Organic Waste Processing Based on Eco-Enzyme for Soil Enrichment in the FMIPA Campus Environment

D R Yuansyah*, R S Ainur dan S M Kiki
Study Program of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
*Email : yuansyahdhaniar.22028@mhs.unesa.as.id

Abstract. Food waste is one of the common types of waste found in households, restaurants, and food centers. This issue has significant impacts on the environment, economy, and food security. The purpose of this research is to contribute to reducing organic waste and soil fertilization. Thus, this study aims to determine whether Eco-Enzyme is effective in supporting ecosystem balance and soil biodiversity. The research was conducted in March 2023 at the Green House of the Biology Department, State University of Surabaya. The data collection technique used direct observation using a pH meter, conductivity meter, and sampling technique. The observation and data analysis took place over a period of 3 months. Experiments were conducted on plants that were previously infested with pests/insects and had difficulty growing. The plants were regularly given Eco-Enzyme solution for 4 days, and the changes were observed. During this period, the plants were less infested by pests/insects and became more fertile. Eco-Enzyme acts as a catalyst that accelerates the decomposition of organic matter. In this research and implementation of Eco-Enzyme, the focus is on promoting effectiveness in reducing the amount of organic waste and improving soil quality. Over the 3-month observation period, the data analysis showed that Eco-Enzyme has shown positive potential in addressing environmental issues.

1. Introduction

Soil is a crucial natural resource for human life and ecosystems. As the surface of the Earth we tread upon, soil provides a foundation for plant growth, habitat for various organisms, and a place for human activities.However, soil also faces various challenges and threats. Unsustainable farming practices, rapid urbanization, deforestation, soil erosion, pollution, and climate change are factors that can degrade soil quality and fertility. Eco-Enzyme offers an interesting solution to enhance soil quality and promote sustainable agriculture. By combining natural wisdom with modern technology, Eco-Enzyme has become a promising alternative to improve crop productivity, reduce reliance on synthetic chemicals, and minimize negative impacts on the environment.

Several researchers have conducted studies with the aim of developing Eco-Enzyme as a solution to address everyday challenges. For example, Indrajaya (2018) found that Eco-Enzyme can convert ammonia into nitrate (NO3), natural hormones, and plant nutrients, making it suitable as a liquid organic fertilizer due to its macro and micronutrient content. Similarly, Poompanvong et al. (2020) discovered that Eco-Enzyme can convert ammonia into nitrate (NO3), natural hormones, and organic nutrients for plants, indicating that Eco-Enzyme-based liquid fertilizers do not have long-term negative effects. Additionally, the solution is capable of converting CO2 into carbonate (CO3), which aids in natural cycles and facilitates plant growth by acting as a fertilizer.

After reviewing several journals on the utilization of Eco-Enzyme, the author is interested in further examining and directly proving the benefits of Eco-Enzyme itself as an effort to improve soil fertility in the FMIPA UNESA campus environment. Eco-Enzyme refers to a complex organic solution produced by fermenting organic residues, sugars, and water from anaerobic organisms. This Eco-Enzyme solution is versatile, ecologically friendly, and applicable in various fields, particularly in agriculture and the environment (Budiyanto, 2011).

Based on the above description, the author is interested in conducting a research study titled "Organic Waste Processing Based on Eco-Enzyme for Soil Enrichment in the FMIPA Campus Environment" Therefore, this research aims to determine the effectiveness of Eco-Enzyme in plant disease control, soil

quality improvement, and providing alternative utilization of organic waste to enhance its economic value.

2. Methods

The research, including the creation, sampling, and experiments, was conducted directly in March 2023 at the Green House, Department of Biology, Universitas Negeri Surabaya. As for the data collection technique for the Eco-Enzyme experiment on the environment, it was done through several direct observation methods, observing the environment to be tested using Eco-Enzyme. For example, observing plants, water, soil, and air contaminated with chemicals or organic waste. Observations can be performed using measuring tools such as pH meters, conductivity meters, or other analytical instruments. The second method is through sampling. Samples were taken from the environment to be tested and later analyzed in the laboratory. The samples included soil, water, air, or plants. These samples were then analyzed to measure nutrient content, levels of toxic chemicals, or other organic substance content.

