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RESPONSE OF GROWTH AND YIELD OF SHALLOTS (*ALLIUM ASCOLANICUM* L.) BY POTASSIUM NITRATE (KNO3) AND ORGANIC LIQUID FERTILIZATION

Arif Anwar[1], Syamsafitri[1], Mahyuddin[1], Yenni Asbur[1]*, Ichpan Zulfansyah[1], Yayuk Purwaningrum[1], Rahmi Dwi Handayani Rambe[1], Murni Sari Rahayu[1], Saur Ernawati Manik[1], M. Nuh[2], Mahyu Danil[2], Dedi Kusbiantoro[3] and Khairunnisyah[3]

[1]Department of Agrotechnology, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.
[2]Department of Agricultural Product Technology, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.
[3]Department of Agribusiness, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.

***Corresponding Author: Yenni Asbur**
Department of Agrotechnology, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.

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ABSTRACT

The shallots are one of the leading vegetable commodities, but have not shown a real increase in production every year so that efforts are needed to increase the production of shallots. This study aimed to obtain the optimum dose of KNO_3 fertilizer and liquid organic fertilizer in increasing the growth and yield of shallots. The study was conducted at the Balai Benih Induk, Medan, North Sumatra, Indonesia from March-June 2017. This study used factorial randomized block design with three replications. The first factor is the dose of KNO_3 fertilizer: 0 g/plot, 15 g/plot, 25 g/plot, 40 g/plot. The second factor is liquid organic fertilizer: 4.5 mL/L water, 9 mL/L water, 13.5 mL/L water. The results showed that the 40 g/plot KNO_3 fertilizer gave the best growth and yield of shallots. Provision of liquid organic fertilizer 13.5 mL/L water and interaction treatment between 25 g/plot of KNO_3 fertilizer and 40 g/plot with a concentration of liquid organic fertilizer 13.5 mL/L of water could only increasing the number of shallot leaves but have not been able to increase the yield of shallot bulbs.

KEYWORDS: Shallot, potassium nitrate, liquid organic fertilizer.

INTRODUCTION

The shallot (*Allium ascalonicum* L.) is one of many horticultural crops consumed by humans as a mixture of spices as chili. Aside from being a mixture of spices, onions are also sold in the form of processed products such as extracts of onion, powder, essential oils, fried onions,[1] even as medicine for lowering cholesterol, blood sugar, prevent blood clots, lower blood pressure as well as improving blood flow because onions contain a high nutrient, has a lot of vitamins, and acts as an activator of enzymes in the body.[2] Every 100 g of shallot contains 39 kcal, 1.5 g protein, 0.3 g fat, 9.2 g carbohydrate, 0.7 g fiber, 50 IU vitamin A, 0.03 mg vitamin B1, 0.04 mg riboflavin, 0.02 mg niacin, 9.0 mg ascorbic acid, 2.0 mg vitamin C, 36 mg calcium, 40 mg phosphorus, 0.8 mg Zn, and 88 g water.[3]

As many horticultural commodities consumed by the public, the potential for the development of the onion is still wide open not only for the domestic but also overseas.[4] Yield of shallots in North Sumatra is quite low and have not been able to meet local needs.[5] The yield of shallots has fluctuated from year to year. In 2013 yield of shallots was 8.305 t decreased to 7.810 t in 2014, rise again to 9.971 t in 2015 and to 13.368 t in 2016,[6] is still far from yield of shallots in Brebes, ie 386.885 t in 2016.[7]

The average yields obtained from shallot farming in this area reached 7.79 t/ha in 2014,[6] while the average yield of shallots in Brebes Regency reached 11.70 t/ha,[8] while international productivity reached 17.27 t/ha.[9] The low productivity of shallots in North Sumatra is due to the application of technology packages that have not been maximized at the level of farmers so that the quality and yield produced is still low, besides that the use of urea and medicines is quite high, resulting in the shallots susceptible to disease attacks.

