International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Effect of super K organic fertilizer with various sizes of bulbs on growth and production of shallots (*Allium ascalonicum L.*)

Zakaria, M. Amrul Khoiri * and Hapsoh

Faculty of Agricultural Science, University of Riau, Pekanbaru, Riau, Indonesia.

International Journal of Science and Research Archive, 2022, 05(02), 056–066

Publication history: Received on 01 February 2022; revised on 10 March 2022; accepted on 12 March 2022

Article DOI: https://doi.org/10.30574/ijsra.2022.5.2.0061

Abstract

This study aimed to examine the interaction between the dose of Super K organic fertilizer and tuber size, the main effect of Super K organic fertilizer, and the main effect of tuber size on the potassium uptake of shallots. This research is a factorial experiment arranged according to a randomized block design (RAK), while the factors in this study consist of 2 factors, namely factor I: dose of Super K organic fertilizer which consists of 4 levels. P0 = without Super K organic fertilizer, P1 = Super K organic fertilizer 429 kg/ha equivalent to 42, 9 g/plot, P2 = Super K organic fertilizer 715 kg/ha equivalent to 71,5 g/plot, P3 = Super K organic fertilizer 1286 kg/ha equivalent to 128,6 g/plot. Factor II: tuber size (U) which consists of 3 level. U1 = small bulbs (diameter = <1.5 cm or <4 g), U2 = medium-sized bulbs (diameter = 1.5 – 1.8 cm or 4 6 g) and U3 = large bulbs (diameter = >1.8 cm or >6 g). Observations made in this study were plant height (cm), number of tillers per clump (stem), tuber diameter (cm), fresh tuber weight per plant (g) and dry tuber weight per plant (g). The result of this research is that the application of Super K organic fertilizer can increase the rate of photosynthesis. Bulb size can increase the number of tillers and tuber wet weight. The application of Super K organic fertilizer interacted with tuber size on the observation of stomatal conductivity and transpiration rate.

The application of organic fertilizer Super K 1286 kg/ha with large tubers gave a higher yield of 39,717 g/plant.

Keywords: Super K; Tuber size; Shallot; Fertilizer

1. Introduction

Shallots (*Allium ascalonicum* L.) are one of the tuber-producing horticultural commodities that can be utilized in the form of direct spices or packaged fried onions. Based on the analysis of 100 g of raw shallots, there are 31.2 mg of vitamin C, 0.20 mg of B1 (thiamin), 0.11 mg of B2 (riboflavin), 0.7 mg of B3 (niacin), 1,23 of B6 (pyridoxine). mg, carbohydrates 16.80 g, protein 2.5 g, total sugar 7.87 g, total fat 0.1 g, total fiber 3.2 g, water 79.80 g and energy 72 kcal [1].

The area of shallot cultivation in Riau in 2019 was 92 ha, with a production of 507 tons and a productivity of 5.51 tons/ha, while the demand for shallots was 19451.17 tons [2]. This shows that the availability of shallots is not sufficient to meet consumption needs, so shallot cultivation needs to be developed because it is much needed by the community.

The low productivity of shallots is influenced by environmental factors, including low soil fertility, an increase in attack by plant-disturbing organisms, changes in microclimate and low quality seeds [3]. Shallot cultivation requires the application of technology that is in accordance with the conditions of the agroecosystem of the plant so that it can provide optimal results.

* Corresponding author: M. Amrul Khoiri
Faculty of Agricultural Science, University of Riau, Pekanbaru, Riau, Indonesia.

One of the efforts that can be done to increase the productivity of shallot plants is in the management of nutrients. Onion plants require sufficient nutrients for growth and development, especially for tuber formation. One of the elements that play an important role in tuber enlargement is K element, but there are obstacles encountered in the availability of K in the soil, namely the ability of the soil to provide K element is very low, so it is necessary to add fertilizer in the form of fertilizer. This is in accordance with Subandi's statement [4], that the availability of K on agricultural land is generally low so that it is necessary to add K fertilizer.

Nutrien K can be obtained through the use of organic fertilizers. Organic fertilizers that can be used are Super K organic fertilizers. Super K organic fertilizers are organic fertilizers made from by-products of oil palm plants, namely empty oil palm fruit bunche, oil palm vine ash, and solid containing elements of K2O 20.93 %. [5] The element of potassium has the function of increasing carbohydrate metabolism so that the ability of plants to form dry matter will be better. Gunadi stated that potassium in shallots can provide better tuber yields, tuber quality and shelf life which lasts longer, and tubers remain solid even when stored for a long time [6].

In addition to the potassium element, the seeds used in the form of tubers also affect the increase in shallot production. Good tubers are tubers that have gone through a period of dormancy, are healthy, free from defects and of optimal size. Azmi, *et al*. stated that tubers that are too small tend to produce relatively few tillers, while the use of large tubers can increase production costs because the total weight of tubers required is higher even though large tubers have sufficient food reserves to support early plant growth [7]. Ali *et al.* stated that large tubers (12 g) provided a larger number of tubers per plant than medium (8 g) and small (4 g) tubers [8].

