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Diversity of Insect Types on Rice (Oryza Sativa L.) Crops in Minahasa District

Maxi Lengkong[1], Noni N. Wanta[2], Masye H. B. Paruntu[3]
[1, 2,3] *Faculty of Agriculture, Sam Ratulangi University Manado, Kleak Manado Campus, 95115. Indonesia*

Abstract: *Rice (Oryza sativ a L.) is one of the most important cultivated plants in human civilization because it is the primary source of carbohydrates for most of the world's population after cereals, corn and wheat. West Kakas District, Minahasa Regency, is a rice production centre, but until now, lowland rice farming has experienced problems in the field caused by insect pest attacks. Research can be carried out so that insect pest control measures can be effective and right on target and minimize the negative impacts of using chemical insecticides. The study aims to determine the types and diversity of insects on rice plants in West Kakas District, Minahasa Regency. Hopefully, this research can provide information on the presence of insects that live and are associated with lowland rice plants so that insect pest control strategies can be implemented that are right on target, on time and for their proper use. The research will use the purposive sampling method of 5 observation points at 4 locations. The process of catching insects is carried out directly using insect nets. The insect samples caught were collected and grouped according to type. The type and population density of insects caught will be counted and identified, then analyzed for diversity using the Shenon and Wivier formula so that we get a diversity index (H), similarity index (E), richness index (R) and dominance index (C). Research results show that insects are pests and natural enemies. Pest insects consist of 5 orders, 12 families and 16 species, namely Dolycorus sp, Scotinophara sp., Stenodema sp, Leptocorisa sp, Paraecosmetus sp, Cofana spectra, Recilia sp ., Nephotetix sp, Oxya sp., Anacridium sp, Chilo sp, Parnara sp, Cnaphalocrocis sp . , Orseolia sp, Chlorops sp, and Phyllotretra sp. Meanwhile, natural enemies consist of 3 orders, 9 families and 9 species, namely Cyrtohinus sp . , sp, Agryophylax sp . , Sepedon sp., Encarsia sp., Menochilus sp., Ophionea sp . , Paederus sp., Sceliphron sp. and Agriocnemis sp. Shannon and Wiever's diversity analysis results are H' = 2.81 or moderate diversity index, richness index R = 4.67 or medium criteria value, evenness index E = 0.52 or moderate and unstable evenness index, and dominance index C = 0.37 or low dominance.*
Keywords: *Types of insects; Insect Diversity; Shenon and Wivier formula*

I. Introduction

Rice (Oryza sativa L.) is an agricultural crop that is currently a staple food crop in various countries with tropical climates, especially in Asia and Africa (Herawati, 2012). In 2019 Indonesia produced rice with a total of 54.60 tons of GKG (Grinded Dry Grain) but experienced a decrease of 7.76 per cent (4.60 million tons) when compared to 2018, which produced a total rice production of 59.20 million tons of MPD (Anonymous, 2020). Various factors, especially insect pests, can affect the production of rice crops. Insect pests are organisms that damage plants or crop products due to their life activities, primarily to obtain food, which can cause physical damage and agricultural losses (Hasyim, 2015).

Minahasa Regency, including West Kakas District, has a suitable climate for growing lowland rice. Many farmers cultivate this plant because it has been done for generations (Najoan, 2021). Tountimomor Village is one of the centres for lowland rice production in the West Kakas sub-district. Until now, rice farming in Tountimomor Village, West Kakas District, has experienced many obstacles, including pest and disease attacks. Some rice

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pests identified in previous studies include Brown Planthopper (Nilaparvata lugens), Green Planthopper (Nephotettix virescens), White Pest (Nympula depunctalis), Leaf Folder (Cnaphalocrocis medinalis), Ganjur Pest (Orseolia prize), Rice Stem Borer White (Scirpophaga annotate), Walang Sangit (Leptocorisa oratorios), (Hevianti and Syahril, 2018), Black Ladybug (Pareaucosmetus sp), (Manueke et al., 2017), Pink Rice Stem Borer (Sesamia inferences), Ground Bedbug (Scotinophara coarctata), Ground Dog (Gryllotalpa sp.), (Iswanto and Munawar, 2020).

