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Potential of water hyacinth compost and N, P, K, S fertilizers on K-available, K-uptake, and quality of shallots (*Allium ascalonicum* L.) in inceptisols of Jatinangor

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Abstract
Compost is the organic matter derived from plants, animals, and waste organic decomposition or fermentation subjected to the process. The addition of organic matter to the soil is very important so that plants get enough nutrients for growth. One of the materials in making compost is water hyacinth. Inorganic fertilizers are deliberately created by human beings in factories and contain high levels of certain. As for some commonly used inorganic fertilizers such as urea, SP-36, KCl, and ZA (Ammonium Sulphate). The research aimed to determine the effect of water hyacinth compost and N, P, K, and S fertilizer application on K-available, K-uptake, and yield of shallot plants. The experiment was carried out from June to September 2020 at the Experimental Garden of the Laboratory of Soil Chemistry and Plant Nutrition, Faculty of Agriculture, Universitas Padjadjaran, Jatinangor, Sumedang. The experimental design used was a randomized completely block design (RCBD) consisting of seven treatments with four repetitions, namely: control; 1 N, P, K, S recommendations; ¾ N, P, K, S recommendations; ½ compost + ¾ dose of N, P, K, S; 1 compost + ¾ dose of N, P, K, S; 1½ compost + ¾ dose of N, P, K, S; and 1 compost + 1 N, P, K, S. The compost used 25 Mg ha-1 water hyacinth compost and the recommended fertilizer was 200 kg urea, 300 kg SP-36, 200 kg KCl, and 500 kg ZA. The results showed that (1) a combination of water hyacinth compost with N, P, K, and S fertilizers was affected significantly K-available, K-uptake, and shallot bulb yield consisting of wet weight, dry weight, and number of bulbs; and (2) The ½ Compost + ¾ N, P, K, and S fertilizer treatment produces eight tubers per polybag with an average fresh tuber weight and dry stored tuber weight respectively weighing 113.24 g and 83.83 g polybag^{-1}, this treatment is the most efficient in increasing the quantity of shallots because it did not show significantly different results from the 1 compost + ¾ N, P, K, S fertilizers treatment which produced the highest quantity among the other treatments.

Keywords: Shallots, water hyacinth compost, N, P, K, S fertilizer, inceptisols of Jatinangor

Introduction

Commodity of Shallots has many benefits, containing carbohydrates, sugar, fatty acids, protein, and other minerals. Onions have a function as a food flavoring and as an ingredient in traditional medicine because onions are part of a group of spices that do not have substitutes [1].

The demand for shallots will continue to increase in line with people's needs which continue to increase, according to data from BPS (2018) 2014 to 2018 the level of shallot consumption by the Indonesian population increased each year by 2.93%, with the consumption rate in 2014 amounting to 2,487 kg kap^{-1} year^{-1} increased to 2,764 kg kap^{-1} year^{-1} in 2018. Production in 2018 reached 1.5 million tons and increased compared to 2017 which reached 1.47 million tons [2]. However, this condition is not offset by a decline in shallot productivity, according to [3] from 2014 to 2017, shallot productivity in Indonesia experienced a decline, from initially 10,223 Mg ha^{-1} to 9.31 Mg ha^{-1}, meanwhile in the same year area of shallot harvested land increased, in 2014 the harvested land area reached 120,704 ha and in 2017 it became 156,779 ha. Several factors that influence increasing the quantity and quality of shallot plants are quality bulbs, soil conditions, type of variety, and fertilizer used.

Inceptisols occupy 40 percent of agricultural land in Indonesia with an area of 70.52 million Ha [4]. Inceptisols are immature soils that still resemble the parent material and when compared with mature soils, the development of their profile is weaker [5]. The texture of the entire soil solum is generally clay, the soil structure is crumbly, the consistency is loose, and the organic matter content is small. Inceptisols have a low level of soil fertility [6, 7] but if proper treatment is carried out, the fertility and chemical properties can be increased [6].

Fertilization is a good step in increasing the fertility of the Inceptisols soil [21]. Stated that soil fertility conditions can be maintained if you combine organic fertilizer and inorganic fertilizer. This is because shallots have balanced needs with good quality through balanced fertilization technology while maintaining soil health.

One organic fertilizer that can be used is water hyacinth compost, [20] stated that giving water hyacinth fertilizer can contribute nutrients, increase porosity, aeration, and soil microorganisms as well as increase the soil's water holding capacity, good root development, so that nutrient uptake increases and the result is growth and production. to be better [22]. Stated that the provision of water hyacinth compost at a dose of 25 Mg ha^{-1} succeeded in increasing the growth and yield of shallot production.

