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Identification of Insect Pests on Rice Plants in Umbu Wangu Village for the Development of an Entomology E-Atlas

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ABSTRACT
Insects represent one of the most diverse groups of organisms, and many species act as destructive pests in rice ecosystems. However, the diversity of insect pests in Umbu Wangu Village has not been documented despite recurring yield losses reported by farmers. This study aimed to identify the insect pests associated with rice plants and to develop an electronic atlas (e-atlas) as a digital learning medium for the Entomology course. The research followed a Research and Development design using the ADDIE model, with field surveys carried out in rice fields of Umbu Wangu Village. Insect specimens were collected through direct capture and subsequently identified based on morphological characteristics. The results recorded seven pest species belonging to three orders: Hemiptera, Lepidoptera, and Orthoptera. To complement these findings, an e-atlas was designed as an instructional tool. Expert validation of the e-atlas yielded an average score of 85.5%, which falls into the "very valid" category, indicating strong feasibility for educational use. The documentation of pest diversity provides essential baseline data for local rice protection strategies. At the same time, the validated e-atlas offers an innovative medium that supports student-centered learning in entomology and bridges research outcomes with educational practice.

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1. INTRODUCTION

Southwest Sumba (SBD), one of the regencies on Sumba Island, is characterized by fertile land with high potential for agricultural development. This region consists of extensive rice fields, perennial plantations, and diverse forests, including teak and mahogany (1). Among the major commodities cultivated, rice is the most important, as it serves as the staple food for the Indonesian population and the main source of carbohydrates (2). According to Statistics Indonesia (3), rice production in Indonesia reached approximately 54.65 million tons of milled dry grain, underscoring its central role in national food security. However, the agricultural sector in SBD faces significant challenges from pest attacks on rice plants, which lead to reduced yields, declining grain quality, and threats to local food security (4).

Insects, belonging to the diverse phylum Arthropoda, are widely recognized as major pests in agriculture, as they can damage crops by feeding on plant parts, sucking sap, and transmitting diseases (5). There are many types of insects that are major pests for plants cultivated by humans. Insect pests can damage plants by eating plant parts, sucking leaf fluids, and carrying plant diseases (5). For rice, one of the most common pests is the green leafhopper (*Leptocorisa acuta*), which can cause severe yield losses (6).

Interviews with farmers in Umbu Wangu Village revealed that rice yields have declined since 2018 due to insect pest infestations. Farmers rely primarily on insecticides for pest control, but unwise use of these chemicals not only eliminates natural enemies but also accelerates pest resistance, leading to the emergence of secondary pests that are more difficult to control. Previous studies (7) have identified insect pest diversity in rice fields using tools such as sweep nets and light traps; however, they have not provided direct community-based solutions for pest control through education and improved understanding of insect pests.

In parallel, entomology learning in higher education is often constrained by limited practical sessions and a lack of adequate teaching media (8). Instruction is commonly restricted to theory, without sufficient opportunities for students to directly observe or identify insect specimens. Technology-based learning media, such as electronic atlases (e-atlases), have been shown to overcome these challenges by providing comprehensive visual and textual information, thereby increasing students' understanding and interest in learning (8), technology-

based learning media, such as electronic atlases (e-atlases), can help overcome this problem by providing more complete images and information about pest insect species, increasing students' understanding and interest in learning. E-atlases have proven effective in improving students' understanding of biology materials and can be used as flexible learning resources (9).

Although there have been studies that identify insect pests and the use of e-atlas in learning, there has been no study that integrates the identification of insect pests with e-atlas media as an aid in the Entomology course in Umbu Wangu Village. Addressing this research gap is important, as e-atlas has the potential to improve entomology learning and provide practical solutions for rice farmers in managing pest problems. This study aims to identify the types of insect pests in rice fields in Umbu Wangu Village and to develop and evaluate the feasibility of e-atlas as a learning medium for the Entomology course. This study is expected to contribute to facilitating the recognition and control of pests and providing more effective learning media for students. The main research gap lies in the limited integration of field identification of insect pests with the application of e-atlas learning media. Although the use of digital media such as e-atlas in biology education has been proven effective, there has been no research that specifically integrates this media with material on rice pests that is relevant to the needs of local communities and entomology teaching. Therefore, this study attempts to bridge this gap by developing an e-atlas as a learning solution that can be accessed by students and farmers, as well as increasing the effectiveness of teaching on insect pest identification.

