Effect of Types of Local Organic Matter on Vertisol Soil on Growth and Yield of Three True Shallot Seed Varieties

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Abstract. The success of shallot cultivation in vertisol soil is influenced by the use of seeds and the application of organic matter. This aim of this study aims to determine was to the effect of local organic matter on vertisol soil on the growth and yield of three true shallot seed (TSS) varieties. The research was carried out in Plembutan, Playen, Gunung Kidul. The research was conducted from May–August 2021. The research method used a Split Plot Design with 3 replications. The main plot consists of types of local organic matter (B), consisting of B1 = Cow, and B2 = Goat, B3 = Chicken. While the sub-plots were Varieties (V), consisting of: V1 = Maserati, V2 = Sanren, and V3 = Lokananta. Plant height, number of leaves, number of bulbs per clump, dry bulb weight per clump, bulb diameter, and productivity were all measured. The data was analyzed using variance and DMRT 5%.The results showed that the type of local organic matter did not significantly interact with the TSS variety. Plant height, number of leaves, number of tubers per clump, dry tuber weight per clump, tuber diameter, and productivity were not affected by the organic matter and variety treatments. The type of local organic matter from cows produces the highest growth and yields, followed by goats and chickens. The lokananta variety produced the highest productivity, followed by Sanren and Maserati.

Keywords: Organic matter · Productivity · Shallots · Vertisol · Yield

1 Introduction

Shallots as a strategic commodity whose demand is always increasing, require an increase in the amount of production. Production development can be done by innovating cultivation technology and expanding the planting area. The use of seeds or true shallot seed (TSS) can be used as an innovation in shallot cultivation technology. The use of TSS can provide advantages including efficient seeds, cheaper costs, does not carry pathogens, efficient fertilizers, resistance to hot temperatures, and high yields [1]. The use of TSS gives varying results. The Tuk Tuk variety in Brebes yields up to 27 t/ha [2]. The use

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of TSS increased the highest growth and productivity in different varieties such as Maja [3], Bima [4] and Sanren, lokananta [5].

The addition of planting areas can take advantage of sub-optimal land such as vertisol soil. Vertisol soil has physical properties of heavy texture with high clay content, low volume weight, dark color, saturated moisture and high field capacity [6], low organic matter, slightly acidic to neutral pH (pH 5.5–7.4), P very low-high potential, high category potential K, low available P, [7, 8] and high-very high cation exchange capacity (CEC) [9]. However, Sukmasari et al. [10] reported that vertisol soil has an alkaline pH, P2O5 and K2O are very low. The physical condition of this soil makes it difficult to cultivate the soil, because Vertisol soil has a small tillage value, expands when wet, and shrinks when dry [6, 11].

Improvement of vertisol soil properties can be done by adding organic matter so that the soil is more fertile and nutrients are optimally available. Organic matter in the soil has the benefit of increasing the ability to hold water and soil structure, microbiological activity, cation exchange capacity [12], and the availability of P and S nutrients [8]. Organic matter is a complete source of nutrients, although its availability varies. According to Purnawanto and Budi [11] shallot plants require loose soil. The use of manure was able to increase the N, P, and K content and improve the physical properties of the soil. The use of solid manure can increase the availability of nutrients, so that it affects root growth, corn production [13]. Several potential sources of organic matter in the Gunung Kidul area include cows, goats, and chickens. The results of the research [14] stated that the use of goat and cow fertilizer significantly affected the number of tubers per clump, plant height, but not significantly on the wet and dry weight of tubers. Organic fertilizers also affect K content, but have no effect on N, P, Ca, MG [15].

Manure is a product that comes from livestock business waste, various types of livestock, including cows, goats, sheep, horses, buffalo, chickens, and pigs [16]. The use of the type of manure has a significant effect on the growth and yield of shallot plants [12, 17–19]. The use of organic matter will improve the availability of soil nutrients. Nutrients can stimulate the growth of roots, stems, leaves, and height and growth of onion bulbs. Furthermore, the use of cow manure significantly affects the yield and quality of shallots such as plant dry weight and wet tuber weight [20]. The use of rabbit droppings has a significant effect on the yield of chayote [21]. The use of cow manure has increased the yield of shallots with the best yield at a dose of 30 t/ha. But economically at a dose of 20 t/ha [22].

Based on these problems, research on the utilization and local organic matter and TSS in vertisol soils is required. The goal of this study was to see how the type of organic matter on Vertisol soil affected the growth and yield of three TSS varieties.

2 Materials and Methods

2.1 Location

This research is located in Plembutan, Playen, Gunung Kidul, DIY starting in May–August 2021.

2.2 Materials and Equipment

Research materials were obtained from commercial TSS (Maserati, Lokananta, and Sanren varieties), inorganic fertilizers, local organic matter (cow, goat, and chicken), and seedling media. Supporting equipment consists of scales, rulers, refractometers, calipers, and cultivation tools.

