

# Increasing The Yield Of Shallot (*Allium Cepa* L.) Using Types And Doses Of Solid Organic Fertilizers

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**Abstract:** This study aims to determine the effect of the type and dose of solid organic fertilizer on the yield of shallot (*Allium cepa* L.). The method used in this study was a Randomized Block Design (RBD) factorial pattern, 4x3, with 3 replications and 2 plant samples, resulting in 72 experimental units. The treatment consisted of 2 factors, namely: The first factor is the type of solid organic fertilizer (J), consisting of 3 levels: J<sub>1</sub> = cow manure, J<sub>2</sub> = goat manure, J<sub>3</sub> = chicken manure. The second factor is the dose of solid organic fertilizer (D) consisting of 4 levels D<sub>1</sub> = 10 tons / ha = 25 g / polybag, D<sub>2</sub> = 20 tons / ha = 50 g / polybag, D<sub>3</sub> = 30 tons / ha = 75 g / polybag, D<sub>4</sub> = 40 tons / ha = 100 g / polybag. The provision of solid organic fertilizer types significantly affected the parameters of wet tuber weight and dry tuber weight. The best treatment of solid organic fertilizer types was found in the treatment J<sub>2</sub> = goat manure. The treatment of solid organic fertilizer doses did not have a significant effect on the parameters of the number of bulbs, dry bulb weight and air dry bulb weight of shallot.

**Keywords:** shallot, type, solid organic fertilizer.

## 1. Introduction

Shallots (*Allium cepa* L.) are a horticultural commodity that plays a vital role in the Indonesian economy and food needs. High demand for shallots, both for household and industrial use, makes them a highly sought-after crop in agricultural cultivation practices. However, the main challenge in increasing shallot production is optimizing plant growth and productivity through effective and environmentally friendly cultivation techniques (Mariyah *et al.*, 2022).

According to the Center for Agricultural Data and Information (2023), shallot production in Indonesia reached 1.98 million tons in 2022, and reached 2.14 million tons in 2023. However, Indonesian shallot production is not yet sufficient to meet the needs of all segments of the population. Indonesia remains the second-largest importer, importing shallots at an average value of USD 51.76 million.

According to data from the Central Statistics Agency (2023), shallot production decreased to 10,070 tons per year in 2022. Shallot production in Aceh remains relatively low, partly due to suboptimal agronomic practices in shallot cultivation. One effort to increase shallot production is to improve the agronomic system of shallot cultivation by maximizing the use of organic fertilizers.

Fertilization is a key factor in the success of shallot cultivation. The use of chemical fertilizers has long been common practice among farmers to increase yields. However, excessive reliance on chemical fertilizers can cause various problems, such as decreased soil fertility, environmental damage, and increased production costs. With increasing awareness of the importance of sustainable agriculture, organic fertilizers are becoming a popular alternative (Maskur and Maghfoer, 2019).

Solid organic fertilizers, especially those derived from livestock waste such as cows, goats, and chickens, have significant potential for use in shallot cultivation. Each type of fertilizer has different characteristics and nutrient content, which can affect plant growth and yield (Priyadi *et al.*, 2021). For example, cow manure is generally rich in nitrogen and can

improve soil fertility, while chicken manure has a higher phosphorus content, which is beneficial for root and tuber development (Laia, 2024).

However, uncertainty remains regarding the most effective type and dosage of solid organic fertilizer for shallot cultivation. Each type of organic fertilizer requires a different dosage to achieve optimal results, depending on soil conditions and the specific needs of the plant (Randamuluk *et al.*, 2012). Therefore, in-depth and targeted research is needed to explore the effects of various types and dosages of solid organic fertilizer from cows, goats, and chickens on shallot growth and productivity.

It is hoped that this research will provide practical recommendations for farmers in selecting the most appropriate type and dosage of organic fertilizer. Ultimately, this will support sustainable and environmentally friendly increases in shallot productivity and provide added value to organic farming in Indonesia.

## 2. Literature Review

Organic fertilizers are used to improve soil fertility and provide nutrients for plants. Examples of solid organic fertilizers include compost, manure, green manure, and others. Solid organic fertilizers are materials used to improve soil fertility and provide nutrients for plants, made from decomposed natural materials. These fertilizers have significant benefits for improving soil health and plant growth (Fathin *et al.*, 2019). Solid organic fertilizers offer various important benefits for plants, particularly in supporting healthy growth and optimal yields. Organic fertilizers provide numerous benefits for plants, from improving soil fertility to producing higher-quality crops. With their environmentally friendly nature and ability to improve overall soil health, organic fertilizers are an ideal choice for supporting sustainable agriculture and ensuring healthy and productive harvests (Laili, 2022).