2. RESEARCH METHOD

This research was conducted in November-December 2024, at the rice fields of Umbu Wangu Village, South Wewewa District, Southwest Sumba Regency, the rice field area under study covers 270 ha. The research location map is figure in 1.

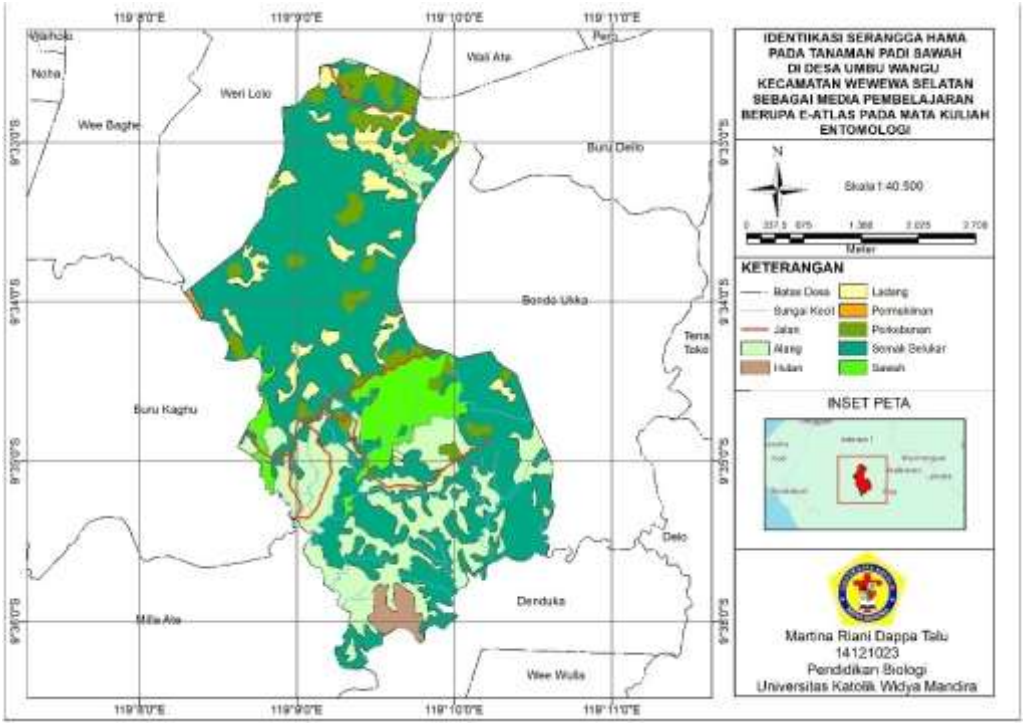

Figure 1. Map of Research Location

This type of research is research and development. The research data obtained in the form of types of insects in rice plants was developed into an e-atlas with a development design using the ADDIE model and accompanied by product validation techniques by the validator. This study only uses 3 stages of ADDIE, namely analyze, design and development stages. This is because the purpose of this study is only limited to developing and producing valid learning media to be implemented based on the validator's assessment (10). This research was conducted using the exploration method (field by field method) at the specified location and data collection of insect pest types is carried out using the method of directly catching insect pests found using nets, observing their morphological characteristics and identifying them directly (11).

Determination of the location of the rice fields and sampling using a net (Sweep Net) (12). Each insect pest observed and caught by the net is put into a bottle and labeled to facilitate data collection. Sampling is carried out in the morning at 06.00-08.00. Insects are usually found in the morning coinciding with the blooming flowers or temperatures around 26 ℃ So that it is easy to catch insect pests (13). During the day, the number of insects on a plant will decrease compared to the morning (14). This is because the temperature during the day increases quite

high beyond the optimum temperature limit of insects so that insects will die if they exceed the tolerance range (15).Each type of insect caught in the net is put inside a bottle, recorded on the observation sheet and documented the type of insect found using a camera. The type of insect found at the research location is identified using available literature such as identification books or browsing the internet.