2. Material and Methods

2.1. Research Place

The research has been carried out in the technical implementation unit (UPT) of the Faculty's Experimental Garden Agriculture, Riau University, Binawidya Campus Km 12.5 Pekanbaru City.

2.2. Research Materials and Tools

The materials used were shallot seeds of the Bima Brebes variety, Super K organic fertilizer, Urea fertilizer, TSP, Dhithane M-45, and Sevin 85 S insecticide. The tools used were digital scales, analytical balances, caliper, land management tools and tools write.

2.3. Research methods

This research is a factorial experiment arranged according to a randomized block design (RAK), while the factors in this study consist of 2 factors, namely factor I; dose of Super K organic fertilizer which consists of 4 levels. P0 = without Super K organic fertilizer, P1 = Super K organic fertilizer 429 kg/ha equivalent to 42.9 g/plot, P2 = Super K organic fertilizer 715 kg/ha equivalent to 71.5 g/plot, P3 = organic fertilizer Super K 1286 kg/ha is equivalent to 128.6 g/plot. Factor II: tuber size (U) which consists of 3 levels. U1 = small bulbs (diameter = <1.5 cm or <4 g), U2 = medium-sized bulbs (diameter = 1.5 1.8 cm or 4 6 g) and U3 = large bulbs (diameter = >1.8 cm or >6 g).

Observations made in this study were plant height (cm), number of tillers per clump (stem), tuber diameter (cm), fresh tuber weight per plant (g) and dry tuber weight per plant (g). Super K organic fertilizer was applied 1 week before planting along with other fertilizers (250 kg urea per ha (25 g per plot), SP-36 150 kg per ha (15 g per plot)). Shallot bulb seeds have criteria as seeds and are ready to be planted. Before planting, the tubers are cut one quarter of the way at the end of the tuber, so that the tubers grow evenly and accelerate the shoots, then smeared with Dithane M-45 the day before planting to avoid disease, and planted into the planting hole until the end of the tuber looks flush with the soil surface.

The data obtained were analyzed statistically, namely the analysis of variance (ANOVA). The results of the variance that had a significant effect were tested with Duncan 5%. Data analysis using SAS 9.1 program.

3. Results

Table 1 Chlorophyll content of onion plant leaves (µmol m^{-2}) in the application of fertilizer organic Super K and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	88.900^{a}	83.367^{ab}	93.467^{a}	87.133^{a}	88.217^{AB}
Medium (1.7–1.8)	85.667^{ab}	90.400^{a}	90.267^{a}	94.200^{a}	90.133^{A}
Large (1.9–2.0)	82.133^{ab}	74.200^{b}	87.667^{a}	89.367^{a}	83.42^{B}
Average	85.567^{AB}	82.656^{B}	90.467^{A}	90.233^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 2 The rate of photosynthesis of shallot leaves (µmol CO_2 m^{-2} s^{-1}) on application of Super K organic fertilizer and tuber size

BulbSize(cm)	SuperOrganicFertilizerK(kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	30.433^{abc}	36.020^{a}	30.850^{abc}	27.277^{bc}	31.145^{A}
Medium (1.7–1.8)	26.283^{c}	29.453^{abc}	28.930^{abc}	28.177^{abc}	28.211^{A}
Large (1.9–2.0)	27.890^{abc}	35.233^{ab}	26.297^{c}	29.187^{abc}	29.652^{A}
Average	28.202^{B}	33.569^{A}	28.692^{B}	28.213^{B}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 3 Leaf transpiration rate of shallots (mmol H^2O m^{-2} s^{-1}) on application of Super K organic fertilizer and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	1.446^{bc}	1.983^{ab}	1.800^{abc}	1.530^{abc}	1.690^{A}
Medium (1.7–1.8)	1.403^{bc}	1.140^{c}	1.420^{bc}	1.873^{ab}	1.459^{A}
Large (1.9–2.0)	1.753^{abc}	2.190^{a}	1.373^{bc}	1.313^{bc}	1.657^{A}
Average	1.534^{A}	1.771^{A}	1.531^{A}	1.572^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 4 Onion leaf stomata conductivity (mol H_2O m^{-2} s^{-1}) on application of Super K organic fertilizer and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	0.766^{c}	0.856^{ab}	0.806^{abc}	0.770^{c}	0.800^{A}
Medium (1.7–1.8)	0.763^{c}	0.733^{c}	0.766^{c}	0.810^{abc}	0.768^{A}
Large (1.9–2.0)	0.816^{abc}	0.880^{a}	0.780^{bc}	0.743^{c}	0.805^{A}
Average	0.782^{AB}	0.823^{A}	0.784^{AB}	0.774^{B}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 5 The concentration of CO_2 in the leaf cells of shallots (µmol CO_2 mol^{-1}) on application of Super K organic fertilizer and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	17.400^{a}	10.713^{a}	19.427^{a}	18.457^{a}	16.499^{A}
Medium (1.7–1.8)	21.907^{a}	14.293^{a}	15.953^{a}	15.430^{a}	16.896^{A}
Large (1.9–2.0)	21.870^{a}	10.880^{a}	22.773^{a}	17.187^{a}	18.178^{A}
Average	20.392^{A}	11.962^{a}	19.384^{A}	17.024^{AB}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 6 Onion plant height (cm) on application of Super K organic fertilizer and bulb size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	37.680^{a}	37.740^{a}	40.040^{a}	38.907^{a}	38.592^{A}
Medium (1.7–1.8)	37.960^{a}	37.680^{a}	39.480^{a}	39.740^{a}	38.715^{A}
Large (1.9–2.0)	38.100^{a}	38.967^{a}	37.867^{a}	39.733^{a}	38.667^{A}
Average	37.913^{A}	38.129^{A}	39.129^{A}	39.460^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 7 Number of tillers per clump of shallot plants (stems) on application of Super K organic fertilizer and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	6.400^{bcd}	4.866^{d}	5.733^{cd}	6.066^{bcd}	5.766^{B}
Medium (1.7–1.8)	6.866^{abcd}	6.200^{bcd}	6.600^{abcd}	6.266^{bcd}	6.483^{B}
Large (1.9–2.0)	8.133^{ab}	8.066^{abc}	7.800^{abc}	8.866^{a}	8.216^{A}
Average	7.133^{A}	6.377^{A}	6.711^{A}	7.066^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 8 The diameter of the largest bulb of shallot (cm) on the application of Super K organic fertilizer and the size of the bulb

