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The Increase of Organic Shallots (*Allium cepa var ascalonicum L.*) Production through the Application of Compost on Inceptisol Soils

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Abstract This study was conducted at the Experimental Garden of the Faculty of Agriculture, Islamic University of North Sumatra, Jalan Karya Wisata, Gedung Johor Village, Medan Johor Sub-district, Medan City, North Sumatra Province at an altitude of ± 25 meters above sea level, with Inceptisol soil type. This study was conducted from March 2021 to May 2021. This study aims to determine the compost type that could increase the production of shallots (Allium cepa var ascalonicum L.) in Inceptisol soil. The study used a non-factorial Randomized Block Design (RAK) with 5 treatments, namely compost type with five replications (25 experimental plots), including P_1 = Liquid Organic Pineapple Fertilizer of 4.5 ml/liter of water/polybag, P_2 = straw compost of 20 tons/ha (1 kg/polybag), P_3 = rice husk charcoal compost of 10 tons/ha (1.5 kg/polybag), P_4 = market waste compost of 10 tons/ha (2 kg/polybag), P_5 = market waste compost enriched with trichoderma of 10 tons/ha (2 kg/polybag). Parameters observed were the number of tubers per plant, the number of tubers per plot, the weight of the tubers per plant, the weight of the tubers per plot, and the size of the tubers. The results show that the type of compost treatment had a significant effect on the production of shallots. Market waste compost enriched with trichoderma (P5) resulted in the highest production.

Keywords Compost Type, Inceptisol Soil

1. Introduction

The need for Shallots (*Allium ascolanicum L.*) is very high since they are used in every menu of cuisine. The needs for Shallots in North Sumatra are only 40% met by local production, while the rest is distributed from other regions [16]. In 2019, Shallot production in North Sumatra was 18,072 tons with a harvested area of 2,246 hectares. However, the need for onions in North Sumatra reached 4,057 tons per month [1].

Various efforts have been made by the government of North Sumatra to increase the production of shallots, including planting in the lowlands with Inceptisol soil types. Inceptisol soil is nutrient-poor soil. It can be fertilized using both organic and inorganic fertilizers to increase the productivity of shallots. However, with environmental and health issues, organic fertilizer is an option [18].

Organic fertilizers are sourced from several types and ways of application. The materials to make organic fertilizer can be market waste available in abundance every day, from former rice cultivation in the form of straw, and rice husks available in each growing season.

One of the organic materials for fertilizer which is commonly used is rice straw compost. In this case, compost has the function of improving soil structure, strengthening the binding capacity of aggregates (nutrients) in sandy soil, increasing endurance and water absorption, improving drainage and pores in the soil, and adding and activating nutrients [19].

R. Prabavathi et al [14] stated that the people and government wanted to improve traditional and modern farming methods by converting them to automated services to increase output. In addition, farmers use traditional farming cycles and the latest innovations. Since the global food system is facing severe challenges, there is a need for investment in research to provide new solutions for precision agriculture. Digital technology farming systems have emerged to address contemporary issues in sustainable agriculture and to obtain optimal yields from the right inputs.

Adding rice straw compost to the soil is beneficial for improving soil structure and increasing nutrient availability for plants. Straw compost contains C-organic nutrients (20.02), N (0.75%), P (0.12%), K (0.69%), and C/N (23.69) [2]. Furthermore, Prasetiya et al. [12] stated that consistent use of straw compost in the long term will be able to increase the organic matter content of the soil and restore soil fertility. Giving 20 tons/ha showed the highest yields on plant height, tuber diameter, and tuber weight per sample. Based on Hayati [6] stated that straw compost has complete nutrients, but its content is low; so, it needs to be combined with inorganic fertilizers to increase plant growth and production. Rice husk charcoal contains various types of organic acids that are able to release nutrients bound in the mineral structure of the ash. The contents of rice husk charcoal are SiO_2 (52%), C (31%), K (0.3%), N (0.18%), F (0.08%), and calcium (0.14%). It also contains other elements such as Fe_2O_3, K_2O, MgO, CaO, MnO, and Cu in small amounts as well as several types of organic matter.

High silica content can be beneficial for plants because it becomes more resistant to pests and diseases due to tissue hardening [15]. Rice husk charcoal as a substitute for potassium fertilizer is one step in reducing the use of chemical fertilizers. In addition, it can reduce the pollution caused by the waste, such as water pollution and air pollution, and increase the percentage of soil aggregation. Improvements in soil aggregation have not had an impact on improving the percentage of available water pores and slow drainage pores [4].

