Journal of Tropical Horticulture
Vol 4, No 2, October 2021, pp. 26-30
ISSN 2622-8432 (online)
Available online at http://jthort.org

RESEARCH ARTICLE

The Effect of Liquid Organic Fertilizer From Coconut Husk And Dolomite On Shallot (*Allium Cepa* L.) Growth And Yield

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ARTICLE HISTORY

Received : 12 July 2021
Revised : **22 September 2021**
Accepted : 15 October 2021

KEYWORDS

Potassium;
Calcium;
Magnesium;
Fresh shallot bulbs weight;

ABSTRACT

Shallot is the most produced vegetable in Indonesia. The consumption of shallot per kg/capita/year is continuously increasing, therefore there is a need to ensure enough supply. The lack of nutrients in the soil is a problem in shallot production. Shallot needs macronutrients such as Nitrogen (N), Phosphorus (P), Potassium (K), and Calcium (Ca) to improve its yield and quality. The application of liquid organic fertilizer from coconut husk and dolomite can be the solution. This study was conducted using Factorial Randomized Block Design consisting of two factors, concentration of liquid organic fertilizer (0%, 10%, 20%, and 30%) and dolomite (with dolomite or without). The results showed that the application of 20% liquid organic fertilizer, the application of dolomite, and the combination of both (P_2D_1) had the highest value on fresh shallot bulbs weight per clumps and bulb weight after storage parameters, and had the lowest value on weight loss percentage parameter.

1. INTRODUCTION

One of nine national research main priorities is to encourage the development and utilization of domestic products, that includes food, plantations, and horticulture (Ristekdikti, 2020). In the horticulture sector, shallot, garlic, and chili pepper are commodities that received attention to be developed.

Shallot is an annual crop with 90% of edible part. The nutrient compositions of shallot per 100 grams are calorie of 39 kcal, protein of 2.50 g, and fat 0.30 g.

Shallot was the highest produced vegetables in Indonesia, followed by cabbage and cayenne pepper (Central Bureau of Statistic 2018), and also placed second in vegetable export in the same year. Shallot productivity in 2018 was 9,59 ton/ha, higher than previous years that was 8,37 ton/ha in 2016 and 9.06 ton/ha in 2017 (CBS 2019). Even the productivity was increasing, it is still important to continue developing this commodity to ensure national food security. According to the Ministry of Agriculture (2019), there was an increase in shallot consumption from 2.57 kg/capita/year in 2017 to 2,76 kg/capita/year in 2018.

One of the national research targets for 2020 - 2024 is to increase the national productivity of shallot (Ristekdikti, 2020). According to data from the Ministry of Agriculture (2018), increasing the productivity of shallots can be done by expanding the planting area and also improving cultivation technology. Improvements in cultivation technology can be done by adding nutrients to the soil and plants. Based on the research results, in addition to the elements N, P and K, shallot plants also need calcium (Ca) to increase yield and quality.

Calcium is an important element in the formation of cell walls. Ca2+ is the link between the pectin chain in the cell wall structure (Taiz and Zeiger 2010; Marschner 2012). Based on this function, it is assumed that the application of calcium will increase the integrity of the shallot cell wall and so that it has a longer shelf life.

One type of fertilizer that has a high amount of Ca is dolomite ($CaMg(CO)_3)_2$. According to Buckman and Brady (1982), dolomite is a farming lime that can add Ca and Magnesium (Mg) to meet the need of plants and can improve the physical property of the soil, and does not leave harmful residue in the soil. According to research results from Handayani (2017) application of 1,5 ton/ha dolomite at 4 weeks before planting resulted in a significantly higher number and weight of bulbs per clump, and significantly lower weight loss compared to an application at planting and application two weeks before planting.

Apart from dolomite, a fertilizer that is thought to increase the productivity of shallots is liquid organic fertilizer (LOF) made from coconut husk. Coconut husk

liquid organic fertilizer contains N of 1,58%, P_2O_5 of 0,79% and K_2O of 1,68% (Suriadi 2020).

Based on the description, it was deemed necessary to research the application of coconut husk LOF and dolomite to increase the yield and quality of shallots.

2. MATERIALS AND METHODS

This study was conducted in Ranononcu Sub-district, Poso District, on July – December 2020.

2.1 Experimental Design

This study was arranged using Factorial Randomized Block Design with 2 factors. The first factor (Factor A) was the application of dolomite with two levels of treatments:
D0 = control
D1 = 10 ton/ha dolomite

The second factor (Factor B) was the application of liquid organic fertilizer consisted of four levels of treatments:

P0 = control
P1 = LOF concentration of 10%
P2 = LOF concentration of 20%
P3 = LOF concentration of 30%

There were 8 combinations of treatments. Every combination was replicated three times, so there were 24 experimental units. Each experimental unit consisted of 5 polybags, so there were 120 polybags in total. The parameters observed were plant height, number of leaves per clump, bulb diameter, fresh bulb weight per clump, bulb weight after storage per clump, and the weight loss percentage.