According to Rante (2018), measures to control a type of insect pest can be effective and right on target and minimize the negative impacts of using chemical insecticides, so it is necessary first to monitor the type, population density and diversity of the insect pest. The types and diversity of insects in a rice ecosystem can be determined by identifying and analyzing the insect diversity index. Insect-catching methods can be carried out in various ways, such as catching using a sweeping technique using an insect net based on a sound and correct method design so that all types of insects can be seen and identified and their diversity analyzed using the Shannon and Wivier formula.

West Kakas sub-district in Tountimomor village is a centre for lowland rice plants. Therefore, it is suspected that the presence of many types and densities of insect populations will be found, and efforts to evaluate the presence of insects in the lowland rice ecosystem are deemed necessary to be carried out in the form of research so that efforts can be made to control attacks and damage. What happens can be implemented in an integrated pest control concept.

Special purpose

The research aims to determine the type and diversity of insects on lowland rice plants in Tountimomor village, West Kakas subdistrict, Minahasa regency.

II. Research Methods

2.1. Time and place

This research was carried out in April-October 2023 in Tountimomor village in West Kakas District, then continued at the Laboratory of the Department of Plant Pests and Diseases, Plant Protection Study Program, Faculty of Agriculture, Sam Ratulangi University, Manado.

2.2 Tools and Material

The tools and materials used in this research are rice plant area, adhesive glue (mouse glue), bamboo, name labels, brushes, meters, transparent plastic, camera, *hand counter*, microscope insects, loupe, stationery and books. reference for insect identification, namely), Boror et al. (1994), Shepard (1992), (Hendrichs, 1994), Holand (2012), Kim *et al.* (2011), Hawkeswood (2003), Sembel (2014), Lee *et al.* (2011), Nurhabibah, (2018).

2.3 Research methods

This research was carried out using a purposive sampling method, namely directly capturing insects by sweeping using an insect net. Insect sampling was carried out at 3 rice planting locations, which were about to enter the generative stage when panicles were formed. Each location was sampled three times. All types and populations of insects caught will be taken to the laboratory to be counted according to type or species and continued with identification to the species and genus level. Based on data on the number of insect species caught during 3 observations, the data can be analyzed to obtain a diversity index, namely

the H, E, R, and C indexes.

2.4 Procedure Study

a. Survey and determination of location

Conducted to determine 3 locations or places for sampling insects on rice plants in Tountimomor village in West Kakas District

b. Making insect nets

The insect net will be made using tile cloth. The diameter of the insect net will be 35 cm, and the length of the stem will be 150 cm. It is a tool for catching insects.

c. Catching insects using sweeping techniques

Before catching insects, 3 rice planting locations will settle into the generative period, namely after panicle formation occurs. Each observation location was taken with a size of 50 m X 70 meters. At each location of the rice plant as a sample observation location, 5 sweeping points were first determined, namely diagonally, to obtain 5 observation points. The size of each observation point is 10

d. Parameters Observation

1. .Identify the types of insects caught during sweeping
2. The type and number of populations are used as data to analyze the insect diversity index found on rice plants

2.5 Data analysis

The identification results will provide data on the type of insect, and the calculation of each type of insect caught will provide data on the population size of each type/species. Type data will be displayed in the table and described to be narrated. They will be combined for species and population data based on location/collection points at the 3 observation locations, and insect species diversity analysis can be carried out using the Shannon and Wivier insect species/species diversity formula.

III. Results and Discussion

3.1 Insect Type Identification Results

Based on the identification results from this research, it was found that the insect pests consisted of 5 orders, 12 families and 16 species. In comparison, the natural enemies consisted of 3 orders, 9 families and 9 species. The types of insect pests and natural enemies can be seen in Table 5.1. the following.