Market waste is a very potential source of organic matter since it is abundant every day. Its utilization to increase the production of organic shallots needs to be studied, thereby reducing environmental pollution and creating clean, healthy, and comfortable traditional market conditions, as well as overcoming the scarcity of fertilizers [22]. The provision of additional nutrient intake in liquid form will also have an effect on plants. Organic fertilizers can be processed from waste materials, including one sourced from pineapple. Liquid organic fertilizers are mostly applied through the leaves or referred to as foliar liquid fertilizers containing essential macro and micronutrients (N, P, K, S, Ca, Mg, B, Mo, Cu, Fe, Mn, and organic matter) [17].

Therefore, the author has carried out a study entitled "the Increase of organic shallots (Allium cepa var ascalonicum L.) production through the application of compost on Inceptisol soils."

2. Materials and Methods

This study was conducted at the Experimental Garden of the Faculty of Agriculture, Islamic University of North Sumatra, Jalan Karya Wisata, Gedung Johor Village, Medan Johor District, Medan City, North Sumatra Province at an altitude of ± 25 meters above sea level. This study was conducted from March 2021 to May 2021.

The study used a non-factorial Randomized Block Design (RAK) with 5 treatments, namely compost type with five replications (25 experimental plots), including P_1 = Liquid Organic Pineapple Fertilizer of 4.5 ml/liter of water/polybag, P_2 = straw compost of 20 tons/ha (1 kg/polybag), P_3 = rice husk charcoal compost of 10 tons/ha (1.5 kg/polybag), P_4 = market waste compost of 10 tons/ha (2 kg/polybag), P_5 = market waste compost enriched with trichoderma of 10 tons/ha (2 kg/polybag). The parameters observed were the number of tubers per plant, the number of tubers per plot, the weight of the tubers per plant, the weight of the tubers per plot, and the size of the tubers.

3. Results and Discussion

3.1. Number of Tuber per Plant (tubers)

The type of compost (P) had a significant effect on the number of tubers per plant. Data on the number of tubers per onion plant is presented in Table 1.

Table 1. Average Data of Organic Shallot Production using Compost Type Treatment

Treatment of Compost Type	Number of tubers per plant (tubers)	Weight of the tubers per plant S (g)	Weight of the tubers per plot (g)	Number of the tubers per plot (Umbi)	Size of tubers Per Polybag (mm)
P1	12.92 b	8.56 d	49.80 c	73.20 c	7.63 c
P2	12.32 b	10.44 c	61.00 c	69.80 d	8.44 b
P3	12.44 b	10.12 c	58.80 d	73.00 c	8.83 b
P4	14.40 a	13.92 b	76.80 b	81.60 b	10.15 a
P5	15.36 a	16.40 a	95.40 a	87.40 a	10.41 a

Note: Numbers followed by unequal letters in the same column show a significant difference at the 5% level based on Duncan's Distance Test.

