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Added Value of Organic Waste as A Natural Fertilizer in Increasing the Growth and Production of Shallots

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ABSTRACT

Organic waste such as household, agricultural, and animal waste can be composted. Composting technology works when mixed with micronutrients to produce waste. Compost is divided into two parts, namely the active part and the solid part. Increasing the growth of shallot production can be done through good farming methods, such as replacing artificial fertilizers with organic fertilizers in the form of liquid and liquid organic fertilizers. This study is factorial in the form of a Factorial Randomized Block Design (FRBD) with 2 replications and 2 factors, the first factor is the provision of natural solid fertilizer (P) doses in 4 levels P0 = 0 kg/plot, P1 = 1.5 kg/plot, P2 = 2.5 kg/plot, P3 = 3.5 kg/plot. The second factor, the provision of natural fertilizer water (C), has 4 levels, namely C0 = 0 ml/liter of water/plot, C1 = 250 ml/liter of water/plot, C2 = 500 ml/liter of water/plot, C3 = 750 ml/liter of water/plot.. The parameters observed were plant height, number of tillers, diameter of shallots, wet shallot production, dry shallot production and conversion of shallot production per hectare. The results of radiological analysis showed that the provision of solid and liquid fertilizers from a mixture of organic waste had a significant effect on plant height in years 4, 5 and 6 MST, the number of spikes at the age of 5, 6 years. and 7 MST, bulb diameter, wet bulb production, dry bulb production, conversion of potato production per hectare. The combination of solid natural fertilizer and water did not have a significant effect on all the parameters observed. The best treatment was the provision of solid fertilizer at a dose of 3.5 kg per plot (P3) and liquid fertilizer at a dose of 750 ml per liter of water per plot (C3).

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1. INTRODUCTION

In recent years, there has been a shortage of chemical fertilizers and the high price of fertilizers that must be purchased by shallot farmers, resulting in a decline in shallot production, and automatically the selling price of shallots at the consumer level has also increased. Researchers are looking for a solution by utilizing organic waste or garbage as organic fertilizer by using fermentation technology to decompose organic waste into organic fertilizer as an alternative to the scarcity of chemical fertilizers (RRI. Co.Id - Endarmy Sorot Kelangkaan Pupuk Subsidi, 2024.)

Organic waste is defined as materials discarded in the household and agricultural sectors such as rice straw, corn straw, soybean straw, peanut straw, livestock manure, coconut fiber and shells, rice bran, and the like (Hakim et al. , 2023). Agricultural waste is divided into pre-harvest waste, harvest waste, and post-harvest waste. Furthermore, post-harvest waste can be classified into waste before and after processing or agricultural industrial waste (Simarmata et al. , 2019). Composting technology to convert agricultural waste and urban organic waste into natural fertilizer (compost) has developed rapidly. Aerobic and anaerobic composting on a small or industrial scale can be used to produce organic fertilizer or organic ameliorants to improve soil fertility, and fertilization efficiency and increase crop productivity sustainably (Hakim et al. , 2022)

Effective utilization of organic waste will reduce the use of inorganic fertilizers and encourage sustainable environmentally friendly agriculture. In addition, agricultural waste can be used as raw material to produce bioenergy (biogas), food-growing media, and animal feed (Sekaringtyas Ramadhani et al. , 2022). Composting is the controlled conversion of biodegradable organic products and waste into stable products with the help of microorganisms. Composting is a long-standing technology, although some drawbacks have reduced its extensive use and efficiency (Lubis et al. , 2022). Composting is an aerobic microbiological process facilitated by bacteria and fungi, and it is also a method for producing fertilizer or soil conditioner. Processing of increasing amounts of household organic waste before final disposal (Zamriiti et al., 2021). Nitrogen (N) nutrients are good for accelerating plant growth (number of leaves), and making plants greener, and phosphorus nutrients are useful for helping the absorption and respiration processes in leaves, and participating in the respiration, photosynthesis, and nutrition processes. Magnesium (K) is useful for helping to make protein from carbohydrates, and strengthening plants to prevent leaf fall (Yosephine et al., 2021). Liquid organic fertilizer is a fertilizer resulting from the fermentation process of various types of organic waste materials containing phytohormones, amino acids, and vitamins that are beneficial for plants (Sumini et al., 2021). Organic fertilizers derived from animal waste, especially livestock such as chickens, goats, and cows, have complete nutrient content when fermented to make solid organic fertilizers (Yosephine et al., 2021). Liquid organic fertilizer is a fertilizer produced from the fermentation process of various organic wastes, containing phytohormones, amino acid,s and vitamins that are useful for plants (Sumini et al., 2021). Manure from animal waste, especially animals such as chickens, goats and cows, is rich in nutrients when fermented to produce solid organic fertilizer (Yosephine et al., 2021).

