Science Education and Application Journal (SEAJ)
Program Studi Pendidikan IPA
Universitas Islam Lamongan
http://jurnalpendidikan.unisla.ac.id/index.php/SEAJ

September, 2025. Vol. 7, No. 2,
p-ISSN: 2656-6672
e-ISSN: 2656-8365
pp. 143-154

Effect of Soaking Duration Bulb in 75% Old Coconut Water on Growth and Yield of Bima Brebes Shallot (*Allium cepa* L.): Plant Height, Leaf Count, Bulb Number, Bulb Diameter, and Bulb Weight

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Article Info

Article History
Received: June, 17th 2025
Revised: June, 26th 2025
Accepted: June, 28th 2025
Published: June, 29th 2025
Keywords
Shallot, Old Coconut Water, Soaking Duration

Abstract

Effect of Soaking Duration Bulb in 75% Old Coconut Water on Growth and Yield of Bima Brebes Shallot (Allium cepa L.): Plant Height, Leaf Count, Bulb Number, Bulb Diameter, and Bulb Weight. *Shallot production in Central Kalimantan in 2021 decreased from the previous year due to the lack of application of growth regulators by farmers in addition to fertilizing. The provision of growth regulators from coconut water is one effort to increase crop production. Coconut water contains minerals and growth hormones that are very much needed by plants. Similar research has been conducted previously with 75% young coconut water, but the administration with old coconut water has not been carried out, so it becomes the basis for the research. This study aims to determine the effect of the duration of soaking shallot bulbs of the Bima Brebes variety in 75% old coconut water on the growth and yield of bulbs. The study was conducted in July-October 2023, located in Menteng Village, Palangka Raya City. This study used a 75% concentration of old coconut water with 5 different treatment levels based on a completely randomized design method with 8 replications. Observations and data collection included plant height, number of leaves, number of bulbs, bulb diameter, and wet weight of bulbs. The data obtained were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference (LSD) with the help of SPSS software. The results of the ANOVA and LSD tests showed that soaking shallot bulbs in old coconut water had a significant effect on the number of bulbs (p value = 0.02 <0.05) with P2 = 10.13 and bulb weight (p value = 0.02 <0.05) with P2 = 8.10 g. The results of the analysis of plant height, number of leaves, and bulb diameter had no effect. Soaking shallot bulbs in old coconut water for 4 hours was quite optimal in increasing the number of bulbs and wet weight of bulbs compared to other treatments. Soaking the bulbs for 4 hours was able to increase the number of bulbs by 131% and the weight of bulbs by 169% so that these findings can be applied by shallot farmers in increasing bulb yields. The success rate of this study was greatly influenced by factors and constraints such as high humidity and low sunlight intensity, which can affect bulb development.*

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Citations: Robiyansyah, M., Lestariningsih, N., & Sari, L. I. N. (2025). Effect of Soaking Duration Bulbs in 75% Old Coconut Water on Growth and Yield of Bima Brebes Shallot (Allium cepa L.): Plant Height, Leaf Count, Bulb Number, Bulb Diameter, and Bulb Weight. Science Education and Application Journal (SEAJ), 7(2), 143-155.

INTRODUCTION

Shallots (*Allium cepa*) are one of the seasonal vegetable commodities that have a significant contribution to agricultural production in Indonesia (Irjayanti et al., 2022). Shallots have a fairly high economic value because, almost every day, people often use them as cooking ingredients and traditional medicines. The need for shallots in Indonesia continues to increase every year (Aryani et al., 2019). However, recently, shallot production has decreased in several regions in Indonesia, one of which is Central Kalimantan. The factor that greatly influences the decline in shallot productivity is the less-than-supportive climate conditions. High rainfall causes shallot bulbs to rot easily, resulting in crop failure (Souminar et al., 2018).