Table 1. Progress of Eco-Enzyme Making Observations

No	Day/Date	Activity	Desc.(Documentation)
1.	Tuesday, March 7th, 2023	Preparation and creation of Eco-Enzyme at the Biology Green House	
2.	Friday, March 17, 2023	Presentation of materials and initial progress	
3.	Friday, April 7th, 2023	Check on the 1st month of Eco-Enzyme	
4.	Sunday, May 7th, 2023	Check on the 2nd month of Eco-Enzyme	

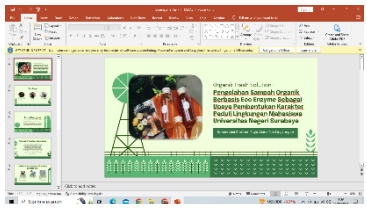
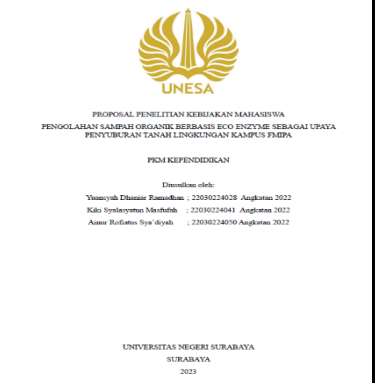
5.	Friday, May 12, 2023	Presentation of group work to the class and supervising lecturer	
6.	Friday, May 26th, 2023	Submission of Eco-Enzyme PKM Proposal to the faculty	
7.	Wednesday, June 7th, 2023	Check on the 3rd month and harvest of Eco-Enzyme results	

Table 2. Application of Eco-Enzyme on Plants

No.	Day/Date	Activity	Desc.(Documentation)
1.	Wednesday, June 7th, 2023	Preparation of Eco-Enzyme solution by mixing 2 bottle caps of Eco-Enzyme solution with 1 full bucket of water.	

2.	Wednesday, June 7th, 2023	Stir until the water in the bucket becomes murky. The black color in the picture beside is due to the color of the bucket itself, not the Eco-Enzyme solution.	
3.	Wednesday, June 7th, 2023	Watering Plant A (Taiwan Beauty Flower) adequately with the solution.	
4.	Wednesday, June 7th, 2023	Watering Plant B (Krokot Rose Flower) adequately with the solution.	
5.	Thursday, June 8th, 2023	Day 1 After watering with the Eco-Enzyme solution.	

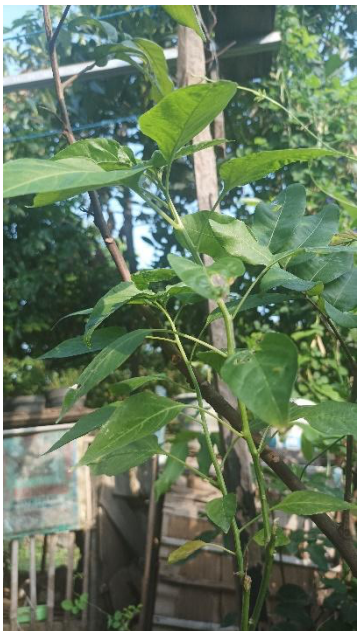
6.	Friday, June 9th, 2023	Day 2 After watering with the Eco-Enzyme solution.	
7.	Saturday, June 10th, 2023	Day 3 After watering with the Eco-Enzyme solution, Plant A shows abundant blooming.	
8.	Saturday, June 10th, 2023	Day 3 After watering with the Eco-Enzyme solution, Plant B grows vigorously and new buds begin to emerge.	
9.	Sunday, June 11th, 2023	Day 4 After watering with the Eco-Enzyme solution, Plant A produces numerous purple flowers and new shoots start to grow.	

10.	Sunday, June 11th, 2023	Day 4 After watering with the Eco-Enzyme solution, Plant B shows the growth and development of flower petals.	

Table 3. Application of Eco-Enzyme on Plant Pest, Black Ants

No.	Day/Date	Activity	Desc.(Documentation)
1.	Wednesday, June 7th, 2023	Documentation of chili plants infested with black ant pests.	
2.	Wednesday, June 7th, 2023	Spraying the Eco-Enzyme solution on the bucket solution for watering the plants using a sprayer.	

