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Efektivitas Pemanfaatan Eco enzym dari Limbah Rimpang (Rhizoma) terhadap Pertumbuhan Tanaman Selada Hijau (Lactuca Sativa L.)

Effectiveness of Using Ecoenzyme from Rhizome Waste (Rhizoma) on the Growth of Green Lettuce (Lactuca Sativa L.)

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Abstract

This study aims to identify microbes contained in rhizome waste ecoenzymes and analyze their effects on the growth of green lettuce (Lactuca sativa L.). The method used was an experiment with a Completely Randomized Design (CRD) design involving four ecoenzyme treatments at concentrations of 0%, 10%, 20%, and 30%, and six repetitions. The effect of ecoenzymes was tested on plant growth parameters, namely weight, height, and number of leaves. The data obtained were analyzed using normality tests, homogeneity tests, ANOVA, and Duncan to determine significant differences between treatments. The results showed that rhizome waste ecoenzymes contained Bacillus subtilis microbes that played a role in increasing the growth of green lettuce plants. The treatment of 20% ecoenzyme (T2) gave the best effect on increasing plant weight (69.83 grams), plant height (48.32 cm), and number of leaves (21.50 strands). Climatic factors such as soil pH showed stability that supported microbial activity, with an average pH of 4.5 across all treatments. Overall, rhizome waste ecoenzymes can be an effective alternative organic fertilizer in increasing the growth of green lettuce plants.

***Keywords*: Ecoenzyme, Rhizome Waste, Microbes, Green Lettuce**

Abstrak

Penelitian ini bertujuan untuk mengidentifikasi mikroba yang terkandung dalam ekoenzim limbah rimpang dan menganalisis pengaruhnya terhadap pertumbuhan tanaman selada hijau (Lactuca sativa L.). Metode yang digunakan adalah percobaan dengan rancangan Acak Lengkap (RAL) yang melibatkan empat perlakuan ekoenzim pada konsentrasi 0%, 10%, 20%, dan 30%, dan enam kali pengulangan. Pengaruh ekoenzim diuji terhadap parameter pertumbuhan tanaman yaitu berat, tinggi, dan jumlah daun. Data yang diperoleh dianalisis menggunakan uji normalitas, uji homogenitas, ANOVA, dan Duncan untuk mengetahui perbedaan nyata antar perlakuan. Hasil penelitian menunjukkan bahwa ekoenzim limbah rimpang mengandung mikroba Bacillus subtilis yang berperan dalam meningkatkan pertumbuhan tanaman selada hijau. Perlakuan ekoenzim 20% (T2) memberikan pengaruh terbaik terhadap peningkatan berat tanaman (69,83 gram), tinggi tanaman (48,32 cm), dan jumlah daun (21,50 helai). Faktor iklim seperti pH tanah menunjukkan stabilitas yang mendukung aktivitas mikroba, dengan pH rata-rata 4,5 di semua perlakuan. Secara keseluruhan, ekoenzim limbah rimpang dapat menjadi pupuk organik alternatif yang efektif dalam meningkatkan pertumbuhan tanaman selada hijau.

Kata kunci: Eco Enzym, Limbah Rimpang, Mikroba, Selada Hijau

1. Introduction

The growth of green lettuce plants can be influenced by various factors, including nutrient

availability and interactions with microbes in the ecosystem. One of the factors that can affecting the growth of lettuce plants is the use of ecoenzymes as organic fertilizers. Ecoenzymes are made from a mixture of organic materials such as fruits, sugar, and water which

Ecoenzyme is the latest breakthrough in agriculture because of its many benefits. This ecoenzyme functions as a fertilizer and pest repellent. Thus, it is hoped that the existence of this ecoenzyme will help Indonesian farmers become less dependent on inorganic fertilizers and reduce the dangers caused by inorganic fertilizers (Alrades, 2023).

Mundergo fermentation process. Various enzymes are produced during the fermentation process, which are very important for plant growth. Ecoenzymes contain nutrients that help the growth of plants and microorganisms such as bacteria and fungi, which help improve the balance of microbes in the soil (Alrades, 2023). Ecoenzymes are the latest breakthrough in agriculture because of their many benefits. This ecoenzyme functions as a fertilizer and pest repellent. Thus, it is hoped that the presence of this ecoenzyme will help Indonesian farmers become less dependent on inorganic fertilizers and reduce the dangers caused by inorganic fertilizers (Ririn, 2023).

