Asian Multidisciplinary Research Journal of Economy and Learning

Volume 3, Issue 5, Page 10 – 17, 2026, Article No. AMJEL. 00092
ISSN: 3063-1424

Growth and Yield Response of Shallot (Allium ascalonicum L.) to Various Concentrations of Eco-Enzyme Fertilizer

Swati Sembiring[1], Lita Nasution[2], Dedi Holden Simbolon[3], Magdalena Saragih[4], Donatus Dahang[5], Rajiv Ginting[6], Juliana Simbolon[7], Yolanda Febrima Tarigan[8], Rifa Diah Valahsya Sembiring[9], Indra Prabowo Pandiangan[10], Eristo Syahmana Tarigan[11], Sri Rejeki Silaban[12]

[1,2,4,5,6] Department of Agrotechnology, Faculty of Science and Technology, Universitas Quality, Indonesia

[7] Department of Agribusiness, Faculty of Science and Technology, Universitas Quality, Indonesia

[3] Master Program of Elementary Education, Universitas Quality, Indonesia

[8,9,10,11,12] Undergraduate Students of Agrotechnology, Faculty of Science and Technology, Universitas Quality, Indonesia

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

https://doi.org/10.70471/jh9ck595

Received: 18/05/2026
Published: 31/05/2026

Original Research Article

Abstract

Shallot (Allium ascalonicum L.) is a horticultural commodity with high economic value, but its productivity is often constrained by declining soil fertility associated with prolonged and intensive inorganic fertilization. This study evaluated the growth and yield response of shallot to various eco-enzyme fertilizer dosages and identified the most effective dosage under polybag-based open-field experimental conditions. The experiment was arranged in a non-factorial Randomized Complete Block Design (RCBD) with five treatments and five replications: E0 (without eco-enzyme), E1 (100 mL plot^{-1}), E2 (200 mL plot^{-1}), E3 (300 mL plot^{-1}), and E4 (400 mL plot^{-1}). Each plot referred to one polybag experimental unit. The observed variables were plant height, number of leaves, number of tillers, fresh bulb weight, and dry bulb weight. The results showed that eco-

**Corresponding author: Email:* swati.sembiring@universitasquality.ac.id

Cite as: Sembiring, S., Nasution , L. ., Simbolon, D. H., Saragih, M. ., Dahang, D. ., Ginting, R. ., Simbolon, J. ., Tarigan, Y. F. ., Sembiring , R. D. V. ., Pandiangan , I. P. ., Tarigan , E. S. ., & Silaban , S. R. . (n.d.). Growth and Yield Response of Shallot (Allium ascalonicum L.) to Various Concentrations of Eco-Enzyme Fertilizer: English. Asian Multidisciplinary Research Journal of Economy and Learning, 3(5), 10-17. https://doi.org/10.70471/jh9ck595

enzyme dosage affected several vegetative variables at specific observation times, but the response was not uniform across all growth stages. E2 produced the highest plant height at 14, 28, and 42 days after planting (DAP), whereas E3 produced the highest leaf number at 28 DAP. Yield formation was more favorable under the lowest eco-enzyme dosage. Treatment E1 produced the highest fresh bulb weight (167.2 g plot^{-1}) and dry bulb weight (131.2 g plot^{-1}), corresponding to approximately 5.03% and 19.06% increases over the control, respectively. These findings indicate that 100 mL plot^{-1} was the most efficient eco-enzyme dosage for improving bulb yield of Bima Brebes shallot under the conditions of this experiment.

Keywords: *Allium ascalonicum; Bima Brebes; eco-enzyme; liquid organic fertilizer; organic waste; shallot yield*

1. INTRODUCTION

Shallot (Allium ascalonicum L.) is one of the most economically important horticultural commodities in Indonesia because it is used continuously in household consumption, culinary industries, and food processing. In addition to its culinary value, shallot contains bioactive compounds such as flavonoids, saponins, and sulfur-containing compounds that contribute to its functional value as a traditional medicinal plant (Rukmana, 2014). The demand for shallot tends to increase along with population growth and changes in food consumption patterns. In Sumatera Utara, this issue is particularly relevant because local production has not fully met regional consumption demand. Badan Pusat Statistik (2020) reported that shallot production in Sumatera Utara reached 16,337 tons, while consumption demand reached 36,653.7 tons, indicating a persistent supply gap that requires productivity improvement through more efficient cultivation technologies.