Table 1. Results of Identification of Types of Pests and Natural Enemies Found on Rice Plants in Tountimomor Village, West Kakas District, Minahasa Regency

No.	Type/Species	Order: Family	Status
Pest Insects			
1.	*Scotinophara* sp.	Hemiptera: Pentatomidae	Pest
2.	*Dolycorus* sp.	Hemiptera: Pentatomidae	Pest
3.	*Stenodema* sp.	Hemiptera: Miridae	Pest
4.	*Leptocorisa* sp.	Hemiptera: Alydidae	Pest
5.	*Paraecosmetus* sp.	Hemiptera: Lygaeidea	Pest
6.	*Cofana* sp.	Hemiptera: Cicadellidae	Pest

7.	*Recilia* sp.	Hemiptera: Cicadellidae	Pest
8.	*Nephotetix* spp.	Hemiptera: Cicadellidae	Pest
9.	*Oxya* sp.	Orthoptera: Acrididae	Pest
10.	*Anacridium* sp.	Orthoptera: Acrididae	Pest
11.	*Chilo* sp.	Lepidoptera: Crambidae	Pest
12.	*Parnara* sp.	Lepidoptera: Hespiriidae	Pest
13.	*Cnaphalocrocis* sp.	Lepidoptera: Pyralidae	Pest
14.	*Orseolia* sp.	Diptera: Cecidomydae	Pest
15.	*Chlorops* sp.	Diptera: Choloropidae	Pest
16.	*Phyllotretra* sp.	Coleoptera: Chrysomelidae	Pest
Natural enemies			
1.	*Cyrtohinus* sp.	Hemiptera: Miridae	Predators
2.	*Conocephalus* sp.	Orthoptera: Tettigoniidae	Predators
3.	*Agryophylax* sp.	Diptera: Tachinidae	Predators
4.	*Sepedon* sp.	Diptera: Sciomyzidae	Predators
5.	*Encarsia* sp.	Diptera: Aphelenidae	Parasitoids
6.	*Menochilus* sp.	Coleptera: Coccineliidae	Predators
7.	*Ophionea* sp.	Coleop[tera : Carabidae	Predators
8.	*Paederus* sp.	Coleoptera: Staphylinidae	Predators
9.	*Sceliphron* sp.	Hymenoptera: Sphecidae	Predators
10.	*Agriocnemis* sp.	Odonata: Coenagrionidae	Predators
11.	*Tetragnatha* sp.	Aranea: Tetragnathidae	Predators
12.	*Oxyopes* sp.	Aranea: Oxyopidae	Predators

Table 1 above shows that the types of insect pests and natural enemies in the rice planting area at the research location can provide information that insect pests are dominated by the order Hemiptera with 5 families, namely the family, Pentatomida consisting of 2 types, namely *Scotinophara* sp . and *Dolycorus* sp., the Miridae family, namely *Stenodema* sp., the Alydidae family, namely *Leptocorisa* sp., the Lygaeidea family, namely *Paraecosmetus* sp., the Cicadellidae family consisting of 3 types, namely *Cofana* sp., *Recilia* sp. and *Nephotetix* spp. Then, the Lepidoptera order consists of 3 families, namely Crambidae, namely *Chilo* sp.; Hespiriidae family, namely *Parnara* sp. and the Pyralidae family, namely *Cnaphalocrocis* sp. The Orthoptera order consists of 1 family, namely Acrididae, with 2 types: *Oxya* sp . and *Anacridium* sp. The Diptera order consists of 2 families, namely Cecidomydae, *Orseolia* sp. and the Choloropidae family, *Phyllotretra* sp. All 16 types/species with insect pest status indicate that their existence is an insect pest that attacks and damages rice plants' leaves, stems and grains.