Efforts that can be made to overcome this include providing inorganic fertilizer and organic liquid fertilizer. Inorganic fertilizers that can be given to

increase the growth and yield of shallots in North Sumatra are the provision of nitrogen-containing and potassium-containing fertilizers. Nitrogen plays a role in making amino acids, proteins, enzymes, is a major component of chlorophyll, so it is very important in photosynthesis, an important part of some vitamins and improving the quality and production of vegetables.[10] Potassium functions to activate enzymes, play a role in photosynthesis, protein formation and sugar transport. Besides that potassium plays an important role in the process of opening and closing stomata, as well as improving the quality of fruits and vegetables. High K concentrations can improve physical quality, disease resistance, and shelf life of fruits and vegetables.[11] The use of KNO_3 fertilizer can increase P and K concentrations in trubus lettuce tissue,[12] increase vegetative growth and generative curly red chili,[13] and be able to increase the dry weight of soybean varieties of Kaba, Burangrang, and Wilis,[14] while the results of[15] showed that KNO_3 fertilizer was not able to give a significant effect on the growth and yield of shallots.

In addition to inorganic fertilizers, organic fertilizer is needed to improve soil physical, chemical and biological properties. Organic material is a loose grain adhesive, a source of plant nutrients and an energy source for most soil organisms.[16] One of the organic fertilizers used is liquid fertilizer. Liquid fertilizer is more readily available, does not damage the soil and plants, and has a binding solution so that when applied can be directly used by plants, besides that it can be given through plant roots or leaves because the elements have been decomposed so that it is easily absorbed by plants.[17] Some researchs shown that the provision of liquid organic fertilizer can increase the weight of potato tubers,[18] increase the yield of field rice, paddy rice,[19;20;21;22] and black rice.[23]

Based on the foregoing, this study aimed to know at the growth response and the yield of shallots by providing KNO_3 fertilizer and liquid organic fertilizer.

MATERIALS AND METHODS

The research was carried out in Balai Benih Induk, Gedung Johor, Medan, North Sumatra, Indonesia from March to June 2017. This study used factorial randomized block design with three replications. The first factor is the provision of potassium nitrate fertilizer (KNO_3), consisting of 4 levels, namely: 0 g/plot, 15 g/plot, 25 g/plot, and 40 g/plot. The second factor is the provision of liquid organic fertilizer, consisting of 3 levels, namely: 4.5 mL/L water; 9 mL/L water, 13.5 mL/L water. Variables observed were plant height, number of leaves, number of bulb, fresh weight of bulb with leaves per plot, and dry weight of bulb with leaves per plot of shallot.

RESULTS AND DISCUSSION

Table 1 shown that the interaction treatment between KNO_3 fertilizer and liquid organic fertilizer had no significant effect on plant height, number of bulbs, fresh weight and dry weight bulb with leaves per plot shallots. This means that KNO_3 fertilizer and liquid organic fertilizer cannot be fully utilized by shallot. According to,[24] there are four factors that influence the success of fertilization so that plants can grow and develop optimally, namely the right variety, right dose, on time, and right place. Exactly what this means is that the fertilizer provided is sure to provide balanced nutrients and in accordance with the nature of the soil. The right dose means that the amount of fertilizer to be supplied must be adjusted to the needs of the plant. Timely means that fertilizer is adjusted to the dynamics of crop absorption and the supply of nutrients by plants to avoid losing fertilizer. Right place it means is to recognize crop rooting patterns and morphology so that it can apply fertilizer appropriately.

The KNO_3 fertilizer application significantly affected plant height, weight of clean and dry weight of onion plants per plot (Table 1). Fertilizer is best KNO_3 at a dose of 40 g/plot because it provides the highest growth of shallots. In contrast to some studies that indicate that the application of fertilizers KNO_3 no real effect on growth Virginia tobacco,[25] and growth of the shallots.[15] However, in line with several studies showing that KNO_3 fertilizer application significantly affected the growth of soybean.[14] iles-iles,[26] and shallots.[27] This is due to KNO3 fertilizers contain the element potassium (K) and nitrogen (N). According to,[28] the application of fertilizers containing elements of N can increase plant growth, increase protein synthesis, formation of chlorophyll which causes leaf color to become greener, and increase the ratio of shoot roots. N is also a building material for proteins, nucleic acids, enzymes, nucleoproteins, and alkaloids. N deficiency will limit cell division and enlargement.[29] According to,[30] the main function of nutrient K is to help the formation of proteins and carbohydrates. K also plays a role in strengthening the body of the plant so that the leaves, flowers, and fruit do not easily fall, so K is a source of strength for plants.