Productivity improvement in shallot cultivation depends strongly on soil fertility, nutrient availability, and the efficiency of fertilization management. Long-term reliance on inorganic fertilizers can reduce soil organic matter, weaken microbial activity, and lower the nutrient-buffering capacity of the growing medium, especially when fertilizer use is not balanced with organic inputs (Sutanto, 2017). This condition encourages the development of low-cost and environmentally compatible fertilization strategies. Eco-enzyme, a fermented liquid produced from organic waste, brown sugar, and water, has been proposed as a potential liquid organic fertilizer because it contains organic acids, dissolved minerals, enzymes, and microbial metabolites that may support nutrient cycling in the rhizosphere (Hemalatha, 2020; Vama & Cherekar, 2020).

The relevance of eco-enzyme in crop production lies not only in its nutrient contribution but also in its role in organic-waste valorisation. Arun and Sivashanmugam (2015) demonstrated that garbage enzyme has biocatalytic potential through enzymatic activity that assists organic matter decomposition. Patel et al. (2021) also reported that eco-enzyme can improve the quality of organic media through increased biological activity. Recent studies further indicate that eco-enzyme application may support crop growth when used at appropriate dosages. Salsabila and Winarsih (2023) reported growth improvement in pakcoy following eco-enzyme application, while Tuapattinaya et al. (2024) found that eco-enzyme functioned as a liquid organic fertilizer for mustard plants. These findings suggest that eco-enzyme can serve as a practical organic input, although its agronomic effect remains crop- and dosage-dependent.

In shallot cultivation, nutrient balance is critical because the crop has a shallow fibrous root system concentrated in the upper soil layer and forms bulbs from swollen leaf sheaths. Vegetative development is characterized by leaf, root, and tiller formation, whereas yield development depends on the translocation of photosynthates to bulbs as storage organs (Tjitrosoepomo, 2016; Triandini, 2018). Nitrogen supports leaf expansion and canopy development, while phosphorus and potassium are essential for root activity, assimilate transport, and bulb formation (Rukmana, 2014; Khaidir, 2019). Therefore, successful fertilization must support vegetative growth without excessively shifting assimilate allocation away from bulb development.

Eco-enzyme dosage is therefore a central agronomic issue. Insufficient dosage may not provide adequate stimulation of microbial activity and nutrient release, whereas excessive dosage may increase organic acid accumulation, alter media pH, and disturb root function (Nazim & Meera, 2017; Hemalatha, 2020). A similar principle has been observed in organic fertilization studies on shallot, where yield response depends on the balance between nutrient supply, physiological growth, and storage-organ development (Asrijal, 2021; Anwar et al., 2024). Thus, more eco-enzyme does not necessarily produce higher yield; the effective dosage must be empirically determined under specific cultivation conditions.

Based on these considerations, this study aimed to evaluate the growth and yield response of Bima Brebes shallot to various eco-enzyme fertilizer dosages and to identify the most effective dosage for bulb production. The study is expected to provide a practical basis for organic-waste-based liquid fertilization in shallot cultivation, particularly for smallholder horticultural systems in Sumatera Utara.

2. METHODS

2.1. Study Site and Experimental Design

The study was conducted for one planting season in an open-field experimental area located at 3.6049° N and 98.6468° E in Sumatera Utara, Indonesia. Although the experiment was placed under open-field conditions, the cultivation system used polybags; therefore, the study should be interpreted as a polybag-based field experiment rather than a conventional land-plot trial. The site was selected because it represents a horticultural cultivation environment suitable for shallot growth.

The experiment used a non-factorial Randomized Complete Block Design (RCBD) to reduce the effect of environmental heterogeneity across the experimental area (Gomez & Gomez, 1984). Five eco-enzyme treatments were evaluated: E0 (without eco-enzyme), E1 (100 mL plot^{-1}), E2 (200 mL plot^{-1}), E3 (300 mL plot^{-1}), and E4 (400 mL plot^{-1}). Each treatment was replicated five times, resulting in 25 experimental units. In this manuscript, the term plot refers to one polybag experimental unit; consequently, the unit mL plot^{-1} denotes the amount of filtered eco-enzyme solution applied to each polybag at each application time.