Shallot production in Central Kalimantan in 2021 only reached 34 tons. This production decreased when compared to shallot production in 2020, which reached 79 tons. This production is still relatively low when compared to some surrounding areas, such as South Kalimantan, which was able to produce 389 tons, and West Kalimantan, which was able to produce 104 tons (Central Statistics Agency, 2022). One of the factors causing this low production is that local farmers in planting shallots are not accompanied by the provision of growth regulators in addition to fertilizing. The use of commercial fertilizers is still quite lacking if not accompanied by the provision of growth regulators. The provision of growth regulators is one effort that can be made to increase plant production (Pramita et al., 2018). The use of exogenous growth regulators is a solution that is quite helpful in the problem of decreasing shallot production. Endogenous hormones produced by plants are often below optimum concentrations, so that exogenous hormones are needed as precursors to endogenous hormones to stimulate physiological work (Rustam et al., 2020). The cooperation between endogenous and exogenous hormones maximizes physiological work in plants.

Plant growth regulators or phytohormones are organic compounds that are not nutrients that can encourage plant growth and development (Pujiasmanto, 2020). The provision of plant growth regulators is intended to stimulate plants by accelerating their growth so that plant production increases. Plant growth regulators are divided into two types, namely natural plant growth regulators derived from natural materials and synthetic plant growth regulators that are made in a laboratory. The provision of synthetic plant growth regulators with a concentration of 5-10 ml/L is effective in increasing the number of roots and wet weight of shallot bulbs (Nursandi et al., 2022). Soaking porang seeds in natural plant growth regulators from coconut water for 3 hours can accelerate shoot formation and plant height (Sari et al., 2024). The use of natural plant growth regulators is highly recommended because they are more environmentally friendly, inexpensive, and easy to obtain. One of the natural plant growth regulators that can be used is coconut water.

Coconut water contains several growth hormones that are very much needed by plants. Growth hormones contained in coconut water include auxin, cytokinin, and gibberellin (Saptaji et al., 2015). Old coconut water contains fat (0.34%), protein (0.29%), phosphorus (0.05 mg/L), calcium (1.4 mg/L), pH (5.59), ash (0.47%), and water content (94.96%) (Coulibally et al., 2023). The cytokinin hormone content in old and young coconut water is quite different. Old coconut water contains 5.8 mg/L cytokinin, 0.07 mg/L auxin, and 0.01 mg/L gibberellin (Muazzinah & Nurbaiti, 2017). Meanwhile, young coconut water contains cytokinin (kinetin) 273.62 mg/L, auxin (IAA) 198.55 mg/L, and zeatin 290.47 mg/L (Kristina & Syahid, 2012). Cytokinin and auxin are hormones that play a very important role in cell division in meristematic tissue for the formation of shoots and stem elongation. Cytokinin stimulates cell division by increasing the rate of protein synthesis, while auxin stimulates cell elongation in the stem (Febmita & Putri, 2023). Auxin and gibberellin initiate apical growth and cell enlargement in meristematic tissue. The potassium content in coconut water can facilitate the entry of nutrients by regulating the process of opening and closing stomata (Mukarlina et al., 2010).

Research conducted by Simangunsong et al. (2017) showed that soaking the bulbs in young coconut water for 2 hours affected the yield of shallot bulbs. Furthermore, research (Saptaji et al., 2015) showed that a concentration of 100% young coconut water had an effect on increasing the growth of stevia plants. Several of these studies were used as the basis for research on soaking shallot bulbs in old coconut water. This study used a 75% concentration of old coconut water with a soaking time of 0-8 hours. Old coconut water was chosen because it is rarely used compared to young coconut water. The 75% concentration was chosen so that the osmolarity remains optimal for hormone absorption in the bulb tissue, thereby minimizing the risk of plasmolysis which is adjusted to the opinion (Rajiman, 2018) that too high a concentration of growth regulators can inhibit growth while too low a concentration is less effective in stimulating growth. The soaking time is limited to 8 hours for reasons of minimizing the risk of phytotoxicity in the bulbs, referring to (Arianti et al., 2022) that soaking seeds in gibberellic acid (GA3) for up to 12 hours affects the number of shallot leaves.

