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Optimization of Drying Time and Eco Enzyme Concentration on Shallot Production (*Allium cepa* L.)

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Abstract

Eco enzyme is a complex solution derived from the fermentation of organic matter, characterized by a light to dark brown color and a fresh, sour aroma. Fermentation yields environmentally friendly enzymes and other functional components beneficial for agriculture. Eco enzymes offer various advantages for shallot plants, including enhanced growth and increased shallot production. This study aims to investigate the effects of watering frequency and Eco enzyme concentration on the growth and yield of shallots (*Allium cepa* L.). A randomized block design (RBD) was employed, incorporating two treatment factors: the watering timing and the eco enzyme concentration. The treatment factors are as follows: Factor I, Watering Time (W), consists of three treatment levels: 1 time per day, 1 time every two days, and 1 time every three days. Factor II, Concentration of Eco Enzyme (E), includes three treatment levels: 0.8 ml per 240 ml of water per plant, 1.6 ml per 240 ml of water per plant, and 2.4 ml per 240 ml of water per plant. The observed variables in this study were the number of tubers per sample (cloves), the fresh weight of tubers per sample (grams), and root length (centimeters). The results indicated that both the timing of watering and the application of eco-enzyme concentrations significantly affected the number of tubers per sample, the fresh weight of tubers per sample, and root length.

Keywords: Concentration, Eco Enzyme Application, Production, Shallots, Watering Time

1. Introduction

Shallots represent a promising horticultural commodity with significant economic value and market demand. Intensive cultivation is essential for shallots (Director General of Horticulture, 2020). This strategic commodity contributes substantially to national economic growth, particularly in enhancing the income and welfare of the population. However, shallot farmers frequently encounter challenges in their cultivation practices. Low production levels are primarily attributed to limited access to fertilizers, as the high cost prevents adequate nutrient intake for shallot plants, resulting in diminished yields. The shallot market offers extensive opportunities for household consumption and the processing industry, catering to domestic and export markets. Demand for shallots remains consistent throughout the year, leading to a continuous increase in demand in tandem with population growth.

Eco enzyme is a fermented organic waste product with bright prospects for the future. Eco-enzymes are solutions of complex organic substances produced from the fermentation process of organic residues, sugar, and water, which have many benefits (Alkadri & Asmara, 2020). This eco-enzyme liquid is dark brown and has a sour aroma (Hemalatha and Visantini, 2019) and is helpful in agriculture (Penmatsa et al ., 2019) as a plant watering fertilizer, Ecoenzyme can contribute nutrients for plant growth, but for the application of eco enzymes to plants, water still needs to be added. The content of natural Eco Enzyme can enhance soil fertility. Research conducted by Dr. Rosukan Poompanvong from Thailand indicates that Eco Enzyme can convert ammonia into nitrate (NO3). Additionally, Eco Enzyme can convert carbon dioxide (CO2) into carbonate (CO3), facilitating the natural cycle that promotes plant growth, acting as a fertilizer. The application of Eco Enzyme has been shown to improve plant growth and yield, including plant height, leaf count, and fresh weight of lettuce. This improvement occurs because the increased application of Eco Enzyme to the soil positively affects its chemical, physical, and biological properties.

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Eco Enzyme contains α-amylase, maltase, and proteolytic enzymes. This enzyme can break down starch compounds found in the endosperm of food reserves into glucose compounds. Glucose is a source of energy for plant growth. The application of eco-enzymes to plants can affect plant morphology, such as leaf color, leaf size, fruit, and stem diameter also becoming more extensive, and this has been tested on chili, which has better growth than the growth of chili plants without the application of eco enzymes. Changes in morphology that occur in plants are due to the content contained in the eco enzyme, which can function as liquid organic fertilizer. The nutrient content in eco enzymes also depends on the organic materials used. For example, applying eco enzyme ten ml/L of water on shallot plants resulted in a tuber weight 108.06 per sample. Meanwhile, in this study, applying eco enzyme 0.8 ml/L of water produced a bulb weight per sample of 124.24 g. This study aimed to determine the effect of Eco Enzyme concentration and watering time on the growth and production of shallots (*Allium cepa* L.).

