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Applying Types Of Solid And Liquid Organic Fertilizer Dosages To Onion (*Allium ascalonicum* L.) Production

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ABSTRACT

One of the plant cultivation techniques to increase shallot production is fertilization. Fertilization is the application of fertilizer to increase the supply of nutrients needed by plants to improve the yield and quality of plant products. This research aims to determine and obtain a combination of the type of organic fertilizer and dosage of liquid organic fertilizer that has the best effect on the production of shallots (Allium ascalonicum L.). The research was conducted on farmers' land in Sukajadi Village, Talang Kelapa District, Banyuasin Regency, South Sumatra. The study was carried out from March to June 2023. This research used an experimental method with a split-plot design with 12 treatment combinations repeated 3 times. The treatment in question is the main plot: type of organic fertilizer consisting of chicken manure, buffalo dung fertilizer, and goat dung fertilizer, while sub-plots: dosage of liquid organic fertilizer consisting of control; 10 L/ha; 15 L/ha and 20 L/ha. The variables observed were the number of tubers per cluster (tuber), tuber weight per cluster (g), and tuber weight per plot (kg). The research results showed that a combination of organic chicken manure and liquid organic fertilizer at a dose of 20 L/ha gave the best production of shallots, namely 0.61 kg/ plot (2.44 tons/ha).

Keywords: *types of organic fertilizer, dosage, liquid organic fertilizer, shallots, production*

1. INTRODUCTION

Shallots (*Allium ascalonicum* L.) is one of the superior horticultural commodities with a promising prospect to meet national consumption, provide income for farmers, and contribute to the country's foreign exchange. The importance of this commodity lies not only in its use as a culinary spice, raw material for the food industry, and flavor enhancer due to its aroma but also in its medicinal properties attributed to the presence of enzymes that contribute to improving health, anti-inflammatory and antibacterial properties, as well as regenerative effects (Fatirahma dan Kastono, 2020); (Priyadi et al., 2021).

According to the Badan Pusat Statistik dan Direktrorat Jenderal Hortikultura (2023), the production of shallots in Indonesia in 2021 amounted to 2,004,590 tons, while in 2022, it experienced a decrease to 1,982,360 tons. In South Sumatra province, the production of shallots in 2021 was 1,125 tons; in 2022, it slightly increased to 1,130 tons.

The low productivity of shallots is attributed to ineffective cultivation methods and excessive application of inorganic fertilizers, leading to soil fertility depletion and subsequent decline in soil productivity (Andri et al., 2022). Enhancing shallot productivity can be achieved through proper fertilization management. The continuous and excessive use of inorganic fertilizers without incorporating organic fertilizers may result in soil compaction, ultimately diminishing soil productivity. The prolonged application of inorganic fertilizers reduces soil fertility levels (Aminuddin dan Anam, 2017).

Soil fertility enhancement through the application of organic fertilizer involves utilizing materials with relatively lower nutrient content. Despite this, organic fertilizers play a crucial role in enhancing various physical properties of soil, including permeability, porosity, structure, water retention capacity, and cation exchange capacity (Roidah, 2013). Manure derived from animals such as chickens, goats, and buffaloes after complete decomposition stands out among the commonly used organic fertilizers. The effectiveness of organic fertilizers in improving soil quality is attributed to their ability to enhance the soil's physical, chemical, and biological characteristics. The nutrient composition of organic fertilizers is influenced by factors such as the type of animal, its age, the bedding material, and the animal's diet (Ananto, 2020).

According to Safriyani et al. (2022), using chicken manure fertilizer has enhanced the growth and yield of shallot plants. Similarly, research conducted by Hasan and Ruswadi (2016) suggests that goat manure can increase shallot production. Furthermore, the study by Martinus et al. (2017) indicates that buffalo manure, besides serving as a source of organic material, can also boost the nutrient availability for shallot plants. It is important to note that manure contains macro and micro nutrients essential for plant growth and is crucial in maintaining nutrient balance in the soil. Due to the long-lasting effects of animal manure and its role as a nutrient reservoir for plants, adding organic fertilizer in liquid form directly to the soil and plant root zone is recommended to enhance the yield of shallot plants.

