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The Use of Three Techniques to Control the Pest of "Walang Sangit" (*Leptocorisa oratorius* F.) on White Glutinous Rice (*Oryza sativa* L. var *glutinosa*)

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ABSTRACT

The rice bug *Leptocorisa oratorius* F., commonly known as "walang sangit," is a significant pest affecting paddy rice plantations, particularly during the generative phase. This study aimed to evaluate the effectiveness of three control methods for managing *L. oratorius* F. on white sticky rice plants in Harmonika Baru, Padang Bulan Selayang II, Medan Selayang District, Medan. Insects collected during the study were identified at the Pest Laboratory, Faculty of Agriculture, University of Sumatra Utara, between May and October 2023. The experiment used a purposive sampling method with three treatments: (1) the application of golden snail carcass traps, (2) papaya leaf extract, and (3) the fungal biocontrol agent *Beauveria bassiana.* The results showed that the insects collected under the three treatments belonged to the same five orders and 19 families, with a total of 2,593 individuals caught using golden snail carcass traps, 743 individuals using papaya leaf extract, and 528 individuals using *B. bassiana*.. The score calculation of AD1 were 2.593 individual while AF1 were 359; AD2 were 743, AF2 were 138; AD3 were 528 individuals, AF3 were 137 individuals. The Richness index (R) was 7.57 (R1), 7.67 (R2), and 2.64 (R3). Biodiversity indices showed richness indices (R) of 7.57 (R1), 7.67 (R2), and 2.64 (R3); evenness indices (E) of 0.80 (E1), 0.80 (E2), and 0.75 (E3); dominance indices (C) of 1 for all treatments; and Shannon diversity indices (H') of 2.48 (H'1), 2.64 (H'2), and 2.70 (H'3). The findings indicate that the application of golden snail carcass traps was the most effective treatment. Additionally, three insect functional groups were identified: herbivores, predators, and scavengers.

INTRODUCTION

Glutinous rice, also known as sticky rice, originates from Asia and has since spread across the world, including Indonesia. Sticky rice offers various health benefits, such as supporting growth, bone and tooth formation, and aiding in the management of diabetes (Alfatih, 2016). In Indonesia, the Agricultural Research and Development Agency has released three superior varieties of sticky rice, including Lusi (white sticky rice) and Inpari 25, Opak Jaya (red sticky rice), and Setail (black sticky rice) (BBPTP, 2015).

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Each variety of sticky rice exhibits distinct morphological characteristics. The length, width, thickness, and shape of rice grains can be used to differentiate between varieties. These differences are also valuable in identifying potential mixing of rice varieties for health-related purposes (Hanas et al., 2017). In Indonesia, white sticky rice is abundant, and its demand increases annually. National sticky rice consumption grew by an average of 19.10% per year between 2014 and 2018 (BPS, 2019).

White sticky rice belongs to the Graminae family. Its grains contain approximately 80–85% starch, primarily located in the endosperm as starch granules measuring 3–10 millimicrons. This starch comprises two types of glucose polymers: amylose and amylopectin (Priyanto, 2012). Additionally, glutinous rice contains vitamins (especially in the aleurone layer), minerals, and water. Starch, a carbohydrate polymer, has two structural components: amylose and amylopectin (Priyanto, 2012).

Farmers face increasing challenges in cultivating sticky rice, including global climate change, which fosters the proliferation of pests and diseases that threaten production. Consequently, farming profits decrease as farmers are compelled to spend more on pesticides.

In Indonesia, grasshoppers and *Leptocorisa oratorius* (commonly known as "walang sangit") are two significant pests that can cause yield losses of up to 50%. Reports indicate that a population of 100,000 *L. oratorius* per hectare can reduce yields by 25%. Additionally, research has found that a population of five grasshoppers and four *L. oratorius* per nine rice bushes can result in a 15% yield reduction (BBPTP, 2009).