2.3 Method

The research design used was a split divided plot design with three replications. The main plot is the type of organic matter (B), consisting of B1 = Cow, and B2 = Goat, B3 = Chicken. While the sub-plots are Varieties (V), consisting of: V1 = Maserati, V2 = Sanren, and V3 = Lokananta.

2.4 Research Implementation

Research activities are divided into nursery, land preparation, planting, maintenance and harvesting. The nursery was carried out in a seedling tank with a size of 30 cm × 50 cm filled with seedling media with a thickness of 7.5 cm, then grooves were made with a depth of 1–2 cm and a distance between grooves of 8–10 cm. Furthermore, TSS is sown in the furrows, then the grooves are closed and carried out maintenance until the age of 35 days. Land preparation begins with tilling the soil 2 weeks before planting. The beds are made with a size of 1 × 3 m. The beds were given basic fertilization 3 days before planting in the form of organic material 10 $t.ha^{-1}$, (according to treatment) and inorganic fertilizer (Phonska 400 $kg.ha^{-1}$, ZA 200 $kg.ha^{-1}$, SP-36 100 $kg.ha^{-1}$ and KCl 100 $kg.ha^{-1}$. Transplantation was carried out on the land using a spacing of 10 cm x 15 cm and 1 perforated seed. Routine maintenance in the form of watering, fertilizing, and weeding weeds. Follow-up fertilization was given 2 times, namely at the age of 3 WAP, given NPK fertilizer with a dose of 400 $kg.ha^{-1}$, ZA 200 $kg.ha^{-1}$. The second supplementary fertilization at the age of 7 WAP. Weed control was carried out early on. Harvesting was done at the age of 11 WAP.

2.5 Parameters Measurement and Data Analysis

Plant height was measured at the age of 3, 5 and 7 weeks after planting, observed from the soil surface to the tip of the highest leaf which was straightened vertically upwards. Observations on the number of leaves in each clump were counting the number of leaves per clump at 3, 5 and 7 weeks after planting; The number of shallot bulbs was counted for each clump at harvest. The dry bulb weight per clump was observed by weighing the dry bulb weight with the leaves of each sample after the shallots were dried in the sun for 1 week; Diameter was observed at harvest by measuring the diameter of the tuber with a caliper. The number of observation samples was 10 plants. Productivity is calculated by converting from weight per plot of 3 m^2 to 1 hectare with an effective area of 60%. Plant height, number of leaves, number of tubers per clump, dry bulb weight per clump, tuber diameter, and productivity were the observation parameters. ANOVA and DMRT 5% data analysis.

Table 1. Effect of types of organic matter on plant height of three TSS varieties

Treatment	3 WAP	5 WAP	7 WAP
Local Organic Matter			
Cow	14,26 ± 3,58	23,03 ± 6,91	31,55 ± 9,62
Goat	14,46 ± 3,69	22,74 ± 6,71 a	30,63 ± 9,35
Chicken	13,26 ± 3,41	21,05 ± 6,39	28,43 ± 8,90
TSS Varieties			
Maserati	18,05 ± 3,41	29,46 ± 6,39	40,00 ± 8,90
Lokananta	29,46 ± 6,39	29,61 ± 6,71	40,11 ± 9,62
Sanren	19,21 ± 3,69	30,03 ± 6,91	31,55 ± 9,62
CV (%)	13,06	15,37	15,78

3 Results and Discussion

On all growth and yield parameters, the results revealed that there was no significant interaction between local organic matter types and TSS varieties. The use of local organic matter and varieties had no significant effect on plant height, number of leaves, productivity, tuber dry weight per clump, number of tubers and diameter.

3.1 Growth Component

Table 1 shows the results of observations of the effect of local organic matter types and varieties on plant heights of 3–5 WAP.

Treatment of types of organic matter had no significant effect on plant heights of 3–5 WAP. It is suspected that the type of organic material has quality characteristics that are not much different so that the decomposition process of organic matter takes place slowly for all organic materials [23]. The presence of organic matter will improve the stability of soil aggregates, drainage, aeration, water holding capacity, nutrients, and organisms. Several studies have stated that the use of manure has a significant effect on the growth of shallots [12, 17–19], because nutrients will be able to stimulate growth. Roots, stems, leaves, and height and growth of onion bulbs. The use of biochar can provide nutrients for shallots, so it significantly affects the wet weight and dry weight of the bulbs [24].

The use of varieties also did not give an insignificant effect on plant height 3–5 WAP. This condition is due to each variety having specific genetic characteristics in adapting to the growing environment, especially the availability of nutrients so that varieties will respond differently to growth [24] because each variety has different adaptability [5]. TSS varieties significantly affected plant growth [25].

