

Sustainable Use Of Shallot Waste As An Ecoenzyme To Improve Shallot Vegetative Growth

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ABSTRACT

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Ecoenzyme is a natural liquid produced by fermenting organic materials for three months. The resulting liquid contains essential nutrients, making it suitable for plant growth. Ecoenzyme can also be made from organic waste, such as shallot waste, containing several important nutrients found in onion skins, such as K, Mg, and Fe. It also contains the hormones auxin and gibberellin. This study aims to determine the effect of ecoenzyme on the growth of shallots of the Bima Brebes variety. This research took place in Demulih Village, Susut District, Bangli Regency, Bali Province starting in September 2025 – January 2026, the design used was a randomized block design (RBD) consisting of 6 treatments, namely P0: 0 ml/l ecoenzyme, P1: 10 ml/l ecoenzyme, P2: 15 ml/l ecoenzyme, P3: 20 ml/l ecoenzyme, P4: 25 ml/l ecoenzyme and P5: 30 ml/l ecoenzyme, each treatment was repeated 6 times so that there were 36 experimental units. The parameters observed were plant height, number of leaves and number of tillers, the data obtained from the research results were tested by analysis of variance and further Duncan test was carried out at a level of 5% if it gave significant results. Based on the research results, ecoenzyme enriched with shallot waste significantly affected the vegetative phase of the plant, including leaf number in week 3 and tiller number in weeks 4 and 5, but had no significant effect on plant height. Ecoenzyme has the potential to be used in sustainable shallot cultivation.

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1. Introduction

Indonesia has several regions that cultivate shallots extensively. The final stage of cultivation produces organic waste. The resulting organic waste includes leaves, skins, roots, and bulbs that do not make it through the sorting process. Furthermore, household waste also produces shallot skins mixed with fruit and vegetable waste. This organic waste is not optimally utilized and is often discarded, often producing a foul odor. In line with statement that this underutilized organic waste has the potential to pollute the environment [1].

Organic waste processing is very necessary to realize sustainable agriculture and can reduce environmental pollution by producing products that are useful for the agricultural sector. Organic waste can be processed into ecoenzymes. Ecoenzymes are organic liquids produced through the natural fermentation process of organic materials [2]. Ecoenzymes are rich in important bacteria that play a role in accelerating the decomposition of organic waste so that they will affect soil fertility,

besides that they can also control pests and diseases [3]. One of the advantages of ecoenzymes is that they are rich in important enzymes such as protease, amylase and lipase. The presence of these enzymes can affect the working system of growth hormones in plants [4]. Ecoenzymes can be made using shallot waste because shallot skins contain elements K, P, Mg and Fe and contain growth hormones such as auxin and gibberellin [5]. Shallot skins contain hormones that can stimulate plant growth, such as auxin, gibberellin, cytokinin, and abscisic acid, which play a role in cell division and root growth [6].

Processing organic shallot waste into ecoenzymes can reduce environmental pollution. Using organic waste as the primary ingredient in its production results in an environmentally friendly liquid that is beneficial as a nutrient for plant growth. The use of ecoenzymes in agriculture is expected to reduce environmental pollution caused by the continuous use of inorganic fertilizers and minimize the use of inorganic fertilizers in agriculture, thus supporting sustainable agriculture. Ecoenzyme at a concentration of 20 ml/l provides the best results for the growth and yield of shallots [7]. This study aims to determine the effect of ecoenzyme enriched with shallot waste on the growth of shallots of the Bima Brebes variety.

2. Method

2.1. Time and Place

This research was conducted over a period of four months and seven days, from September 2025 to January 2026, in Demulih Village, Susut District, Bangli Regency, Bali Province.

2.2. Tools and Materials

Ecoenzyme production: shallot waste, fruit peel waste, vegetable waste, molasses, water, knife, sieve, measuring cup, bucket, gloves, scale, 100-liter drum, small hose, small jerry can, bottle, stationery, and camera.

Shallot cultivation: shovel, hoe, sprayer, scale, bucket, measuring cup, watering can, 30 x 30 cm polybags, Bima Brebes shallot seeds and paddy soil, ecoenzyme enriched with shallot waste, additional nutrients from rabbit urine, and neem leaf botanical pesticide.