2. Material and Methods

This research was conducted on Agricultural Land, Harmonika Baru Street, Tj. Sari with an altitude of ± 25 meters above sea level, located at longitude 3°32′56.400″N 98°38′34.800″E . The materials used were the seeds of the Tajuk variety of shallots, an eco-enzyme solution, and water. The tools used were hoes, machetes, sprinklers, tape measure, plastic ruler/roller, analytical scales, sample stakes, plastic rope, bamboo, stationery, and other tools to support this research. The method in this study was a randomized block design (RBD) using 2 treatment factors: immersion time and eco-enzyme concentration. The treatment factors are as follows: Factor 1, namely Watering Time (W), consists of 3 treatment levels, namely 1 x 1 day; 1 x 2 days, 1 x 3 days, and Factor II, namely the concentration of Eco Enzyme (E) consisting of 3 treatment levels, namely: 0.8 ml/240 ml of water/plant; 1.6 ml/240 ml water/plant; 2.4 ml/240 ml water/plant.

Eco enzyme concentration and watering time look like in the following picture:

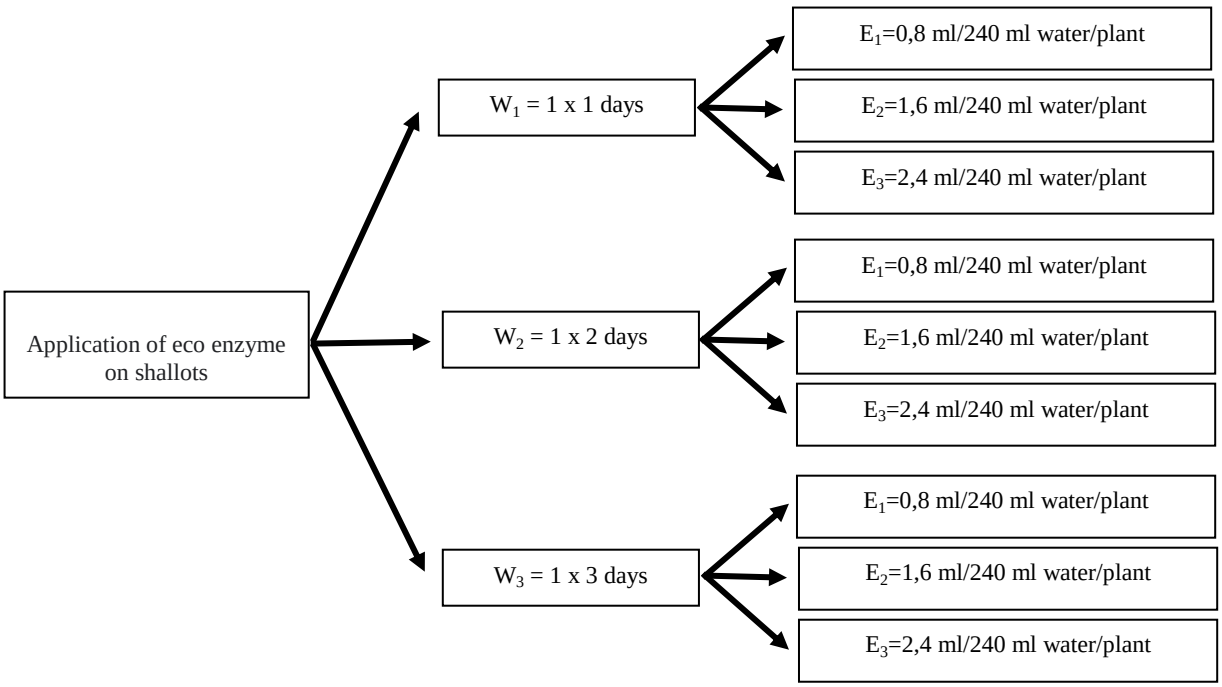

Figure 1. Research flow diagram of Application of Eco Enzyme Watering Time on Shallots

3. Results and Discussion

3.1. Number of tubers/samples (cloves)

Table 1 illustrates that, in terms of watering application frequency and eco-enzyme concentration, the highest number of tubers per sample was observed in the W3E3 treatment (watering once every three days with an eco-enzyme concentration of 2.4 ml per 240 ml of water per plant). Conversely, the lowest number of tubers was recorded in the W1E1 treatment (watering once daily with an eco-enzyme concentration of 0.8 ml per 240 ml of water per plant). Table 1 also shows that the interaction of the two treatments significantly affected the number of tubers per sample, with the W3E3 treatment combination substantially different from all other treatment combinations.