Development of e-atlas media using three ADDIE models, namely Analysis towards needs for learning resources in the form of e-atlas for identification of pest insects in rice fields and the eligibility requirements as a learning resource for students of the Biology Education Study Program. The second stage is the design of content and contents in accordance with the results of research on the identification of pest insects in rice fields developed by e-atlas with the initial section consisting of a Cover containing the title, author's name, and agency logo, Foreword, Table of Contents. The core section consists of an introduction to insect material, results in the form of types, pest insects, morphology, and symptoms of cuased attacks. The closing section consists of a glossary, bibliography and author biography. The third stage is Development, at this stage the media is designed using the Canva application, then uploaded to the Anyflip account to become a digital book, then the media validation is carried out which is developed by media experts and material experts to obtain assessments and suggestions from both validators. Furthermore, the revision of the e- atlas learning media is adjusted from the notes and suggestions from the validator to correct the shortcomings of the e-atlas. Furthermore, the link is shared with the Entomology Course Lecturer to be used in the lecture process.

The instruments used in this study include insect pest observation sheets and e-atlas media validation sheets by material experts and media experts. Data analysis used in this study is qualitative analysis, and data analysis of validation results by media expert validators and material experts. The research data were analyzed using qualitative analysis by describing insect pests in the rice fields of Umbu Wangu Village. Validation data by the validator was converted into a scoring guideline which can be seen in table 1.

Table 1. Linkert Scale Scoring Guidelines

No	Category	Score
1	Very good	5
2	Good	4
3	Pretty good	3
4	Not good	2
5	Not good	1

Determination of the validation score for the development of e- atlas media is calculated using the formula

$$\boldsymbol{P = \frac{\sum x}{\sum xi} \times 100\%}$$

Description:
P = Percentage of eligibility
$\sum x$ =Total score
$\sum xi$ =Maximum score

Validity data analysis to determine the feasibility of the developed e-atlas media follows the scoring guidelines in table 2.

Table 2. Learning Media Eligibility Criteria

Numerical Scale (%)	Information
81-100%	Very valid
61- 80%	Valid
41-60%	Quite valid
21-40%	Less valid
0-20%	Invalid

3. RESULT AND DISCUSSION

The study identified seven insect pest species across three orders: *Hemiptera-Nezara viridula* (southern green stink bug, recorded in two distinct color morphs), *Leptocorisa oratorius* (rice ear bug), *Sogatella furcifera* (white-backed planthopper), and *Anasa tristis* (to be verified); *Lepidoptera-Cnaphalocrocis medinalis* (rice leaffolder); *Orthoptera-Oxya japonica* (rice grasshopper). The research data are presented in Table 3.

Table 3. Insect pests found in the rice fields of Umbu Wangu Village

No	Order	Family	Genus	Species
1	Lepidoptera	Crambidae	Cnaphalocrocis	*C. medinalis*
2	Hemiptera	Delphacidae	Sogatella	*S. furcifera*
3		Pentatomidae	Nezara	*N. viridula*
4		Pentatomidae	Nezara	*N. viridula*
5		Pentatomidae	Anasa	*A. tristis*
6		Alydidae	Leptococcosis	*L. oratorius*
7	Orthoptera	Acrididae	Oxya	*O. japonica*

Table 1 shows a list of insect pests found in the rice fields of Umbu Wangu Village, along with their respective orders, families, genera, and species. This study identified seven species of insect pests found in parts of rice plants, both on fruits and leaves, in the morning, the types of insect pests found in the rice fields of Umbu Wangu are presented in Figure 2.