2.3. Research Design

This study used a randomized block design (RBD) consisting of 6 treatments replicated 6 times, resulting in 36 experimental units as follows:

(P0) Without ecoenzyme

(P1) 10 ml ecoenzyme / 1 liter of water = 168.3 ml/polybag

(P2) 15 ml ecoenzyme / 1 liter of water = 169.1 ml/polybag

(P3) 20 ml ecoenzyme / 1 liter of water = 170 ml/polybag

(P4) 25 ml ecoenzyme / 1 liter of water = 170.8 ml/polybag

(P5) 30 ml ecoenzyme / 1 liter of water = 171.6 ml/polybag

2.4. Research Implementation

Ecoenzyme Production

1. Prepare the equipment and materials for making ecoenzyme with a ratio of 3 parts organic waste, 1 part molasses, and 10 parts water (3:1:10).
2. Chop or cut the organic waste into smaller pieces.
3. Place the waste in a drum, then add molasses dissolved in water until the waste is evenly submerged.
4. Close the drum tightly for 3 months to maximize the fermentation process. To release gas during fermentation, create a gas outlet by attaching a small hose to the drum lid. Connect the other end of the hose to a jerry can or small bottle filled with water.
5. After 3 months, the ecoenzyme will have a dark brown color and a sour aroma typical of fermentation. The resulting liquid can be harvested by filtering it and bottling it.

Planting Shallots

1. Prepare tools and materials
2. Place the tilled soil into 36 polybags.
3. Cut the tips of the shallot bulbs before planting, then plant them in the prepared medium.
4. Water daily, but always pay attention to the moisture content of the medium.
5. Apply ecoenzyme every 10 days after planting, according to the concentration for each treatment [8]
6. Apply additional nutrients from fermented rabbit urine at a concentration of 35 ml/L for 36 polybags every 14 days by watering [9].
7. Apply a botanical pesticide made from neem leaves every 7 days to prevent pests and diseases [10].
8. Regular weeding is carried out to prevent competition for nutrients and pest and disease attacks.

2.5. Observation Variables

a. Plant Height

Plant height was measured with a ruler in cm, from the soil surface to the tip of the straight leaf. Measurements were taken every 7 days [11].

b. Number of Leaves

The number of leaves was calculated from the number of leaf blades growing on each shallot plant [12].

c. Number of Tiller

The number of tillers was calculated from each growth and formation of tillers on the shallot plant [13].

2.6. Data Analysis

The research data was analyzed using analysis of variance (ANOVA). If significant results were obtained, Duncan's test was performed using SPSS.

3. Results and Discussion

Pictures of Shallot Plants on the 3rd Week, 4th Week and 5th Week



3 WAP

4 WAP

5 WAP

3.1. Ecoenzyme Nutrient Content Enriched with Shallot Waste

Table 1. Ecoenzyme Nutrient Content Enriched with Shallot Waste

Bahan	C- organic (%)	Total N (%)	Phosphorus (P) (%)	Potassium (K) (%)	PH
Ecoenzyme enriches shallot waste	1,170 (R)	0,040 (SR)	28,590 (T)	447,100 (ST)	5,450 (M)

Description: R = Low, SR = Very low, T = High, ST = Very high, M = Sour

The use of organic shallot waste as an ecoenzyme is the right solution as an environmentally friendly nutrient support for shallot plants (*allium ascalonicum L.*). Based on the results of laboratory analysis, ecoenzyme enriched with shallot waste contains essential nutrients such as organic carbon, nitrogen, phosphorus and potassium. Organic carbon is a nutrient that can increase and stimulate the activity of soil microorganisms and improve soil quality [14]. The increased activity of soil microorganisms can increase the decomposition process of organic matter in the soil into simpler elements so that the available elements are easily absorbed by plants.

The organic carbon content is relatively low, This is because carbon compounds are widely used by microorganisms that work during fermentation as an energy intake [15]. Nitrogen is a nutrient that can support vegetative plant growth such as stimulating leaf growth, the very low total N content can be caused by nitrogen evaporation as the temperature increases during the fermentation process [16], in addition it is suspected due to the lack of raw materials with high nitrogen content.