Shallot plants need Potassium (K) fertilizer, in addition to N and P fertilizer. Potassium (K) is an important macronutrient for plants because this element has a role as an activator of several enzymes in plant metabolism. The role of K in shallots is that K can provide better tuber yield, high quality, and storability of the bulbs and also the bulbs will remain dense even if stored for a long period [11]. The source of K for shallot plants is KCl fertilizer with a K requirement of 120 kg K_2O ha^{-1} [12].

The research aimed to determine the effect of giving water hyacinth compost and N, P, K, and S fertilizer on K-available, K-uptake, and yield of shallot plants.

Materials and Methods

A. Materials and Tools

The materials used were planting media in the form of Inceptisols soil from Jatinangor, shallot seeds of the Batu Ijo variety, compost of water hyacinth, 200 kg of Urea, 300 kg of SP-36, 200 kg of KCl and 500 kg of Ammonium Sulphate (ZA) as well as various chemicals required for analysis of K-available and K-uptake.

The tools used are polybags measuring 30 cm x 30 cm, analytical balance, caliper, cutter, and laboratory equipment such as a spectrophotometer, chromameter digestion block, and other laboratory equipment.

B. Experimental Design

The experimental design used was a Randomized Completely Block Design (RCBD) with 7 treatments, and each treatment was repeated 4 times with 2 experimental units namely:

A = control
B = N, P, K, S fertilizer recommendations
C = ¾ N, P, K, S fertilizer recommendations
D = ½ compost + ¾ dose of N, P, K, S fertilizer
E = compost + ¾ dose of N, P, K, S fertilizer
F = 1½ Compost + ¾ dose of N, P, K, S fertilizer
G = compost + N, P, K, S fertilizer

The design responses observed were K-available, K-uptake, and shallot yield.

C. Sampling

Plant samples in the form of leaf organs were taken when the shallots reached 5 weeks after planting to analyze K in the shallot plants. Leaf samples were taken by cutting the base of the leaf using a cutter, then the sample was stored in a paper envelope to maintain the humidity of the sample, then the sample was analyzed for nutrient uptake in the laboratory.

Soil samples were taken before and after planting. Samples taken before planting were carried out to determine the initial soil analysis, while samples taken after planting were carried out to determine the K-available in the soil after treatment. Soil samples after planting were taken from the area around the plant roots as much as 200 g and put in plastic to be tested for soil K-availability in the laboratory.

Plant samples in the form of tubers were obtained from the shallot harvest, both fresh weight and dry weight.

D. Response design

The data observed in the research were K-available, K uptake, and shallot crop yield.

E. Data analysis

Data analysis used variance and continued with Duncan's multiple range test.

Results and Discussion

A. K-Available and K-Uptake: The results of research on K-available content in soil and K-uptake by shallot plants in various fertilization treatments are presented in Table 1.

Table 1: Content of K-available in the soil and K-uptake by shallot plants in various fertilization treatments in Jatinangor Inceptisols

Treatments	K-Available (cmol kg^{-1})	K-Uptake (mg plant^{-1})
Control (A)	0,67 a	44,08 a
N, P, K, S fertilizer recommendations (B)	1,17 b	56,98 b
¾ N, P, K, S fertilizer recommendations(C)	1,12 b	58,22 b
½ Compost + ¾ dose of N, P, K, S fertilizers (D)	1,23 bc	72,87 c
Compost + ¾ dose of N, P, K, S fertilizers (E)	1,53 d	73,77 c
1½ Compost + ¾ dose of N, P, K, S fertilizers (F)	1,50 cd	67,52 c
Compost + N, P, K, S fertilizers (G)	1,33 bcd	70,96 c

Note: Numbers followed by the same letter are not significantly different based on Duncan's multiple range test with a significance level of 5%.

The data in Table 1 shows that the treatment combination produces more available K compared to the control treatment (A) and the N, P, K, S treatment alone (B and C). The highest available K content, namely 1.53 cmol kg-1, was produced in the treatment of 1 water hyacinth compost + ¾ dose of N, P, K, S (E), and the lowest was produced in the control treatment, namely 0.67 cmol kg^{-1}. This situation shows that the combination of organic fertilizer and inorganic fertilizer can increase the availability of K in the soil. Research results [14] show that the application of ¾ N, P, K + ½ organic fertilizer can increase the content of K-available, N-total, P-available, and soil pH of Inceptisols.

The data in Table 1, it shows that the highest plant K-uptake was produced in (E) treatment with an average K-uptake of 73.77 mg $plant^{-1}$. However, these results were not statistically significantly different compared to the K-uptake in the ½ compost + ¾ dose of N, P, K, and S treatment (D), namely 72.87 mg $plant^{-1}$, so the fertilizer dose in this treatment was considered sufficient to increase uptake. K plants. Meanwhile, the lowest K-uptake was produced in treatment A, namely control with an average K-uptake of 44.08 mg $plant^{-1}$.