Table 2 shows the effect of organic matter type and variety on the number of leaves of three TSS varieties aged 3–5 WAP.

The use of local organic matter types had no significant effect on the number of leaves of 3–5 WAP. This is due to the quality of organic matter and the slow decomposition

Table 2. Effect of types of organic matter on leaf number of three TSS varieties

Treatment	3 WAP	5 WAP	7 WAP
Local Organic Matter			
Cow	2,54 ± 1,12	3,64 ± 1,58	5,69 ± 3,21
Goat	2,73 ± 1,15	3,86 ± 1,63	6,24 ± 3,30
Chicken	2,47 ± 1,07	3,45 ± 1,51	4,97 ± 3,06
TSS Varieties			
Maserati	3,48 ± 1,12	4,84 ± 1,58	7,25 ± 3,21
Lokananta	3,31 ± 1,07	4,69 ± 1,51	6,74 ± 3,06
Sanren	3,53 ± 1,15	5,07 ± 1,63	8,56 ± 3,30
CV (%)	22,15	22,10	29,04

process. Manure is a product of livestock waste of varying quality, including cows, goats, sheep, horses, buffalo, chickens, and pigs [16]. The nutrients in chicken manure have a significant impact on shallot growth [12, 17–19]. Nutrients can stimulate the growth of roots, stems, leaves, and onion height. The findings of the study by Tambunan et al. [26] also revealed that the treatment of planting media had no significant effect on plant height parameters 2–3 WAT. This was due to the fact that the shallot seedlings had their own food reserves to aid in the growth process at the start of the growth period. In addition, according to Nuro et al. [27] organic fertilizers have slow-release properties or are slowly available (decomposes slowly).

The use of TSS varieties did not significantly affect the number of leaves 3–5 WAP. This condition is caused by each variety due to specific genetic characteristics in adapting to the growing environment [24], because each variety has different adaptability [5].

3.2 Shallot Yield Components

Table 3 shows the results of observations on productivity, dry tuber weight per clump, number of tubers, and tuber diameter in the Three TSS Varieties. This is in line with the results of research by Setyaningrum and Arbiwati [28] which stated that the use of cow and goat manure did not significantly affect the growth and yield of shallot bulbs.

The use of organic materials did not significantly affect all yield parameters. According to Purnawanto and Budi [11] shallot plants require loose soil. The addition of organic matter will improve the physical and chemical properties of the soil, making it more fertile and nutrient-dense. Organic matter in the soil improves water retention, soil structure, microbiological activity, and cation exchange capacity [12], and the availability of P and S nutrients [8]. Organic matter is a complete source of nutrients, although its availability varies. The use of organic fertilizers affected the growth and yield of shallots. Cow manure gave the best results at 45 DAP plant height, wet biomass weight, and safe dry weight and number of bulbs per clump compared to quail manure [29].

Table 3. Effect of types of organic matter on productivity, weight of dry tubers per clump, number of tubers, and tuber diameter of three TSS varieties

Treatment	Productivity ($kw.ha^{-1}$)	Dried Bulbs Weight per clump (gram)	Number of Bulbs	Bulb Diameter (cm)
Local organic Matter				
Cow	30,36 ± 13,09	5,29 ± 4,26	1,02 ± 0,51	1,67 ± 0,45
Goat	29,84 ± 13,46	4,93 ± 4,14	1,13 ± 0,52	1,53 ± 0,44
Chicken	28,43 ± 12,46	3,33 ± 3,94	0,98 ± 0,48	1,38 ± 0,42
TSS Varieties				
Maserati	36,84 ± 12,46	6,06 ± 4,14	1,29 ± 0,48	1,93 ± 0,42
Lokananta	43,64 ± 13,46	6,17 ± 4,26	1,33 ± 0,51	1,98 ± 0,44
Sanren	37,69 ± 13,09	5,83 ± 3,94	1,53 ± 0,52	2,19 ± 0,45
CV (%)	22,59	12,8	24,79	14,72

The nutrients in chicken manure have a significant impact on shallot yield [12, 17–20]. Vertisol soil has physical properties of heavy texture with high clay content, low volume weight, dark color, saturated moisture, and high field capacity [6], P and K nutrient compositions with low-very high variations, pH [7, 8, 10] and high-very high cation exchange capacity (CEC) [9].

The use of TSS varieties had no discernible effect on all yield parameters. The results of the study differ from the results of [3–5, 25] that the use of TSS varieties significantly affects the yield.

4 Conclusion

The findings revealed that the type of local organic matter did not have a significant interaction with the TSS variety. Plant height, number of leaves, number of tubers per clump, dry tuber weight per clump, tuber diameter, and productivity were not affected by the organic matter and variety treatments. Organic matter from cows produces the best growth and yields, followed by goats and chickens.

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