Integrated pest and disease management (IPM) is a control approach that takes into account ecological factors so that control is carried out so as not to disturb the natural balance too much and not cause major losses. IPM can be carried out using the following strategies: use pest and diseases resistant varieties, use healthy plants, utilize natural enemies, mechanical (tools) and physical (catching) control and the use of pesticides only if necessary and carried out precisely according to the dose, target and time (Siregar, 2016). Siregar et al. (2018) found that areca nut, tobacco leaves, cassava leaves, rubber, noni fruit and papaya leaves could be used to control of pests in paddy plantation. They reported that nearly 100% death of golden snails could yield losses and could potentially maintain food security in Dairi. Very potential pests that could damage the rice crops have been identified, including seed flies, insectivorous insects, green false caterpillars, green hornworms, army caterpillars, white pests, white false pests, ground bedbugs, leafhoppers green, brown planthoppers, stem borers and grasshoppers (Siregar et al., 2018; Sodiq and Mujoko, 2020).

The objective of this experiment was to determine the most effective method in controlling “walang sangit” on white sticky rice plants in Medan, Northern Sumatera.

MATERIALS AND METHOD

This study was carried out from May to October 2023 at the Harmonika Baru, Padang Bulan Selayang II, Medan Selayang District, Medan City, North Sumatra Province, Indonesia, 26 meters above sea level (masl) over 400 meters of rice paddy sampling area. Identification of insects caught in traps were identified at the Pest Laboratory, Faculty of Agriculture, University of Sumatra Utara, Medan.

The materials used in this research were white glutinous rice plant seeds of the warp variety, 70% alcohol, water, detergent, golden snails found in areas around rice fields, the *B.bassiana*, papaya leaves and supporting materials, and others. The tools used in this research were tweezers, cutter, bamboo, 1.5 liter aqua bottle, rope, cloth, adhesive paper tape, net/gauze, hand sprayer, sieve, wood saw, scissors, nails, hammer. ,stationery, pliers, wire, soil meter, scales, cellphone camera, notebook, mixing container, plastic samples, pest identification books Kalshoven (1981) and Borror (1996) and other supporting tools.

Sampling of Location

Land preparation was carried out by cleaning the rice fields from remaining straw and wild grass. After cleaning, then check the water channels in the rice fields that will be examined. Then plow the rice fields using a hand tractor.

Seed preparation was done in a 1m x 3m nursery plot, next to the planting area. Rice seeds were sown 25 days before planting. The nursery field was irrigated gradually from 0-3 cm water bath to being flooded.

When the seedling was 21 days old, they were transferred to the research field by planting 2 seedlings per holes, having 20 cm spaces between rows and 6 cm between hills. The crops were fertilized with NPK, SP 36, and Urea at 4, 6, and 12 weeks.

Frequency density was calculated by taking the frequency of pest found and dividing it by the bin size. It was counted by the following formula FD=F/w, where FD = Frequency density, F = Frequency and w = bin size.

Richness index (R1) was calculated by using the Margalef equation as follow:

$$R = (S-1)\ (1)/Ln.\ N.$$

where R is index of species richness Margalef, S is number of species observed, N is number of individual (all types observed), Ln = natural logarithm value.

Evenness Index Analysis (E) was done by using the Magurran equation:

$$E= H/H\ max.$$

where E was evenness index, H' was value of evenness index, H max. was ln S, and S was number of species.

Dominance index value (C), diversity index value (H') was intended to determine the distribution of individuals between types found, assuming; H '= Zero if there is only one type in the sample data collected, and H' = Maximum if there are as many types as possible. Diversity Index (H'), using the Shanon Wiener equation.Where H' = diversity index, pi = ni/N, ni = number of individual types i, N = total number of individuals of all types.

Application of Golden Snail Carcass Trap

Golden snail (*Pomacea canaliculata* L.) taken from the rice field was finely chopped and weighed 125 g then left for 24 hours before being put into a trap bottle (1.5 l mineral water bottle). The bottle was cut at the end of the bottle and then glued together. The attractant was put into the bottle. As an entrance to the trap, the bottle cap was turned upside down and then inserted into the bottle. The trap was installed at a height of 30 cm above the base of the grain, installation was carried out 65 days after planting. Carcass traps were installed at each point specified on the experimental graph. This trap was installed in the morning at 08.00 am and collection is carried out on the 3rd day at 04.00-05.00pm. The duration of trap installation was 3 days for each observation. Pest sampling was carried out 18 times every 3 days for 8 weeks, starting in the final vegetative phase of sticky rice plants (6th week after planting sticky rice in rice fields). The samples of insect were collected and bring to Laboratory of Pest, Faculty of Agriculture, University of Sumatera Utara for identified by the method of Siregar (2018).