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	2.150^{a}	2.063^{a}	2.173^{a}	2.120^{a}	2.126^{A}
Medium (1.7–1.8)	2.120^{a}	2.140^{a}	2.097^{a}	2.210^{a}	2.141^{A}
Large (1.9–2.0)	2.133^{a}	2.080^{a}	2.110^{a}	2.103^{a}	2.106^{A}
Average	2.134^{A}	2.094^{A}	2.126^{A}	2.144^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 9 Fresh tuber weight per onion plant (g) on application of Super K organic fertilizer and tuber size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	26.853^{bc}	17.977^{c}	29.283^{abc}	28.787^{abc}	25,725^{B}
Medium (1.7–1.8)	27.343^{abc}	27.760^{abc}	31.940^{ab}	32.343^{ab}	29,847^{AB}
Large (1.9–2.0)	30.930^{ab}	30.263^{abc}	32.933^{ab}	39,717^{a}	33,461^{A}
Average	28.376^{AB}	25.333^{B}	31.386^{AB}	33,616^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

Table 10 Dry bulb weight per onion plant (g) on application of Super K organic fertilizer and bulb size

Bulb Size (cm)	Super Organic Fertilizer K (kg/ha)				Average
	0	429	715	1286	
Small (1.4–1.5)	4.063^{ab}	3.100^{b}	4.970^{ab}	5.463^{ab}	4.399^{A}
Medium (1.7–1.8)	4.320^{ab}	5.397^{ab}	5.957^{ab}	5.887^{ab}	5.390^{A}
Large (1.9–2.0)	6.173^{a}	4.893^{ab}	5.713^{ab}	6.170^{a}	5.737^{A}
Average	4.852^{A}	4.463^{A}	5.546^{A}	5.840^{A}	

The numbers in the columns and rows followed by the same uppercase and lowercase letters were not significantly different according to Duncan's multiple spacing test at the 5% level.

4. Discussion

4.1. Chlorophyll Content of Shallot Plant Leaves (μmol m^{-2})

Table 1 shows that the application of organic fertilizer Super K 1286 kg/ha with medium tuber size has the highest chlorophyll content of 94,200 (μmol m^{-2}) significantly different from the application of organic fertilizer Super K 429 kg/ha and large tuber size with chlorophyll content of 74,200 (μmol m^{-2}), but did not differ from the other treatments. Without the application of Super K organic fertilizer with small tubers, it was also significantly different from the application of Super K organic fertilizer at 429 kg/ha and large tubers, this happened because the small tubers did not form many tillers so that the K used in the soil was more for the formation of leaf color.

Munawar explained that in vegetable crops such as shallots, adequate supply of K can improve the size, color, taste, and skin of the fruit which are important for storage and transportation. Therefore, an adequate supply of K will ensure the function of the leaves during fruit growth and the amount of sugar in the fruit [9]. Higher chlorophyll content is usually found in dark green leaves. This is in line with the results of research [10], on the morphology of cassava leaves which have a dark green color while lettuce leaves are light green, so that the chlorophyll content in cassava leaves is higher than lettuce leaves. The leaf thickness factor can also affect the chlorophyll content, because thin leaves generally wilt when picked so that the chlorophyll is easily degraded.

4.2. Rate of Photosynthesis of Shallot Plant Leaves (μmol CO_2 m^{-2} s^{-1})

Table 2 shows that the application of organic fertilizer Super K 429 kg/ha with small tuber size was significantly different from the application of organic fertilizer Super K 1286 kg/ha with small tuber size, without the application of organic fertilizer Super K with medium tuber size, and the application of organic fertilizer Super K 715 kg/ha with large tuber size, but not significantly different from other treatments. The rate of photosynthetic activity is influenced by sunlight, if photosynthetic activity increases, the activity of Translocation of nutrients will increase, so plants will absorb more nutrients, meaning the need for fertilizer will increase.