2.2. Planting Material, Growing Medium, and Eco-Enzyme Preparation

The planting material consisted of uniform bulb seedlings of the Bima Brebes cultivar, a shallot variety widely cultivated in Indonesia because of its adaptability and yield potential (Wibowo, 2007). The growing medium consisted of topsoil and compost at a 2:1 (v/v) ratio and was placed in polybags measuring 25 cm × 30 cm. The use of compost was intended to improve media structure, increase organic matter, and support microbial activity during the application of liquid organic fertilizer (Sutanto, 2017).

The eco-enzyme was prepared through fermentation of fruit organic waste, brown sugar, and water at a 3:1:10 ratio for approximately 90 days, following the general fermentation procedure described by Vama and Cherekar (2020). After fermentation, the solution was filtered to remove solid residues and to obtain a more homogeneous liquid fertilizer. The filtered eco-enzyme solution was applied directly to the growing medium around the root zone by drenching. Application began at 14 days after planting (DAP) and was repeated at two-week intervals according to the assigned treatment dosage. This timing was selected because shallot plants enter an active vegetative phase after establishment, during which nutrient demand increases for leaf and tiller development (Triandini, 2018). Standard crop management practices, including watering, weed control, and general plant maintenance, were carried out uniformly across all treatments.

2.3. Observed Variables

The observed growth variables were plant height (cm), number of leaves (leaves plant^{-1}), and number of tillers (tillers clump^{-1}). Plant height was measured from the base of the plant to the tip of the longest leaf. Measurements were conducted periodically at 14, 28, 42, and 56 DAP. Yield variables consisted of fresh bulb weight and dry bulb weight, recorded at harvest. Harvest was conducted at physiological maturity, indicated by the collapse or bending of approximately 70% of the leaves, which is commonly used as a harvest indicator in shallot cultivation (Rukmana, 2014). These variables were selected because they represent the transition from vegetative development to bulb formation, the main determinant of shallot productivity (Khaidir, 2019).

2.4. Statistical Analysis

The collected data were analysed using Analysis of Variance (ANOVA) at the 5% significance level to evaluate the effect of eco-enzyme dosage on each observed variable. When the treatment effect was significant, treatment means were compared using Duncan's Multiple Range Test (DMRT) at the 5% level (Gomez & Gomez, 1984). The interpretation of treatment differences in the Results section follows the DMRT grouping shown in each table; therefore, variables or observation times with the same letter within a column were interpreted as not significantly different. The statistical model for the RCBD was:

$$Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$$

where:

- Y_{ij} = observed value of the i-th eco-enzyme treatment in the j-th block;
- μ = overall mean;
- τ_i = effect of the i-th eco-enzyme treatment;
- β_j = effect of the j-th block;
- ε_{ij} = experimental error.

3. RESULTS AND DISCUSSION

3.1. Effect of Eco-Enzyme on Vegetative Growth

Eco-enzyme application produced different responses across vegetative growth stages. Plant height responded positively to the moderate dosage, particularly during the early to mid-growth stages. Treatment E2 (200 mL $plot^{-1}$) produced the highest plant height at 14, 28, and 42 DAP. However, at 56 DAP, all treatments shared the same DMRT letter, indicating that the final plant height was not significantly different among treatments. This pattern suggests that eco-enzyme contributed more clearly to early vegetative stimulation than to final plant stature.

The relatively higher plant height under E2 may be associated with the availability of organic acids, enzymes, and microbial metabolites that support organic matter decomposition and nutrient release. Arun and Sivashanmugam (2015) reported that enzyme-rich fermented liquid can accelerate the decomposition of organic materials, while Patel et al. (2021) emphasized the role of eco-enzyme in improving biological activity in organic media. Nevertheless, increased vegetative growth should not be interpreted automatically as increased yield because shallot productivity depends on the subsequent allocation of assimilates to bulb tissues (Triandini, 2018).

Table 1. Mean plant height of shallot under different eco-enzyme dosages

Treatment	14 DAP	28 DAP	42 DAP	56 DAP
E0	9.94 bc	17.72 bc	27.08 b	39.88 a
E1	11.06 b	21.34 ab	31.46 a	38.34 a
E2	13.82 a	23.46 a	34.60 a	42.44 a
E3	9.54 bc	16.82 bc	32.58 a	40.62 a
E4	8.76 c	16.02 c	33.22 a	39.46 a

Note. Means with the same letter within a column are not significantly different (DMRT 5%). DAP = days after planting.