This study aims to determine the effective soaking time of shallot bulbs in old coconut water to increase the growth and production of shallot plants. Researchers hypothesize that soaking the bulbs in coconut water for 4-6 hours can maximize the diffusion of cytokinin hormones into the bulb tissue, thereby increasing the efficiency of bulb formation.

METHODS

This research was conducted for 3 months from July to October 2023. The research location is in Menteng Village, Jekan Raya District, Palangka Raya City Regency. The tools used in this study include digital scales, calipers, pH meters, lux meters, rulers, plastic bottles, measuring cups, measuring spoons, trays, sieves, plant sprayers, hammers, nails, scissors, knives, plant nets, transparent UV plastic, wooden blocks, stopwatches, and stationery. The materials used in this study include old coconut water (11-12 months of maturity) purchased from the local market, pH (4.5-5.5), total dissolved solids (6 g/100 ml), and cytokinin content (5.8 mg/L). Bima Brebes variety red onion seed bulbs (10-15 g), diameter (1-2 cm), seed age (2-3 months), bright shiny color, not rotten, and disease-free. Soil (pH 6.5-7.0), planting media (soil, husks, and manure) with a ratio of 1:1:1, polybag size 25×12 cm, NPK fertilizer dose 120 g, MKP 48 g, and MAP 48 g, referring to the suggestions and instructions for fertilization.

This study used a Completely Randomized Design (CRD). This study obtained 5 levels of treatment consisting of: P0 = 0 hours (control), P1 = 2 hours of immersion, P2 = 4 hours of immersion, P3 = 6 hours of immersion, and P4 = 8 hours of immersion, and the concentration of immersion for all treatments was 75%. The treatment was repeated 5 times, plus 3 for standard error, equal to 8 repetitions, so that there were 40 experimental units, each experimental unit consisting of 2 plants. The variables observed in this study included plant height, number of leaves, number of tubers, tuber diameter, and wet weight of tubers per sample.

The research procedure starts from making planting media in polybags, preparing seedlings, preparing old coconut water, applying soaking treatment, planting seedlings, plant maintenance including watering, fertilizing, and controlling pests and diseases, and collecting data. Seeds that are ready to be soaked are cut into 1/3 parts. The tubers are soaked in 75% old coconut water (300 ml coconut water + 100 ml distilled water) according to the specified soaking time. The tubers that have been soaked are rinsed with distilled water and dried for 15 minutes before being planted. Fertilization is carried out at intervals of 10 days at the age of 10 HST and 20 HST using NPK + MAP and at the age of 30-50 HST using NPK + MKP, each of which is dissolved in 10 liters of water then poured into the planting media as much as 250 ml of fertilizer solution. The ambient temperature conditions during the day range from 29-32 ℃ and at night, 24-27 ℃.

ANOVA testing can be performed assuming that the data must be normally distributed and homogeneous (Gamst et al., 2018). Data on tuber growth and yield were tested for Shapiro-Wilk normality and Levene homogeneity. Normal and homogeneous data were then analyzed using Analysis of Variance (ANOVA) with the help of SPSS software. ANOVA results that showed an effect were continued with the Least Significant Difference (LSD) test. The LSD test is used to determine the mean difference of all pairs of sample groups (Roflin et al., 2024).

RESULTS AND DISCUSSION

A. Plant Growth

Data from observations of plant height and number of leaves showed that each result of variance analysis on soaking time did not have a significant effect (p value = 0.98> 0.05) and (p value = 0.39> 0.05) on plant height and number of leaves. The results of the data analysis of plant height and number of leaves can be seen in Table 1 below.