Absorption of water and CO_2 in sufficient quantities with the help of sufficient sunlight causes the photosynthesis process to run well [11]. Anni *et al*. explained that the rate of photosynthesis is influenced by light intensity. An increase in the rate of photosynthesis occurs when the light intensity increases. When the light intensity is low, the rate of photosynthesis decreases. Each plant species has an optimal range of light intensity for the photosynthesis process to increase growth and production [12]. In addition to sunlight, nutrients also affect the rate of photosynthesis.

Napitupulu and Winarto stated that the application of potassium fertilizer aims to increase the rate of photosynthesis of plants [13]. By increasing the rate of photosynthesis, photosynthate will be produced which is used in the formation of new plant cells. This is in line with the results of this study, that small and large tubers that were given Super K organic fertilizer showed a higher photosynthetic rate than medium sized bulbs that were not given Super K organic fertilizer. This means that with the addition of Super K organic fertilizer, photosynthetic activity increased. Thus, potassium plays an important role in photosynthesis.

Marzouk *et al.* stated in his research that potassium plays a role in the translocation of metabolites from leaves to plant roots, so that it has good vegetative growth. In addition, potassium also has the ability to regulate the synthesis and accumulation of starch in tubers because it is assisted by several enzymes. The element of potassium in plants as a cofactor for the process of chlorophyll formation and the process of photosynthesis [14].

4.3. Shallot Transpiration Rate (mmol H2O m^{-2} s^{-1})

Table 3 shows that there was an interaction between the application of Super K organic fertilizer with tuber size, where the application of Super K organic fertilizer 429 kg/ha with large tubers was significantly different from without fertilizer application with small and medium tubers, fertilizer 429 kg/ha with medium tubers, fertilizer 715 kg/ha with medium and large tubers, and fertilizer 1286 kg/ha with large tubers, but not significantly different from other treatments. The highest transpiration rate is the application of fertilizer at 429 kg/ha with large tubers, this happens because basically large tubers tend to produce a lot of tillers, so that many leaves will be formed.

The results of the study [15] showed that the number of leaves on acacia plants which were more than other plants played an important role in increasing the plant's ability to transpiration because increasing the number of leaves meant an increase in the number of available stomata. The leaves of the shallot plant will receive sunlight so that the leaf temperature will increase, if the leaf temperature is too high it can disrupt the plant's metabolism, for that it is necessary to make an effort to liberate this energy, namely by transpiration.

Mansur explained that if the absorption of CO_2 increases, the transpiration activity of the leaves will also increase, as well as the value of the amount of transpiration which is influenced by the amount of stomata opening in plant leaves [16]. The opening and closing of the stoma is influenced by one element of K. The results of the study [17] showed that the administration of a formulation of Trichokompos empty palm oil bunches which contained K elements could increase the transpiration rate in shallot plants because the cell turgidity in the stomata increased so that the transpiration rate would also increase. Potassium taken up by guard cells causes the opening and closing of stomata due to changes in cell turgor pressure in plant leaves.

4.4. Stomata Transmission of Shallot Plant Leaf (mol H_2O m^{-2} s^{-1})

Table 4 shows that there was an interaction of Super K organic fertilizer application with tuber size, where the application of Super K organic fertilizer 429 kg/ha with large tubers was significantly different from without fertilizer application with small and medium tubers, fertilizer 429 kg/ha with medium tubers, fertilizer 715 kg/ha with medium and large tubers, fertilizer 1286 kg/ha with small tubers and large tubers, but not significantly different from other treatments. Stomata are generally found on the leaf surface, but stomata are also found on both leaf surfaces. Stomata will open when the turgor pressure of the two guard cells increases. The increase in guard cell turgor pressure is caused by the entry of water into the guard cells. [18] stated that stomatal conduction was increased due to open stomata. If the stomata open, there will be an accumulation of potassium ions (K^+) in the guard cells.

Ions penetrate the membrane by diffusion through integral proteins in the membrane, where these proteins accelerate the rate of diffusion. One of these small proteins or polypeptide antibiotics can accelerate the transport of cations called ionophore which is capable of transporting cations across the membrane. The size of this ionophore channel will determine the selectivity of the membrane to determine the type of cation to be transported, for example valinomycin (valinomycin). Valinomycin is a molecule that is selective for potassium ions.

Ulianas and Heng stated that the chemical nature of valinomycin which has a negatively charged pole on the oxygen atom in the interior of the valinomycin cavity, causes potassium ions to be bound to the oxygen atom in valinomycin [19]. The large amount of valinomycin in the membrane causes more potassium ions to be bound to the valinomycin molecule. This situation causes more potassium ions to enter the membrane and reduces the number of potassium ions on the membrane surface so that it affects the stomatal conductivity. The results of the study [17] showed that the administration of formulated oil palm empty fruit bunches Trichokompos containing K gave an increase in stomata conduction in the leaves of shallot plants.