Leaf number showed a more limited response than plant height. The highest leaf number was recorded in E3 (300 mL $plot^{-1}$) at 28 DAP, but no significant difference was observed at 14, 42, and 56 DAP based on the identical DMRT letters within those columns. This indicates that the effect of eco-enzyme on leaf production was temporary and stage-specific. Nitrogen availability and microbial activity may have promoted leaf formation during the active vegetative phase, but the effect did not persist uniformly until the later growth stage. Similar dosage-dependent responses have been reported for eco-enzyme and liquid organic fertilizer applications in vegetable crops (Salsabila & Winarsih, 2023; Tuapattinaya et al., 2024).

Table 2. Mean leaf number of shallot under different eco-enzyme dosages

Treatment	14 DAP	28 DAP	42 DAP	56 DAP
E0	8.46 a	11.94 a	23.86 a	33.86 a
E1	9.00 a	12.00 a	23.84 a	34.16 a
E2	9.04 a	13.14 ab	23.06 a	36.98 a
E3	9.26 a	14.98 b	22.12 a	35.98 a
E4	8.72 a	13.06 ab	21.80 a	36.32 a

Note. Means with the same letter within a column are not significantly different (DMRT 5%). DAP = days after planting.

3.2. Effect of Eco-Enzyme on Tiller Formation and Bulb Yield

Tiller formation is an important yield-related variable in shallot because each tiller has the potential to contribute to bulb formation. The results showed that E1 (100 mL plot^{-1}) produced the highest number of tillers at 42 DAP, reaching 8.28 tillers clump^{-1}. However, at 56 DAP, the treatments were not statistically different. This indicates that E1 stimulated earlier tiller development, but the difference among treatments became less distinct toward the final vegetative stage.

The stronger tiller response under E1 suggests that a lower eco-enzyme dosage may have created a more balanced root-zone condition for shallot. Khaidir (2019) explained that tiller formation is influenced by nutrient availability and hormonal balance around the root system. Excessive organic liquid input may not always improve this balance because higher concentrations can increase the accumulation of organic acids and alter rhizosphere conditions (Nazim & Meera, 2017; Hemalatha, 2020).

Table 3. Mean tiller number of shallot under different eco-enzyme dosages

Treatment	14 DAP	28 DAP	42 DAP	56 DAP
E0	1.94 a	3.06 b	5.78 a	8.54 a
E1	2.00 a	2.88 ab	8.28 b	9.74 a
E2	1.72 a	2.88 ab	7.32 ab	9.06 a
E3	1.86 a	2.58 b	6.26 a	7.92 a
E4	1.88 a	2.94 b	6.10 ab	8.20 a

Note. Means with the same letter within a column are not significantly different (DMRT 5%). DAP = days after planting.

The yield variables showed the clearest agronomic response. E1 produced the highest fresh bulb weight, reaching 167.2 g plot^{-1}, while the control produced 159.2 g plot^{-1}. This represents an increase of approximately 5.03% over the control. Although the increase in fresh bulb weight was moderate, the result indicates that a low eco-enzyme dosage was more effective than higher dosages for supporting marketable bulb formation under the conditions of this experiment.

Table 4. Mean fresh bulb weight of shallot

Treatment	Fresh bulb weight at 65 DAP (g plot^{-1})
E0	159.2 a
E1	167.2 b
E2	156.2 a
E3	156.6 a
E4	157.2 a

Note. Means with the same letter within a column are not significantly different (DMRT 5%). DAP = days after planting.

Dry bulb weight responded more strongly. E1 produced the highest value (131.2 g plot^{-1}), compared with 110.2 g plot^{-1} in the control, representing an increase of approximately 19.06%. This indicates that E1 improved dry matter accumulation and photosynthate translocation to bulbs as storage organs (Rukmana, 2014; Triandini, 2018).

Table 5. Mean dry bulb weight of shallot

Treatment	Dry bulb weight (g plot^{-1})
E0	110.2 a
E1	131.2 c
E2	112.8 ab
E3	114.0 b
E4	115.8 b

Note. Means with the same letter within a column are not significantly different (DMRT 5%).

3.3. Production Efficiency and Physiological Interpretation

The overall response pattern indicates a distinction between vegetative stimulation and yield efficiency. E2 and E3 tended to improve certain vegetative indicators, particularly plant height and leaf number at specific observation times, whereas E1 produced the best bulb yield. This finding supports the view that the optimum dosage of liquid organic fertilizer is not necessarily the dosage that maximizes vegetative growth. In bulb crops, yield depends on the balance between source activity, represented by leaves, and sink strength, represented by bulb development.