The shallot plant is the most popular plant in the Alliaceae family. The shallot plant belongs to the genus Allium and is available in various colors. Shallots are the second oldest vegetable after tomatoes which are widely used in Indonesia and throughout the world as a food supplement, and shallots are an agricultural commodity that cannot be replaced by other commodities (Wahyuni et al, 2024). Shallots are one of the commodities that play an important role in regional economic development because the price of shallots always increases every year so many Indonesian farmers plant this crop (Triyono et al., 2021) and (Fauzan and Sedek, 2021). Shallots are one of the strategic commodities in Indonesia because the price of shallots fluctuates with inflation (Posat Agency, 2022). The high increase in inflation is due to the increase in the price of shallots. In addition, grass is also one of the high-value crops planted by most farmers (Pane and Supriana, 2020). Agricultural development based on agriculture can be carried out by increasing production to increase farmers' income. The demand for shallot products in Indonesia increases by 5% per year for household consumption and seeds, this is in line with the increase in the population of Indonesia every year (Pane and Supriana, 2020a).

2. METHOD

2.1 Place and time

This research was conducted from November 2023 to May 2024 in Minta Kasih Village, Salapian District, Langkat Regency, North Sumatra Province at an altitude of ±89 m above sea level.

2.2 Tools and materials

The materials used were red onion seeds of the Sanren F1 variety, 10 agricultural herbal plants fermented using biologically effective organisms (EM4) and molasses as an energy source for the organisms. The anaerobic fermentation process takes 21 to 30 days to produce solid organic fertilizer and liquid fertilizer by utilizing agricultural waste. Researchers processed the soil in the research area by processing the soil by stirring and turning it to loosen the soil and drying the soil for

1 week to kill pests and diseases. Soil moisture in the exposure area was measured to achieve a neutral pH at the scene. 6-7.

2.3 Research methods

The research method used a factorial randomized block design (RBD), consisting of 2 treatments with 16 treatment combinations and 2 replications with a total number of plots of 32. The following 2 treatment factors consist of:

a. Solid organic fertilizer factor with the symbol "P" consists of 4 levels, namely;
   P_0 = 0 kg/plot
   P_1 = 1.5 kg/plot
   P_2 = 2.5 kg/plot
   P_3 = 3.5 kg/plot

b. Liquid organic fertilizer factor with the symbol "C" consists of 4 levels, namely;
   C_0 = 0 ml/liter of water/plot
   C_1 = 250 ml/liter of water/plot
   C_2 = 500 ml/liter of water/plot
   C_3 = 750 ml/liter of water/plot

Analysis of observation data used in analysis of variance is based on a linear model. To determine the effect of treatment on the observed growth parameters, calculations were carried out using systematic sampling and variance analysis. If the variance analysis has a significant effect, it will be carried out using the smallest significant difference (LSD) test at the 5% level.

2.4 Observed Parameters

The parameters observed in this study include: plant height (cm); tubers diameter (mm); wet tubers production (g); dry tubers production (g).

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

Average data from observations of plant height measurements (cm) of shallot plants with solid organic fertilizer (SOF) and liquid organic fertilizer (LOF) treatments on plants in the 4th , 5th and 6th weeks after planting, then after conducting a difference analysis . showed that PAP treatment was most effective at 4 , 5 and 6 weeks after planting, while PAC treatment was applied to plants aged 4, 5 and 4 years. 6 weeks after transplantation (WAP).