4.5. Concentration of CO_2 in Shallot Leaf Cells (μmol CO_2 mol^{-1})

Table 5 shows that there was no interaction between the application of Super K organic fertilizer and tuber size. For plants that grow in the field, CO_2 is never a limiting factor, but a lack of CO_2 also cannot form carbohydrates properly, in addition to its availability in the atmosphere CO_2 is also influenced by plant nutrition, therefore it is necessary to enrich CO_2 to increase yields and improve product quality. If plants have excessive CO_2 it will be toxic to plants, because high CO_2 will directly inhibit succinate dehydrogenase, thereby disrupting the function of the tricarboxylic acid cycle and aerobic respiration.

Kuswandi *et al.* explained that the number of moles of CO_2 gas that reacted would be greater if the concentration of potassium carbonate (K_2CO_3) solution was greater [20]. The results showed that increasing the application of Super K fertilizer with various sizes of tubers did not give significant results to the concentration of CO_2. This has an impact on the formation of tubers which do not produce more carbohydrate accumulation and the tuber yield is relatively the same. Munawar explained that this occurs because some of the non- exchangeable K becomes available to plants when K can be exchanged or soluble K is absorbed by plants or is lost to leachate during the growing season, even though the amount is very small to meet plant needs [9].

The results of the study [17] showed that the formulation of Trichokompos empty fruit bunches (TKKS) containing K nutrients did not have a significant effect on the concentration of CO_2 in shallot plant cells.

4.6. Shallot Plant Height Merah (cm)

Table 6 shows that there is no interaction between Super K organic fertilizer application and bulb size on shallot plant height. The growth of plant height showed relatively similar uniformity, this was because the absorption of plant nutrients in the soil was also relatively the same so that there was no significant difference in the growth of shallot plant height. The organic Super K fertilizer given cannot be utilized by plants because the K cations are bound by the soil adsorption complex, so that K uptake in the soil to reach the root surface is slow before it is ready to be absorbed by plants. The results of the study [13] showed that the administration of K had no significant effect on the plant height of shallots.

The results of the study [21] stated that there was no significant interaction between variety and dose of NPK fertilizer on plant height, number of tillers per plant, and plant dry weight. The results of the study [22] showed that there was no interaction between tuber size and biourin concentration at 14 days after planting (DAT), 28 days after planting (DAT) and 42 days after planting (DAT) on shallot plant height. This is because the older the plant age, the growth shows simultaneously so that the plant height is almost the same. Nutrients that play an important role in influencing plant growth other than K are N nutrients.

The N nutrient content in the initial soil before planting was relatively low, namely 0.13%, as well as in organic potassium fertilizer the N nutrient content was only 0.82%, but in this study N was added according to the recommended dose for each experimental unit. . [9] explained that the N content in plant tissue was about 2% 4% dry weight of the plant. The uptake of N nitrate for synthesis into protein is also influenced by the availability of K^+ ions but on the observation of plant height the element K did not give a significant effect. Onion plant height in the description is 25 cm - 44 cm, while the plant height variable has a range of 37.680 cm and 40,040 cm. Based on these data, it can be seen that the plant height corresponds to the description of the plant, although it does not reach the maximum height of 44 cm.

4.7. Number of Tillers per Clump of Shallots (stems)

Table 10 shows that the application of Super K organic fertilizer of 1286 kg/ha with large tuber sizes was significantly different from that without fertilizer application, 429 kg/ha, 715 kg/ ha and 1,286 kg/ha with small tubers, 429 kg/ha and 1286 kg. /ha with medium tuber size, but not significantly different from other treatments. This can happen because large tubers have more tuber layers, thus more food reserves are available and shoots that will grow also have more opportunities.

The inside of the onion bulb can be found many lateral shoots, these shoots can form new discs and from these new discs can grow leaf petals so that new bulbs can be formed. Thus, each red onion bulb can become several bulbs, this characteristic results in the formation of a clump of plants. The results of the study [23] stated that the treatment of small tubers gave low yields because small tubers did not have side tubers and had little food reserves so that the formation of new tubers would be less.

Nugroho *et al.* explained that the increased growth of shallots in the treatment of large tubers (U3) was due to the large and heavy seeds having more food supplies [22]. This is in line with the opinion [24] states large -sized tubers have relatively more tuber layers. Therefore, the ability to grow will be stronger as well, in addition, large seeds have a wider root cross-sectional area so that the number of roots that grow will be more. This means that the amount of nutrients that can be absorbed is in sufficient quantities, thereby increasing plant growth.

4.8. Diameter of the Largest Bulb of Shallot Plants (cm)

Table 8 shows that there is no interaction of Super K organic fertilizer application with tuber size on tuber diameter variables. Shallot bulbs are formed from the base of the swollen leaves in layers to form pseudo stems as bulbs, whose function is to store food reserves. On the discus or the short main stem, there are buds that can form new clumps of plants or tillers. Provision of organic potassium fertilizer will stimulate photosynthesis and the results in the form of carbohydrates will be transported to all parts of the plant organs. However, in this study, it did not have a significant effect on tuber enlargement. This happens because the K that is absorbed by plants is not only for tuber enlargement, but also for the growth of other plant organs. This shows the important role of K in tuber enlargement.