The use of cow manure is a technological package capable of improving the soil environment, thereby supplying macro- and micronutrients, as well as growth hormones from the auxin and cytokinin groups, which can improve soil fertility and increase edamame soybean production. The auxin found in atonik can even enhance the growth of citrus seedlings (Purba, 2018).

Cow manure is a fertilizer produced from livestock waste or other naturally occurring waste. Farmers should have long been familiar with cow manure, as its slow decomposition process has reduced the use of organic fertilizers. Research by Suastana showed that applying manure at a dose of 20 tons/ha resulted in the highest number of root nodules per plant in peanut plants (Purba, 2018). One waste product that can be reused as a fertilizer supplement is cow manure. The nutrient content in cow manure is highly beneficial for plant nutrition, thus optimizing plant growth. Cow manure contains 28.1% nitrogen (N), 9.1% phosphorus (P), and 20% potassium (K), all of which can aid plant growth (Rosadi, 2019).

Chicken manure is an organic material that influences the physical, chemical, and biological properties of the soil. Analysis by Suryani *et al.*, (2010) found that bacteria found in chicken manure included *Lactobacillus acidophilus*, *Lactobacillus reuteri*, *Leuconostoc mensenteroides*, and *Streptococcus thermophilus*, with a small number of Actinomycetes and molds.

Utilizing organic matter in the form of chicken manure offers advantages, including supplying nutrients to the soil and increasing water retention. Increasing soil water content leads to the regeneration of organic matter, resulting in the formation of organic acids. Anions from organic acids can displace phosphate bound to Fe and Al, releasing it and making it available to plants. Chicken manure has the highest nitrogen content at 2.10%, compared to

only 1.46% and 1.07% of phosphorus and potassium, respectively. The use of chicken manure can be an alternative to inorganic fertilizers. Furthermore, the environmentally friendly use of chicken manure can help preserve agricultural land, thus supporting sustainable agriculture (Ananda, 2022).

### 3. Method

This research was conducted in the experimental field of Saney Village, Lhoong District, Aceh Besar Regency, starting from November 2024 to February 2025. The tools used in this study were: hoes, shovels, rulers, plastic bags, analytical scales, label paper, and stationery. The materials used were cow, goat and chicken manure, which came from residents around the study, soil from the study area, polybags (35x35 cm) with a volume of 10 kg of soil and shallot seeds of the Tajuk variety. This study used a Randomized Block Design (RBD) method with a factorial pattern consisting of two factors. The first factor was the type of solid organic fertilizer, consisting of 3 levels. The second factor was the dose of solid organic fertilizer, consisting of 4 levels, so there were 12 treatment combinations, with 3 replications, resulting in 36 treatment combinations. Each treatment combination contained 2 plants, resulting in a total of 72 experimental units.

The first factor was the type of solid organic fertilizer, consisting of three levels:

J1 = Cow Manure

J2 = Goat Manure

J3 = Chicken Manure

The second factor was the dosage of solid organic fertilizer, consisting of four levels:

D1 = 10 tons/ha = 25 g/polybag

D2 = 20 tons/ha = 50 g/polybag

D3 = 30 tons/ha = 75 g/polybag

D4 = 40 tons/ha = 100 g/polybag

If the F-test analysis showed a significant effect, then an honestly significant difference (HSD<sub>0.05</sub>) test was conducted at the 5% probability level to compare the treatment means.

#### 3.1. Research Implementation

##### Planting Media Preparation

The soil used for the shallot planting medium is air-dried topsoil. Any clumps of soil are crushed and sifted using a sieve. The air-dried soil is then placed into 10 kg polybags.

##### Seed Preparation

The seeds used are the Mahkota variety. The criteria for selecting shallot seeds are: healthy, unblemished, 1.5-2 cm in size, bright skin color, and no signs of disease.

##### Planting

The selected shallot seeds are then planted in polybags simultaneously in the afternoon. Before planting, it is important to trim the tips of the shallot bulbs by about 1 cm to speed up the germination process and help the shoots grow more quickly and evenly. Next, make a planting hole about 3 cm deep. Then, place the shallot bulbs, cut side up, in the planting medium. Cover the shallot bulbs with the planting medium until the entire bulb is lightly covered with soil. After planting, water the plants with sufficient water to maintain the moisture of the growing medium and ensure proper water absorption without causing waterlogging.