The effect of watering application time on the number of shallot bulbs per sample at various eco enzyme concentrations is shown in Figure 2, which shows that the longer the watering time and the higher the eco enzyme concentration, the higher the number of bulbs per sample. The results showed that the treatment of watering time and

concentration of eco enzyme significantly affected the number of tubers per sample, tuber fresh weight per sample, and root length.

Table 1. Average number of tubers per sample (suing) at the time of watering application and eco enzyme concentration.

Treatment	Number of Tubers per sample (cloves)			Replications	Mean	Std. err.	(95% conf.	Intervals)
	E_1	E_2	E_3					
W_1 (1x1 day)	10.45	10.78	12.11	1	12.8533	0.7070832	11.2228	14.48387
W_2 (1x2 days)	11.56	11.56	12.78	2	12.4833	1.092524	9.963969	15.0027
W_3 (1x3 days)	13.67	15.22	14.33	3	12.1489	0.729308	10.4671	13.83068

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

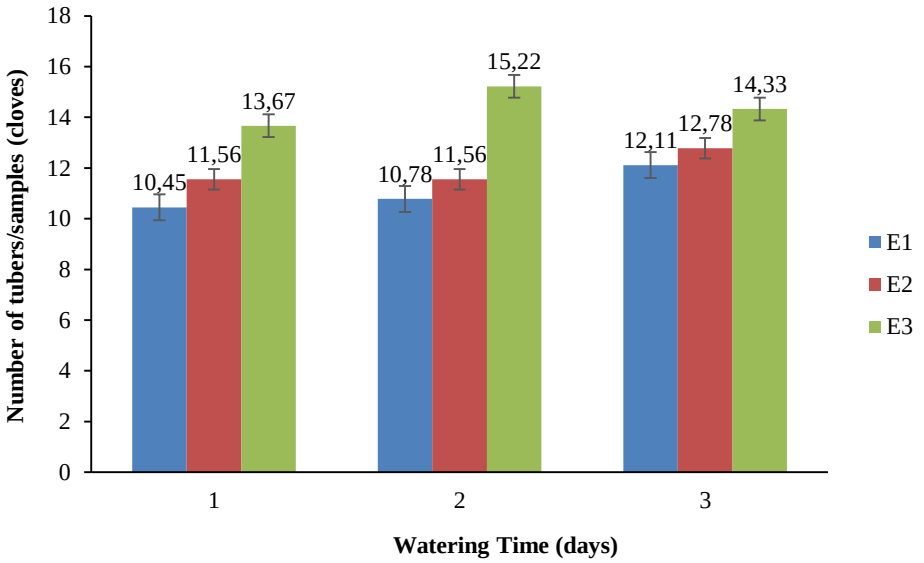

Figure 2. The Effect of Eco Enzyme Concentration and Watering Time on the Number of Shallot Bulbs/Samples.

The results showed that the time of watering and the concentration of Eco Enzyme significantly affected the root length of shallot plants. The most extended plant root length is in the W3E3 treatment at 14.33 cm, and the smallest in the W1E1 treatment at 10.45 cm. Giving Eco Enzyme can increase the supply of nutrients in plants. The nutrient content contained in Eco Enzyme will be available and absorbed by plants after undergoing an overhaul or decomposition from the activities of soil organisms. Soil organic matter is also a source of energy for organisms to Help provide the nutrients plants need. Eco Enzyme acts as a supplier of nutrients for shallot plants. (Bakir, 2022) states that adding eco enzymes can increase the supply of macro and micronutrients plants need for their growth. In the study (Arif et al ., 2023), the wet weight of red onion bulbs was 110.88 grams after being applied with the eco enzyme. The results showed that the concentration of Eco Enzyme significantly affected the number of bulbs per shallot sample. The most significant number of tubers is the treatment W3E3 treatment of 14.33 cloves, and the lowest is the W1E1 treatment of 10.45 cloves. The provision of increasing Eco Enzyme will increase the supply of potassium needed in the formation of shallot bulbs. Increasing the potassium and phosphorus elements is required to form shallot bulbs. Increasing the supply of potassium and phosphorus elements by administering Eco Enzyme will further increase tuber formation in each plant.

3.2. Fresh Weight of Tuber per sample (g)

Table 2 shows that in the treatment of watering application time and eco enzyme concentration on tuber fresh weight per sample, the highest was in the W3E3 treatment (watering 1 x 3 days with an eco enzyme concentration of 2.4 ml/240 ml water/plant) and the lowest fresh tuber weight per sample was found in the W1E1 treatment (watering 1 x 1 day with an eco enzyme concentration of 0.8 ml/240 ml water/plant).