Istina the importance of plants for element K because this element is able to synthesize protein to stimulate the formation of more perfect tubers [25]. Plants can take up K in the soil in sufficient amounts or even more, but it does not have an impact on increasing production. It can be seen that medium and large tubers have met the requirements for optimal growth because they contain more than 2% K elements, but the K elements that are absorbed are not only for tuber enlargement, but also for the formation of other plant parts.

Medium and large tubers produce more tillers than small tubers, thus the need for K elements will be more, because K elements are involved in many biochemical and physiological processes of plant growth and yield, so that they are not sufficient for tuber enlargement which is more optimal than tubers which is small. The number of tillers formed will produce a large number of leaves.

4.9. Fresh Bulb Weight per Shallot Plant (g)

Table 9 shows that the application of organic fertilizer Super K 1286 kg/ha with large tubers was significantly different from that without fertilizer application and fertilizer application of 429 kg/ha with small tubers, but not different from the other treatments. Fresh tuber weight is the weight of tubers when the plant is still alive and weighed immediately after harvest. The increase in fresh weight of tubers was influenced by the amount of water absorption and the accumulation of photosynthetic products in the leaves to be translocated for tuber formation. So the difference in water content will affect the fresh weight of the tubers produced. The application of organic fertilizer Super K 1286 kg/ha with large tubers tends to produce a lot of tillers, thus the water absorbed and the accumulation of carbohydrates will also be more and this will affect the weight of the fresh tubers.

The results of the study [22] stated that the highest results obtained from the parameters of the weight of fresh tubers with leaves were in the treatment of large tubers weighing 132,533 g/ plant clump, significantly different from the medium tuber treatment i.e. 104,033 g/ plant clump. While the lowest yield was in the treatment of small tubers weighing 96,166 grams/ plant clump. The increased growth of shallots in the treatment of large tubers was due to the large and heavy seeds having more food supplies.

Sufyati *et al.* stated that all yield components were significantly higher at the use of three seed tubers per planting hole. The results showed that the reduction in the number of seed tubers per hole caused a significant decrease in all yield components to the number of tubers per clump, root wet weight, dry tuber weight and dry tuber weight [26]. This is in line with this study which showed that larger tubers with more tillers produced higher plant fresh weight. In addition to the size of the tuber, the element K also plays an important role in increasing the fresh weight of a plant, especially onion bulbs.

4.10. Weight of Dried Bulbs per Shallot Plant (g)

Table 10 shows that without the application of Super K organic fertilizer and the application of 1286 kg/ha with large tuber size, significantly different from the application of Super K fertilizer 429 kg/ha with small tuber size, but not significantly different from other treatments. The production of a plant is the resultant of the photosynthesis process, the decrease in assimilation due to respiration and the translocation of dry matter into the crop. The increase in production is directly proportional to the increase in the relative growth and net yield of photosynthesis. The growth was directly related to the ratio of leaf area, specific leaf weight, and assimilation per leaf unit. Increasing these components will increase the results obtained.

The results of the study [23] stated that the low weight of the seeds showed that the dry weight of the shallots was decreasing. Dry weight is the weight of the photosynthate content of the tuber. If the dry weight of a plant is large, then the results of the metabolic process are equal to the dry weight of the plant.

The results of the study [22] stated that the highest yield of the dry tuber weight parameter was in the treatment of large tubers weighing 97,66 g/plant clump, significantly different from the medium tuber treatment, namely 69,66 g/plant clump. While the lowest yield was in the treatment of small tubers weighing 59,62 g/plant clump which was not significantly different from that of medium tubers. The dry weight yield describes the ability of plants to accumulate organic matter during growth, if the nutrient contribution is neglected, the dry weight gain is expressed as a result of carbon dioxide reduction [25].

Suminarti explained that the low ability of plants to produce assimilate was also caused by the low absorption of K by plants. For plants with low K availability, photosynthetic activity is also low, which in turn has an impact on the low photosynthate produced [27]. This statement is in accordance with the results of the study where the application of organic potassium fertilizer did not have a significant effect on all tuber sizes, but the combination of fertilizer application with tuber size did have an effect on plant dry weight.

Prasetyo stated that the application of palm ash ash can increase the dry weight of the plant because it can increase the pH, K and Na levels of the soil and other cations such as Ca and Mg [28]. Elemental Ca plays an important role in plants. The element Ca becomes part of the cell structure, namely cell walls and membranes, and is needed in the formation or division of new cells, namely those found in the meiotic spindles [29]. Ca^{2+} ions are essential for the translocation of carbohydrates and nutrients.

While the important role of Mg in plants is as a component of the chlorophyll molecule in all green plants, and plays an important role in almost all plant metabolism and protein synthesis. Oil palm ash is also one of the basic ingredients of Super K fertilizer. Setiyowati stated that the small size of the tubers is an indication that the content of organic compounds in the tubers such as carbohydrates, proteins, fats and others are very small, so that the dry weight components obtained are also relatively the same and few [30].