Application of Vegetable Pesticides in Papaya Leaves

Making vegetable biopesticide uses 1 kg of papaya leaves, then pounding/blending them until smooth and adding 1 liter of water. Then it is filtered and water is obtained from the pounded/blended papaya leaves. To maintain the toxic content of vegetable insecticides, it should be applied in the morning or evening. The papaya plants *(C. papaya)* has potential as a vegetable biopesticide. Based on research conducted by Konno (2004), papaya sap contains a group of cysteine protease enzymes such as papain and chymopapain. Papaya sap also process alkaloids, terpenoids, flavonoids and non-protein amino acids which are very toxic to plant-eating insects. The presence of chemical compounds contained in papaya plants can kill pest organisms. Papaya leaf extract is a natural ingredient that can be used as an insecticide that is effective and safe for the environment. The application of papaya leaf botanical pesticide is carried out at a dose of 100 ml of papaya leaf extract/1 liter of water. The application is carried out in the afternoon at 16.00 WIB, with an application time every 7 days, and a total of 8 applications over 8 weeks. Pest sampling was carried out 7 days after application of botanical pesticides papaya with 8 sampling times over 8 weeks, starting in the final vegetative phase of sticky rice plants (6th week after planting sticky rice in rice fields).

Application of Vegetable Pesticides of Papaya Leaves

Vegetable pesticide of papaya leaves was prepared by homogenizing 1 kg of papaya leaf in 1 l of water. The filtrate was filtered by using household coconut milk screen. To get the best result of the pesticide, one should prepare and apply it at the same day. The dosage was 100 ml of papaya leaf extract mixed with 1 l of water. The application was done at after noon, 7 days a week, for 8 weeks in a row. Pest sampling was carried out 7 days after application of botanical pesticides papaya with 8 sampling times over 8 weeks, starting in the final vegetative phase of sticky rice plants (6th week after planting the rice in rice fields).

Application of *Beauveria bassiana*

Beauveria bassiana was applied at a dose of 15 gr/1 liter of water in the afternoon at 16.00 WIB, with an application time every 7 days, and a total of 8 applications over 8 weeks. Pest sampling was carried out 7 days after application of *B. bassiana*, with 8 sampling times over 8 weeks, starting in the final vegetative phase of sticky rice plants (6th week after planting sticky rice in rice fields) (Wibowo et al, 2013).

RESULTS AND DISCUSSION

Diversity of Insects Caught

The treatments gave different results of the pest caught during the experiment (Table 1). It showed that carcass of golden snails showed the highest diversity (Table 1). The insects caught from rice fields treated with carcass traps for golden snails consisted of 5 orders and 19 families with an insect population of 2593 individuals. Meanwhile, the application

Table 1. Number and types of insects caught with varying applications

Order	Family	Genera	Carcass Trap Application	Application of Vegetables Pesticides	Appliation *Beauveria bassiana*
Coleoptera	Coccinellidae	*Coccinella*	21	6	12
	Coccinellidae	*Verania*	38	10	14
	Chrysomelidae	*Dicladispa*	20	12	7
	Staphylinidae	*Paederus*	29	7	5
	Coccinellidae	*Epilachna*	38	17	9
Diptera	Muscidae	*Musca*	130	23	10
	Muscidae	*Atherigona*	115	12	4
	Cecidomyiidae	*Orseolia*	54	6	10
	Calliphoridae	*Chrysomya*	107	9	8
	Calliphoridae	*Lucilia*	95	14	14
	Drosophilidae	*Drosophila*	23	18	10
	Ephydridae	*Hydrallia*	65	10	7
	Tipulidae	*Tipula*	39	2	6
	Sarcophagidae	*Sarcophaga*	94	9	9
	Stratiomyidae	*Hermetia*	26	11	7
Hemiptera	Alydidae	*Leptocorisa*	1024	202	111
	Alydidae	*Riptortus*	28	45	56
	Pentatomidae	*Scotinophara*	77	29	9
	Cicadellidae	*Recilia*	29	35	22
	Cicadellidae	*Nephotettix*	35	53	26
Hymenoptera	Pompilidae	*Auplopus*	30	6	11
	Apidae	*Xylocopa*	23	8	6
Orthoptera	Pyrgomorphidae	*Atractomorpha*	94	83	47
	Tettigoniidae	*Tettigonia*	31	5	8
	Acrididae	*Oxya*	187	75	92
	Tettigoniidae	*Conocephalus*	141	36	8
	Total		2593	743	528

