



Effect of Chicken Manure and Mulch Types to Growth and Yield of Shallot (*Allium ascalonicum* L.) in Lowland

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Authors' contributions

This work was carried out in collaboration among all authors. Author DA wrote the manuscript. Author MD performed the experiment, wrote the manuscript and analyzed the data. Author ID read the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The research aimed to study the interaction between chicken manure dose and mulch type to growth and yield of shallot in lowland.

Study Design: Factorial design in Randomized complete block design.

Place and Duration of Study: The research was conducted in experimental garden of Faculty of Agriculture, Andalas University, West Sumatera, Indonesia from September-December 2019.

Methodology: Factorial design with 3 factors in block randomized design was used in the research. The first factor chicken manure dose that consisted of three degrees (30 ton/ha, 40 ton/ha and 50 ton/ha). The second factor was type of mulch that consisted of two degrees (black plastic mulch and silver plastic mulch). The observed parameters were height of plant, number of leaves, number of bulb per clump and dry weight per hectare. The data was analyzed by using F test in 5% and followed by Duncan's New Multiple Range Test in 5%.

Results: The result showed that the interaction between chicken manure and mulch type did not

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affect the growth and yield of shallot.

Conclusion: Chicken manure and mulch type were not effective to use for increasing the growth and yield of shallot in same time.

Keywords: Chicken manure; lowland; mulch; shallot.

1. INTRODUCTION

Shallot (*Allium ascalonicum* L.) is annual the horticultural plant that was widely consumed by the Indonesian people [1]. The plant contains carbohydrate (69.97%), fructose (1.63%), glucose (2.03%), FOS (1.35%) and inulin (2.71%). This plant also contains allicin and essential oil that plays role as fungicide and bactericide [2].

The shallot production of Indonesia always increased last four years. In 2015, the production was 1,229,189 ton and followed 1,446,869 ton in 2016 and 1,470,155 ton in 2017. The last data in 2018 showed that the production was 1,503,438 ton [3]. This data showed that in 2017 to 2018, the increasing of production was not significant than 2016 production. This condition is required to study to analyze the problem and to maintain the increasing of production.

One of problem in shallot cultivation in Indonesia is the availability of productive land. Most of soil type in Indonesia is ultisol that is widely available in tropical zone [4]. The ultisol is classified to marginal land with the low productivity, low nutrient content because organic matter in horizon O is leached by flooding particularly in high rainfall area. This land is widely used by Indonesian farmer to cultivate [5].

One of effort to solve the problem is fertilization. Fertilization is nutrients addition process to soil that aims to add the nutrients that contains by soil to provide them for plants. The fertilization was conducted by using organic or inorganic fertilizer. The organic fertilizer was from rest of creatures both plants and animals [6]. The organic matter that contained in organic fertilizer played role to soil fertility. Organic matter played role granules stimulation, decreasing plasticity and cohesion, soil structure improvement, increasing the soil durability to hold water so that the drainage underwent well, stable humidity and temperature and also increasing of soil microorganism activity. One of organic matter source was chicken manure.

Chicken manure contained 1.00% of N, 2.80% of P₂O₅, 0.40% of K₂O. The previous result reported that 20 ton/hectare of chicken manure produced 4.3408 ton/hectare, higher than untreated by chicken manure (3.7508 ton/hectare). The use of variety Brebes in low land ultisol soil with 200-400 kg/ha of Zwavelzure ammoniak (ZA), 300 kg/ha of urea, 200 kg/ha of TSP and 200 kg/ha of KCl with 0-5 ton/ha of rice husk could produce 8.25-11.83 ton/ha of fresh weight of shallot [7].

The shallot development is still conducted in low land that it was still main problem in cultivating this plant. Apart from cultivation system, the environmental factor also affected the growth and development of plant. The shallot could not survive to high drought and temperature because this plant root was short meanwhile during growth and development, water and high humidity was required by plant. This condition caused the micro climate modification was required to keep the plant could growth and develop well. The temperature and humidity was the main micro climate that significantly affected the plant growth.

The mulch use was a effort to modify the environmental condition in order to be suitable for plant so that the plant could grow and develop well. Mulch was the soil covered material to make profitable condition to growth, development and yield increasing of plant. Generally, there were two type of mulch, organic and inorganic [8]. Organic mulch was the plant harvesting waste materials such as leaves, stem, rice straw and others. Inorganic mulch was from synthetic material such as plastic mulch.

Mulch played role to modify the micro climate. Mulch could decrease the rate of evaporation caused by solar radiation. It could optimize the growth and development of plant. Furthermore, mulch played role as to suppress weed growth, modifying water balance, temperature and soil humidity and also provide the suitable condition for plant [9]. The research aimed to study the interaction of chicken manure and mulch type to growth and yield of shallot.