Liquid organic fertilizer is a solution derived from decomposing organic materials from plant residues and animal manure, containing multiple essential elements. The advantage of liquid organic fertilizer lies in its ability to quickly address nutrient deficiencies, avoid nutrient leaching issues, and provide nutrients rapidly (Rahayu et al., 2016). NASA liquid organic fertilizer, or NASA, is obtained from organic materials derived from livestock and poultry manure, plant residues, natural waste, specific plant types, and other natural materials. Environmentally friendly, representing a

100% natural liquid organic fertilizer formulation (Damari, 2012)

The findings of a study conducted by Widiastutik et al. (2018) demonstrated that applying liquid organic fertilizer at a rate of 20 L/ha yielded the most favourable outcomes for shallot plants. In a separate study by Nugrahini (2013), treating liquid organic fertilizer at a rate of 15 L/ha resulted in the best results for shallot plants. Research on the cultivation of plants using an organic technology approach, specifically the implementation of organic fertilizer in conjunction with liquid organic fertilizer for shallot cultivation, has not been extensively conducted, particularly in South Sumatra. Despite the potential for shallots to be developed as a crop, it is imperative to research shallot cultivation to determine the optimal combination of organic fertilizer types and liquid organic fertilizer doses that will significantly impact shallot production.

2. MATERIAL AND METHODS

This study was carried out in one of the farmers' fields in the Sukajadi Village, Talang Kelapa District, Banyuasin Regency, South Sumatra, from March to June 2023. The materials used in this study were shallot bulb seeds of the Nganjuk variety, chicken manure fertilizer, buffalo manure fertilizer, goat manure fertilizer, liquid organic fertilizer NASA, and Atonik plant growth regulator.

The research design employed in this study was a Split-Plot Design. Each treatment was replicated 3 times with the following treatments: The first factor (Main Plot) was the Type of Organic Fertilizer, which included chicken manure, buffalo manure, and goat manure. The second factor (Subplot) was the Dosage of Liquid Organic fertilizers, including control, 10 L/ha, 15 L/ha, and 20 L/ha.

The research implementation process involved several vital stages. Firstly, land preparation was conducted by creating 36 plots measuring 1 m x 2 m each, with a planting distance of 15 cm x 15 cm. The distance between plots was 50 cm, while the distance between replications was 1 m. Following this, fertilization was carried out by applying organic fertilizer two weeks before planting, with different treatments such as chicken manure, buffalo manure, and goat manure at a 25 tons/ha dose for each treatment. Subsequently, NASA liquid organic fertilizer was applied three times at 2, 4, and 6 weeks after planting, varying doses according to treatment (control; 10 L/ha; 15 L/ha; and 20 L/ha). The planting material was prepared by cutting the top 1/3 of the tuber seeds and soaking them in PGR for 60 minutes. Planting was done by creating a hole with a depth of 5 cm and inserting 1 shallot bulb seed in each hole. Maintenance activities included watering, weeding, pest and disease control, and harvesting was conducted based on the Nganjuk variety's harvest age, which is 60 days after planting. Yellowish leaves, wilting base of leaves, compact tubers on the ground, fallen plants, and purplish-red tubers indicated harvesting.

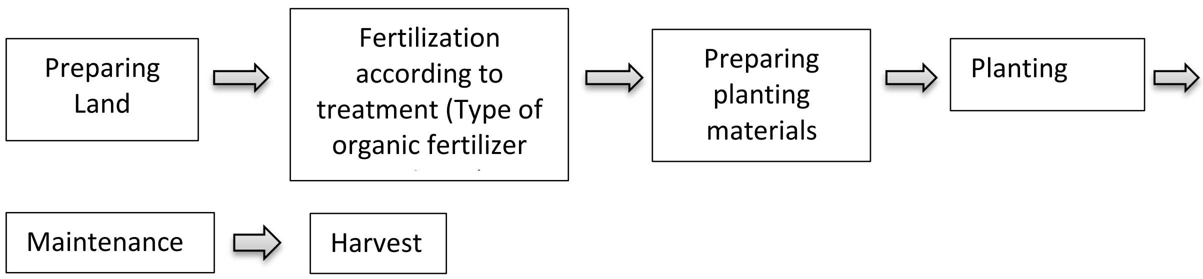

Figure 1. Research Flow Diagram

The data obtained were analyzed statistically based on the analysis of variance on each measured observation variable and further tested for real treatments using the 5% level of the Honest Real Difference Test (BNJ) method.

3. RESULT AND DISCUSSION

The diversity analysis results (Anova) indicate that administering organic fertilizer types and liquid organic fertilizer dosages and their interactions significantly influence all observed variables (Table 1).

Table 1. The results of the analysis of variance of the effect of the type of organic fertilizer and the dose of liquid organic fertilizer on the observed variables

observed variables	Treatment			CC (%)
	J	D	I	
Number of tubers per hill (tubers)	**	**	**	2,01
Tuber weight per hill (g)	**	**	**	1,32
Tuber weight per plot (kg)	**	**	**	6,20

Note : ** = Highly significant effect
J = Organic fertilizer type
D = dosage of liquid Organic fertilizer
I = Interaction
KK = Diversity Coefficient

The influence of the type of organic fertilizer and the dose of liquid organic fertilizer on the observed variables

The findings from the variance analysis indicated that both the type of organic fertilizer treatment and the dosage of liquid organic fertilizer had an extremely significant impact on the number of tubers per hill, the weight of tubers per hill, and the weight of tubers per plot. Table 2 provides the average values for the type of organic fertilizer and dosage of liquid organic fertilizer for the variables under observation.