3.	Wednesday, June 7th, 2023	Spraying on all plants affected by pests.	
4.	Thursday, June 8th, 2023	Day 1 after spraying, black ant pests begin to leave, leaving only their eggs.	
5.	Friday, June 9th, 2023	Day 2, the eggs of the ant pests start to fall off, and the ants move away from the chili plants they used as their nests.	
6.	Saturday, June 10th, 2023	Day 3, black ant pests are completely eliminated and do not return to create nests.	

7.	Sunday, June 11th, 2023	Day 4, final observation on plants infested with pests, and until day 4, the chili plants are no longer visited by black ant pests.	

3. Results and Discussion

Interpretation of plant analysis

Table 1 presents the progress observations of Eco-Enzyme from the initial production until the third month, including the process of presenting the Eco-Enzyme project. In the first month, Eco-Enzyme produced alcohol. This indicates that during the first month, the fermentation process in Eco-Enzyme resulted in alcohol production. It signifies that the microorganisms used in Eco-Enzyme can convert specific substances into alcohol. In the second month, Eco-Enzyme produced vinegar. This demonstrates that the alcohol produced in the previous month underwent oxidation to become vinegar. This process typically involves acetobacter bacteria, which can transform alcohol into acetic acid, the main component of vinegar. In the third month, Eco-Enzyme produced more Eco-Enzyme. Consequently, in the third month, a new batch of Eco-Enzyme was generated. This indicates that the fermentation process in Eco-Enzyme reached the stage of reproduction and further development. The newly produced Eco-Enzyme might have a higher concentration and strength compared to the previous batch.

Success Indicators

The success of Eco-Enzyme can be assessed based on several characteristics. Firstly, it should have a reddish-brown color, although the color may vary depending on the materials used. This indicator demonstrates that successful Eco-Enzyme exhibits a reddish-brown color, although the specific shade may vary depending on the materials used. It indicates that the right composition of ingredients and microorganisms is necessary to achieve the desired color. Secondly, it should have a fresh acidic aroma corresponding to the materials used (if it smells rotten, it indicates failure). This indicator shows that successful Eco-Enzyme should have a fresh acidic aroma that corresponds to the materials used. If there is a rotten smell, it indicates a failure in the fermentation process and there may be issues with the microorganisms used or inappropriate fermentation conditions. Thirdly, it should have white mold on the surface (Pitera mold), while black mold indicates failure. However, this can be remedied by adding sugar in the appropriate amount as initially prescribed. This indicator shows that successful Eco-Enzyme should have white mold (Pitera mold) growing on its surface. The presence of white mold indicates that the fermentation process is proceeding well. However, if the mold is black, it indicates a failure in the fermentation process. Adding sugar in the specified amount can help restore failed Eco-Enzyme.

Overall, successful Eco-Enzyme must meet all the mentioned success indicators, including the appropriate reddish-brown color, fresh acidic aroma, and the growth of white mold (Pitera mold) on its surface. If Eco-Enzyme fails to meet these indicators, the fermentation process may not be successful, and adjustments to the ingredient composition or fermentation conditions may be needed to achieve the desired results.

Testing on Plants

In Table 2, the application of Eco-Enzyme on Plant A, which is Taiwan Beauty, and Plant B, which is Krokot Mawar, shows that the watering of the Eco-Enzyme solution on these plants has produced significant reactions. Both plants exhibited changes within four days, including notable flower development and the emergence of new shoots. It can be concluded that by mixing two bottle caps (with each cap having a volume of 40 mL), the growth of Taiwan Beauty and Krokot Mawar ornamental plants can be stimulated. This is because Eco-Enzyme is a solution that contains various essential nutrients such as enzymes, vitamins, amino acids, and natural hormones. These nutrients provide optimal support for plant growth, including the formation of roots, leaves, and flowers. By providing the Eco-Enzyme solution, Taiwan Beauty and Krokot Mawar plants receive an adequate nutrient supply and can efficiently utilize it for rapid growth. Additionally, Eco-Enzyme has the ability to stimulate root system growth and development. By promoting root growth, Taiwan Beauty and Krokot Mawar plants can absorb more water and nutrients from the soil. Strong and healthy roots enable plants to grow rapidly and optimize the process of photosynthesis. Furthermore, the Eco-Enzyme solution can influence the production of plant hormones such as auxins and cytokinins. These hormones play a crucial role in regulating plant growth. By providing the Eco-Enzyme solution, Taiwan Beauty and Krokot Mawar plants can receive hormonal stimuli that accelerate their growth and development.