### Application of Solid Organic Fertilizer

Cow, goat, and chicken manure were applied one week before planting by sprinkling each type of solid organic fertilizer into polybags filled with growing medium. The solid organic fertilizer was applied according to the prescribed dosage.

### 3.2. Observed Variables

#### 1. Number of Bulbs per Plant

Observations on the number of bulbs were conducted after harvesting the shallots. The shallot bulbs were then cleaned of dirt and soil. The harvested shallot clumps were then tied at the center of the stem, labeled, and the number of shallot bulbs per polybag was counted.

#### 2. Wet Bulb Weight (g)

Observations on bulb weight were conducted after the shallot bulbs were cleaned of dirt and soil. The harvested shallot clumps were then tied at the center of the stem, labeled, and weighed using an analytical balance.

#### 3. Weight of air dried tubers (g)

Observation of the weight of the dry bulbs was carried out after the wet shallot bulbs had been air-dried for +7 days. After the dry bulbs have been cut, all the dry onion stems/clumps are then weighed using an analytical scale.

## 4. Findings and Discussion

### 4.1. Effect of Solid Organic Fertilizer Type on Shallot Yield

#### 4.1.1 Number of Bulbs

The results of the F-test of the analysis of variance showed that the application of the solid organic fertilizer type studied had no significant effect on the number of bulbs per plant. The average number of bulbs per shallot plant resulting from various types of solid organic fertilizer can be seen in Table 1.

**Table 1. Average number of bulbs per shallot plant resulting from the application of a solid organic fertilizer type**

| Treatment                       | Number Of Tubers |
|---------------------------------|------------------|
| J <sub>1</sub> : cow manure     | 8,58             |
| J <sub>2</sub> : goat manure    | 10,29            |
| J <sub>3</sub> : chicken manure | 9,96             |
| HSD                             | -                |

**Description: Numbers followed by the same letter in the same column are significantly different at the 5% level of honest significant difference (HSD) test.**

Table 1 shows no significant difference in the number of shallot bulbs produced by the application of solid organic fertilizer. It is suspected that solid organic fertilizer has not fully decomposed, thus providing nutrients that can be optimally absorbed by the plants, especially for bulb formation. N and K nutrients can enhance the bulb formation process. The availability of N improves the quality of shallot bulbs for optimal growth and production, while K increases fruit production and aids in the formation of carbohydrates and proteins in plants (Karim *et al.*, 2022).

Furthermore, the number of bulbs is also influenced by the diameter of the shallot bulbs. The fewer bulbs, the larger the diameter, and conversely, in plants with a large number of bulbs, the bulbs tend to be smaller (Kania and Maghfoer, 2018). The organic matter content in manure provides nutrients, especially K, which is beneficial for shallot bulb formation. Despite unfavorable environmental conditions, shallot plants can still grow and produce a significant number of bulbs, albeit relatively small ones. The number of shallot bulbs planted during the off-season is lower than during the dry season. This is because shallots planted during the rainy season (off-season) are affected by weather and climate (Suneth *et al.*, 2020).

#### 4.1.2 Wet Bulb Weight (g)

The results of the F-test of the analysis of variance showed that the application of the type of solid organic fertilizer studied significantly affected the wet bulb weight parameter. The average wet bulb weight of shallots due to various types of solid organic fertilizer is shown in Table 2.

**Table 2. Average wet weight of shallot bulbs due to the application of solid organic fertilizer types**

| Treatment                       | Wet Bulb Weight (gr) |
|---------------------------------|----------------------|
| J <sub>1</sub> : cow manure     | 86,25 a              |
| J <sub>2</sub> : goat manure    | 105,00 b             |
| J <sub>3</sub> : chicken manure | 99,58 b              |
| HSD                             | 6,04                 |

**Description: Numbers followed by the same letter in the same column are significantly different at the 5% level of honest significant difference (HSD) test.**

Table 2 shows that the highest wet weight of shallot bulbs due to the application of solid organic fertilizer was found in treatment (J<sub>2</sub>: Goat Manure), which was not significantly different from treatment (J<sub>3</sub>: Chicken Manure) but significantly different from treatment (J<sub>1</sub>: Cow Manure).

It is suspected that the organic matter in goat manure helps tubers in the soil form optimal offspring, and also aids in the plant's growth phase, providing essential nutrients. Loose soil textures have a high level of organ stress. Manure contains nutrients in the water, so it can be observed the production of offspring is accelerated and the abundance of offspring is increased, resulting in a high yield (Fausi *et al.*, 2022).