Table 2 also shows that the interaction of the two treatments significantly affected the tuber fresh weight per sample, with the W3E3 treatment combination substantially different from all other treatment combinations.

The effect of watering application time on the fresh weight of bulbs per sample of shallot at various eco enzyme concentrations is shown in Figure 3, which shows that the longer the watering time and the higher the concentration of eco enzyme, the fresh weight of tubers per sample increases.

Table 2. Average fresh weight of tubers per sample (g) at the time of application of watering and the concentration of Eco Enzyme.

Treatment	Number of Tubers per sample (cloves)			Replications	Mean	Std. err.	(95% conf.	Intervals)
	E_1	E_2	E_3					
W_1 (1x1 day)	120.07	136.94	154.07	1	140,116	5.001785	128.5814	151.6497
W_2 (1x2 days)	121.21	142.84	156.43	2	138,116	5.001785	126.5814	149.6497
W_3 (1x3 days)	124.24	145.23	157.04	3	141,116	5.001785	129.5814	152.6497

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

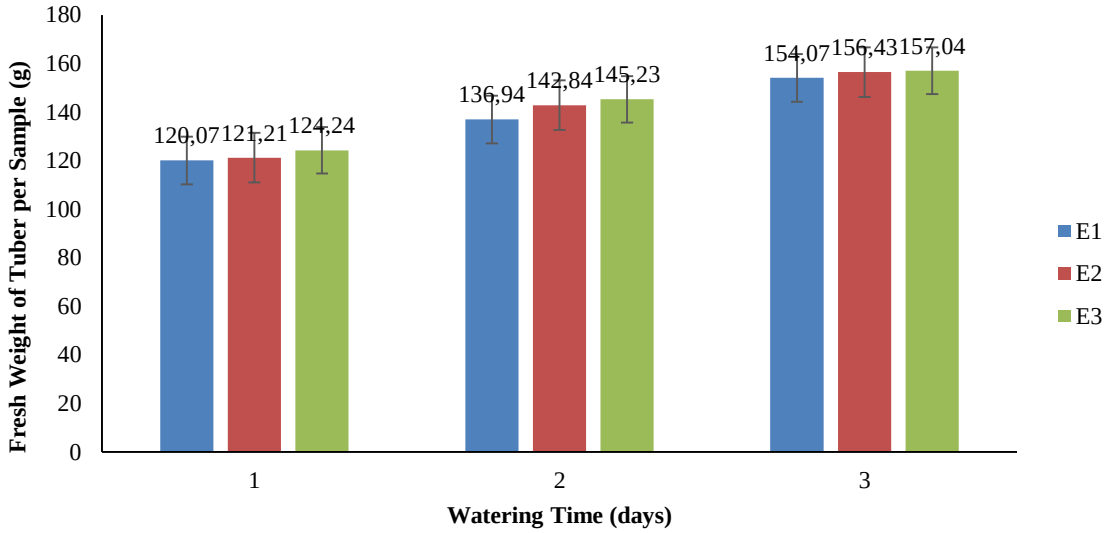

Figure 3. Effect of Eco Enzyme Concentration and Watering Time on Fresh Weight of Bulbs per Shallot Sample.

3.3. Root Length (cm)

Table 3 shows that in the treatment of watering application time and eco enzyme concentration on root length, the highest was in the W3E3 treatment (watering 1 x 3 days with an eco enzyme concentration of 2.4 ml/240 ml water/plant) and the lowest root length was in the W1E1 treatment (watering 1 x 1 day with an eco enzyme concentration of 0.8 ml/240 ml water/plant).

Table 3. Mean Root Length (cm) at Treatment Time of Watering Application and Concentration of Eco Enzyme.

Treatment	Number of Tubers per sample (cloves)			Replications	Mean	Std. err.	(95% conf.	Intervals)
	E_1	E_2	E_3					
W_1 (1x1 day)	120.07	136.94	154.07	1	140,116	5.001785	128.5814	151.6497
W_2 (1x2 days)	121.21	142.84	156.43	2	138,116	5.001785	126.5814	149.6497
W_3 (1x3 days)	124.24	145.23	157.04	3	141,116	5.001785	129.5814	152.6497

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

Table 3 also shows that the interaction of the two treatments significantly affects root length. The W3E3 treatment combination was substantially different from all other treatment combinations.