5. Conclusion

- The application of Super K organic fertilizer can increase the rate of photosynthesis, but not in other observations. While the size of the tubers can increase the number of tillers and wet weight of tubers, but not in other observations.
- The application of Super K organic fertilizer interacted with tuber size in observing stomatal conductivity and transpiration rate, but did not interact with other observations.
- The application of 1286 kg/ha Super K organic fertilizer with large tubers gave a higher yield of 39,717 g/plant, but was not efficient in the absorption of K elements in Super K organic fertilizer.

Compliance with ethical standards

Acknowledgments

The author would like to thank my lecturers, education staff and all those who have helped me so that I can complete my research.

Disclosure of conflict of interest

All authors declare there is no conflict of interest in this paper.

References

[1] Kuswardhani DD. Sehat Tanpa Obat dengan Bawang Merah-Bawang Putih [Healthy Without Drugs with Onion-Garlic.]. Yogyakarta: Rapha Publishing;2016

[2] Badan Pusat Statistik and Direktorat Jenderal hortikultura. Produksi Bawang Merah Menurut Provinsi [Shallot Production by Province] [Internet]. Jakarta; ©2019 [dikutip 20 Januari 2021]. Tersedia dari https://www.pertanian.go.id

[3] Triharyanto E, Samanhudi B. Pujiasmanto and D. Purnomo. Kajian Pembibitan dan Budidaya Bawang Merah (*Allium ascalonicum* L.) Melalui Biji Botani (True Shallot Seed) [Study of Seedlings and Cultivation of Shallots (*Allium ascalonicum* L.) Through Botanical Seeds (True Shallot Seed)]. Seminar Nasional Fakultas Pertanian UNS Surakarta.. 2013. 1– 11.

[4] Subandi. Peran dan Pengelolaan Hara Kalium Untuk Produksi Pangan di Indonesia [The Role and Management of Potassium Nutrients for Food Production in Indonesia]. Jurnal Pengembangan Inovasi Pertanian. 2013; 6(1): 1 – 10.

[5] Fitri A, Rosita S, and H. Chairani. Pertumbuhan dan produksi bawang merah dengan pemberian berbagai pupuk organik [The growth and production of shallots with the application of various organic fertilizers]. Jurnal Online Agroteknologi. 2014; 2(2): 482 – 496.

[6] Gunadi, N. Response of potato to potassium fertilizer sources and application methods in andisols of West Java. Indonesian Journal of Agricultural Science. 2009; 10(2): 65 – 72.

[7] Azmi C, IM Hidayat, and G Wiguna. Pengaruh varietas dan ukuran umbi terhadap produktivitas bawang merah [The effect of variety and tuber size on the productivity of shallots]. Jurnal Hort. 2011; 21(3): 206 – 213.

[8] Ali MAM, Ml Hossain, M Zakaria, A Naznin, Md and M. Islam. Effect of bulb size on quality seed production of onion in Bangladesh. International Journal of Agronomy and Agricultural Research (IJAAR). 2015; 6(4): 174 – 180.

[9] Munawar A. Kesuburan Tanah dan Nutrisi Tanaman [Soil Fertility and Plant Nutrients]. Bogor: IPB Press; 2011.

[10] Dharmadewi AAIM. Analisis kandungan klorofil pada beberapa jenis sayuran hijau sebagai alternatif bahan dasar food suplement [Analysis of chlorophyll content in several types of green vegetables as an alternative to food supplement basic ingredients]. Jurnal Edukasi Matematika dan Sains. 2020; IX(2): 171 – 176.

[11] Anisyah F Sipayung, R and Hanum C. Pertumbuhan dan produksi bawang merah dengan pemberian berbagai pupuk organik [Growth and production of shallots by application of various organic fertilizers]. Jurnal Online Agroekoteknologi. 2014; 2(2): 482 – 496.

[12] Anni IA. Saptiningsih, E and Haryanti, S. Pengaruh naungan terhadap pertumbuhan dan produksi tanaman bawang daun (*Allium fistulosum* L.) di Bandungan, Jawa Tengah [Effect of shade on growth and production of leek (*Allium fistulosum* L.) in Bandungan, Central Java.]. Jurnal Biologi. 2013; 2(3): 31 – 400.

[13] Napitulu D. and Winarto L. Pengaruh pemberian pupuk N dan K terhadap pertumbuhan dan produksi bawang merah [Effect of N and K fertilizers on the growth and production of shallots]. Jurnal Hort. 2010; 20(1): 27 – 35.

[14] Marzouk NM, NMK Hassan, ZF Fawzy, and HR El-Ramady. Cassava cultivars response to different levels of potassium fertilization under drip irrigation and sandy soil conditions. Egyptian Journal of Soil Science. 2020; 60(3): 317 – 334.

[15] Setiawan ABR, Budi SW, and Wibowo C. Hubungan kemampuan transpirasi dengan dimensi tumbuh bibit tanaman *Acacia decurrens* terkolonisasi *Glomus etunicatum* dan *Gigaspora margarita* [Relationship of transpiration ability with growth dimensions of *Acacia decurrens* colonized seeds of *Glomus etunicatum* and *Gigaspora margarita*]. Jurnal Silvikultur Tropika. 2015; 06(2): 107 – 113.