Table 1. Plant Height and Number of Leaves Data

Variable	Treatment	N	Mean & LSD	SD	Normality	Homogeneity	Anova
Height of Plants	P0	8	26.16^{a}	16,27	0,00	0,42	0,98
	P1	8	30.71^{a}	12,77	0,00		
	P2	8	29.44^{a}	12,14	0,00		
	P3	8	30.16^{a}	13,33	0,04		
	P4	8	28.93^{a}	18,06	0,00		
Total of Leaves	P0	8	15.38^{a}	10,99	0,37	0,94	0,39
	P1	8	22.88^{a}	11,40	0,27		
	P2	8	26.88^{a}	12,24	0,08		
	P3	8	23.63^{a}	12,35	0,74		
	P4	8	19.25^{a}	13,20	0,49		

1. *Height of Plants*

The results of the LSD test on the average plant height showed no significant difference in each treatment marked with the same letter label. The absence of significant influence and difference in plant height was due to the fact that the Nitrogen (N) nutrient contained in old coconut water was not sufficient to meet the nutrient requirements during the growth period of shallots. Old coconut water contains 0.004 g/100g of nitrogen, while young coconut water contains 0.008 g/100g of nitrogen (Sinaga et al., 2015). Nitrogen (N) is a nutrient that is essential for plants during the vegetative growth period, which includes the growth of stems, leaves, and roots. Lack of Nitrogen (N) in plants can inhibit their vegetative growth. Nitrogen stress can alter plant growth and development, which can reduce yields (Huang et al., 2020). As the age of the plant increases, the amount of nutrients required also increases, so that the availability of nutrients will gradually decrease and run out. Nitrogen can support plant height growth because it acts as a component of amino acids, proteins, and chlorophyll pigment components, which are important in the process of photosynthesis. The higher the dose of nitrogen given, the maximum plant height can be produced (Lutfiah et al., 2021).

The best average height of shallot plants was found in the P1 treatment, with an average plant height reaching 30.71 cm, and the lowest in the control treatment (P0) with an average of 26.16 cm. The average height of shallot plants is quite low. The average height of the Bima Brebes variety of shallots in optimal conditions can reach 37-50 cm (Rosna et al., 2021). The less-than-optimal average height of shallot plants is thought to be due to the presence of plants infected with disease. This is evidenced by several symptoms that can be observed in shallot plants infected with the disease, such as yellowing leaves and curling and falling to the ground. These symptoms indicate that the shallot plants are infected with moler disease caused by pathogenic fungi. Moler disease is generally caused by the fungus Fusarium oxysporum, which spreads through soil, agricultural tools, and contaminated seeds. The characteristics of infected plants include yellowing leaves, curved, twisted, or deformed shapes. The infection process begins when fungal spores enter the root tissue of the shallot plant, which is weakened or stimulated by environmental conditions with high humidity. The spores then spread through the plant's vascular system, disrupting the absorption of water and nutrients, resulting in stunted plant growth (Manang et al., 2024).

2. Total of Leaves

The results of the LSD test on the average number of leaves showed no significant difference in each treatment marked with the same letter label. The absence of significant influence and difference in the number of leaves is due to the very small nitrogen content in coconut water, so that its effect is not very visible. Similar to plant height, nitrogen also plays a very important role in increasing the number of leaves because nitrogen is an essential nutrient needed during the vegetative phase (Huang et al., 2020). In accordance with its function, nitrogen plays a very important role in the formation of plant organs such as leaves because nitrogen is used in the process of chlorophyll synthesis, which is a component of leaves in the process of photosynthesis (Lutfiah et al., 2021). The application of synthetic exogenous hormones can increase tolerance to biotic and abiotic stress in plants by regulating enzyme activity, photosynthesis, and nitrogen metabolism (Kim et al., 2022).