Photosynthesis is crucial in shallot bulb formation because it produces energy that is stored in the bulbs. The more energy produced, the larger and more numerous the bulbs formed. This aligns with the statement of Purnamasari *et al.*, (2020) that the more photosynthates produced by plants, the better the process of cell formation and division, which helps the plant produce new organs such as bulbs. The nutrient potassium (K) plays a crucial role as an enzyme activator in plant metabolism. Furthermore, potassium aids in the formation of proteins and carbohydrates in shallots, increases plant resistance to disease, and improves bulb quality (Triadiawarman *et al.*, 2022).

#### 4.1.3 Air-Dry Bulb Weight (g)

The results of the F-test of the analysis of variance showed that the application of the type of solid organic fertilizer studied significantly affected the dry bulb weight parameter. The average dry bulb weight of shallots affected by various types of solid organic fertilizer is shown in Table 3.

**Table 3. Average dry weight of red onion bulbs due to the application of solid organic fertilizer.**

| Treatment                       | Dry Bulb Weight (gr) |
|---------------------------------|----------------------|
| J <sub>1</sub> : cow manure     | 75,50 a              |
| J <sub>2</sub> : goat manure    | 88,75 b              |
| J <sub>3</sub> : chicken manure | 85,17 ab             |
| HSD                             | 4,90                 |

**Description:** Numbers followed by the same letter in the same column are significantly different at the 5% level of honest significant difference (HSD) test.

Table 3 shows that the highest dry weight of shallot bulbs due to the application of solid organic fertilizer was found in treatment (J<sub>2</sub>: Goat Manure), which was not significantly different from treatment (J<sub>3</sub>: Chicken Manure) but significantly different from treatment (J<sub>1</sub>: Cow Manure).

This is suspected because the application of chicken manure provides a balance of nitrogen (N), phosphorus (P), and potassium (K). This allows the plant to better carry out its physiological processes, which ultimately stimulates and supports bulb formation. The weight of shallot bulbs can vary depending on the moisture content and storage temperature. Too high a moisture content at the start of storage can cause the bulbs to rot, while too low a moisture content can cause them to shrink. Therefore, maintaining the correct moisture content is crucial for maintaining bulb quality during storage (Pawarta *et al.*, 2019).

The weight loss of shallot bulbs after storage typically ranges from 5% to 30%. The greater the shrinkage, the lower the freshness of the bulbs. Conversely, low shrinkage indicates better bulb quality and a longer shelf life (Sutriana *et al.*, 2018; Susilawati *et al.*, 2024).

## 4.2 Effect of Solid Organic Fertilizer Dosage on Shallot Yield

### 4.2.1 Number of Bulbs

The results of the F-test of the analysis of variance indicate that the solid organic fertilizer dosage studied had no significant effect on the number of bulbs per plant. The average number of bulbs per shallot plant resulting from various solid organic fertilizer dosages is shown in Table 4.

**Table 4. Average number of bulbs per shallot plant due to the administration of solid organic fertilizer doses**

| Treatment                      | Number Of Tubers |
|--------------------------------|------------------|
| D <sub>1</sub> : 25 g/polybag  | 10,28            |
| D <sub>2</sub> : 50 g/polybag  | 10,22            |
| D <sub>3</sub> : 75 g/polybag  | 9,11             |
| D <sub>4</sub> : 100 g/polybag | 8,83             |
| HSD                            | -                |

**Description:** Numbers followed by the same letter in the same column are significantly different at the 5% level of honest significant difference (HSD) test.

Table 4 shows no significant difference in the amount of solid organic fertilizer applied to the number of bulbs in shallot plants. It is suspected that the amount applied was insufficient to increase the number of bulbs. The soil also significantly influences the plant, resulting in a lack of nutrients needed for onion growth, particularly for bulb formation.

According to Suryana (2018), a plant will grow and develop well if the nutrients provided can be absorbed by the plant, are in a form suitable for root absorption, and are in sufficient condition. Furthermore, the inability to produce bulbs is associated with yellowing of the shallot leaves. Yellowing of the leaves causes a reduction in chlorophyll and photosynthesis, thus reducing photosynthate production (Gardner, 2016). According to Gough (2015), the number of leaves formed during vegetative growth significantly affects the number of bulbs (Asri *et al.*, 2019).