2. MATERIALS AND METHODS

2.1 Experimental Site

The research was conducted in experimental garden of Faculty of Agriculture, Andalas University, Padang, West Sumatera, Indonesia with altitude 250 above sea level (asl) and the soil type was ultisol. The research was conducted from September to December 2019. The used materials were Brebes variety (shallot variety), urea, KCl and SP as fertilizer, chicken manure, black and silver plastic mulch, mankozeb 80%, Klorpiritos 530 g/L, Sipermetrin 55 g/L and water.

2.2 Methods

The factorial design with two factors in randomized complete block design was used in the research. The first one was chicken manure dose that consisted of three degrees. The second factor was mulch that consisted of two degrees with three blocks. The 18 plots were obtained, each plot consisted of 36 plants and for each plot, five plants were taken randomly as sampling.

The treatments were:

Factor A (dose of chicken manure):

- A1 : 30 ton/hectare
- A2 : 40 ton/hectare
- A3 : 50 ton.hectare

Factor B (mulch type)

- B1 : Black plastic mulch
- B2 : Silver plastic mulch

The data was analyzed by using F test in 5% and followed by Duncan's New Multiple Range Test (DNMRT) in 5%.

2.3 Procedure

The procedure was started by land preparation. The plot height was 30 cm and plot space was 40 cm for irrigation canal. The chicken manure was applied to plot after land preparation. The dose was applied according the treatments. The application was conducted by mixing with soil and not treated for a week. The mulch was applied a week after chicken manure was applied. The hole was made with 20 cm x 20 cm in space. One shallot seedling was planted for a hole.

The fertilization was conducted to increase the nutrients in soil. The fertilization was conducted

three times. The application of KCl, SP-36 and urea were applied in 7-21 days after planting (dap) and ZA was applied 35 dap. The fertilizer was applied 3 cm around shallot plant. The harvesting was conducted when 80% of shallot leaves were yellowing and the bulbs appeared in soil surface. The observed parameters were height of plant, number of leaves, number of bulb per clump and dry weight of bulbs per hectare.

3. RESULTS AND DISCUSSION

3.1 Height of Plant

The interaction between chicken manure and mulch type did not affect the height of plant (Table 1). Height of shallot plant is shown in Fig. 1. This result indicated that the 30 ton/hectare of chicken manure application has sufficed the nutrients requirement of plant. The height of plant was caused by the cell division and elongation that occurred in plant shoot. The process was generated by plant from the nutrients availability in plant and organic matter in plant [10]. Nutrients in ultisol soil was bound by Al in soil so that the nutrients were not available in soil. The organic matter to soil increased the soil cation exchange capacity so that the bound nutrients were released and available for plants. In this case, the chicken manure contributed to growth plant because the chicken manure contained the higher N, P, K and Mg than other fertilizer. The chicken manure contained 1.44% of Mg than other fertilizer [11,12].

The Mg availability in soil could increase the soil pH because Mg also decreased the toxin that caused by Al and Fe content in soil such as ultisol soil. Mg was the nutrient that required for various plant metabolism such as photosynthesis, cell formation, protein formation, starch formation, energy transfer and arrangement of carbohydrate to whole parts of plant [13].

The mulch application showed that the mulch was effective to support the growth of shallot plant. The mulch use caused the optimal environmental condition for shallot and also maintained the physical condition of soil. The mulch also hold the evaporation and protected the the soil from rain. The good physical soil provided the good drainage [14].

3.2 Number of Leaves

Number of shallot leaves was not also affected by interaction between chicken manure and

mulch types (Table 2). According the result, number of leaves of shallot was 35-41 and suitable according the description (14-50). This result also indicated that the 30 ton/ha of chicken manure has sufficed for the nutrients requirement for shallot growth.

The leaves growth was affected by the nitrogen availability in soil, but in ultisol soil, the nutrients were not available for plant because they were bound by Al. The addition of chicken manure, could release the bound nutrients and the nutrients could be absorbed by plant. Furthermore, the chicken manure contained nitrogen that required by plant in vegetative stage in plant tissue formation. N play role to stimulate the growth particularly stem, branch and leaves and encouraged the chlorophyll for photosynthesis process [15].

3.3 Number of Bulb per Clump

The result showed that the interaction chicken manure and mulch types did not affect the number of bulb of shallot. Otherwise, the different result was shown by the dose of chicken manure

as single factor. According the result, dose 30 ton/ha and 50 ton/ha was better than 40 ton/ha (Table 3).