Although the nitrogen requirement from coconut water is less, the nitrogen requirement from commercial fertilizer is quite fulfilled; however, the growth results are still less than optimal. The factor suspected to be the cause of the less-than-optimal function of nitrogen contained in coconut water and commercial fertilizer absorbed by plants is due to the lack of sunlight intensity. The results of the lux meter showed that the average sunlight intensity at the research location was 1127 lux, with a duration of direct sunlight exposure of 3-4 hours/day (30-40%), and maximum exposure to sunlight of 10 hours/day (100%). The intensity of sunlight required by plants such as shallots in low shade requires 230 μmol/m2 or around 12420 lux to optimize growth (Navvab, 2011). Sunlight is very much needed by plants in carrying out cell metabolism for their growth and development. The sunlight exposure required by shallot plants ranges from 70-100% or 10-12 hours (Gómez-López, M.D., 2023). This lack of sunlight is caused by weather conditions that are constantly cloudy and shaded, so that the metabolic process of the shallot plant is hampered.

The best average number of leaves was found in the P2 treatment, with an average of leaves reaching 26.88 strands, and the lowest was in the P0 (control) treatment, with an average of 15.38 strands. The difference in the average number of leaves between these treatments is thought to be due to concentration factors and the length of soaking time. The longer the soaking time of the tuber seeds in coconut water, the lower the quality of the seeds. Tuber seeds that are soaked for too long will damage the cells and tissues of the seeds that which can inhibit the growth and development of potential shoots. In accordance with the opinion of Triharyanto et al. (2021) that soaking plant seeds in growth regulators with high concentrations and for a long time can reduce the vigor of the seeds. Vigor is the ability of seeds to grow shoots/sprouts. The decrease in the vigor of the seeds will cause the formation and growth of shoots, both leaf shoots, stems, and tubers, to be inhibited.

B. Crop Yield

The observation data of the number of tubers and tuber weight showed the same variance analysis results on the soaking time, having a significant effect (p value = 0.02 <0.05) on the number of tubers and tuber weight. While the tuber diameter did not have a significant effect (p value = 0.54> 0.05). The results of the data analysis of the number of tubers, tuber weight, and tuber diameter can be seen in Table 2 below.

Table 2. Number of Bulbs, Bulb Weight, and Bulb Diameter Data

Variable	Treatment	N	Mean & LSD	SD	Normality	Homogeneity	Anova
Total of Bulbs	P0	8	4,38[a]	3,16	0,21	0,83	0,02
	P1	8	6,25[a]	3.01	0,08		
	P2	8	10,13[b]	4.76	0,17		
	P3	8	5,63[a]	3.34	0,99		
	P4	8	4,25[a]	3,37	0,55		
Weight of Bulbs	P0	8	3,01[a]	3,17	0,02	0,15	0,02
	P1	8	4,48[a]	2,18	0,31		
	P2	8	8,10[b]	3,92	0,41		
	P3	8	3,18[a]	1,84	0,66		
	P4	8	3,80[a]	4,02	0,21		
Diameter of Bulbs	P0	8	5,80[a]	4,25	0,12	0,16	0,54
	P1	8	7,41[a]	3,53	0,17		
	P2	8	8,83[a]	3,65	0.00		
	P3	8	5,99[a]	2,74	0,09		
	P4	8	6,59[a]	5,16	0,24		

1. *Total of Bulbs*

The results of the LSD test on the average number of tubers showed a significant difference in P2 marked with different letter labels. The highest number of tubers was in P2 with an average of 10.13, and the lowest value was in P4 with an average of 4.25. Old coconut water contains the cytokinin hormone, which can stimulate the growth and development of shoots. Shoots that grow and develop until harvest time will form tubers. Coconut water contains the hormones auxin and cytokinin, in help cell division (mitosis) in tuber tissue, so as to stimulate the growth of tuber shoots and stem elongation (Elviana et al., 2021).