[16] Mansur M. Potensi serapan CO_2 pada beberapa jenis kantong semar (*Nepenthes* spp.) dataran rendah [CO2 absorption potential in several types of lowland semar bag (*Nepenthes* spp.)]. Jurnal Ilmu-ilmu Hayati. 2017; 6(1): 47 – 57.

[17] Arman Z, Nelvia and Armaini. Respons fisiologi, pertumbuhan, produksi dan serapan P bawang merah (*Allium ascalonicum*) terhadap pemberian trichokompos tandan kosong kelapa sawit (TKKS) terformulasi dan pupuk P di lahan gambut [Physiological responses, growth, production and P uptake of shallots (*Allium ascalonicum*) to the application of formulated oil palm empty fruit bunches (TKKS) trichocompost and P fertilizer on peatlands]. Jurnal Agroteknologi. 2016; 6 (2): 15–22.

[18] Susanti DM, Herman and F. Puspita. Pemberian trichokompos tandan kosong kelapa sawit terformulasi terhadap pertumbuhan dan hasil tiga varietas bawang merah (*Allium ascalonicum* L.) di lahan gambut [Provision of formulated oil palm empty fruit bunch trichocompost on the growth and yield of three shallot varieties (*Allium ascalonicum* L.) on peatlands]. Jurnal Photon. 2017; 7(2): 9 – 19.

[19] Ulianas A, and LY. Heng. The effects of changing membrane compositions and internal electrolytes on the respon of potassium ion sensor. Jurnal Saintek. 2015; 7(1): 1 – 10.

[20] Kuswandi, Anam, K and Laksana YP. Solubilitas gas CO_2 dalam larutan potassium karbonat [The solubility of CO2 gas in potassium carbonate solution . Journal of Chemical Engineering]. Jurnal Teknik Kimia. 2008; 3(1): 178–186.

[21] Sumarni S. and Hidayat A. Budidaya Bawang Merah: Panduan Teknis Budidaya Bawang Merah [Shallot Cultivation : A Technical Guide to Shallot Cultivation]. Bandung: Balai Penelitian Tanaman Sayuran; 2005.

[22] Nugroho U. Syaban, RA and Ermawati, N. Uji efektivitas ukuran umbi dan penambahan biourine terhadap pertumbuhan dan hasil bibit bawang merah (*Allium ascalonicum* L.) [Effectiveness test of tuber size and addition of biourine on growth and yield of shallot (*Allium ascalonicum* L.) seedlings]. Agriprima, Journal of Applied Agricultural Sciences. 2017; 1(2): 118 – 125.

[23] Ernawati L. Pengaruh bobot bibit dan dosis pupuk kalium terhadap serapan K, pertumbuhan dan hasil tanaman bawang merah (*Allium ascalonicum* L.) varietas bima [Effect of seedling weight and dose of potassium fertilizer on K uptake, growth and yield of shallot (*Allium ascalonicum* L.) bima variety]. Jurnal Agroswagati. 2015; 2(3): 332 – 343.

[24] Entaunayah NH. Barus, and Adrianton. Tanggap pertumbuhan dan produksi bawang merah (*Allium ascalonicum* L.) varietas Lembah Palu pada berbagai ukuran umbi dan dosis pupuk kalium [Growth response and production of shallot (*Allium ascalonicum* L.) Palu Valley variety at various bulb sizes and doses of potassium fertilizer]. Jurnal Agroland. 2015; 22(2): 106 – 113.

[25] Istina IN. Peningkatan produksi bawang merah melalui teknik pemupukan NPK [Increased production of shallots through NPK fertilization techniques]. Jurnal Agro. 2016; 3(1): 36–42.

[26] Sufyati Y. Imran AKS. and Fikrinda. Pengaruh ukuran fisik dan jumlah umbi per lubang terhadap pertumbuhan dan hasil bawang merah (*Allium ascalonicum* L.) [Effect of physical size and number of tubers per hole on growth and yield of shallot (*Allium ascalonicum* L.)]. Jurnal Floratek. 2006; 2: 43 – 54.

[27] Suminarti NE. Pengaruh pemupukan N dan K pada Ppertumbuhan dan hasil tanaman talas yang ditanam di lahan kering [Effect of N and K fertilization on growth and yield of taro plants grown on dry land]. Jurnal Akta Agrosia. 2010; 13(1): 1 – 7.

[28] Prasetyo TB. Pemanfaatan abu jenjang kelapa sawit sebagai sumber k pada tanah gambut dan pengaruhnya terhadap produksi jagung [Utilization of oil palm ash as a source of k in peat soil and its effect on maize production]. Jurnal Solum. 2009; 6 (2): 95 – 100.

[29] Halvin JL. Beaton JD. Nelson WL. Soil Fertility and Fertilizers: An Introduction to Nutrient Management. New Jersey: Pearson Prentice Hall; 2005.

[30] Setiyowati, Haryanti, S and Hastuti RB. Pengaruh perbedaan konsentrasi pupuk organik cair tehadap produksi bawang merah (*Allium ascalonicum* L) [The effect of different concentrations of liquid organic fertilizer on the production of shallots (*Allium ascalonicum* L)]. Jurnal Bioma. 2010; 12(2): 44 – 48.