2.2 Production of Coconut Husk Liquid Organic Fertilizer

Chopped coconut husk was mixed with brown sugar and EM4 solution, put in a sealed container, and fermented for two weeks.

2.3 Planting

The bulbs for seed were treated by submerging with dithane-45 solution for 30 minutes. The top third of the bulb was cut before planted. One bulb was planted in each planting hole.

2.4 Statistical Data Analysis

Data collected from the study were analyzed using analysis of variance and continued with further testing using Duncan Multiple Range Test at 5% or 1%.

3. RESULTS AND DISCUSSIONS

3.1 Plant Height

Analysis of variance result showed that treatments applied did not significantly affect plant height. The average plant height is shown in Table 1.

Table 1. Average plant height at 2, 3, 4 and 5 WAP

Treatment	Plant Height (cm) at (WAP)			
	2	3	4	5
Factor A (Concentration of LOF)				
P_0	18,80	24,45	26,75	29,85
P_1	20,76	25,37	27,84	29,83
P_2	20,85	26,50	29,11	30,49
P_3	19,59	27,06	29,39	30,99
Factor B (Application of Dolomit)				
D_0	19,81	26,03	28,06	30,00
D_1	20,20	25,67	28,49	30,59
Factor A x B				
P_0D_0	19,13	25,64	27,69	30,27
P_1D_0	20,42	25,80	27,85	29,33
P_2D_0	21,35	27,20	29,43	30,97
P_3D_0	18,32	25,46	27,27	29,42
P_0D_1	18,47	23,27	25,81	29,44
P_1D_1	21,10	24,93	27,83	30,34
P_2D_1	20,35	25,81	28,80	30,02
P_3D_1	20,87	28,66	31,52	32,57

Means followed by the same letters are not significantly different based on the DMRT test at 0.05 level

A nutrient that plays an important role in plant growth is Nitrogen. The optimal availability of N will have an impact on better plant growth and yield. Although, when N availability is low, the result would not be different from the control or without the addition of fertilizers. Nitrogen plays the most important role in various physiological processes such as giving plants a dark green color, increasing the number of leaves and stems, as well as the growth and development of other vegetative parts (Leghari et al. 2016). Sufficient Mg nutrient in plants is very important for better efficiency of N use (Cakmak 2013).

3.2 Number of Leaves

Analysis of variance result showed that treatment of a

single factor of liquid organic fertilizer and dolomite, as well as the combination of both factors, did not significantly affect the number of leaves. The average number of leaves is presented in Table 2.

Table 2. Average number of leaves at 2,3,4 and 5 WAP

Treatment	Number of leaves at (WAP)			
	2	3	4	5
Factor A (Concentration of LOF)				
P_0	8,43	12,60	19,58	23,52
P_1	9,27	13,57	17,61	24,03
P_2	9,43	13,25	19,47	25,70
P_3	8,90	13,80	19,77	26,62
Factor B (Application of Dolomite)				
D_0	8,65	13,15	18,85	26,33
D_1	9,37	13,46	19,36	23,60
Factor A x B				
P_0D_0	7,93	13,27	20,53	27,27
P_1D_0	8,67	13,07	15,87	26,40
P_2D_0	10,00	13,60	20,07	25,93
P_3D_0	8,00	12,67	18,93	25,73
P_0D_1	8,93	11,93	18,62	19,77
P_1D_1	9,87	14,07	19,36	21,67
P_2D_1	8,87	12,90	18,87	25,47
P_3D_1	9,80	14,93	20,60	27,50

Means followed by the same letters are not significantly different based on the DMRT test at 0.05 level

A similar result was showed in Sebastian (2019), that the application of coconut husk LOF was not significantly affected the number of leaves, even when combined by Gandasil fertilizer. In contrast with the study by Wilman et al. (2009), N was significantly affected the number of tillers and leaves.

The level of N in coconut husk LOF was presumed to be not optimal to affect the number of leaves, so there was no significant difference from the control.

3.3 Number of Bulbs per Clump, Bulb Diameter, and Fresh Bulb Weight per Clum

Table 3 shows that the treatments did not significantly affect the number of bulbs per clump. While in bulb diameter parameter, only application of dolomite treatment demonstrated a significant effect.

One of the nutrients in dolomite is Magnesium. Magnesium plays a role in carbohydrate synthesis that would be stored in the bulb. Magnesium and Nitrogen are constituents of chlorophyll (Winarso 2005), the proportion is 2,7% of chlorophyll molecule weight and is the activators of many enzymes (Yan and Hou 2018), thus Mg and N affected photosynthesis and carbohydrate partition in a plant (Wang et al. 2019).

The highest fresh bulb weight per clump resulted from the single factor of P_2 (20% of LOF), the application of dolomite (D_1), and the combination of both (P_2D_1). The higher dosage of LOF to 30% resulted in lower fresh bulb weight. Research by Romiyadi and Sufiadi (2015) also showed that the higher concentration of liquid coconut husk immersion, the lower the fruit weight yielded.