Cytokinins in coconut water play an important role in the cell division process, so that they can help the formation of shoots in plants. The average number of tubers in P4 (4.25) was lower compared to the P0 control (4.38). Soaking tubers in old coconut water for more than 4 hours can reduce the number of tubers produced. The right duration of tuber soaking can optimize the number of tubers; conversely, soaking tubers for too long can cause cell and tissue damage to the tubers.

Soaking shallot bulbs in plant growth regulators for a long time and at high concentration can reduce the vigor of the bulbs. The decrease in bulb vigor causes the formation of shoots to be inhibited, resulting in few bulbs. Soaking for 4 hours (P2) shows optimal cytokinin diffusion into the bulb meristem, thus stimulating the initiation of shoots. Soaking for more than 4 hours can cause osmotic stress, which can change the properties of the auxin transporter. The unstable properties of the auxin transporter can interfere with the process of organ formation in plants (Triharyanto et al., 2021).

Soaking tubers in old coconut water and young coconut water at the same concentration showed differences from previous studies. Research (Simangunsong et al., 2017) stated that soaking for 2 hours with young coconut water is the optimal time. In this study, soaking for 4 hours with old coconut water is the optimal time. This difference is due to the different potassium content between old and young coconut water. Old coconut water contains more K^+, 257.52 mg/100 g, and young coconut water contains less K^+, 203.70 mg/100 g (Pakaya et al., 2021). High K^+ in old coconut water can extend cell viability during soaking, thereby extending the optimal duration for young coconut water (Saptaji et al., 2015).

The number of bulbs produced is directly proportional to the number of leaves. If the number of leaves produced is small, the number of bulbs produced will also be small. In accordance with the opinion of (Firmansyah & Bhermana, 2019) that the number of leaves produced by shallot plants can be an indicator of the number of bulbs produced, the more leaves produced, the more bulbs produced. This is proven by the Pearson Correlation Test between the number of bulbs and the number of leaves, with a value of $p = 0.00 < 0.01$ (significant) and a correlation value of $r = 0.89$ (strong positive correlation). The direction of the correlation is indicated by the (+/-) sign. If the correlation (+) of two factors is directly proportional, if the correlation (-) of two factors is inversely proportional. The strength of the correlation is indicated by the R value. If the r value approaches +1/-1, then the correlation is said to be strong; if the r value approaches zero (0), the correlation is said to be weak, and if the r value = 0, there is no correlation (Berry & Johnston, 2023). Thus, the number of bulbs produced is also influenced by the number of leaves produced on shallot plants.

2. *Weight of Bulbs*

The results of the LSD test on the average tuber weight showed a significant difference in P2 marked with a different letter label. The highest tuber weight was in P2 with an average of 8.10 g, and the lowest weight was in P0 (control) with an average of 3.01 g. Old coconut water contains cytokinin and auxin hormones that can stimulate tuber cell division in plants (Elviana et al., 2021). Tubers that were not soaked in old coconut water (P0) did not produce optimal tuber weight because there were no hormones that stimulated tuber growth and development. In contrast to P3 and P4, which experienced a decrease in tuber weight. The decrease in tuber weight occurred due to the duration of soaking the tubers for too long, causing toxicity to the tubers, which caused the quality of the tubers to decrease.

High toxicity causes cells and tissues of the buds in the bulbs to be damaged, so that the growth and development of the bulbs decrease. In accordance with the opinion of (Simangunsong et al., 2017) that shallot seeds soaked in growth regulators at high concentrations for a long duration can cause poisoning in the bulb seeds so that the growth and development of the shallot plant is inhibited. The average weight of the bulbs produced is very small when compared to commercial shallots, ranging from 40-60 g. The factor believed to be the cause of the less than optimal weight of the bulbs produced is the inhibition of the photosynthesis rate in plants due to low sunlight intensity (1127 lux) and less than sufficient lighting duration (3-4 hours/day or 30-40%). The inhibited photosynthesis process disrupts the transport of assimilates, nutrients and water. Assimilates and nutrients are transported by water from the leaves to other organs such as bulbs, through the transport tissue (phloem). The wet weight of the bulbs is influenced by the water content in the tissue, nutrients, and metabolic results (Anni et al., 2013). The increase in shallot harvest is a result of increased photosynthesis performance of a plant; the assimilate will be accumulated as food reserves in the bulbs (Nugroho et al., 2017).