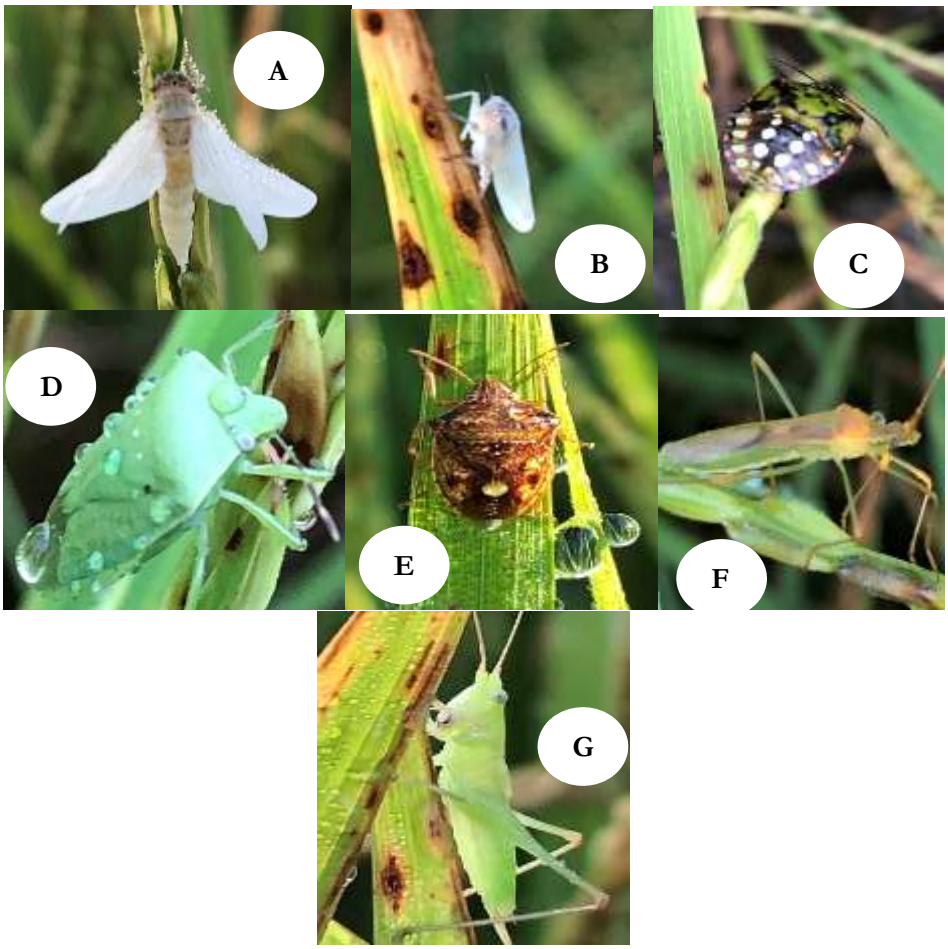

Figure 2. Pest insects found in Umbu Wangu Rice Fields a) *C. medinalis*, b) *S. furcifera* c) *N. viridula* d). *N. viridula*, e). *A. tristis* f). *L. oratorius* g). *O. japonica*

Figure 2 shows *Cnaphalocrocis medinalis* (rice leaffolder), which exhibits some color variation but generally appears whitish to pale yellow. The larvae fold rice leaves and feed inside the folds, causing white streaks on the outer surface of the leaves. The life cycle lasts 30–60 days, from egg, larva, pupa to adult moth. Adults were observed in the morning on rice panicles. Unlike stem borers, *C. medinalis* is a major rice pest known for damaging leaf tissues, reducing photosynthetic activity, and thereby decreasing plant vigor and grain quality (Salsabilla & Riyanto, 2021). *Sogatella furcifera* (white-backed planthopper; Hemiptera: Delphacidae) was observed on rice leaves in the morning. Adults are small (~3–4 mm) with a characteristic pale dorsal band. This species is a known vector of Southern rice black-streaked dwarf virus (SRBSDV)—not the rice tungro viruses (RTSV/RTBV), which are transmitted by *Nephotettix leafhoppers*. Feeding by planthoppers causes hopperburn, leaf yellowing, and can markedly reduce yield (Sariyanti, 2017).

Nezara viridula (southern green stink bug; Hemiptera: Pentatomidae) was frequently observed on rice panicles in the morning. This species possesses a shield-shaped body measuring 11.5–16.5 mm in length, with antennae divided into five distinct segments. It produces a characteristic unpleasant odor when disturbed, a defensive mechanism typical of Pentatomidae. Two color morphs were recorded in the field: a uniform green morph and a morph with small dark spots on the dorsal surface. Both morphs belong to the same species and feed on developing grains by piercing the spikelets and sucking plant sap. Such feeding causes shriveled kernels, chalky spots, and reduced grain quality, thereby lowering overall harvest value. Females are highly fecund, capable of laying up to 260 eggs during their lifetime, which underscores the pest's potential to build up large populations if not effectively managed.

