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Effect of Watering Time and Liquid Organic Fertilizer Concentration on the Growth and Production of Shallots (*Allium Ascalonicum* L.)

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Abstract
Shallot production in Indonesia has yet to meet market needs due to subsidized chemical fertilizers' scarcity. Another alternative to replacing chemical fertilizers is the use of liquid organic fertilizer. This research aimed to determine the effect of watering time and concentration of liquid organic fertilizer on the growth and production of shallots (*Allium ascalonicum* L.). The design in this study was a Randomized Block Design (RAK), consisting of 2 treatment factors, namely watering time (W) consisting of 2 treatment levels, W1= 1x1 week, W2= 1x2 weeks and POC concentration (P) consisting of 4 treatment levels namely: P1= 2 ml/240 ml water/plant, P2= 4 ml/240 ml water/plant, P= 6 ml/240 ml water/plant and P4= 8 ml/240 ml water/plant. Data analysis uses analysis of variance; if the treatment factor significantly affects the variance test, a mean difference test is carried out using the Duncan Multiple Range Test (DMRT) at a 5% level. The results showed that POC watering time significantly affected tuber diameter and number of tubers per sample. However, they had no significant effect on the fresh weight of tubers per sample and the dry weight of tubers per sample. POC concentration significantly affected tuber diameter, number of tubers per sample, fresh weight per sample, and dry weight per sample.

Keywords— : *watering time; POC; red onion*

Introduction

The shallot plant is a bulbous spice vegetable and is a horticultural commodity. The tubers and leaves are widely used, significantly complement cooking spices, to add flavor and enjoyment to food. Red onions can also be used for high blood pressure, diabetes, dysentery, flatulence, and wounds because they contain enough nutrients, such as protein, riboflavin, and lime. Shallots, which have a distinctive odor, also have antibacterial properties, so they can be used to delay meat damage and do not have any detrimental side effects (Adam *et al*., 2019). Shallots are a superior national vegetable with an important role and must be cultivated intensively. According to Direktorat Jenderal Hortikultura (2020), The average Indonesian consumption of shallots reaches 2.76 kg/capita/year. With the increasing population, the consumption of shallots will also increase. The increasing consumption of shallots can be offset by the increase in shallot production over the last 5 years. Data from Badan Pusat Statistik (BPS) (2020) shows that red onion production in 2016 was 1,446,860 tons; in 2017, it was 1,470,155 tons; in 2018, it was 1,503,436 tons; in 2019, it was 1,580,247 tons, and in 2020 it was 1,815,445 tons. Shallot productivity in Indonesia is still relatively low, around 9 – 10 tons of dry bulbs per hectare, compared to countries such as Thailand and the Philippines, where the average production reaches 12 tons per hectare. The lack of sufficient bulb seeds for needs causes the low productivity of shallots in Indonesia. To meet the average need for shallot seeds of around 1.2 tons per hectare, Indonesia still has to import 40% from the Philippines to meet the cultivation needs of almost 94,000 ha. Shallot imports also meet consumption needs (Nurhidayah *et al*., 2016). Efforts to increase shallot production cannot be separated from the role of fertilizer as a soil fertilizer. Shallots require complete nutritional elements during their growth, including N, P, K, Ca, Mg, and Na. These elements can be obtained by applying organic and inorganic fertilizers in both solid and liquid form. The advantage of liquid organic fertilizer is that it can stimulate the formation of chlorophyll in leaves so that photosynthesis can increase. Providing large amounts of organic fertilizer sustainably can increase the nutrients plants can absorb (Hadi *et al*., 2020).

Differences in intermittent fertilization intervals, one of the most important actions to increase nutrient supplies so that the required nutrients are available, include liquid organic fertilizer intervals. Providing liquid organic fertilizer for plants is related to the appropriate type, concentration, method, and time of fertilization. Fertilization pays attention to the proper application time. Hairuddin dan Ariani (2017) stated that applying POC with a concentration of 60 ml/200 ml of water produced the highest plant height, number of leaves, and number of tubers. Jamilah (2016) stated that the 2-week interval treatment for giving POC resulted in higher fresh and dry tuber weights per hill than the 1-week interval treatment. Liquid organic fertilizer (POC) is a liquid material produced from weathering waste organic materials from plants and animals. When applied to plants, POC can stimulate growth and increase the production of shallot plants. The advantage of POC is that it can fulfill the nutrients in plants entirely and does not experience the leaching of nutrients. Another advantage of POC is that this fertilizer does not damage the soil, and there is no need to be afraid that it could be fatal to plants, even if applied frequently. POC also contains a binding agent that plants can use directly in the soil. Applying POC to soil can help increase the soil's microbes and improve the soil's physical and chemical properties, thereby helping to fertilize the soil. Fertile soil conditions with the availability of nutrients needed by plants can increase plant growth and production. POC applied to vegetables increases crop production (Saputra D. et al., 2020). Research from Wahidiyah *et al*. (2021) states that the interval for administering POC should be once every 7 days or 14 days; this can be seen from the length of the plant and the area of the plant leaves produced. In onion plants, POC application every 14 days gives the best growth results.