Table 2. Effect of type of organic fertilizer and dose of liquid organic fertilizer on the number of tubers per clump, tuber weight per clump, and tuber weight per plot

Treatment	Number of tubers per clump (tubers)	Tuber Weight Per Clump (g)	Tuber Weight Per Plot (kg)
---------- Types of Organic Fertilizers ----------			
POKA	8,40 c	30,17 c	0,58 c
POKKu	6,38 a	24,27 a	0,44 a
POKKb	7,35 b	26,15 b	0,50 b
BNJ 0,05 =	0,15	0,37	0,03
---------- Liquid Organic Fertilizer Dosage (L/ha) ---------			
Kontrol	6,87 a	25,60 a	0,47 a
10	7,16 b	26,47 b	0,50 ab
15	7,53 c	27,16 c	0,52 bc
20	7,96 d	28,22 d	0,53 c
BNJ 0,05 =	0,20	0,47	0,04

Note: Numbers followed by the same letter in the same column mean they are not significantly different at the 5% BNJ level.

The study's findings indicated that using chicken manure fertilizer resulted in superior crop yield compared to the application of buffalo manure and goat manure. This result was supported by the varying number of tubers per clump, averaging 8.40 tubers, and the weight of tubers per clump, averaging 30.17 g, and the weight of tubers per plot, averaging 0.58 kg. These outcomes can be attributed to disparities in the rate of nutrient absorption by plants, where chicken manure decomposes faster, making it more readily available to provide essential nutrients for plant growth. Prasetyo (2014) asserts that the decomposition rate of each type of organic fertilizer utilized influences the rate of nutrient absorption. Additionally, Aisyah et al. (2018) state that chicken manure can potentially enhance the availability of nutrients for plants. This result is due to chicken manure's ability to alter the soil's physical, chemical, and biological properties, thereby contributing to soil fertility. Furthermore, chicken manure contains higher levels of nitrogen (N), phosphorus (P), and potassium (K) compared to buffalo manure and goat manure. These nutrients, particularly N, P, and K, are crucial for the growth and development of shallot plants during their generative phase, ultimately leading to increased crop production.

Buffalo manure exhibited the lowest productivity compared to chicken manure and goat manure during the treatment. This productivity is evident from the variables such as the number of tubers per cluster, which had an average of 6.38 tubers, the weight of tubers per cluster, with an average of 24.27 g, and the weight of tubers per plot, with an average of 0.44 kg. These findings indicate that the nutrient content in buffalo dung fertilizer is not readily available or is slowly released to plants. In other words, the decomposition rate is low, hindering the absorption of nutrients by plants. Hartatik and Widowati (2006) support this notion by stating that nutrients in livestock manure are not easily accessible to plants, as the level of decomposition or mineralization of these materials dramatically influences their availability. The mineralization rate can be determined by the C/N ratio, where a higher value indicates a slower mineralization process. According to Syekhfani (2012), the C/N ratio is commonly used to indicate the ease of decomposing organic materials, with a higher C/N ratio indicating more incredible difficulty in decomposition.

Using goat manure fertilizer has resulted in higher crop production than buffalo manure, although it still falls short compared to chicken manure. This result can be observed through various variables, such as the number of tubers per cluster, which averages 7.35 tubers. The weight of tubers per cluster is 26.15 grams, and the weight per plot averages 0.50 kilograms. The reason behind this discrepancy lies in the slow-release nature of goat manure and its denser composition, which leads to a longer decomposition process. According to Bara and Chozin (2009), goat manure consists of round granules resistant to physical breakdown, making it denser and resulting in slower decomposition in the soil. Additionally, Nuro et al. (2016) state that organic fertilizers, including goat manure, have a slow-release property, meaning that their nutrients are released gradually and continuously over an extended period. This characteristic helps to minimize nutrient loss through water leaching.

The study's findings indicated that applying liquid organic fertilizer at a rate of 20 L/ha yielded the highest production levels compared to other treatments. This yield was evident in critical variables such as the number of tubers per cluster, the weight per cluster, and the weight per plot, averaging 7.96 tubers, 28.22 g, and 0.53 kg, respectively. These results highlight the importance of applying liquid organic fertilizer at the correct dosage to promote optimal root development, enhancing nutrient and water absorption efficiency. Factors such as the availability of CO2, water, and chlorophyll are crucial in facilitating potassium absorption, which in turn aids in the optimal transfer of carbohydrates and proteins, leading to increased generative growth (production) of shallots in terms of both the number and weight of bulbs. A study by Rahayu et al. (2016) demonstrated that varying doses of liquid organic fertilizer directly impacted the fertilizer's nutrient composition, with higher doses correlating with enhanced plant generative growth.