A record identified as *Anasa tristis* (Hemiptera: Coreidae) was also noted on rice leaves, described as having a brown to black body with linear markings and spots. However, *A. tristis* is widely documented as the squash bug in North America and is rarely associated with rice cultivation in Asia. This suggests that the specimen may have been misidentified and could represent a closely related coreid species. Nonetheless, the observed insect exhibited typical coreid feeding behavior, inserting its stylets into rice leaves to extract fluids. This action caused visible feeding lesions, reduced photosynthetic efficiency, and ultimately hindered plant growth (Hutagaol, 2024). Further taxonomic confirmation is required through morphological or molecular analysis. Another significant pest found was *Leptocorisa oratorius* (rice ear bug; Hemiptera: Alydidae), a slender insect measuring 17.5–19.5 mm. This species was observed on rice panicles and stalks during the morning. It feeds primarily on developing grains by piercing through the husk, causing shriveled or stained kernels commonly referred to as "pecky rice." Such damage not only reduces yield but also degrades the market value of the rice (Schaefer *et al*., 2000)

Finally, *Oxya japonica* (rice grasshopper; Orthoptera: Acrididae) was documented feeding on rice leaves. This grasshopper varies in color from greenish brown to yellow and has enlarged hind legs adapted for jumping. It consumes leaf tissue, reducing the effective surface area for photosynthesis. Heavy infestations can cause severe defoliation, resulting in lower biomass accumulation and significant yield losses (Putri, 2017). The next stage of the research results was developed as a learning media in the form of an e-atlas for the entomology course presented at the link https://anyflip.com/qvvsn/zdmu/ , and the QR barcode presented in Figure 3.

Figure 3. e-atlas Media Barcode

E-atlas media is designed attractively and displays content in the form of images of types of insect pests. The images displayed on the e-atlas media are images of species that are the result of direct documentation in their habitat, namely in the rice fields. This is in accordance with the statement from (17)who said that a good photo is the one authentic and representative. Photos are a source of accurate information, in the developed e-atlas. Furthermore, the e-atlas media was validated by two validators, namely material experts and media experts to determine the feasibility of the e-atlas as a learning medium in entomology courses, the data from the validation results of the e-atlas by the validator are presented in table 2.

Table 2. Results of the E-Atlas Media validation test

No	Validators	Total scores obtained	Percentage	Criteria
1	Media Expert	60	80%	Very Valid
2	Material Expert	68	91%	Very Valid
3	Average		85.5%	Very Valid

Table 2 shows the results of the validation test on the E-Atlas learning media conducted by two validators, namely media experts and material experts. Based on the assessment results by the media expert validator, the score was 60, which if converted into a percentage reached 80%. This percentage is included in the Very Valid category, which shows that in terms of design and appearance, the E-Atlas media has met the eligibility criteria

for use as a learning media. The assessment by the material expert validator obtained a score of 68 with a percentage of 91%. This value is also included in the Very Valid category, which means that the content of the material presented in the E-Atlas media is very appropriate, precise, and suitable for use in the learning process. the average validation result obtained a percentage of 85.5%. so that the E-Atlas media is declared very valid, both in terms of appearance and content, so that it can be used as a supporting media in the learning process.

This study successfully identified seven species of insect pests belonging to three main orders, namely Hemiptera, Lepidoptera, and Orthoptera. The three orders are generally known as groups of insects that have the potential to damage rice plants, both directly and indirectly, and are often found in rice fields in various regions of Indonesia.

The results of this study indicate that the Hemiptera order is the most dominant order, with five species found. This finding is in line with the statement (18), which states that Hemiptera is one of the most common insect pest groups found in rice plants because of its ability to suck plant fluids, both in leaves, stems, and rice fruits. Species such as Sogatella furcifera (white-backed planthopper) and *Leptocorisa oratorius* (rice bug) are important pests in rice fields. Putra (2018) emphasized that S. furcifera is the main vector of tungro disease, and its presence can cause very significant crop losses. Meanwhile, *L. oratorius* is known as a rice fruit-sucking pest that can cause a decrease in grain quality due to the appearance of black spots on the seeds (19). Species from the Lepidoptera order, namely Cnaphalocrocis medinalis, were found as rice leaf miner pests. This insect damages leaf tissue and inhibits the photosynthesis process. (20)noted that attacks by these moth larvae can reduce photosynthesis efficiency by up to 50% in certain planting seasons. Meanwhile, from the Orthoptera order, Oxya japonica as a rice grasshopper also causes serious damage to plant leaves. (21)stated that rice grasshoppers are one of the biotic factors that cause a reduction in green leaf area, which has a direct impact on rice production.