One problem with applying liquid organic fertilizer is the watering time. The time to water liquid organic fertilizer must be by the plant's needs. Watering time will affect the speed of providing soil nutrients (Zamzami *et al*., 2016). Plants will quickly respond to nutrients in the soil if they are applied according to the correct concentration and application time. Application of POC at the right time will increase the nutrient content in the soil, thereby causing organic matter to undergo a mineralization process. The correct timing of POC application can increase the mobility of nutrients and micro and macrobiological activity in the soil to increase soil fertility. As soil fertility improves, plant roots will also have more freedom to absorb nutrients, resulting in plant growth and production differences. However, application times that are too fast or too long will reduce plant growth and production because the organic material is not readily available for plant absorption. Hence, absorption by plants is not optimal and results in lower plant growth and production compared to the correct application time (Ichsan *et al*., 2017). This research aimed to determine the effect of watering time and concentration of liquid organic fertilizer on the growth and production of shallots (*Allium ascalonicum* L.).

Literature Review

Shallot plants originate from South Asia around India, Pakistan, and Palestine. Red onion (*Allium ascalonicum* L.) is one of the leading vegetable commodities that farmers have intensively cultivated. This vegetable commodity is included in the group of non-substituted spices which function as food seasonings and traditional medicines. This commodity is also a source of income and employment opportunities, significantly contributing to regional economic development. Shallots are a commodity cultivated by farmers from the lowlands and highlands. They can live in dry climates at air temperatures between 25-32℃ and humidity of 50-70% with a minimum of 70% light and loose, fertile soil containing enough organic material to produce the best growth and production (Hakim et al., 2023). The physical morphology of shallots can be divided into several parts: roots, stems, leaves, flowers, and bulbs. Shallots have fibrous roots with a shallow root system and scattered branches at a depth of between 15-20 cm in the soil with a root diameter of 2-5 mm (Savva & Freken, 2002)

Liquid organic fertilizer (POC) is fertilizer whose essential ingredients come from animals or plants that have undergone fermentation in the form of liquid and contain a maximum of 5% chemical ingredients. Liquid Organic Fertilizer (POC) generally has a low chemical content so that POC can provide nutrients according to plant needs in the soil. POC is in liquid form, so there is no accumulation of fertilizer concentration in one place/more evenly; it is easily and quickly absorbed by plants, free from heavy metal contamination and pathogenic microbes. POC can also overcome soil density and bind water and nutrients in an unstable manner to avoid the leaching process (*leaching*) and binding (*fixation*) by complex soil solids. Apart from improving soil's physical, chemical, and biological properties, liquid organic fertilizer can also help increase crop production and improve the quality of crop production (Nasuha et al., 2015). Liquid organic fertilizer contains 13 types of macro and microelements that all plants need. This fertilizer is also equipped with humic and fulvic acids.

Research Method

This research was carried out on Jalan Balai Kelurahan, Sempakata, Medan Selayang District, Medan City, North Sumatra, at an altitude ± 25 meters above sea level. The research was carried out from February to May 2022. The materials used were Batu Ijo variety shallot seeds, Liquid Organic fertilizers (POC), and water. The tools were a hoe, member, analytical balance, measuring cup, machete, nameplate, measuring tape, and stationery. The design used was a factorial Randomized Block Design (RAK), namely Factor 1: Watering Time (T), namely: T_1 = 1x1 week; T_2 = 1x2 weeks; Factor 2 is: POC concentration (K), namely: K_1: 2 ml/240 ml water/plant; K_2: 4 ml/240 ml water/plant; K_3: 6 ml/240 ml water/plant; K_4: 8 ml/240 ml water/plant. All treatment combinations were eight combinations and repeated 3 times. If the results of the variance test show a significantly different effect, then it will be tested using the Duncan test. Observations made in this research were: Tuber Diameter per Sample (mm), Number of Bulbs per Sample (cloves), Fresh Weight of Bulbs per Sample (g), and Dry Weight of Bulbs per Sample (g).