Plants that have natural eco-enzymes can be more fertile. This is based on an in-depth study by Dr. Rosukan Poompanvong from Thailand. Ecoenzymes have the ability to convert NO3 and carbon dioxide (CO2) into carbon trioxide (CO3). It increases plant growth and fertilization (Ronny Nangoi, 2022).

As a source of energy for plants, agricultural waste contains liquid organic fertilizer, ecoenzymes consisting of proteolytic enzymes, maltase enzymes, and alpha-amylase. These ecoenzymes break down starch compounds in the endosperm of food stores into glucose (NA Ginting, 2021).

One approach that can be used to increase plant growth is by using rhizome waste ecoenzymes (Fitrah, et al, 2024). Rhizome waste ecoenzymes are considered to have nutrients and microbes that can increase plant growth because they are made from rhizome waste such as ginger, turmeric, or temulawak (Chen, 2020).

2. Research Method

This study used a quantitative approach with an experimental method (Zaenal, 2020) to test the effect of microbes identified in rhizome waste ecoenzymes on the growth of green lettuce (Lactuca sativa L.). This study was conducted using a Completely Randomized Design (CRD) with four treatments, namely control (without ecoenzyme), and ecoenzyme application with concentrations of 10%, 20%, and 30%. Each treatment was repeated six times, resulting in a total of 24 plant samples.

The research was conducted at the Bandung Intern Indah Complex, Gedebage, for the process of making ecoenzymes and plant growth, while the microbial test was conducted at the

West Java Provincial Health Department Laboratory. The use of ecoenzymes in this study lasted for 4 to 8 weeks, including the preparation stage, fermentation of rhizome waste for three months, and application of ecoenzymes to green lettuce plants.

Data were collected through observation. The main parameters included identification of fungal species on ecoenzymes, measurement of height, weight, and number of plants. Other environmental factors, such as pH, were measured using a pH meter. The Shapiro-Wilk normality test, homogeneity test with F test, and hypothesis test with analysis of variance (ANOVA) were used to analyze the data at a significance level of 0.05 (Hidayat, 2021).

There are three main stages in the research procedure. The preparation stage includes the collection and fermentation of rhizome waste, preparation of seeds and planting media, sterilization of materials and tools, and the use of ecoenzymes to measure plant growth and analyze microbes. The implementation stage includes the use of ecoenzymes, plant growth measurements, and microbial analysis. The completion stage includes data processing, statistical analysis, and preparation of research report.

This study aims to evaluate the effectiveness of ecoenzyme as an organic liquid fertilizer in increasing the growth of green lettuce, so that it can provide benefits for farmers in producing high-quality plants with optimal harvest yields.

3. Results and Discussion

Research result:

Table 1. The Effect of Ecoenzyme Results from Rhizome Waste on the Weight Growth of Green Salad

ANOVA

Heavy

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	483,167	3	161,056	5,707	.004
Within Groups	4553.333	20	227,667		
Total	5036.500	23			

Referring to Table 1. shows the Sig. value of 0.004, which is smaller than 0.05. This means that there is a significant difference between the treatments.ecoenzymeon the growth of green lettuce plant weight, so the alternative hypothesis is accepted, namely that the eco-enzyme of rhizome waste has an effect on the growth of green lettuce plant weight.

Table 2. The Effect of Ecoenzyme Results from Rhizome Waste on the Height Growth of Green Lettuce

ANOVA

Tall

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	40.159	3	13,386	20,648	.000
Within Groups	12,966	20	.648		
Total	53.125	23			

Referring to Table 2 shows the Sig. value of 0.000, which is smaller than 0.05. This means that there is a significant difference between the treatments.ecoenzymeon the growth of green lettuce plants, so the alternative hypothesis is accepted, namelyecoenzymeRhizome waste affects the growth of green lettuce plants.

Table 3. The Effect of Ecoenzyme Results from Rhizome Waste on the Growth of Green Lettuce Leaves

ANOVA
Strands

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36,458	3	12.153	6,659	.003
Within Groups	36,500	20	1,825		
Total	72,958	23			

Referring to Table 3. shows the Sig. value of 0.003, which is smaller than 0.05. This means that there is a significant difference between the ecoenzyme treatment on the number of green lettuce leaves, so the alternative hypothesis is accepted, namely that the rhizome waste ecoenzyme affects the number of green lettuce leaves.