The bulb is the storage site for photosynthetic products in shallot plants, so the number of bulbs will increase as the number of leaves increases. This is consistent with research (Sumarni *et al.*, 2013), which states that bulbs are formed from layers of leaves that fuse and enlarge. Leaf layer enlargement is influenced by nitrogen, which produces nucleic acid, which plays a role in cell division, ensuring proper leaf formation and continued development into shallot bulbs. Leaves are the site of food processing, or photosynthesis, aided by chlorophyll, sunlight, carbon dioxide, and water. These are then processed and converted into carbohydrates and oxygen, which are distributed throughout the plant to meet the plant's nutrient needs (Fadlilah *et al.*, 2022).

#### 4.2.2 Wet Bulb Weight (g)

The results of the F-test of the analysis of variance indicated that the dose of solid organic fertilizer studied had no significant effect on the wet bulb weight parameter. The average wet bulb weight of shallots resulting from various doses of solid organic fertilizer is shown in Table 5.

**Tabel 5. Rata-rata bobot umbi basah bawang merah akibat pemberian dosis pupuk organik padat**

| Perlakuan                      | Wet Bulb Weight (gr) |
|--------------------------------|----------------------|
| D <sub>1</sub> : 25 g/polybag  | 92,22                |
| D <sub>2</sub> : 50 g/polybag  | 104,44               |
| D <sub>3</sub> : 75 g/polybag  | 95,00                |
| D <sub>4</sub> : 100 g/polybag | 96,11                |
| BNJ                            | -                    |

**Description: Numbers followed by the same letter in the same column are significantly different in the 5% level of honest significant difference (HSD) test.**

Table 5 shows no significant difference in the wet bulb weight of shallots due to the application of solid organic fertilizer. The highest wet bulb weight resulting from the application of solid organic fertilizer was found in treatment (D<sub>2</sub>: 50 g/polybag).

It is suspected that excessively high soil water content can inhibit bulb formation, resulting in low bulb weight. Shallots are more sensitive to water stress during bulb formation and enlargement than during the vegetative stage (Khokhar, 2017). Prolonged water overload in shallots causes a decrease in dry bulb weight, but both wet and dry bulb weights increase with reduced watering frequency (Ariska and Rachmawati, 2017). Bulb weight loss is caused by evaporation and respiration during storage (Sugianto & Jayanti, 2021).

#### 4.2.3 Air-Dry Bulb Weight (g)

The results of the F-test of the analysis of variance showed that the dose of solid organic fertilizer studied had no significant effect on dry bulb weight. The average weight of dry bulbs of shallots affected by various doses of solid organic fertilizer is shown in Table 6.

**Table 6. Average dry weight of red onion bulbs due to the administration of solid organic fertilizer doses.**

| Treatment                      | Dry Bulb Weight (gr) |
|--------------------------------|----------------------|
| D <sub>1</sub> : 25 g/polybag  | 81,11                |
| D <sub>2</sub> : 50 g/polybag  | 87,00                |
| D <sub>3</sub> : 75 g/polybag  | 79,33                |
| D <sub>4</sub> : 100 g/polybag | 85,11                |
| BNJ                            | -                    |

**Description: Numbers followed by the same letter in the same column are significantly different in the 5% level of honest significant difference (HSD) test.**

Table 6. Shows that there is no significant difference due to the dosage of solid organic fertilizer on the parameters of the dry weight of shallot planting. The dry weight of shallot bulbs due to the highest dosage of solid organic fertilizer was in the treatment (D<sub>2</sub>: 50 gr/polybag). Manure has good water retention capabilities, so that a greater proportion of manure compared to mineral materials results in a higher water content stored in the soil. Goat manure contains 31% organic material with a C/N ratio of 20-25% (Lumbanraja and Harahap 2015), The results of research by Intara *et al.*, (2011), show that the available water content in soil added with organic materials is higher than without organic materials. Soil that is too moist causes the water content in the bulbs to also increase, so that when stored there is a high weight loss. Weight loss is influenced by storage temperature and water content in the tubers. The higher the storage temperature and water content, the greater the tuber weight loss (Mutia *et al.*, 2017).

## 5. Conclusion and Recommendation

Based on the results and discussion, it can be concluded:

The application of solid organic fertilizer significantly affected the parameters. The application of solid organic fertilizer did not significantly affect the number of tubers, but did significantly affect the wet and dry tuber weights. The best application of solid organic fertilizer was J<sub>2</sub> = Goat Manure. The application of solid organic fertilizer dosage did not significantly affect the parameters of tuber number, dry tuber weight, and air-dry tuber weight. The best application of solid organic fertilizer was D<sub>2</sub> = 20 tons/ha = 50 g/polybag.

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