Table 1: Average plant height, number of bulb, fresh weight of bulbs with leaves per plot, and dry weight of bulbs with leaves per plot of shallots with KNO_3 and liquid organic fertilizer.

Treatments	Plant height (cm)	Number of bulb (bulb)	Fresh weight of bulbs with leaves per plot (g)	Dry weight of bulbs with leaves per plot (g)
KNO_3 fertilizer				
0 g/plot	31.4b	5.8	278.2b	252.9b
15 g/plot	31.1b	5.4	342.7b	317.9b
25 g/plot	34.2a	6.1	343.3b	318.9b
40 g/plot	34.9a	5.9	386.4a	361.4a
Organic liquid fertilizer				
4.5 mL/L water	32.0	5.7	340.8	315.8
9 mL/L water	33.6	5.9	331.0	307.7
13.5 mL/L water	33.1	5.8	341.2	314.9
Interaction	(-)	(-)	(-)	(-)

Note: Rows in the same column followed by unequal letters differ significantly at the 5% level based on the Duncan test (-) Interaction was not significantly different

Fertilizer of KNO_3 40 g/plot resulted in fresh weight and dry weight of bulbs with leaves per plot compared to 15 g/plot and 25 g/plot KNO_3 fertilizer. According to,[16] fertilizer as a relevant source of nutrients for plant growth. Increased fertilizer K provides highly significant effect on the weight of bulbs per hill. The results of[31] showed that application of KNO*3* fertilizer in the soil causes optimal growth of shallots. The addition of K with high doses showed best yields for K instrumental in helping the process of photosynthesis, the formation of new organic compounds are transported to the organs of the dump, the bulb. Another influence of K fertilization is to produce quality bulbs of shallots.[32]

The application of KNO_3 fertilizer had no significant effect on the number of bulbs shallot (Table 1). In contrast to the results of the study by[33] which showed that the application of KNO_3 fertilizer significantly affected shallot bulbs. This is because K is very important in the process of shallot growth because K is an essential nutrient needed by shallot after the N element in plant metabolism, but K needs more than other elements, because K plays an important role as a catalyst in conversion proteins become amino acids and carbohydrate compilers.[34] Furthermore,[33] stated that K plays a role in increasing vegetative growth of plants such as the formation, enlargement and elongation of bulbs and influences in increasing the shallot weight. In addition, it is also supported by[35] which states that K is needed for the process of photosynthesis formation and can increase bulb weight.

The application of liquid organic fertilizer had no significant effect on plant height, number of bulbs, net weight, and dry weight of bubls per plot (Table 1). This proves that some components of plant growth are more predominantly influenced by genetic factors than environmental factors, especially liquid organic fertilization.[36] In contrast to the results of[37] which showed that the application of liquid organic fertilizer significantly affected the growth and yield of shallots. However, the results of this study are in line with several research results which show that application of liquid organic fertilizer has no significant effect on the growth of potato plants,[18] curly lettuce,[17] black rice,[23] and corn.[38] This is due to the growth and yield of bulb shallot more influenced by the density and variety of plants.[39]

Table 2: Average number of leaves shallot at 31 days after planting (DAP) with KNO_3 fertilizer and liquid organic fertilizer.

Treatments	KNO_3 fertilizer				Rataan
	0 g/plot	15 g/plot	25 g/plot	40 g/plot	
	……(cm)……..				
Organic liquid fertilizer					
4.5 mL/L water	26.6c	29.5c	26.8c	26.1c	27.2bc
9 mL/L water	29.1c	25.3c	30.3c	31.7bc	29.2ab
13.5 mL/L water	28.1c	25.4c	34.9a	33.3ab	30.4a
Rataan	27.9ab	26.7b	30.8a	30.3a	

Note: Numbers in the same column and row followed by different letters are significantly different at the 5% level based on the Duncan test.

The average number in the same row and column followed by the same letter is significantly different at the 5% level based on the Duncan test.