Results and Discussion

The results showed that watering time significantly increased tuber diameter. The largest tuber diameter was found in treatment W1 at 18.86 mm, while the most minor tuber diameter was found in treatment W_2 at 16.14 mm. The faster POC application time makes the availability of nitrogen elements better. The N content is sufficient to stimulate better vegetative growth, influencing the formation of shallot bulbs. Each plant requires a different time of application of nutrients; applying liquid organic fertilizer once a week can increase the growth and yield of shallots (Saputra *et al*., 2020).

Table 1. Average Tuber Diameter per Sample (mm) Due to Treatment of Watering Time and POC Concentration.

Treatment	Tuber Diameter per Sample (mm)
W_1	16,86b
W_2	16,14a
P_1	15,61a

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P_2	16,28b
P_3	16,61b
P_4	17,50c

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the DMRT test at the 5% test level.

From Table 1, it can be seen that the POC concentration significantly increases the tuber diameter. The largest tuber diameter was found in treatment P_4 at 17.50 cm, while the smallest was in treatment P_1 at 15.61 cm. Increasing the POC concentration will further increase the nutrient content in the soil. Plant roots absorb nutrients from POC in the soil well to respond to plant growth. Soil fertility will affect plant growth and production. Availability of nutrient content in the soil, both primary macronutrients, secondary macronutrients, and micronutrients, will increase plant growth and production. Primary macronutrients include N, P, K, C, H, and O_2. Secondary macronutrients include Ca, Mg, and S. Meanwhile, micronutrients include Fe, Mn, Zn, Cu, Mo, Cl, and B. The nutrient potassium is essential for the formation of shallot bulbs. Mahendra *et al*. (2020) state that increasing the concentration of POC given to water can increase plant growth and production.

The results showed that watering time significantly increased the number of shallot bulbs. The highest number of tubers was found in treatment W_1 at 2.64 cloves, while the lowest number of tubers was found in treatment W_2 at 2.33 cloves. The shorter the POC application interval, the more nutrients available to plants, thereby increasing plant growth and production. Plants need the nutrient N to stimulate plant vegetative growth, increasing the number of tubers (Jamilah *et al*., 2017).

Table 2. Average Number of Tubers per Sample (siung) Due to Treatment of Watering Time and POC Concentration.

Treatment	Number of Tubers per Sample (cloves)
W_1	2,64b
W_2	2,33a
P_1	2,06a
P_2	2,44b
P_3	2,56b
P_4	2,89c

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the DMRT test at the 5% test level.

From Table 2, it can be seen that the POC concentration significantly increases the number of tubers per sample. The highest number of tubers per sample was in treatment P_4, amounting to 2.89 cloves, while the lowest was in treatment P_1, amounting to 2.06 cloves. Increasing the POC concentration will further increase the calcium nutrient content in shallot plants. A good photosynthesis process forms the tuber diameter. Kipahit liquid organic fertilizer also contains the nutrient calcium (Ca), which plays a vital role in the photosynthesis process, so it is optimal where the element calcium (Ca) functions in cell division and elongation, thus stimulating the formation of larger tubers (Renaldi *et al*., 2021).

The results showed that watering time had no significant effect on the fresh weight of tubers per sample. The heaviest fresh weight of tubers per sample was in treatment W_1, weighing 70.06 g, and the lightest in treatment W_2, weighing 64.31 g. You need to pay attention to several things when watering liquid organic fertilizer, namely the type of foliar fertilizer used, the nutrient content of the foliar fertilizer, the concentration of the solution given, and the time of spraying. Plants' needs for various nutrients during their growth and development are not the same; they

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require different times and not the same amount, so in terms of fertilization, it is best to give them when plants need nutrients intensively so that their growth and development takes place well (Muldiana S. & Rosdiana, 2017).

Table 3. Average Fresh Weight of Tubers per Sample (g) Due to Treatment of Watering Time and POC Concentration

Treatment	Fresh Weight of Tubers per Sample (g)
W_1	70,06
W_2	64,31
P_1	52,22a
P_2	63,33b
P_3	71,28b
P_4	81,89c

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the DMRT test at the 5% test level.