B. Shallot crop Results

The results of research on the yield of shallot bulbs are presented in Table 2.

Table 2: Number of Bulbs, Wet Weight, and Dry Weight of Shallot Bulbs in Various Fertilization Treatments in Inceptisols of Jatinangor

Treatment	Number of Tubers	Wet Weight of Tubers (g)	Dry Weight of Tubers (g)
Control (A)	4 a	74,10 a	45,53 a
N, P, K, S fertilizer recommendations (B)	7 b	95,19 b	63,30 b
¾ N, P, K, S fertilizer recommendations (C)	8 bc	96,28 b	62,10 b
½ Compost + ¾ dose of N, P, K, S fertilizers (D)	8 bc	113,24 c	83,83 c
Compost + ¾ dose of N, P, K, S fertilizers (E)	9 c	117,41 c	89,38 c
1½ Compost + ¾ dose of N, P, K, S fertilizers (F)	8 bc	102,60 bc	78,57 c
Compost + N, P, K, S fertilizers (G)	8 bc	108,33 bc	80,68 c

Note: Numbers followed by the same letter are not significantly different based on Duncan's multiple range test with a significance level of 5%.

The results of the research (Table 2) show that the application of a combination of the two fertilizers produced a greater number of tubers and higher wet weight and tuber fresh weight than the control treatment (A). Treatment A (control) produced the lowest of tubers (4 tubers), the lowest of wet weight and dry weight, namely 74.10 g and 45.53 g. This is due to low K-available in the soil and K-uptake by shallot plants. The absence of nutrients N, P, K, and S hurts the growth and development of shallots. N deficiency will limit cell division and enlargement [15]. A lack of element K can inhibit growth, reduce disease resistance, and reduce shallot yields. P deficiency in shallots will reduce root and leaf growth, bulb size, and yield, but slow down optimal aging [16]. Meanwhile, if there is a lack of S elements, the plants will not grow well and the plants will become stunted, thin, and yellow leaves including newly emerged leaves [17]. Lack of these nutrients will result in low shallot yields.

The research results also showed that treatment (E) produced the highest number of tubers (9 tubers), and the highest wet weight and dry weight, namely 117.41 g and 89.38 g. However, these results were not significantly different compared to the results in treatment D which produced the number of tubers (8 tubers), wet weight, and dry weight of tubers, namely 113.24 g and 83.83 g. The increase in shallot yield was influenced by the fulfillment of nutrients such as N, P, K, S from the treatment given, namely a combination of water hyacinth compost with N, P, K, S. As stated by [19], the formation of shallot bulbs is influenced by the potassium element which comes from potassium fertilizer mixed with water hyacinth compost. Furthermore, Hanafiah (2010) [22] stated that potassium functions in increasing the activity of various growth enzymes, and carbohydrate metabolisms such as the formation, breakdown, and translocation of starch and nitrogen metabolism and protein synthesis. The availability of potassium in sufficient and balanced quantities has a positive impact on the translocation of assimilate from leaves to storage organs such as shallot bulbs. Research results [19] showed that the combination of potassium fertilizer with organic fertilizer increased plant height, number of bulbs, and fresh weight of shallot bulbs on Fluventic Dystrudept soil.

The results of the research also showed that the highest number of tubers, and the highest wet and dry weights were produced in the treatment of (E), with the result being 9 tubers, 117.41 g wet weight and 89.38 g dry weights. However, these results were not significantly different compared to the results in the treatment of (D) which produced 8 numbers of tubers, 113.24 g wet weight, and 83.83 g dry weight. Increasing shallot yields is influenced by the fulfillment of nutrients such as N, P, K, and S from the treatment given, namely a combination of water hyacinth compost with N, P, K, and S fertilizers. The formation of shallot bulbs is influenced by the K element which comes from potassium fertilizer mixed with water hyacinth compost. [18] States that K in the soil of plant bodies functions in increasing the activity of various growth enzymes, and carbohydrate metabolisms such as the formation, breakdown, and translocation of starch and nitrogen metabolism and protein synthesis. The availability of K in sufficient and balanced quantities has a positive impact on the translocation of assimilate from leaves to storage organs such as shallot bulbs. The research results of [19] showed that the combination of K fertilizer with organic fertilizer increased plant height, number of bulbs, and fresh weight of shallot bulbs on Fluventic Dystrudept soil.

Conclusion

1. The application of a combination of water hyacinth compost with N, P, K, and S fertilizer has a significant effect on available K, K uptake and shallot bulb yield consisting of wet weight, dry weight, and number of bulbs.
2. Treatment ½ Compost + ¾ N, P, K, S (D) is the most efficient treatment by producing some tubers of 8 tubers $polybag^{-1}$, fresh tuber weight of 113.24 g in $polybag^{-1}$ and weight of dry stored tubers of 83.83 g $polybag^{-1}$.

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