Table 2 shown that KNO_3 fertilizer has a significant effect on the number of leaves shallot. The results of this

study are in line with several studies which show that KNO_3 fertilizer has a significant effect on the number of leaves Virginia tobacco[25] and the number of leaf spinach.[40]

Table 2 shown that the shallots that were not applied by KNO_3 fertilizer had a lower number of leaves but were not significantly different from the 25 g/plot dose and 40 g/plot. However, 25 g/ lot of KNO_3 fertilizer is a more efficient dose of the average number of leaves. According to,[41] the level of nutrient application that is too low or too high will result in inhibition of plant growth and development. K levels that are high enough can increase starch content, so that it can stimulate the growth of new leaves. In addition, K can also improve photosynthetic efficiency and plant turgor pressure. Stomata of plants that experience a deficit of water will close so that they can cause the transpiration rate to decrease. Transpiration basically facilitates the rate of flow of water from the soil to plants and most nutrients and other nutrients enter the plant along with the flow of water.[42]

The application of liquid organic fertilizer has a significant effect on the number of leaves shallot (Table 2). In line with the study of[37] which also shows that the application of liquid organic fertilizer has a significant effect on the number of leaves shallot. The best concentration of liquid organic fertilizer that gives the highest number of leaves shallot is 13.5 mL/L water which is not significantly different from the concentration of liquid organic fertilizer 9 mL/L water, but it is significantly different from the concentration of liquid organic fertilizer 4.5 mL/L water. This is because the presence of complete nutrients in liquid organic fertilizer can accelerate the photosynthesis process so that the formation of leaf organ becomes faster. According to,[43] that sufficient nutrients can promote rapid growth including leaf development, larger stems and dark green color and promote vegetative growth above the soil. Furthermore[44] states that if the amount of nutrients given is sufficient to meet the needs of plants, it will increase plant growth and development.

The interaction between KNO_3 fertilizer treatment and liquid organic fertilizer also significantly affected the number of leaves shallot (Table 2). The best treatment interaction that produced the highest number of leaves was the treatment interaction between 25 g/plot of KNO_3 fertilizer with 13.5 mL/L water of liquid organic fertilizer concentration which was not significantly different from the treatment interaction between 40 g/plot KNO_3 fertilizer and 13.5 mL/L water organic liquid fertilizer concentration, but is significantly different from other treatment interactions. This shows that the interaction of KNO_3 25 g/plot fertilizer treatment and 40 g/plot with the concentration of liquid organic fertilizer 13.5 mL/L water can increase the number of leaves shallot, while other treatment interactions have not been able to increase the number of leaves shallot. This shows that the shallot has a certain limit to absorb the nutrients it receives. The level of fertilizer concentration given can affect leaf cell permeability and determine the amount of nutrients that can be absorbed in the fertilization process.[45]

