from the treatment without bokashi. This is thought to be because, at the age of 35-45, DAP bulbs have begun to form so the growth rate has begun to slow down.

3.3. Yield Component and Yield Variables

All yield components and yield variables are significantly affected by bokashi dosages (Table 3). Shallot bulbs yield increased with increasing bokashi dosage, up to 40 tons ha^{-1}. After that, adding bokashi did not increase the bulb's size. The weight of fresh bulbs per hill increased along with increasing bokashi dosage as well as the weight of dry bulbs per hill. However, in the weight of fresh bulbs and dry bulbs per plot, the increase occurred only up to a dose of 20 tons ha^{-1}. Further addition of bokashi did not increase tuber weight per plot. This is because applying bokashi to the soil can increase the nutrient content. Increasing this nutrient content can not only increase plant growth and yield but also increase soil microbiological activity, which in turn will increase nutrient availability for plants (Wenneck *et al*., 2023). Adding bokashi to the soil also enriches oil microbes, which have a positive effect on the biological properties of the soil (Luo *et al*., 2022).

In other research, it was found that cow manure bokashi can increase the number of leaves and the bulb's fresh weight per plant (Ansar *et al*., 2021). In onions, bokashi can increase bulb diameter and weight, and soluble solids (Álvarez-Solís *et al*., 2016), because bokashi can increase water availability for plants (Wenneck *et al*., 2023). Bokashi chicken manure combined with Trichoderma and biological fertilizer significantly increased sweet corn yields (Permayani *et al*., 2020). However, increasing shallot production must be done in an integrated manner between organic fertilizer, inorganic fertilizer, and biofertilizer, combined with good water management (Askari-Khorasgani and Pessarakli, 2020).

Table 3. Yield component and yield variables given different doses of shallot stover bokashi.

Bokashi dosage	Bulb diameter (cm)	Bulb fresh weight per clum (g)	Bulb fresh weight per plot (kg)	Bulb dry weight per clum (g)	Bulb dry weight per plot (kg)
0 tons ha^{-1}	24.10 a	57.80 a	3.05 ab	45.30 a	2.54 ab
10 tons ha^{-1}	25.09 ab	63.45 ab	2.97 a	48.75 a	2.42 a
20 tons ha^{-1}	27.05 abc	73.05 bcd	3.72 c	58.40 bc	3.22 c
30 tons ha^{-1}	28.66 bc	76.05 bcd	3.55 abc	62.05 bc	3.05 bc
40 tons ha^{-1}	30.17 c	69.15 abc	3.22 abc	54.20 ab	2.75 abc
50 tons ha^{-1}	26.10 ab	82.20 cd	3.61 bc	63.10 bc	3.06 bc
60 tons ha^{-1}	27.66 abc	84.65 d	3.68 c	67.25 c	3.16 c

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range tests at the 5% level.

4. CONCLUSIONS

Bokashi of shallot stover significantly affected all growth variables, except the number of leaves per cluster. Shallot stover bokashi also significantly affected all yield component variables. Bokashi doses of 20 tons ha^{-1} and 60 tons ha^{-1} yield the highest average bulb dry weight per plot, namely 3.22 kg plot-1 and 3.16 kg $plot^{-1}$, equivalent to 17.17 tons ha^{-1} and 16.85 tons ha^{-1}. In shallot cultivation, it is recommended to use shallot stover bokashi at a dose of 20 tons ha^{-1}.

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