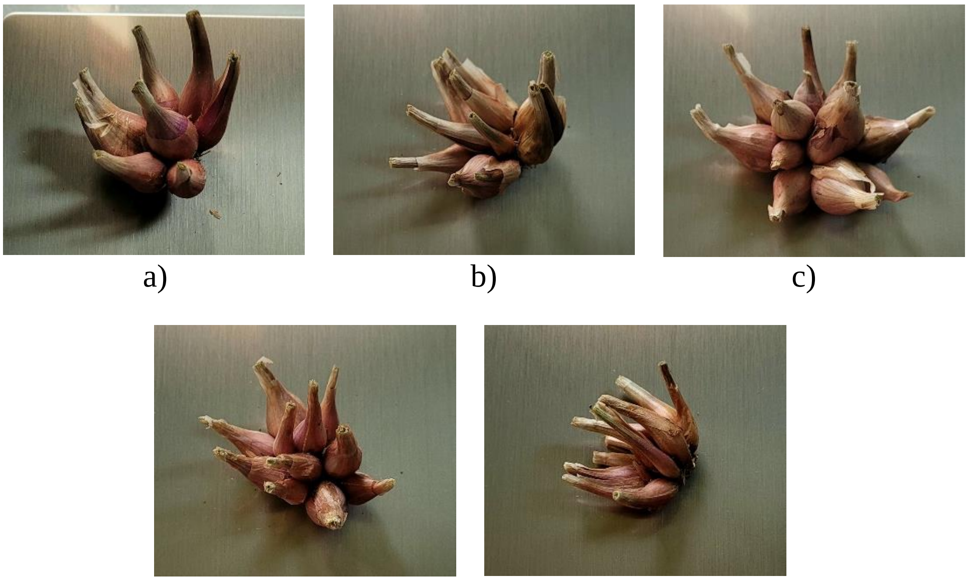
Optimal treatment at P2 only produced an average of 8.10 g wet weight below the commercial average (40-60 g), indicating agronomic irrelevance. Agronomic irrelevance of shallot yields refers to factors causing less than optimal shallot harvests. These factors can be internal to the plant itself or external, related to the environment and cultivation practices (Rahmah et al., 2023). Low-quality seeds will produce weak plants that are susceptible to disease. Infertile and loose soil conditions can inhibit bulb development. Excessive water availability can cause bulb rot. Improper fertilization, either a lack or excess of nutrients, inhibits shallot growth. Pest and disease attacks that are not handled properly cause crop failure due to plant death. Weather conditions that are difficult to control and cultivation techniques such as planting distance and planting depth, are not considered. Therefore, improvements to the agronomic system need to be made so that they are relevant and able to contribute to providing sufficient food for the community.

3. *Diameter of Bulbs*

The results of the LSD test on the average bulb diameter showed no significant difference in each treatment marked with the same letter label. The bulb diameter with the highest value was in P2, with an average of 8.83 mm, and the lowest in P0 (control) with an average of 5.80 mm. Soaking for 4 hours was quite optimal in the resulting bulb diameter, but the average diameter produced was very small when compared to commercial shallots, ranging from 1-3 cm. One factor believed to be the cause of the less-than-optimal bulb diameter produced is the lack of sunlight intensity obtained by the plant.