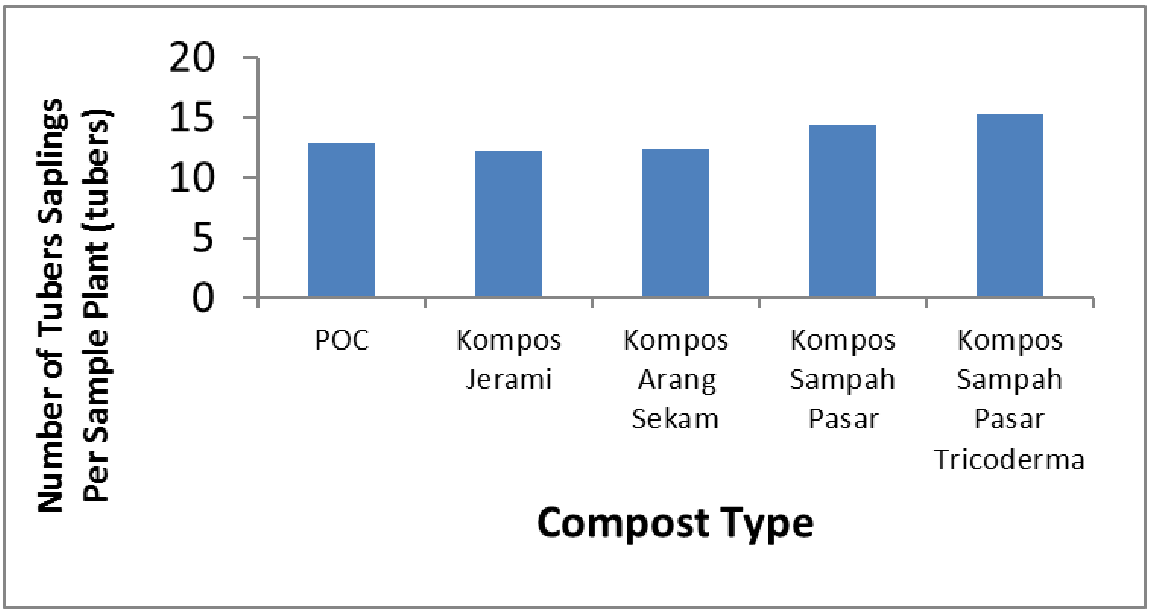

Figure 1. Number of Tubers per Shallot Plant in the Treatment of Compost Type

The treatment of trichoderma market waste compost of 10 tons/ha (P5) resulted in the highest number of tubers per plant (15.36 tubers) compared to giving market waste compost of 10 tons/ha (P4) (14.40 tubers), husk charcoal compost of 10 tons/ha (P3) (12.44 tubers), straw compost of 20 tons/ha (P2) (12.32 tubers), and liquid organic fertilizer of 4.5 ml/liter of water (P1) (12.92 tubers) (Table 1 Figure 1).

3.2. Weight of Tubers per Plant (g)

Compost type (P) had a significant effect on tuber weight per plant. Data on the weight of tubers per plant is presented in Table 1. The compost fertilizer treatment had a significant effect on the weight of tubers per onion plant at harvest, where the treatment of trichoderma market waste compost of 10 tons/ha (P5) resulted in the heaviest tuber weight per plant, i.e., 16.40 g, compared to the application of market waste compost of 10 tons/ha (P4), i.e., 13.92 g, compost charcoal husk of 10 tons/ha (P3), i.e., 10.12 g, straw compost fertilizer of 20 tons/ha (P2), i.e., 10.44 g, and liquid organic fertilizer of 4.5 ml/liter of water (P1), i.e., 8.56 g.

3.3. Weight of Tubers per Plot (g)

The type of compost fertilizer (P) had a significant effect on tuber weight per plot. Data on the weight of tubers per onion plot is presented in Table 1.

The compost fertilizer treatment had a significant effect on tuber weight per plot. The treatment of trichoderma market waste compost of 10 tons/ha (P5) resulted in the heaviest tuber weight per plot, i.e., 95.40 g, compared to the application of market waste compost fertilizer of 10 tons/ha (P4), i.e., 76.80 g, husk charcoal compost fertilizer of 10 tons /ha (P3), i.e., 58.80 g, straw compost (P2) i.e., 61.00 g, and liquid organic fertilizer of 4.5 ml/liter water (P1), i.e., 49.80 g (Table 1 and Figure 2).