The potassium level in coconut husk is quite high, so fertilizer made from coconut husk can be the alternative for KCl. Potassium in coconut husk liquid organic fertilizer plays a role in the transportation of photosynthate to the bulbs, thus can increase the fresh weight of shallot. According to Rahma et al. (2019), PPPP (2017), and Torillo Jr and Mihara (2012). Potassium in coconut husk LOF is 2,48% to 10,25%, while N-total and P-total in coconut husk are 0,1138 mg N/g and 0,3037 mg P/g respectively.

3.4 Bulb Weight after Storage and Percentage of Weight Loss

The single factor and interaction of both factors gave a significant effect on bulb weight after storage and percentage of weight loss. The average bulb weight after storage and percentage of weight loss is shown in Table 4.

The treatment of P_2D_1 resulted in the highest bulb weight after storage, while the highest weight loss resulted from control. According to Muchtadi (1992), the weight loss of vegetables and fruits during storage is mainly because of water loss through transpiration. Calcium has several functions, one of which is to maintain the stability of the cell wall and can reduce weight loss. According to Thor (2019), Calcium is an important factor for cell wall and membrane stability. When Ca supply is low or the transportation of Ca is interrupted, local calcium shortage occurs, which can cause membrane damage and/or cell wall failure (Hocking et al. 2016). The high content of K in coconut husk liquid organic fertilizer can increase plant fresh weight through the increase of the number of cells and reduce transpiration (Center for Plantation Research and Development, 2017).

Table 3. Average number of bulbs per clump, bulb diameter and bulb fresh weight per clump

Treatment	Number of Bulbs per Clump (bulb)	Bulb Diameter (mm)	Fresh Bulb Weight per Clump (g)
Factor A (Concentration of LOF)			
P_0	6,08	14,65	16,87b
P_1	5,68	14,66	16,25b
P_2	6,64	15,62	21,19a
P_3	5,68	14,44	15,55b
Factor B (Application of Dolomite)			
D_0	6,19	14,11b	15,24b
D_1	5,85	15,57a	19,69a
Factor A x B			
P_0D_0	7,18	14,79	18,37b
P_1D_0	5,60	13,93	15,30bc
P_2D_0	6,80	13,58	13,93bc
P_3D_0	5,17	14,13	13,38c
P_0D_1	4,97	14,50	15,38bc
P_1D_1	5,75	15,39	17,21bc
P_2D_1	6,48	17,65	28,45a
P_3D_1	6,20	14,76	17,73bc

Means followed by the same letters are not significantly different based on the DMRT test at 0.05 level

Table 4. Average of bulb weight after storage and percentage of weight loss

Treatment	Bulb weight (g) at storage duration (WAS)				Percentage of weight loss (%)
	1	2	3	4	
Factor A (Concentration of LOF)					
P_0	12,70b	10,73b	8,37b	7,24b	56,35b
P_1	12,84b	10,93b	9,52b	8,95b	45,45ab
P_2	18,33a	16,77a	15,42a	14,30a	37,29a
P_3	12,58b	10,95b	9,70b	8,64b	42,79a
Factor B (Application of Dolomite)					
D_0	11,37b	10,01b	8,37b	7,31b	50,90b
D_1	16,85a	14,68a	13,14a	12,25a	40,04a
Factor A x B					
P_0D_0	13,27b	11,08b	7,62b	6,85b	62,86c
P_1D_0	11,50b	10,30b	8,90b	7,60b	50,28bc
P_2D_0	10,20b	9,54b	8,44b	6,81b	50,42bc
P_3D_0	10,50b	9,13b	8,50b	8,00b	40,05ab
P_0D_1	12,13b	10,38b	9,13b	7,63b	49,84bc
P_1D_1	14,18b	11,56b	10,14b	10,30b	40,63ab
P_2D_1	26,45a	24,00a	22,40a	21,80a	24,16a
P_3D_1	14,65b	12,78b	10,90b	9,28b	45,52bc

Note: Mean followed by the same letters are not significantly different based on the DMRT test at 0.05 level

4. CONCLUSIONS

Based on the obtained results, it can be concluded that:

The single factor of application of liquid organic fertilizer and application of dolomite and the combination of both factors were significant to very significant on parameters fresh bulb weight, bulb weight after storage and percentage of weight loss.

The treatment of 20% LOF concentration gave the highest value on fresh bulb weight and bulb weight after storage, and also gave the lowest percentage of weight loss.

The application of dolomite resulted in higher bulb diameter, fresh bulb weight and bulb weight after storage, and also a lower percentage of weight loss compared to without the application of dolomite.

The combination of treatments/interaction between the concentration of 20% liquid organic fertilizer and dolomite application resulted in the highest fresh bulb weight and bulb weight after storage, and also gave the lowest percentage of weight loss.

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