Discussion:

Types of Microbes in Rhizome Waste Ecoenzymes

Among the various microbes present in the rhizome waste ecoenzyme, Bacillus subtilis is the most common species and is responsible for the decomposition of organic matter and improving soil fertility by producing enzymes such as lipase, amylase, and protease. In addition, Bacillus subtilis produces antibacterial compounds that protect plants from pathogens and increase the availability of phosphate, nitrogen, and potassium in plants.

The Effect of Microbes in Ecoenzymes on Green Lettuce Growth

Microbes in ecoenzyme contribute to increasing the weight, height, and number of leaves of green lettuce plants.

1. Plant Weight: Ecoenzymes increase the weight of lettuce plants by providing nutrients that are essential for plant growth. Microbes contained in ecoenzymes, such as organic matter decomposing bacteria, help break down complex compounds into simpler forms that are easily absorbed by plant roots. One of the main nutrients produced is nitrate and phosphate, which play a role in the formation of plant biomass. Nitrate functions as a source of nitrogen that supports the formation of proteins and enzymes needed for metabolic processes and plant tissue synthesis. Phosphate plays a role in the transfer of energy through ATP (adenosine triphosphate) and the development of stronger roots, so that plants can absorb water and nutrients more efficiently. The results showed that

plants treated with ecoenzymes experienced a greater increase in weight compared to plants that were not treated. This shows that the microbial content in ecoenzymes provides significant benefits in providing nutrients and improving soil fertility, thereby increasing the productivity of lettuce plants.

2. Plant Height: The height of green lettuce plants also increased with the application of ecoenzymes, mainly due to the role of microbes such as Bacillus subtilis. These microbes have the ability to improve soil structure, increase water retention, and increase nutrient availability. Better soil structure allows plant roots to develop more optimally, expanding the area of water and nutrient absorption. In addition, Bacillus subtilis has the ability as a biocontrol agent, which can protect plants from soil pathogens, so that plants can grow healthier and reach more optimal heights. The right concentration of ecoenzymes greatly affects the vertical growth of plants. If the concentration is too low, the effect may be insignificant, while if it is too high, it can cause nutrient imbalance or even toxicity to plants. Therefore, the dose used must be adjusted to obtain optimal growth results.

3. Number of Leaves: Ecoenzyme plays a role in stimulating the vegetative growth of lettuce plants by increasing the activity of soil microbes. These microbes play a role in the decomposition of organic matter and the release of essential nutrients such as nitrogen, phosphorus, and potassium, all of which contribute to leaf development. In addition to providing nutrients, ecoenzyme also increases the availability of natural growth hormones such as auxin and cytokinin. Auxin helps in the division and elongation of plant cells, while cytokinin plays a role in stimulating the development of new shoots and leaves. With the combination of these two hormones, lettuce plants treated with ecoenzyme can produce more leaves compared to the control. The more leaves that are formed, the greater the photosynthetic capacity of the plant. This means that the plant can capture more sunlight to produce energy, thus supporting more optimal overall growth. Thus, the application of ecoenzyme is one of the effective strategies in increasing the yield of lettuce plants naturally and environmentally friendly.

Microbial Quality in Ecoenzymes on Green Lettuce Growth

The quality of microbes in ecoenzymes is influenced by environmental factors, such as soil pH and temperature:

1. Soil pH is an environmental factor that greatly affects microbial activity in ecoenzymes and the availability of nutrients for plants. Microbes in ecoenzymes work optimally in a certain pH range, generally between 5.5 and 7.5, depending on the type of microorganisms contained in it. If the soil pH is too acidic (<5.5) or too alkaline (>7.5), microbial activity can decrease, so that the effectiveness of eco-enzymes in supporting plant growth is reduced. When the soil pH is in ideal conditions, microbes such as Bacillus subtilis, Pseudomonas fluorescens, and Trichoderma spp. can grow well and play a role in the decomposition process of organic matter and the release of essential nutrients, such as nitrogen (N), phosphorus (P), and potassium (K). In addition, soil pH stability also supports the solubility of minerals needed by plants for growth.

The effect of soil pH on the growth of green lettuce can be seen from several aspects:

a. Plant weight: In stable pH, nutrients like nitrogen are available in optimum amounts, which helps in the formation of protein and plant biomass, thereby increasing plant weight.

b. Plant height: Proper pH allows roots to absorb nutrients more efficiently, which supports vertical plant growth.

c. Number of leaves: With stable pH conditions, soil microbes can produce phytohormones such as auxins and cytokinins, which stimulate optimal leaf formation and development.