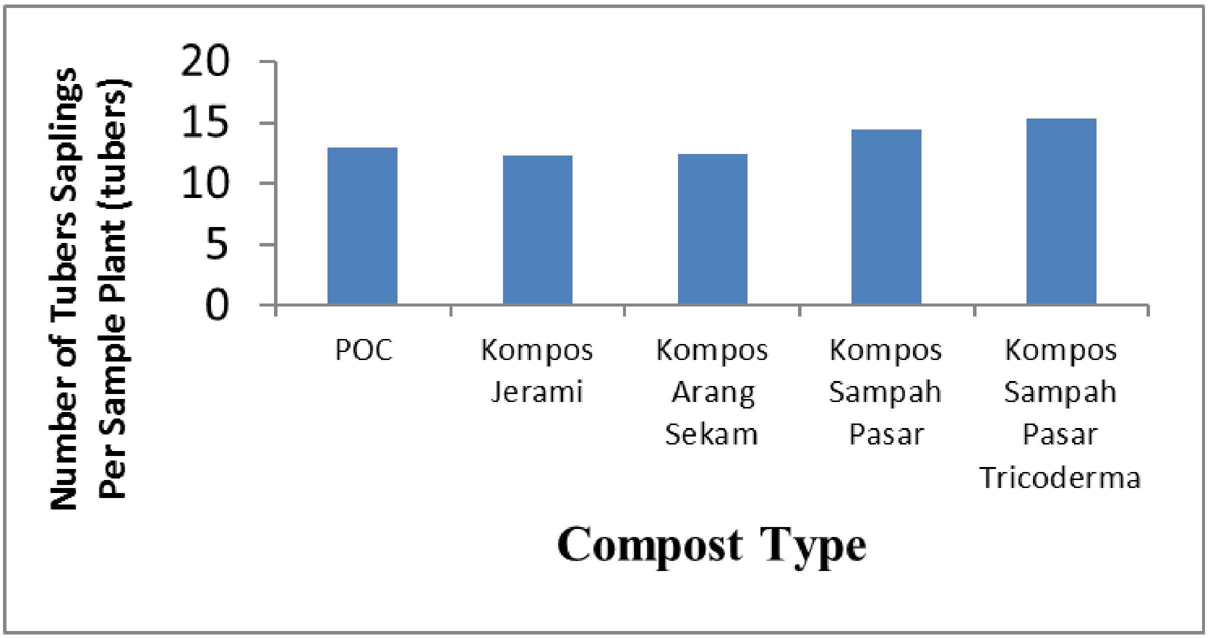

Figure 2. Weight of Tubers per Plot in The Treatment of Compost Type

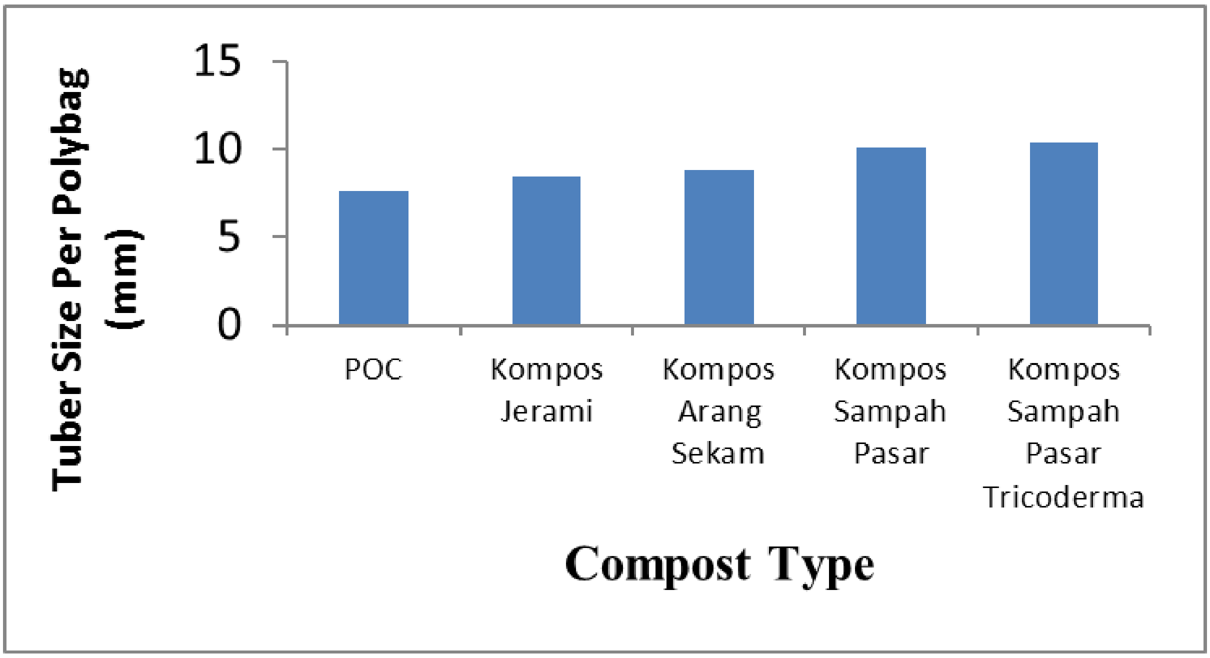

Figure 3. Size of Shallot Tubers in the Treatment of Compost Type

3.4. Number of Tubers per Plot (tubers)

The type of compost significantly affected the number of tubers per plot. Data on the number of tubers per plot is presented in Table 1.

The compost fertilizer treatment had a significant effect on the number of tubers per plot. Market waste compost fertilizer with trichoderma of 10 tons/ha (P5) produced the highest number of tubers per plot, i.e., 87.40 tubers. It was followed with market waste compost fertilizer application of 10 tons/ha (P4) (81.60 tubers), husk charcoal compost fertilizer of 10 tons /ha (P3) (73.00 tubers), straw compost of 20 tons/ha (P2) (69.80 tubers), and liquid organic of 4.5 ml/liter of water (P1) (73.20 tubers)

3.5. Size of Tubers (mm)

The type of compost fertilizer (P) had a significant effect on tuber size. Data on the size of tubers is presented in Table 1.

The type of compost treatment had a significant effect on the size of tubers per polybag of shallots at harvest, where the treatment of market waste compost of 10 tons/ha (P5) resulted in the largest tuber size per polybag, i.e., 10.41 mm. It is followed with the application of market waste compost fertilizer of 10 tons/ha (P4) (10.15 mm), husk charcoal compost fertilizer of 10 tons /ha (P3) (8.83 mm), straw compost of 20 tons/ha (P2) (8.44mm), and liquid organic fertilizer of 4.5 ml/liter of water (P1) (7.63 mm).