The higher dry bulb weight under E1 may reflect a more efficient source–sink balance. A low eco-enzyme dosage likely provided sufficient organic compounds to stimulate microbial activity and nutrient release without creating an excessive acidic load in the growing medium. In contrast, higher dosages may have supported canopy development but did not improve, and in some cases may have limited, the allocation of assimilates to bulb tissues. This interpretation should be treated cautiously because the present study did not directly measure media pH, nutrient content, microbial population, or plant physiological traits.

The findings are consistent with the general principle that organic inputs must be applied at appropriate dosages to achieve agronomic efficiency. Organic fertilizer studies on shallot have shown that plant response is influenced by the interaction between nutrient availability, physiological tolerance, and storage-organ development (Asrijal, 2021; Anwar et al., 2024). Therefore, the present study indicates that 100 mL plot^{-1} was the most effective eco-enzyme dosage for Bima Brebes shallot under the tested polybag-based open-field conditions, but the optimum dosage may vary across soil types, growing seasons, cultivars, and field-scale management systems.

4. CONCLUSION

This study demonstrated that eco-enzyme fertilizer dosage influenced the growth and yield performance of Bima Brebes shallot under polybag-based open-field experimental conditions. The response was stage-specific. E2 (200 mL plot^{-1}) produced the highest plant height during the early to mid-growth stages, while E3 (300 mL plot^{-1}) produced the highest leaf number at 28 DAP. However, these vegetative advantages did not translate directly into higher bulb yield.

The most efficient dosage for yield formation was E1 (100 mL plot^{-1}). This treatment produced the highest fresh bulb weight (167.2 g plot^{-1}) and dry bulb weight (131.2 g plot^{-1}), equivalent to approximately 5.03% and 19.06% increases over the control, respectively. These results indicate that a lower eco-enzyme dosage was more favorable for dry matter accumulation and bulb formation than higher dosages. Therefore, 100 mL plot^{-1} can be considered the optimum dosage under the experimental conditions tested in this study.

5. RECOMMENDATIONS

For practical cultivation under similar polybag-based or small-scale horticultural conditions, eco-enzyme application at 100 mL plot^{-1} is recommended as an efficient dosage to improve shallot bulb yield. The dosage should be applied cautiously and consistently because higher dosages did not improve bulb yield in this experiment. Farmers and practitioners should also consider media condition, organic matter content, irrigation, and cultivar characteristics before adopting eco-enzyme application at a wider scale.

Eco-enzyme use has potential as an environmentally friendly fertilization technology because it converts household organic waste into a functional agricultural input. Its application may contribute to more sustainable shallot cultivation, especially in areas where soil fertility has declined due to intensive inorganic fertilizer use. However, the dosage should be adapted to local soil conditions and supported by proper crop management.

6. LIMITATIONS AND FURTHER RESEARCH

This study was limited to one planting season and a polybag-based open-field system. Consequently, the results should not be generalized directly to large-scale field cultivation without further validation. The study also did not measure the chemical properties of eco-enzyme, media pH, nutrient dynamics, microbial populations, or plant physiological indicators. These variables are important for explaining the mechanism through which eco-enzyme affects the balance between vegetative growth and bulb yield.

Future research should evaluate eco-enzyme application under broader field conditions, different soil types, and multiple growing seasons. Further studies should also analyse the chemical composition of eco-enzyme, especially pH, organic acid content, and macro- and micronutrient concentrations. The combined application of eco-enzyme with compost, biofertilizers, or reduced inorganic fertilizer rates should also be investigated to determine whether synergistic effects can improve shallot productivity and soil quality.

ETHICAL DECLARATION

This study involved crop experimentation only. It did not involve human participants, animal subjects, protected biological materials, or sensitive personal data. Field and institutional procedures were conducted in accordance with standard agronomic research practices.

ACKNOWLEDGEMENTS

The authors express their appreciation to Universitas Quality for providing research facilities and institutional support throughout the study. The authors also acknowledge the academic supervisors, laboratory staff, and field assistants for their scientific input and technical assistance during data collection, experimental management, and manuscript preparation.