From Table 3, it can be seen that the POC concentration significantly increases the fresh weight of tubers per sample. The heaviest fresh weight of tubers per sample was in treatment P_4 at 82.44 g, while the lightest was in treatment P_1 at 52.22 g. The fresh weight of tubers is related to the plant's vegetative growth. Nutrients and water availability influence the high and low fresh weight of plants. Increasing the POC concentration will increase the supply of macronutrients and micronutrients. Nutrient elements that influence the formation of shallot bulbs apart from the nutrients Nitrogen, Phosphorus, and Calcium, there are also micronutrients such as boron (B), zinc (Zn), and iron (Fe), which also influence the dry weight of the plant due to cell formation. The nutrient element B (Boron) is needed, while Zn (Zinc) and Fe (Iron) are needed for the formation of chlorophyll (Fatirahma & Kastono, 2020).

The results showed that watering time had no significant effect on increasing the dry weight of tubers per sample. The heaviest dry weight of tubers per sample was in treatment W_1, weighing 50.79 g, and the lightest in treatment W_2, weighing 46.14 g. The POC watering time interval treatment did not show a significantly different effect on the dry weight of tubers per sample. This happens because the release of nutrients at this interval cannot occur optimally. In the process of photosynthesis, plants in the generative phase will produce carbohydrates that are not entirely used for plant growth but will also be stored and used in the development of flowers, seeds, and fruit (Triadiawarman & Rudi, 2019).

Table 4. Average Dry Weight of Tubers per Sample (g) Due to Treatment of Watering Time and POC Concentration

Treatment	Tuber Dry Weight per Sample (g)
W_1	50,79
W_2	46,14
P_1	38,11a
P_2	46,23b
P_3	52,03bc
P_4	57,51c

Note: Numbers followed by the same letter in the same column mean that they are not significantly different in the DMRT test at the 5% test level.

From Table 4, it can be seen that the POC concentration significantly increases the dry weight of tubers per sample. The heaviest dry weight of tubers per sample was in treatment P4 at 57.51 g, while the lightest was in treatment P1 at 38.11 g. Providing POC can increase the availability and uptake of macro and micronutrients by shallot plants, and POC also contains various nutrients, thereby causing the plants to grow well and produce a high dry weight of tubers. The higher dry tuber weight is related to the plant's leaves, essential in photosynthesis. The results of the photosynthesis process that occurs in shallot leaves will be stored in the form of food reserves in the plant. The increase in photosynthate in the form of total plant dry weight is an accumulation of photosynthate in plant organs, including in the formation of shallot bulbs. The weight of the red bottom tubers is the result of growth and development, with an increase in the size and dry weight of the tubers which cannot change, which means that there is an increase in protoplasm, that is, both the size of the cells and their number increase (Panataria *et al*., 2021). Protoplasm is composed of compounds containing N, so as more protoplasm is formed, the nitrogen content of the plant increases, and the dry weight of the tubers also increases. Application of POC to plants at different concentrations will affect the nutrient content that plants can absorb (Arnianti *et al*., 2020).

Conclusion

From the research results it was found that the watering time treatment significantly increased the diameter of the tubers per sample (the largest tuber diameter was found in the W_1 treatment at 18.86 mm while the most minor tuber diameter was found in the W_2 treatment at 16.14 mm), the number of tubers (the most significant number of tubers was found in the W_2 treatment). in the W_1 treatment it was 2.64 cloves, while the smallest number of tubers was found in the W2 treatment at 2.33 cloves), and the POC concentration significantly increased the tuber diameter per sample (the largest tuber diameter was in the P_4 treatment at 17.50 cm, while the smallest was in the P_1 treatment at 15.61 cm), number of tubers per sample (the highest number of tubers per sample was in treatment P_4 at 2.89 cloves, while the lowest was in treatment P_1 at 2.06 cloves, number of tubers, fresh weight of tubers per sample, dry weight of tubers per sample), fresh weight tubers per sample (the heaviest fresh weight of tubers per sample was in the P_4 treatment of 82.44 g, while the lightest in treatment P_1 was 52.22 g) and the dry weight of tubers per sample (the heaviest dry weight of tubers per sample was in treatment P_4 of 57.51 g, while the lightest in treatment P_1 was 38.11 g).

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