The results show that the size of the tubers matched the description of the onion varieties used, thus the experiment (P5) in this study met the description standard. It is in line with Poerwowidodo [13], stating that plant growth will be optimal if the required nutrients are available in appropriate quantities and forms with the plant's needs.

This is very different from the findings in one of the dairy congresses held in Tuguegarao City, Cagayan in 2018. It was alleged that the same findings were also emphasized, reaffirming the fact that the value or benefit of using dairy cow dung is invaluable. It will recycle and reuse dairy products' manure which can cause environmental pollution and lead to an unprecedented catastrophe caused by global warming [10].

It was highly recommended in the study to adopt vermicomposting using dairy animal waste as an ingredient for the production of vermicompost. It will contribute to the mitigation of environmental pollution, especially gas emissions from dairy animal waste, and as a way of job creation, thereby increasing farmer household incomes and increasing community life.

The type of compost has a significant effect on the production of shallots. The trichoderma market waste compost gives the best results. It is suspected that the trichoderma market waste compost contains organic matter as a nutrient that is sufficient to meet the needs of plants. Elisabeth et al [5] said that the role of organic matter from the plant aspect from the weathering of organic matter can contain organic acids. These acids can increase the availability of nutrients for plants and can be absorbed by plants immediately. The role of Trichoderma sp. is very large in maintaining soil fertility and suppressing the population of pathogenic fungi. Thus, Trichoderma sp. has the potential as an active compost and as a controlling agent for pathogenic organisms [7].

Compost is the result of the decomposition of organic matter by microorganisms. This decomposition is actually a biological process by microorganisms whose energy source comes from organic waste. This biological process runs naturally because microorganisms do need energy to stay alive and reproduce. Sulistyaningsih et al. [17] stated that the bacteria present in the compost extract were quite effective in continuing the process of degradation and decomposition of organic matter. The size and type of compost raw materials affect the decomposition process sooner or later. In addition, the combination of organic waste materials is an important factor in the decomposition process. The more variations of the organic waste mixture, the better the quality of the compost that will be produced [9]. This is in accordance with the results of this study where market waste compost consisting of various kinds of organic materials such as vegetables decomposes faster than straw compost and husk charcoal compost. Elisabeth et al [5] said that the role of organic matter from the plant aspect in the weathering of organic matter can contain organic acids that can increase the availability of nutrients for plants and can be absorbed by plants immediately. Nurhayati et all [11] showed that the application of rice straw compost in the K3 treatment (75 g/polybag) had a significant effect on the moisture content of cocoa seeds by 72.01%, and in the 125 g/polybag treatment it could increase the growth of cocoa seedlings, namely high seedlings, stem diameter, number of leaves, leaf area, root volume, crown and root ratio, and dry weight.

The shallot plant is a pseudo-trunked plant with very thin stems called discs. On the disc, there are buds that can become new plants called lateral shoots or tillers which will form new discs to form new tubers [21].

In this case, the formation of the disc until the formation of tubers really needs nutrients, where the nutrients that are needed in the preparation of tissues are Phosphorus and Potassium which play a role in activating growth enzymes. Based on Poerwowidodo [13] stated that plant growth will be optimal if the required nutrients are available in quantities and forms according to plant needs.

The availability of nutrients (N, P, K) contained in the compost gives a positive response to the growth of tubers, which will be absorbed and carried to the leaves to be assimilated in the process of photosynthesis. One of the products of this photosynthesis is fructans, in which Liliaceae plants store fructans in tubers [21]. An indirect mechanism is also developed by Trichoderma sp to increase plant growth and yield through the production of phytohormones and exopolysaccharides. Trichoderma sp is known as PGPR which produces phytohormones cytokinins and gibberellins [8].

It is suspected that the addition of nutrients from the combined material for each type of compost will be better than one type of compost material. Cahaya and Nugroho [3] showed that the mixture of vegetable waste and goat feces turned into compost faster than the other variables.

4. Conclusion

1. Different types of compost produce different components of shallot production.
2. The trichoderma market waste compost P(5) produced the best results for the production of shallots.
3. The type of compost has a significant effect on the number of tubers per plant, the weight of tubers per plant, the weight of tubers per plot, the number of tubers per plot, and the onion tuber size.
4. The treatment of trichoderma market waste compost showed a higher number of tubers than other fertilizer treatments.

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