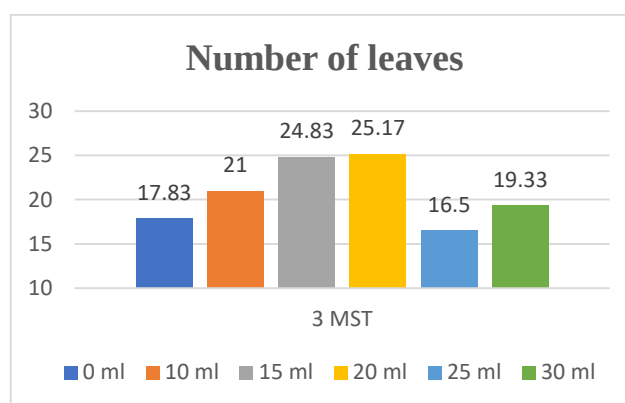
Phosphorus has an important role for plant growth such as supporting cell division and maintenance, photosynthesis, strengthening plants, and playing a role in the proper utilization of other nutrients [17]. Very high potassium can support and play an important role in plant growth. Potassium can function to activate the enzyme system that supports plant metabolic processes and protein synthesis and regulates the flow of photosynthesis results from leaves to all other parts of the plant [18]. The high phosphorus and potassium content is supported by the content of ecoenzyme raw materials, namely shallot waste, especially shallot skins containing phosphorus and potassium. The analysis results show that the pH of ecoenzyme is classified as acidic, this is related to the organic acid content in ecoenzyme [19], ecoenzyme with a low pH can be caused by an increase in the content of organic acids in it such as acetic acid or citric acid. The nutrient content contained in ecoenzyme can be used to support the growth of shallot plants and by utilizing environmentally friendly products can support sustainable agriculture.

3.2. Average Number of Leaves

Table 2. Average Number of Leaves

Treatment	3 MST
P0	17.83 a
P1	21.00 ab
P2	24.83 b
P3	25.17 b
P4	16.50 a
P5	19.33 ab

Table 2. shows the average leaf growth rate at 3 weeks post-planting (WAP) in shallots. Duncan's test at the 5% level showed variations in leaf number across treatments.



The graph shows the growth of the number of leaves of shallot plants (*Allium ascalonicum* L.) treated with various concentrations of ecoenzyme enriched with shallot waste such as P0, P1, P2, P3, P4, and P5 in several weeks after planting (WAP). Observations 3 WAP showed that the P3 treatment gave the highest results compared to other treatments, followed by P2, P1, P5, P0 and P4 treatments. This shows that the P3 ecoenzyme treatment has a better effect on the vegetative growth phase of shallot plants, especially in the 3rd week which is the active vegetative phase, the nutrients in P3 can be absorbed and utilized optimally by plants for their growth process.

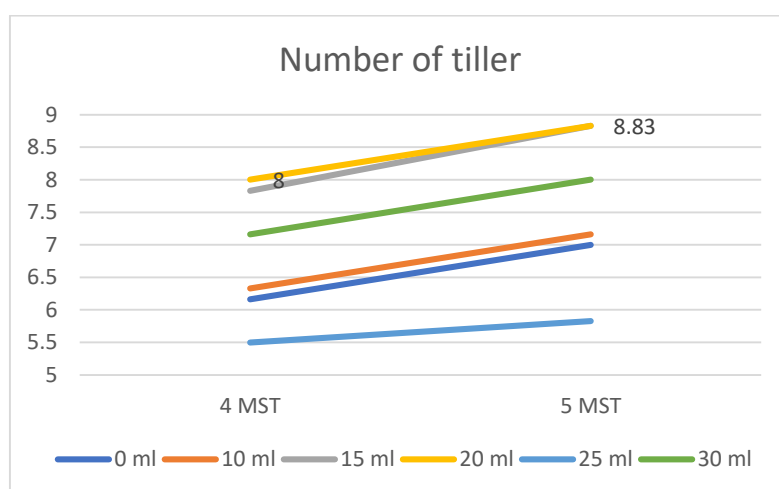
The administration of ecoenzyme can have a significantly different effect on the number of leaves of shallot plants [20]. Ecoenzyme has a nitrogen content that functions to help accelerate the growth of plant leaves, plant roots can absorb nitrogen in the form of NO₃ and NH₄ [21]. Weeks 3 and 4 are included in the active vegetative growth phase where plants really need nutrients to support their growth so that shallots can absorb nitrogen optimally to increase leaf growth. In line with the statement that nitrogen has an important role in supporting plant growth and development such as supporting leaf growth [22]. Although the nitrogen content in ecoenzymes enriched with shallot waste is relatively low, ecoenzymes with shallot waste as the main ingredient contain natural growth hormones such as gibberellins which can influence the growth of plant leaves. In line with statement that gibberellins in shallot skins can function in supporting the growth and addition of plant leaves [23]. Potassium is also needed in plant leaf growth, according to the statement that potassium can function in helping the opening and closing of leaf stomata, increasing the thickness of leaf cell walls, regulating the flow of carbohydrates from photosynthesis and minimizing leaf drying due to exposure to sunlight [24] [25]. Potassium channels the results of photosynthesis to growth points so that it can stimulate the growth of the number of leaves.