The effect of watering application time on shallot root length at various eco enzyme concentrations can be seen in Figure 4, which shows that the longer the watering time and the higher the eco enzyme concentration, the root length increases. The study also showed that the Eco Enzyme concentration significantly affected bulbs' fresh weight per shallot sample. The highest fresh weight of shallot bulbs was in the W3E3 treatment of 124.37 g and the lowest in the W1E1 treatment of 87.4 g. The nutritional content in Eco Enzyme, especially the nitrogen element, is a liquid nitrogen nutrient element that can increase plant growth and the fresh weight of plant tubers. Giving Eco Enzyme with higher concentrations will increase the supply of nutrients to plants, which will then be used to form new plant leaves. By giving watering times of 1 x 3 days, it is thought that it is optimal to supply nutrients to plants, compared to watering times that are too frequent. The need for sufficient nutrients during plant growth can increase the

formation of the number of plant leaves, where the leaves are a place for plants to carry out photosynthesis, and the leaves are also a place for the accumulation of plant photosynthetic results. The photosynthetic process will also increase photosynthetic results in organic compounds, which will be translocated to all plant organs and affect the number of tubers per sample

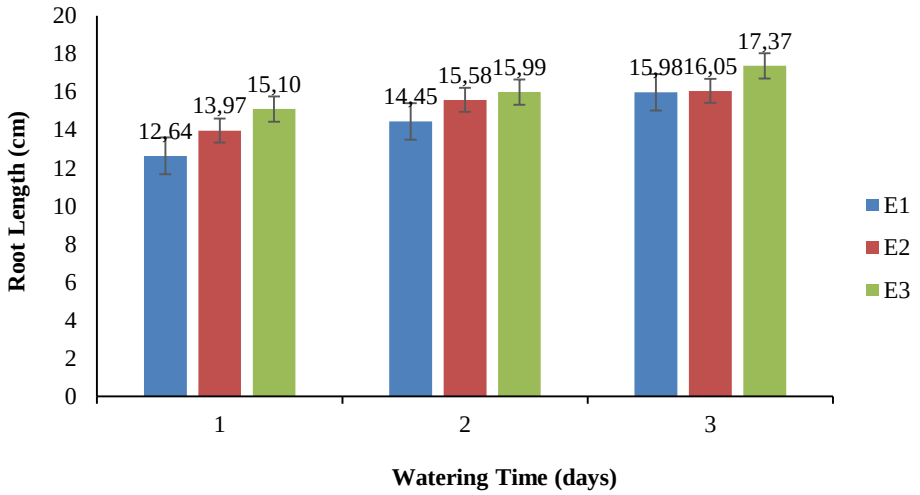

Figure 4. Effect of Eco Enzyme Concentration and Watering Time on Shallot Root Length.

Shallot bulb production is a balance between photosynthesis and respiration. Photosynthesis will increase the carbohydrates that form tubers. The application of Eco Enzyme has a significant effect on root length. The most extended root length was found in the W3E3 treatment at 17.37 cm and the lowest in the W1E1 treatment at 12.64 cm. In the study (Zirrazaq et al., 2024), the spraying treatment of 0.75 ml/L eco enzyme was found that spraying eco enzyme had quite an effect on plant root growth. The enzymes present in Eco Enzyme play a crucial role in breaking down starch compounds found in the food reserve endosperm into glucose.

Glucose serves as a vital source of energy for plant growth. It is circulated throughout plant tissues, functioning as nourishment for plants before converting into energy. This energy enables plants to grow and develop, including the formation of tubers (Ginting et al., 2021). The recommended application frequency for Eco Enzyme watering is once every three days, stimulating shallot plant roots' development. This assertion aligns with the findings of Novianto (2022), who stated that applying Eco Enzyme can promote the formation of plant organs such as leaves, roots, and stems. Additionally, Gustia et al. (2025) reported that the application of Eco Enzyme can enhance the length of plant roots. Lumbanraja et al. (2021) emphasized that for Eco Enzyme to be effective in plants, it is essential to consider the appropriate dosage and watering schedule, as each plant species responds differently to the application of Eco Enzyme.

4. Conclusion

The W3E3 treatment exhibits the highest application time for watering and eco-enzyme concentration concerning the number of tubers per sample, tuber fresh weight per sample, and root length. This treatment involves watering once every three days with an eco-enzyme concentration of 2.4 ml per 240 ml of water per plant. Conversely, the lowest values were observed with watering once daily and an eco-enzyme concentration of 0.8 ml per 240 ml of water per plant.

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