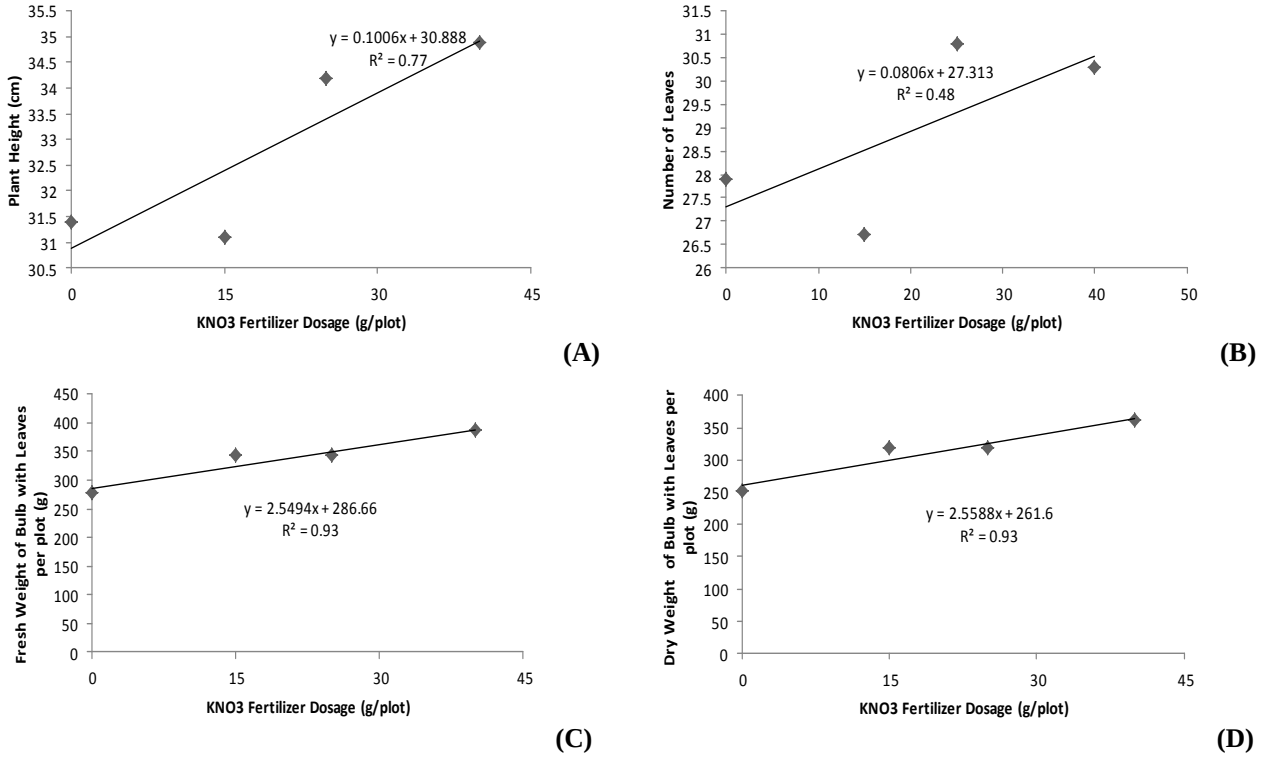

Figure 1: Relations of KNO_3 fertilizer application level to plant height (A), number of leaves (B), fresh weight of bulb with leaves per plot (C), and dry weight of bulb with leaves per plot (D) shallots.

Fig. 1A showed that the form of the relationship between KNO_3 fertilizer and shallot plant height is linear with the regression equation y = 0.1006x + 30. 89 (R^2 = 0.77), which means that increasing the dose of KNO_3 fertilizer will increase the plant height of shallot. Similarly, the form of the relationship between KNO_3 fertilizer and the number of leaves shallot is linear with the regression equation y = 0.0806x + 27.31 (R^2 = 0.48) (Fig. 1B). However, KNO_3 fertilizer has less influence on the number of leaves than the height of shallot. It can be seen from the coefficient of determination (R^2) on the number of leaves that are smaller than the plant height, which are 0.48 and 0.77, respectively. This shows that 77% of KNO_3 fertilizer affects plant height, while the number of leaves is only 48% influenced by KNO_3 fertilizer.

Fig. 1C and 1D also showed that the form of the relationship between KNO_3 fertilizer with fresh weight and dry weight bulbs with leaves per plot was linear with the regression equations, respectively y = 2.5494x + 286.66 (R^2 = 0.93), and y = 2.5588x + 261.6 (R^2 = 0.93), which means that increasing the dose of KNO_3 fertilizer will increase the fresh weight and dry weight of bulbs with leaves per plot shallot. Based on the terminated coefficient value (R^2) it can be seen that the R^2 value of the KNO_3 fertilizer relationship with bulb weight is greater than the relationship between KNO_3 fertilizer and plant height and the number of leaves shallot. This shows that KNO_3 fertilizer with a high K element content is better able to increase the weight of bulbs shallot. According to,[46] K fertilizer has an effect on increasing the dry weight of shallots. The application of high K fertilizer on shallots gives high yields on total yields.

CONCLUSION

The application of KNO_3 fertilizer at a dose of 40 g/plot gave the best growth and yield of shallots as seen from the increase in plant height, number of leaves, fresh weifht of bulbs with leaves per plot, and dry weight of bulbs per plot shallots.

The application of liquid organic fertilizer 13.5 mL/L of water is only able to increase the number of leaves shallot but has not been able to increase the yield of shallots.

Interaction treatment between 25 g/plot of KNO_3 fertilizer and 40 g/plot with a concentration of 13.5 mL/L of liquid organic fertilizer is only able to increase the number of leaves shallot but has not been able to increase the yield of shallots.

Based on the regression equation, KNO_3 fertilizer more influences the fresh weight of bulbs and the dry weight of bulbs with leaves shallot.

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