Meanwhile, for the results of identifying insects or organisms that have the status of natural enemies, from Table 5.1 above, it can be seen that those who dominate the Diptera order are the Tachinidae family, namely the predator *Agryophylax* sp ., the Sciomyzidae family, namely the predator *Sepedon* sp. and Aphelenidae, namely the parasitoid *Encarsia* sp. The Coleoptera order is the Coccineliidae family, namely the predators of *Menochilus* sp.; the Carabidae family, namely the predators of *Ophionea* sp.; and the Staphylinidae family, namely the predator *Paederus* sp. Then the Hemiptera order, namely the Miridae family, namely the predators of *Cyrtohinus* sp ., the Orthoptera order, namely the Tettigoniidae family, namely the predators of *Conocephalus* sp., 0rdo Hymenoptera, namely the Sphecidae family, namely the predators of Sc *eliphron* sp. The Odonata order, namely the Coenagrionidae family, is the predator *Agriocnemis* sp., and the Order Araneae consists of 2 families, namely the Tetragnathidae family, namely the predator *Tetragnatha* sp. and the Oxyopidae family, namely the predator *Oxyopes* sp.

The research results on the types of natural enemies found during observations showed 12 types of natural enemies. Generally, they acted as predators and a kind as a parasitoid. The existence of natural enemies discovered during the research can explain that the role of natural enemies continues to play in maintaining the natural balance of insect

pest populations in rice plantations at the research location. Ecologically, it also shows that integrated pest management is ongoing because indications of a decline in the population of natural enemies, both predators and parasitoids, in a rice planting location, are not occurring. The allegation that the plantation area has used pesticides continuously does not support it, so the research results can show that The presence of natural enemies and insect pests at the research location is still managed and under control.

3.1 Diversity of Insect Types, Pests and Natural Enemies

Based on the results of research on the diversity of insect pests and natural enemies during observations, it was seen that there were 28 types of insect pests and natural enemies from 22 families and 8 orders. As a result of the identification of species diversity, the number of insects and natural enemies caught can be counted during 5 observations, as shown in Table 5.2. the following.

Table 2. Diversity of Types of Pests and Natural Enemies Found in Rice Plants

No.	Type/ Species	Family	Observation					Amount	Average
			1	*2*	*3*	*4*	*5*		
			… tail …						
1.	*Scotinophara* sp.	Pentatomidae	5	10	11	10	6	42	8.4
2.	*Dolycorus* sp.	Pentatomidae	17	41	19	25	22	124	24.8
3.	*Stenodema* sp.	Miridae	12	9	7	15	12	55	11.0
4.	*Leptocorisa* sp	Alydidae	41	53	22	36	34	186	37.2
5.	*Paraecosmetus* sp	Lygaeidea	31	40	29	37	46	183	36.6
6.	*Cofana* sp.	Cicadellidae	43	52	55	46	41	237	47.4
7.	*Recilia* sp.	Cicadellidae	54	46	63	67	52	282	56.4
8.	*Nephotetix* spp.	Cicadellidae	55	65	51	45	57	273	54.6
9.	*Oxya* sp.	Acrididae	28	37	42	19	35	161	32.2
10.	*Anacridium* sp	Acrididae	12	21	27	25	33	115	23.6
11.	*Chilo* sp	Crambidae	19	27	11	17	18	92	18.4
12.	*Parnara* sp	Hespiriidae	15	12	11	7	9	54	10.8
13.	*Cnaphalocrocis* sp.	Pyralidae	12	23	31	2	42	110	22.0
14.	*Orseolia* sp	Cecidomydae	10	19	15	10	14	68	13.6

15	*Chlorops* sp	Choloropidae	15	9	21	14	15	74	14.8
16.	*Phyllotretra* sp	Chrysomelidae	23	41	18	28	31	141	28.2
17.	*Cyrtohinus* sp.	Miridae	12	17	22	14	29	94	18.8
18.	*Conocephalus* sp	Tettigoniidae	9	7	13	10	11	50	10.0
19.	*Agryophylax* sp.	Tachinidae	8	11	9	8	14	50	10.0
20.	*Sepedon* sp.	Sciomyzidae	43	51	36	45	48	223	44.6
21.	*Encarsia* sp	Aphelenidae	12	8	10	32	11	73	14.6
22.	*Menochilus* sp.	Coccineliidae	54	64	50	47	61	276	55.2
23.	*Ophionea* sp.	Carabidae	17	9	8	5	16	55	11.0
24.	*Paederus* sp	Staphylinidae	21	16	31	22	8	98	19.5
25.	*Sceliphron* sp	Specidae	7	7	11	9	10	44	8.8
26.	*Agriocnemis* sp	Coenagrionidae	13	10	9	12	5	49	9.8
27.	*Tetragnatha* sp.	Tetragnathidae	22	12	11	20	17	82	16.4
28.	*Oxyopes* sp	Oxyopidae	8	7	14	18	11	58	11.6