REFERENCES

Anwar, N. H., Satyana, A., & Maghfoer, M. D. (2024). Organic fertilizer alleviates salt stress in shallot by modulating plant physiological responses. Journal of Ecological Engineering, 25(7), 286–294. https://doi.org/10.12911/22998993/188880

Arun, C., & Sivashanmugam, P. (2015). Investigation of biocatalytic potential of garbage enzyme and its influence on stabilization of industrial waste activated sludge. Process Safety and Environmental Protection, 94, 471–478. https://doi.org/10.1016/j.psep.2014.10.008

Asrijal, A. (2021). Effect of biological organic fertilizers and growth regulators for yield of shallot (Allium ascalonicum L.). AgroTech Journal, 6(1), 18–22. https://doi.org/10.31327/atj.v6i1.1562

Badan Pusat Statistik. (2020). Statistik tanaman sayuran dan buah-buahan semusim Indonesia 2020. Jakarta: Badan Pusat Statistik.

Gomez, K. A., & Gomez, A. A. (1984). Statistical procedures for agricultural research (2nd ed.). John Wiley & Sons.

Hemalatha, M. (2020). Eco-enzyme: A sustainable solution for organic waste management. International Journal of Environmental Studies, 12(3), 45–52.

Khaidir. (2019). Morfologi dan pertumbuhan tanaman hortikultura. Jakarta: PT RajaGrafindo Persada.

Larasati, D., Astuti, A. P., & Maharani, E. T. (2020). Uji organoleptik produk eco-enzyme dari limbah kulit buah. Prosiding Seminar Nasional Edusainstek, 278–283.

Mavani, H. A. K., Tew, I. M., Wong, L., Yew, H. Z., Mahyuddin, A., Ghazali, R. A., & Pow, E. H. N. (2020). Antimicrobial efficacy of fruit peels eco-enzyme against Enterococcus faecalis: An in vitro study. International Journal of Environmental Research and Public Health, 17(14), 5107. https://doi.org/10.3390/ijerph17145107

Mulyono, A. E., & Anggaravidya, M. (2024). Application of controlled release fertilizer (CRF) in supporting the growth and productivity of SS Sakato shallot. Evergreen, 11(1), 116–126. https://doi.org/10.5109/7172233

Nazim, F., & Meera, V. (2017). Treatment of bilge water using eco-enzyme. International Journal of Applied Research, 3(3), 423–427.

Pakki, S., Rosahada, A. D., & Kasim, N. N. (2021). Effect of eco-enzyme concentration on plant growth and nutrient availability in organic farming. Journal of Agricultural Science, 15(2), 110–118.

Patel, B. S., Solanki, B. R., & Mankad, A. U. (2021). Effect of eco-enzymes prepared from selected organic waste on domestic wastewater treatment. World Journal of Advanced Research and Reviews, 10(1), 323–333. https://doi.org/10.30574/wjarr.2021.10.1.0159

Rukmana, R. (2014). Bawang merah: Budidaya dan pasca panen. Yogyakarta: Kanisius.

Salsabila, R. K., & Winarsih, W. (2023). Pengaruh pemberian ekoenzim sebagai pupuk organik cair terhadap pertumbuhan tanaman sawi pakcoy (Brassica rapa L.). LenteraBio: Berkala Ilmiah Biologi, 12(1), 50–59. https://doi.org/10.26740/lenterabio.v12n1.p50-59

Sutanto, R. (2017). Pertanian organik: Menuju pertanian alternatif dan berkelanjutan. Yogyakarta: Kanisius.

Tjitrosoepomo, G. (2016). Taksonomi tumbuhan (Spermatophyta). Yogyakarta: Gadjah Mada University Press.

Triandini, A. (2018). Fisiologi dan morfologi tanaman bawang merah. Bogor: IPB Press.

Tuapattinaya, P. M. J., Latuconsina, N. H., & Noya, A. (2024). Eco-enzyme: Liquid organic fertilizer on the growth of mustard plants (Brassica chinensis) as supporting literacy and numeration. BIOMA: Jurnal Ilmiah Biologi, 13(2), 41–51. https://doi.org/10.26877/bioma.v13i2.1098

Vama, L., & Cherekar, M. N. (2020). Production, extraction and uses of eco-enzyme using citrus fruit waste: Wealth from waste. Asian Journal of Microbiology, Biotechnology & Environmental Sciences, 22(2), 346–351.

Wibowo, S. (2007). Budidaya bawang merah di lahan kering. Jakarta: Penebar Swadaya.