The species found in this study were all documented directly in their natural habitat, namely the rice fields of Umbu Wangu Village, in the morning. This is very important because the identification and documentation carried out directly reflect the real ecological conditions and strengthen the validity of the data obtained. In line with the opinion (22), authentic and representative field documentation photos provide added value to the learning process because they show the actual conditions and increase student learning engagement.

The results of this study were further developed into learning media in the form of E-Atlas, which displays images and scientific information from the seven pest species. This e-atlas is designed not only for documentation purposes but also as a visual medium that facilitates entomology learning, with a focus on the recognition and identification of rice pest species. The E-Atlas media has been validated by two experts, namely media experts and material experts, and obtained an average value of 85.5% with the criteria of Very Valid. This is in line with Arsyad's theory (2015) which states that visual media such as atlases or illustrative images can significantly improve conceptual understanding because they help link abstract information with real visual representations. High validation from media experts indicates that the design and visual appearance of the media have met the basic principles of visual communication and readability. Meanwhile, validation from material experts confirms that the content presented is in accordance with academic standards in the field of entomology.

The use of digital-based media such as E-Atlas is very relevant to the demands of 21st century learning. Information technology-based learning media can increase learning motivation and strengthen mastery of the material, especially when accompanied by visual and interactive elements (23). The development of E-Atlas also supports an environment-based and contextual learning approach, which encourages students to understand the relationship between theory and practice in the field.

4. CONCLUSION

Based on the results of research in the rice fields of Umbu Wangu Village, seven species of insect pests were found from three main orders, namely Hemiptera, Lepidoptera, and Orthoptera. Hemiptera is the most dominant order with five species found. The identified insect pests attack the leaves and fruits of rice plants and have the potential to cause significant damage to the harvest. Each species found was documented directly in its habitat, and the results of the documentation were developed into learning media in the form of E-Atlas for entomology courses. The E-Atlas media displays images and scientific information from each species found. The results of the media validation show that the E-Atlas has a very high level of feasibility, with an average score of 85.5% and is included in the Very Valid category in terms of appearance and content. This media is able to provide a contextual learning experience, strengthen students' understanding of rice insect pest identification, and encourage environmental and technology-based learning.

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6. REFERENCES

Anjani, A., Pribadi, T., & B., A. K. (2021). Identification of insect pest attacks on rice plantations (*Oryza sativa* L.) in Tinggarjaya rice fields. *Proceedings Series on Physical & Formal Sciences, 2,* 212–218. https://doi.org/10.30595/pspfs.v2i.184

Ardiana, R., & Dewi, F. R. (2023). Development of vertebrata e-atlas on animalia material for Grade X SMA/MA students. *Journal of Biology Learning Innovation, 4*(1), 46–56. https://journal.unesa.ac.id/index.php/jipb

Fidela, W., & Zulysri. (2024). Identification of insect pests on rice crops (*Oryza sativa*) in Gunung Sarik rice field. *Sapta Agrica Journal, 3*(1), 14–25. https://jurnal.uniraya.ac.id/index.php/Agrica

Hikmat, M., Hati, D. P., Pratamaningsih, M. M., & Sukarman, S. (2023). Study of high productivity dry land in Nusa Tenggara for agricultural development. *Journal of Land Resources, 16*(2), 119–133. https://doi.org/10.21082/jsdl.v16n2.2022.119-133

Hutagaol, T. L. (2024). Diversity of insect pests on rice plants (*Oryza sativa* L.) vegetative phase in rice fields in Ketos Village, Kibin District, Serang Regency, Banten. *[Journal/Proceedings name missing]*.

Istikorini, Y., Firmansyah, M. A., Rusniarsyah, L., Syifaudin, I. S., Latifah, I., & Azzahra, T. A. (n.d.). Training on production of biofertilizers in coffee-based agroforestry systems in Garahan Village, Jember Regency. *Agrokreatif, 9*(2).

Kojong, H. I., Dien, M. F., & Wanta, N. N. (2020). Predatory insects on rice ecosystem in Tombatu District, Southeast Minahasa Regency. *[Journal/Proceedings name missing]*.

Leonardo, V. (2024). Characteristics of pest attacks and intensity of damage to shade trees in the Delta Malvinas City Forest Area of Padang City. *[Journal/Proceedings name missing]*.