Sunlight is very much needed by shallot plants during the growth period to carry out cell metabolism such as photosynthesis. The results of photosynthesis of shallot plants will be accumulated in the bulb section as a food reserve for the plants. Light provides energy for plants as a basis for the process of cell division and differentiation, chlorophyll synthesis, and stomata movement (Wu et al., 2025). If the intensity of sunlight received by the plant is lacking, it can inhibit the process of photosynthesis, resulting in relatively small growth and development of the bulbs. The intensity of sunlight required by shallot plants ranges from 70-100% (Gómez-López, M.D., 2023). The higher the intensity of sunlight, the better the bulbs produced. The rate of photosynthesis is directly proportional to the intensity of sunlight received by the leaves. The intensity of sunlight received by plants can accelerate the process of bulb formation. Increased photosynthate will affect the development of the bulbs so that the resulting harvest is greater (Prayitno & Suryanto, 2020). However, in this study, the exposure to sunlight obtained by shallot plants was only around 30-40% because the location of the plant land was blocked by buildings (shade) and the weather conditions were cloudy, accompanied by rain; as a result the development of the bulbs was disrupted.

The use of fertilizer doses that are not in accordance with plant conditions is also believed to be the cause of the small diameter of the bulbs produced. Shallot plants that produce small bulbs only require a relatively small dose of fertilizer, while shallot plants that produce large bulbs tend to require a relatively large dose of fertilizer. Lack of increase in fertilizer doses in mature plants that require more nutrients. In accordance with the opinion of Hardiansyah & Guritno (2022) that shallot plants that produce small bulbs tend to require few essential nutrients; conversely, shallot plants that produce large bulbs tend to require more essential nutrients. Excessive fertilization of small bulbs will cause weak plant tissue (succulent), shorten the life span of leaves, and increase the susceptibility of plants to disease (Razaq et al., 2017). There is a picture of the shallot results in Figure 1 below.



a) b) c)

d) e)

Figure 1: a) P0=control, b) P1=soaking for 2 hours, c) soaking for 4 hours, d) soaking for 6 hours, and e) soaking for 8 hours

C. Research Constraints and Gaps

The limitation of sunlight of 30-40% can inhibit maximum harvest results, so that it requires future trials with controlled lighting are required. The incident of pathogen attacks caused 18% of plants to die, so that a need for proper fungicide administration during pre-treatment until near the end of harvest in tropical areas that tend to be humid. The use of commercial fertilizer doses was not increased for plant needs at adult age. The yield value reflects less than optimal conditions for increasing relative P2 (not absolute). The average results were not as expected by the researchers.

CONCLUSION

The results of the study concluded that the duration of soaking shallot bulbs in old coconut water had a significant effect on the number of bulbs and the wet bulb weight, with P2 being the best treatment. The average number of bulbs in P2 was 10.13, and the bulb weight was 8.10 grams, which was significantly different from the treatments P0, P1, P3, and P4. The P2 treatment was able to increase the number of bulbs by 131% and the bulb weight by 169%. Meanwhile, the duration of soaking did not significantly affect plant height, number of leaves, and bulb diameter in all treatments. Soaking the bulbs for 4 hours (P2) is in line with the role of cytokinins in meristem activation. Soaking for more than 4 hours causes osmotic stress, which interferes with hormone absorption, causing a decrease in the number of bulbs in P3 and P4. Although P2 increased the yield relative to other treatments, the resulting bulb weight (8.10 g) was less than optimal and remained uncommercial due to limited sunlight intensity (1127 lux) with a direct exposure duration of 3-4 hours (30-40%) and pressure from pathogens. Future studies should validate P2 at sunlight intensity above 70-100%. Measuring the kinetics of cytokinin uptake in tubers and integrating fungicides to curb losses due to pathogens. Thus, this study suggests that the use of old coconut water as a low-cost plant growth regulator can reveal important interactions between soaking duration and environmental stressors.

SUGGESTION

This study should also conduct a treatment experiment with synthetic growth regulators (eg, 6-BAP) to see the comparison of tuber growth and yield to natural growth regulators obtained from coconut water. The use of fungicides needs to be done to isolate plants with pre-planting or planting fungicide dips.

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