Table 1. Average plant height (cm) with SOF (P) and LOF (C) treatments 4 to 6 weeks after planting (WAP)

Treatment	Age Plant Height (cm)		
	4 WAP	5 WAP	6 WAP
Solid Organic Fertilizer (P)			
P0 (0 kg/plot)	36,96bB	42,72cC	50,38bB
P1 (1.5 kg/plot)	38,34bB	42,98cC	50,81bB
P2 (2.5 kg/plot)	38,61bB	43,91bB	51,88bB
P3 (3.5 kg/plot)	41,95aA	47,92aA	57,33aA
Liquid Organic Ferlilizer (C)			
C0 (0 ml/literair/plot)	37,49aA	42,61bB	50,18bB
C1 (250 ml/literair/plot)	38,04bB	43,49bB	50,77bB
C2 (500 ml/literair/plot)	39,97 abAB	44,61 abAB	53,57abA
C3 (750 ml/literair/plot)	41,44aA	46,79aA	55,87aA

Description: In the Multiple Range Test (BMRT), numbers in the same column followed by letters are significantly different at the 5% level (lowercase letters) and significantly different at the 1% level (capital letters).

The data in Table 1 above shows that plant height (cm) due to phosphorus and C treatment at each treatment level at the ages of 4, 5, waste and 6 weeks after planting is very beneficial. This proves that various organic waste formulated into two types of organic fertilizers can increase growth in the height of shallot plants. This is in line with the statement (Lubis et al., 2022) that organic waste from fruits contains enzymes that can help break down nutrients in the soil so that it can increase the availability of nutrients such as Nitrogen, Phosphorus, Potassium, Calcium, Iron, Sodium, Magnesium and vitamins, the same thing was conveyed by (Armaniar et al., 2023).

3.2. Tubers Diameter (mm)

The measurement data for tuber length (mm) on shallot plants (Allium ascalonicum L) exposed to SOF and LOF were tested for differences in average using the multiple distance test (Duncan's). Based on the analysis of variations in the parameters of the diameter of shallots (mm) in shallot plants, it is known that the application of SOF and LOF has a significant effect, but there is no significant effect of interaction between SOF and LOF. Diameter bohlam (mm).

The results of the bulb width (mm) indicating SOF and LOF after the average difference test using the Duncan distance test can be seen in Table 2.

Table 2. Average tuber diameter (mm) according to SOF and LOF management

Treatment	Tubers Diameter (mm)
Solid Organic Fertilizer (P)	
P0 (0 kg/plot)	7,38cC
P1 (1.5 kg/plot)	7,95bB
P2 (2.5 kg/plot)	8,38bAB
P3 (3.5 kg/plot)	9,00aA
Liquid Organic Ferlilizer (C)	
C0 (0 ml/liter air/plot)	7,53cC
C1 (250 ml/liter air/plot)	7,89cC
C2 (500 ml/liter air/plot)	8,59abAB
C3 (750 ml/liter air/plot)	8,70aA

Description: Numbers in the same column followed by different letters are significantly different at the 5% level (lowercase letters) and significantly different at the 1% level (capital letters), according to the multiple range test (BMRT).

In Table 2 above, SOF exposure had a significant effect on tuber diameter \ n (mm). The highest average in the 3.5 kg/plan (P3) treatment was 9.00 mm and the lowest was 0 kg/plan (P0) or 7.38 mm, in the application of LOF there was a significant effect on tuber diameter. (mm). The highest average was in the 750 ml/liter water treatment in area (C3) of 8.70 mm and the lowest was in the 0 ml/liter water treatment in area (C0) of 7.53 mm. This shows that nutrients in SOF and LOF such as potassium contribute to increasing tuber diameter. According to (Andriani Luta et al., 2020), potassium plays a role in the photosynthesis process to produce organic compounds which are then transferred to storage organs such as tubers and improve the quality of the tubers. Magnesium can activate enzymes that plants need to make starch and protein.

3.3. Wet Tubers Production (g)

The average data on wet tuber production (g) in sorghum plants (Allium ascalonicum L) given SOF and LOF treatments were tested for differences in average using Duncan 's multiple range test. Based on the differential analysis of the parameters of tuber moisture production (g) in shallot plants, it is known that the application of SOF and LOF has a significant effect. The average results of wet ball production (g) with the provision of SOF and LOF after testing the average difference using the Duncan distance test can be seen in Table 3.