In Table 3, the application of Eco-Enzyme on Plant Pest, specifically Black Ants, shows differences from day 1 to day 4. Initially, the chili plants were heavily infested with black ants using them as their nesting sites. However, after the application of the Eco-Enzyme solution, the ants reacted to the solution. This may be because the ants disliked the smell of the Eco-Enzyme solution, and the solution contained substances that repelled the ants. By applying the Eco-Enzyme solution around the black ant nests, it can disrupt the ants' chemical communication and prevent them from nesting on the chili plant shoots. This helps control the ant population and prevents them from damaging the plants. Moreover, the attack of black ants on chili plants can cause stress to the plants. The Eco-Enzyme solution can help alleviate plant stress by strengthening the plant's defense system and enhancing its resistance to attacks. This aids in the plant's faster recovery from damage caused by black ants. Providing the spray only once, instead of daily, for repelling pests such as black ants is because Eco-Enzyme solutions are generally designed to provide a long-lasting effect. For example, Eco-Enzyme can provide additional nutrients that will be gradually absorbed by the plants over a specific period. By giving a single spray, it is expected that chili plants will receive the benefits of nutrients and growth stimulation for an extended period of time.

The reason for not providing an excessive amount of Eco-Enzyme and using the prescribed measurement of two 40 mL bottle caps in the water solution is because Eco-Enzyme solutions contain important nutrients such as enzymes, vitamins, amino acids, and natural hormones. If too much Eco-Enzyme solution is added to the watering solution, the plants can receive an overdose of nutrients. Nutrient overdose can cause growth issues such as imbalanced growth, weak root formation, or nutrient poisoning. Plants can respond unfavorably and experience growth disturbances. Furthermore, Eco-Enzyme solutions have a high level of acidity. If an excessive amount of Eco-Enzyme solution is added to the watering solution, the pH of the solution can become imbalanced and overly acidic. Excessive acidity can disrupt the absorption of nutrients by plant roots, and plants may struggle to access essential nutrients from the soil. This can lead to growth problems and plant health issues. Additionally, Eco-Enzyme solutions may be toxic if used in very high concentrations. Adding too much Eco-Enzyme solution to the watering solution can result in the accumulation of harmful chemicals in the soil or the surrounding environment. This can have negative impacts on soil organisms and the ecosystem around the plants.

4. Conclusions

Based on the analysis and discussion above, it can be concluded that waste is a serious global issue with increasing negative impacts on the environment and human health. Effective waste management efforts are crucial, and prioritizing reduction, recycling, and sustainable practices is necessary. Utilizing Eco-Enzyme for organic waste utilization and soil enrichment is one potential solution. The use of Eco-Enzyme can be an appealing solution to improve soil fertility and support agricultural sustainability. However, it is important to follow the proper dosage and usage methods to effectively harness its benefits without harming the plants and the surrounding environment.

References

[1] Anita, Afandi, and Tenriawaru A B 2019 *Pros. Sem. Nas.* (Pontianak: Universitas Tanjungpura) p. 1740.
[2] C W Budiyanto 2022. *DEDIKASI* : *Community Service Reports* 4(1) 31-38
[3] Christine, D 2022 *Zero Waste Indonesia* (Bogor : Institute Pertanian Bogor)
[4] Hasral, M. and Hasan, I. 2018 *J. Agrimart* 5(1)
[5] D Sasetyaningtyas 2018 *Manfaat dan Cara Membuat Eco-Enzym di rumah*
[6] R J Poompanvong, J Oon, dan Oei. 2020 *Modul Belajar Pembuatan Eco-Enzyme*
[7] S Sathya 2015 *Manfaat Eco-Enzym* (Jakarta : Sai Study Group Indonesia)
[8] Sulistyo 2018 *Karakteristik Pupuk Organik Cair (POC)* (Malang : Universitas Brawijaya)