Margaretha, N., Zhafirah, F. Q., Arlika, H., Riani, O. D., & Wicaksono, A. (2024). Food preferences of leaf beetles (*Epilachna varivestis*) and oteng-oteng (*Aulacophora similis*) from several types of Solanaceae plants. *JB&P: Journal of Biology and Its Learning, 11*(1), 81–90. https://ojs.unpkediri.ac.id/index.php/biologi

Maulida, B. (2024). Development of human excretory system e-atlas learning media as a support for students' mastery of concepts at Maarif Nu Simanraya Solokuro Lamongan Middle School. *Proceedings of the Faculty of Teacher Training and Education*, 220–229.

Musa, A. S., Awan, I. U., & Zahrah, F. (2022). The case for validating ADDIE model as a digital forensic model for peer-to-peer network investigation. *Information Systems Frontiers.* https://doi.org/10.1007/s10796-022-10360-8

Novita Sari, K., Ayu, A., Wahyuni, D., Faraszahy, D., Aristva, P., Intania, T., Umayah, A., Gunawan, B., & Arsi, A. (2022). Identification of insect pests on chili plants in Ogan Ilir, South Sumatra. *Proceedings of the 10th National Seminar on Suboptimal Land*, 824–831.

Ora, S. M., Sepe, F. Y., & Missa, H. (2025). The influence of discovery learning model assisted by media teaching aids on junior high school students' learning outcomes. *JUMIN: Jurnal Media Informatika, 6*(2), 1345–1351.

Rengganis, H. (2018). Zoning of water resources utilization areas for irrigation development on Sumba Island, East Nusa Tenggara. *Agricultural Policy Analysis, 14*(1), 17–33. https://doi.org/10.21082/akp.v14n1.2016.17-33

Rizal, S., & Hadi, M. (2015). Inventory of dragonfly species (Odonata) in rice field areas in Pundenarum Village, Karangawen District, Demak Regency. *Bioma, 17*(1), 16–20.

Rohmah, W., Hoesain, M., & Pradana, A. P. (2022). Abundance and diversity of predators in rice plantations with combination application of botanical insecticides and endophytic bacteria. *Jurnal Ilmiah Inovasi, 22*(1), 90–102. https://doi.org/10.25047/jii.v22i1.2973

Salsabilla, E. R., & Riyanto. (2021). Potential of weaver ants (*Oecophylla smaragdina* Fabricius) as predators for whitefly pests (*Bemisia tabaci* Gennadius). *Proceedings of the 2021 National Science Education Seminar*, 1–12.

Sari, P., Sjam, S., & Santosa, S. (2017). Analysis of biodiversity herbivore insects in paddy field at Tamalanrea, Makassar City. *Bioma: Makassar Journal of Biology, 2*(1), 35–45.

Sariyanti, P. A. (2017). Identification of *Burkholderia glumae* bacteria causing bacterial rice rot disease and resistance test on several rice plant varieties (*Oryza sativa* L.). *[Journal/Thesis info missing]*.

Setiawati, D. A., Setiati, N., & Pribadi, T. A. (2019). The development of e-atlas learning media based on mobile learning on cell structure concept. *Journal of Biology Education, 8*(1), 15–25. http://journal.unnes.ac.id/sju/index.php/ujbe

Siregar, A. S., Bakti, D., & Zahara, F. (2014). Insect diversity in various types of farms rice field. *Online Journal of Agroecotechnology, 2*(4), 1640–1647.

Schaefer, C. W., & Panizzi, A. R. (2000). Leaf-footed bugs (Coreidae). In *Heteroptera of economic importance* (pp. 359–426). CRC Press.

Siti, M. Y. G., Missa, H., Ndukang, S., & Djalo, A. (2025). Development of e-atlas of epidermal cell structure and stomata of *Lantana camara* L. leaves as learning media. *JUMIN: Jurnal Media Informatika, 6*(2), 1321–1331.

Tae, V. Y., Seran, Y. N., & Bani, P. W. (2023). Diversity and ecological role of soil insects in the Rafae Forest Area, Raimanuk District, Belu Regency. *Journal Science of Biodiversity, 4*(2), 51–60. https://doi.org/10.32938/jsb/vol4i2pp51-60

Trianto, M., Kaini, S., Warsih, E., & Winarsih. (2020). Diversity of pollinator insects on pineapple plants (*Ananas comosus* (L.) Merr.) in Bincau Village. *Journal of Biology Science & Education, 9*(2), 154–162.