From Table 5.2. above regarding the diversity of insect types, pests and natural enemies found on rice plants at the observation location shows that the results of diversity analysis using the Shannon and Wiever formula are as follows:

a. Shannon and Wiener Diversity Index

The diversity index can characterize the relationship of species/genus groups in a community. Community structure can be studied in several ways: size, composition and species/type diversity. Community structure is closely related to habitat conditions. Habitat changes can affect the level of species/types of population that form a community. The existence of a diversity of organisms that live in an orderly manner, not distributed without any interdependence (interaction), can be studied at the community level, so the concept of community is important for studying ecology. The results of the diversity index analysis are H' = 2.81 because, based on the criteria, if the index is in category 1 <H', then the diversity index is medium. This research shows that the diversity of insect pests and natural enemies at the research location is moderate or does not show high or low species diversity.

***b.Species* Richness Index**

The Wealth Index (R) can be determined by looking at the number of types minus 1 and dividing by the Napier balance value (0.999). Based on the wealth index R = 4.67 analysis and linked to the criteria, if the R-value is 3.5 – 5.0, then the type of wealth is classified as medium. This shows that the results of research on species richness are

moderate, where there are no types of insect pests and natural enemies of low or high value, or in other words, the presence of species is even and moderate.

c. Type Evenness Index (*Index of evenness*)

A community structure is a population of various types or species occupying a particular habitat. Communities are classified by looking at the primary forms and structures, such as dominant species/types, life forms or indicators, and the physical habitat of the community. Based on the analysis results, the evenness index E = 0.52. When connected to the evenness index criteria, if the value is $0.4 < E \leq 0.6$, the evenness is moderate, and the community is unstable. This research shows that the evenness of insect pests and natural enemies in moderate conditions does not increase much or is low. In such conditions, the community structure becomes unstable, and this situation shows that the evenness of species of insect pests and natural enemies can change at any time if physical and biotic factors at the research location have an influence.

d. Dominance Index (*Dominance Index*)

Dominance can be measured based on the total proportion of the individuals of type I to the total number of individuals of type 2. Based on the community, it has a specific structure and pattern of diversity, evenness and dominance with unique characteristics in a community. Analysis of diversity, abundance/richness, evenness and dominance of a community, and the balance of numbers of each species/type. Results of analysis of

Dominance index C = 0.3.77, and if linked to the criteria value $0 < C \leq 0.5$, then dominance is low. The research results show that the presence of insect pests and natural enemies at the research location does not have a dominating species/type, so the dominance value is low. This situation can explain why the diversity of insect pests and natural enemies remains in balance or why no dominant species can be found.

IV. Conclusion

1. The identification results found that insect pests consisted of 5 orders, 12 families and 16 species, namely Dolycorus sp, Scotinophara sp., Stenodema sp, Leptocorisa sp, Paraecosmetus sp, Cofana sp ., Recilia sp ., Nephotetix sp, Oxya sp., Anacridium sp, Chilo sp, Parnara sp, Cnaphalocrocis sp . , Scirchopaga sp, Chlorops sp, and Phyllotretra sp. Meanwhile, natural enemies consist of 3 orders, 9 families and 9 species, namely Cyrtohinus sp . , Agryophylax sp ., Sepedon sp., Encarsia sp., Menochilus sp., Ophionea sp . , Paederus sp., Sceliphron sp. And Agriocnemis sp.
2. Shannon and Wiever's diversity analysis is H' = 2.81 or medium diversity index, richness index R = 4.67 or moderate criterion value, evenness index E = 0.52 or moderate and unstable evenness index, and dominance index C = 0 .37 or low dominance.

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