Table 3. Average wet ball formation (g) with SOF and LOF applications

Treatment	Wet Tubers Production (g)
Solid Organic Fertilizer (P)	
P0 (0 kg/plot)	54,76cC
P1 (1.5 kg/plot)	58,97cC
P2 (2.5 kg/plot)	74,75bB
P3 (3.5 kg/plot)	87,95aA
Liquid Organic Ferlilizer (C)	
C0 (0 ml/liter air/plot)	59,71dD
C1 (250 ml/liter air/plot)	67,32Cc
C2 (500 ml/liter air/plot)	72,51bB
C3 (750 ml/liter air/plot)	76,89aA

Description: Based on the Multiple Range Test (BMRT), the numbers in the columns followed by different letters are significantly different at the 5% level (lowercase letters) and significantly different at the 1% level (capital letters).

In Table 3 above, the determination of SOF has a significant effect on wet tuber production (g). The highest rate of treatment was 3,5 kg of location (P3) i.e. 87,95 grams, and the lowest was 0 kg of location (P0) i.e. 54,76 grams. The results of the LOF management analysis showed a significant effect on wet (warm) tuber production . The highest average was in the treatment of 750 ml of water in area (C3) and 76.89 grams and a minimum of 0 ml/liter of water in area (C0) and 59.71 grams. The composition of SOF and LOF significantly affected the wet ball formation parameters of each sample. The wet weight of the tuber is close to the size of the tuber, the bigger the tuber , the higher the wet weight of the tuber produced . The wet weight of the tubers of each model affects water absorption and photoaccumulation in the leaves , thereby allowing movement of tuber formation . The more photos taken , the larger the organ becomes , and the more moisture accumulates (Siregar et al . , 2023).

3.4. Dry Tubers Production (g)

The average data of dry tuber production measurements (g) on small plants (Allium ascalonicum L) with SOF and LOF, were tested for differences in the average using Duncan's multiple range test. Based on the differential analysis of dry bulb yield parameters (g) in shallot plants, it is known that the application of SOF and LOF has a significant effect. The average results of dry tuber production (g) with SOF and LOF controls after conducting a mean difference test using the Duncan distance test can be seen in Table 4.

Table 4. Average dry tuber production (g) due to the use of SOF and LOF

Treatment	Dry Tubers Production (g)
Solid Organic Fertilizer (P)	
P0 (0 kg/plot)	655,89dD
P1 (1.5 kg/plot)	743,64cC
P2 (2.5 kg/plot)	850,51bB
P3 (3.5 kg/plot)	940,51aA
Liquid Organic Ferlilizer (C)	
C0 (0 ml/liter air/plot)	648,02cC
C1 (250 ml/liter air/plot)	811,77bcB
C2 (500 ml/liter air/plot)	836,15bB
C3 (750 ml/liter air/plot)	898,65aA

Description: Numbers in the same column followed by different letters are significantly different at the 5% level (lower case letters) and significantly different at the 1% level (capital letters), according to the multiple range test (BMRT).

Table 4 above shows that SOF management has a significant effect on dry tuber production (g). The heaviest cutting in the 3.5 kg floor treatment (P3) was 940.51 grams and the least was 655.89 grams in the 0 kg floor treatment (P0). LOF application is very effective in dry tuber production (grams). The highest average was at 750 ml/liter of water treatment in area (C3) and 898.65 grams and the lowest was at 0 ml/liter of water in area (C0) and 648.02 grams. The results of the regression analysis of SOF and LOF administration on dry tuber production (g) showed a linear relationship. The observation results showed that these parameters were very beneficial for dry tuber production in each plot. The observation results showed that these parameters were very beneficial for dry tuber production in each plot. Plant dry weight is an indicator of plant accumulation during photosynthesis and a combination of almost all processes experienced by the plant . The high dry weight of the addition of LOF at a dose of 750 ml /L water/plant indicates that the absorption of water and nutrients for photosynthesis and metabolism is efficient so that photosynthesis can run well . It's finished. high, stored in reproductive organs such as tubers so that one can see that the tubers are very heavy (Hai et al. , 2017).

4. CONCLUSION

The study's results on the treatment of solid organic fertilizer and liquid organic fertilizer treatment can increase the growth and production of shallots. The best treatment is 3.5 kg/plant for solid organic fertilizer and 750 ml/liter of water/plot for liquid organic fertilizer. This study is one of the solutions to the limited availability of fertilizer and the high price of fertilizer in Indonesia, so that shallot farmers can produce organic fertilizer independently at a low cost, and most importantly, the availability of organic waste/garbage around the farmer's land environment. This study needs to be continued using solid and liquid organic fertilizers at a higher level until the optimal point is obtained for the growth and production of shallots.

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