The number of shallot bulbs was affected by soil condition, environmental and nutrients content. In the research, the shallot was planted in ultisol soil, a clay soil that caused the roots were difficult to penetrate the soil. The organic matter addition caused the soil aggregate became better, bigger soil pores, aeration and drainage in soil also became better. The organic matter in soil was important for plant as nutrients sources and also became nutrients for soil microorganism, increased water binding capacity, cation exchange capacity and improved the soil structure [16].

The bulb formation was affected by nutrients availability in soil. The P requirement has been available by chicken manure addition. P availability stimulated cells formation and fat and albumin formation, flowering and fertilization. Furthermore, phosphorus also increased the root development particularly lateral root to support the fall of plant [17].

Table 1. Height of plant of shallot in 7 weeks after planting (cm)

Mulch type	Dose of chicken manure			Average
	30 ton/ha	40 ton/ha	50 ton/ha	
Black	40.34	45.56	41.07	42.32
Silver	42.25	46.82	45.22	44.76
Average	41.30	46.19	43.15	
CoV	8.85 %			

Note: similar letters indicate significantly different according Duncan's New Multiple Range Test 5%; CoV : Coefficient of diversity



Fig. 1. Height of shallot plants in 6 weeks after planting (a. Silver plastic mulch; b. Black plastic mulch)

Table 2. Number of leaves of shallot in 7 weeks after planting

Mulch type	Dose of chicken manure			Average
	30 ton/ha	40 ton/ha	50 ton/ha	
Black	36.33	40.47	35.27	37.36
Silver	38.93	41.73	39.47	40.04
Average	37.63	41.10	37.37	
CoV	8.79%			

Table 3. Number of bulbs of shallot in 8 weeks after planting

Mulch type	Dose of chicken manure			Average
	30 ton/ha	40 ton/ha	50 ton/ha	
Black	8.87	12.27	6.73	9.29
Silver	9.40	12.00	11.80	11.07
Average	9.14 a	12.14 b	9.27 a	
CoV	17.76%			

Note: similar letters indicate significantly different according Duncan's New Multiple Range Test 5%; CoV : Coefficient of diversity

Table 4. Dry weight of bulbs of shallot in 9 weeks after planting

Mulch type	Dose of chicken manure			Average
	30 ton/ha	40 ton/ha	50 ton/ha	
Black	6.27	9.14	6.76	7.39 A
Silver	7.94	12.75	9.51	10.07 B
Average	7.11 a	10.95 b	8.14 a	
CoV	23.18%			

Note: similar letters indicate significantly different according Duncan's New Multiple Range Test 5%; CoV : Coefficient of diversity

The bulbs formation was also affected by environmental factor such as soil temperature, sunlight intensity that obtained by plant and growth hormone. The bulb formation process was significantly affected by low temperature in midnight that could stimulate appearance of bulb formation hormone. This hormone was continued to top of stolon or tuber [18].

3.4 Dry Weight of Bulb per Hectare

The interaction of chicken manure dose and mulch types did not affect the dry weight of bulb per hectare. But single factor of each factor affected the dry weight of bulbs per hectare (Table 4). According the result, 30 ton/hectare and 50 ton/hectare of chicken manure dose were better than 40 ton/hectare. For mulch types treatment, black plastic mulch was better than silver plastic mulch. According the result, dose 40 ton/hectare and silver plastic mulch has been increased the yield of shallot in low land. The Brebes shallot variety cultivation in low land could produce 10 ton/hectare.

The bulbs formation of shallot was not separated from phosphorus availability in soil, but in ultisol soil, this nutrient was not available for plant because high Al saturation caused by high mineral alkaline leaching [5]. The addition of chicken manure released Al-P bond and caused the phosphorus available could be absorbed by plant to form bulbs. Phosphorus was the macro nutrients that required by plant to form root and bulb of plant. High phosphorus content caused the increasing of plant metabolism activity. This condition the plant growth was better and the

bulb was more. The dry weight production was accumulated into bulb as food storage [17]. Fulfillment of food as nutrients source caused the plant more active to perform bulb enlargement and the bulb diameter increased. The chicken manure contained complete macro nutrients and could increase soil microorganism that could support soil structure improvement. This condition stimulated the growth and development of plant [12].

The dry weight of shallot was the accumulation of net carbohydrate assimilate during plant growth. This accumulation was correlated to plant photosynthesis efficiency. The reflection of sunlight by silver plastic mulch increased plant photosynthesis efficiency so that it increased the dry weight. One of role photosynthesis result was as food source and structure of shallot body [19].

4. CONCLUSION

The interaction of Chicken manure dose and mulch type did not affect the growth and yield of shallot. Otherwise, the single factor chicken manure dose and mulch type affected the dry weight of bulbs.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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