3.3. Average Number Of Tiller

Table 3. average number of tiller

Treatment	4 MST	5 MST
P0	6.17 ab	7.00 ab
P1	6.33 abc	7.17 ab
P2	7.83 bc	8.83 b
P3	8.00 c	8.83 b
P4	5.50 a	5.83 a
P5	7.17 abc	8.00 ab

Table 3 shows the average growth rate of tillers at 4 and 5 weeks post-planting (WAP) in shallot plants. Duncan's test at the 5% level showed variations in tiller numbers across several treatment concentrations.



The graph shows the growth of the number of shallot (*Allium ascalonicum* L.) seedlings given various concentrations of ecoenzyme treatment enriched with shallot waste starting from P0 to P5 in several weeks after planting (WAP). The results of observations of 4 WAP showed that the highest number of tiller was in treatment P3, followed by P2, P5, P1, P0, and P4. Observations of 5 WAP showed that treatments P2 and P3 had the same average number of tiller, and the lowest number of tiller was in treatment P4. This shows that the concentration of treatments P2 and P3 has a better effect on the initial growth phase of plants than other treatments.

Ecoenzyme is able to influence plant growth such as the emergence of the number of tiller, this can be caused by the ecoenzyme content which can function optimally in supporting plant growth and the number of tiller. In accordance with the statement that ecoenzyme can affect root growth and can support the growth of new shoots and seedlings [26]. The growth in the number of tillers is thought to be due to the presence of enzymes in ecoenzymes and growth hormones which also play a role in the vegetative growth of plants and can trigger the growth of plant tillers. Ecoenzymes contain enzymes such as lipase which can function to encourage the performance of cytokinin and auxin hormones in plants [27].

This is also in line with the statement that cytokinins can trigger lateral shoot cell division. The presence of cytokinins can encourage the growth of plant organs in the vegetative growth phase and the auxin hormone can support branch growth. Adequate nutrients can also affect the growth of plant tillers [28]. Phosphorus nutrients play an important role in plant growth such as cell division, strengthening plants and improving plant quality, with strong plants being able to maximize the

photosynthesis process thereby optimizing the photosynthate produced. The resulting photosynthate functions as an energy source in the formation of plant tillers [29]. Phosphorus can increase plant growth through its function in cell formation in growing tissues such as plant stems [30]. Adequate nutritional fulfillment is also necessary to support good plant seedling growth, without sufficient nutrition, seedlings will not grow optimally. Potassium can help plants in maximizing water and nutrient absorption in the soil and channeling assimilation to every part of the plant [31].

4. Conclusion

shallot waste can be used as an ecoenzyme because its nutrient content can support the growth of shallot plants, this also has the potential to reduce environmental pollution. The application of ecoenzyme to plants is an environmentally friendly solution in supporting sustainable agriculture. Ecoenzyme can support the growth of shallot plants and has a significant effect on the growth of the number of leaves and the number of tiller. Treatments P2 and P3 with concentrations of 15 ml / l and 20 ml ecoenzyme / l of water for shallots gave better results on the growth of the number of leaves and the number of tiller.

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Data and Software Availability Statements

The data supporting this research are available from the authors no software was developed in the research. Statistical analysis was performed using SPSS software.

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