Interaction effect of organic fertilizer type and liquid organic fertilizer dosage on observed variables

The results of the analysis of variance show that the interaction between the type of organic fertilizer and the dosage of liquid organic fertilizer has a significant influence on the number of tubers per plant, the weight of tubers per plant, and the weight of tubers per plot. The average interaction of the type of organic fertilizer and the dosage of liquid organic fertilizer on the observed variables can be seen in Table 3.

Table.3 The interaction effect of organic fertilizer type and liquid organic fertilizer dosage on the variable number of tubers per clump, tuber weight per clump, and tuber weight per plot

Treatment	Number of Tubers Per Clump (Tubers)	Tuber Weight Per Clump (g)	Tuber Weight Per Plot (kg)
POKA + kontrol	7,87 efg	29,07 f	0,55 efg
POKA + 10 L/ha	8,07 fg	29,73 f	0,57 fg
POKA + 15 L/ha	8,53 gh	30,27 f	0,60 g
POKA + 20 L/ha	9,13 h	31,60 g	0,61 g
POKKu + kontrol	5,87 a	23,00 a	0,40 a
POKKu + 10 L/ha	6,20 ab	24,00 ab	0,43 ab
POKKu + 15 L/ha	6,53 abc	24,53 bc	0,45 abc
POKKu + 20 L/ha	6,93 bcd	25,53 cd	0,47 abcd
POKKb + kontrol	6,87 bcd	24,73 bc	0,45 abc
POKKb + 10 L/ha	7,20 cde	25,67 cd	0,49 bcde
POKkb + 15 L/ha	7,53 def	26,67 de	0,51 cdef
POKKb + 20 L/ha	7,80 efg	27,53 e	0,52 def
BNJ 0,05 =	0,84	1,20	0,09

Note: Numbers followed by the same letter in the same column mean that they are not significantly different at the 5% BNJ level

The variance analysis findings indicated a significant interaction between the type of organic fertilizer treatment and the dosage of liquid organic fertilizer. This interaction substantially impacted the number of tubers per hill, the weight per hill, and the weight per plot. The combination of treatments that yielded the highest number of tubers per hill, weight of tubers per hill, and weight of tubers per plot consisted of chicken manure fertilizer and a dosage of 20 L/ha of liquid organic fertilizer, resulting in 9.13 tubers, 31.60 g, and 0.61 kg, respectively. These results demonstrate that combining chicken manure and liquid organic fertilizer at a dosage of 20 L/ha benefits shallot production. According to Supadma and Arthagama (2008), chicken manure is crucial in enhancing soil fertility. It improves soil fertility, promoting organic farming systems that reflect people's aspirations for a sustainable future. Sutedjo (2010) further emphasized that liquid organic fertilizer enhances plant chlorophyll formation, boosting photosynthetic activity and increasing plant productivity. Research conducted by Idris et al. (2018) supports the notion that generative growth increases with the application of solid and liquid organic fertilizers at higher dosages, meeting the nutrient requirements of plants. By providing chicken manure and liquid organic fertilizer at high dosages of up to 20 L/ha, shallot production can be increased, and the physiological processes in plant tissues will function optimally, resulting in higher translocation of photosynthates into the bulbs.

In contrast, the combination of buffalo dung fertilizer treatment and the absence of liquid organic fertilizer (control) resulted in the lowest number of tubers per hill, weight of tubers per hill, and weight of tubers per plot. The average data recorded were 5.87 tubers, 23.00 g, and 0.40 kg. The research findings indicate that the provision of buffalo dung fertilizer alone, without the addition of liquid organic fertilizer, did not support plant growth and yield. This yield is because the organic material in the form of buffalo dung fertilizer played a crucial role in nutrient availability, particularly in facilitating metabolic activities such as photosynthesis. Consequently, the plants did not achieve optimal results. Asri et al. (2019) conducted a study on shallot production and found that insufficient nutrient supply hindered bulb formation and overall yield. The soil quality also influenced plant growth, leading to a deficiency in the necessary nutrients for shallot plants, particularly in bulb formation. Providing buffalo manure alone, without the addition of liquid organic fertilizer, failed to meet the nutrient requirements in a suitable form for root absorption and sufficient quantities.

4. CONCLUSION

The findings from conducting field research and analyzing diversity indicate that the optimal production of shallots, amounting to 0.61 kg/plot (equivalent to 2.44 tons/ha), is achieved through the synergistic application of organic fertilizers, specifically chicken manure and liquid organic fertilizer, at a rate of 20 L/ha.

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