If the pHsoil is not in the optimal range, microbes in ecoenzymes may experience stress and cannot work optimally in increasing soil fertility. Therefore, monitoring soil pH is an important factor in the application of ecoenzymes for the growth of green lettuce plants.

2. Soil Temperature: Soil temperature is also an environmental factor that greatly determines the activity of microbes in eco-enzymes. Soil microbes, especially bacteria such as Bacillus subtilis and fungi such as Trichoderma spp., have an optimal temperature for growth and activity, which is between 25°C and 30°C.

Within this temperature range, the microbes in ecoenzymes can work more efficiently in:

a. Accelerates organic matter decomposition: Optimal temperature increases the activity of enzymes produced by microbes, so that the process of organic matter decomposition becomes faster. This results in faster release of nutrients and is available to green lettuce plants.

b. Increasing nutrient availability: Nutrients such as nitrogen and phosphorus are more readily available when soil temperatures are at their optimum, due to the mineralization process accelerated by soil microbes.

c. Maintaining the balance of good microbes in the soil: Stable temperatures prevent the growth of pathogenic microbes that can inhibit plant growth.

If the soil temperature is too low (<20°C), the microbial activity in the ecoenzyme can slow down, so that the process of decomposing organic matter and releasing nutrients becomes less effective. Conversely, if the soil temperature is too high (>35°C), beneficial microbes can experience stress and even die, which has a negative impact on soil fertility and plant growth.

Soil temperature stability also has a positive impact on the growth of green lettuce because:

1. Roots can absorb nutrients better at optimal temperatures, supporting root growth and overall plant development.

2. Leaves develop more optimally due to better nutrient availability, which allows plants to carry out photosynthesis more efficiently.

3. Plants are more resistant to environmental stress, such as drought or pathogen attack, because healthy soil microbes help increase plant resilience.

Thus, maintaining optimal soil pH and temperature is very important in supporting the quality of microbes in ecoenzymes. The results of the study showed that the use of eco-enzymes derived from rhizome waste, especially those containing Bacillus subtilis, plays a role in improving soil quality and the availability of essential nutrients, which ultimately accelerates the growth of green lettuce plants.

4. Conclusion

Based on the research results, it can be concluded that ecoenzymes from rhizome waste contain Bacillus subtilis bacteria which play a role in increasing soil fertility and the growth of green lettuce (Lactuca sativa L.). The use of this ecoenzyme has been shown to have a positive effect on the weight, height, and number of plant leaves. In addition, the quality of microbes in ecoenzymes is greatly influenced by environmental factors such as pH and soil temperature, which play an important role in its effectiveness.

As a suggestion for further research, it is recommended to explore a wider variation of ecoenzyme concentrations and monitor their impacts over a longer period of time. This aims to determine the optimal concentration that can provide the best results in increasing plant productivity sustainably and optimizing the benefits of ecoenzymes for organic farming..

Bibliography

Apriliyani, Ririn. The Effectiveness of Eco-Enzyme Waste Vegetables On Lettuce Plant Growth Green (Lactuca Sativa L.) Hydroponically. Diss. FKIP UNPAS, 2023.

Arifin, Zaenal. "Educational research methodology." Al-Hikmah Journal 1.1 (2020).

Chen, Y., Wang, Y., and Li, Y. (2022). Effects of greenhouse environment on growth and yield of lettuce (Lactuca sativa L.). Scientia Horticulture, 280, 100041

Ginting, N., & Mirwandhono, RE (2021). Productivity of Turi (Sesbania grandiflora) as a Multi Purposes Plant by Eco Enzyme Application. IOP Conference Series: Earth and Environmental Science, 912(1)

Hidayat, AA (2021). Practical Methods of Statistical Testing With Spss. Surabaya: Health Books Publishing

Nangoi, Ronny, et al. "Utilization of household organic waste as an eco-enzyme for the growth and product of cultivate culture (Lactuca sativa L.)." Journal Applied Agroecotechnology 3.2 (2022): 422- 428. Indonesian Agriculture.

Revelation, Bima Alrades. The Effect of Giving *Eco-Enzyme Against Growth Lettuce Plant (Lactuca Sativa L*. Diss. Raden Intan University of Lampung, 2023.

Prince, F., Lesmana, R., Aisyah, S. And Muazansyah, I., 2024. Utilization Fruit and Vegetable Waste Through Making Eco Enzyme for Use Improving Environmental Sustainability Tanjung Palas. Benuanta Journal, 3(1), Pp.18-23.