Table 2 . AD, RD, AF, RF values on rice fields treated with golden snail carcass traps

Order	Family	Genera	Application of golden snail carcass trap			
			AD	RD	AF	RF
Coleoptera	Coccinellidae	*Coccinella*	21	0,80	10	2,78
	Coccinellidae	*Verania*	38	1,46	10	2,78
	Chrysomelidae	*Dicladispa*	20	0,77	9	2,50
	Staphylinidae	*Paederus*	29	1,11	13	3,62
	Coccinellidae	*Epilachna*	38	1,46	12	3,34
Diptera	Muscidae	*Musca*	130	5,01	18	5,01
	Muscidae	*Atherigona*	115	4,43	18	5,01
	Cecidomyiidae	*Orseolia*	54	2,08	14	3,89
	Calliphoridae	*Chrysomya*	107	4,12	18	5,01
	Calliphoridae	*Lucilia*	95	3,66	18	5,01
	Drosophilidae	*Drosophila*	23	0,88	9	2,50
	Ephydridae	*Hydrallia*	65	2,50	15	4,17
	Tipulidae	*Tipula*	39	1,50	11	3,06
	Sarcophagidae	*Sarcophaga*	94	3,62	18	5,01
	Stratiomyidae	*Hermetia*	26	1,00	11	3,06
Hemiptera	Alydidae	*Leptocorisa*	1024	39,49	18	5,01
	Alydidae	*Riptortus*	28	1,07	12	3,34
	Pentatomidae	*Scotinophara*	77	2,96	14	3,89
	Cicadellidae	*Recilia*	29	1,11	12	3,34
	Cicadellidae	*Nephotettix*	35	1,34	13	3,62
Hymenoptera	Pompilidae	*Auplopus*	30	1,15	12	3,34
	Apidae	*Xylocopa*	23	0,88	11	3,06
Orthoptera	Pyrgomorphidae	*Atractomorpha*	94	3,62	17	4,73
	Tettigoniidae	*Tettigonia*	31	1,19	11	3,06
	Acrididae	*Oxya*	187	7,21	18	5,01
	Tettigoniidae	*Conocephalus*	141	5,43	17	4,73
Total			2593	100	359	100

of papaya leaf extract attracted 5 orders and 19 families with an insect population of 743 individuals. On the other hand, those attracted to *B. bassiana* consists of 5 orders and 19 families with insect population of 528 individuals.

From these results we can see that the highest number of insects was found in the golden snail carcass trap application treatment with a total of 2593 insect individuals, and the lowest number of insects was found in the *B. bassiana* spray application treatment with a total of 528 insect individuals. The number of insects obtained might be influenced by physical environmental factors around the white sticky rice planting area, one of which is rainfall. Previous report by Wardani (2016) showed that rain could directly affect the population of pest insects if there was heavy rain, especially affect the growth and activity of insects.

Important elements in rain analysis are rainfall, number of days and rainfall intensity. The number and types of insects caught in rice fields with the application of the botanical pesticide papaya leaf extract, carcass traps for golden snails, and spraying *B. bassiana*, It can be concluded that the comparison of the number and types of insects From the three treatments experiences fluctuations with each observation. This is due to the abundance of food sources and the suitability of the research land as insect habitat, so that the insects can reproduce. This is in line with the literature of Falahudin et al.(2015) which states that the abundance of insects is influenced by repro-ductive activities which aresupported by a suitable environment and adequate food sources.

Absolute Density, Relative Density, Absolute Frequency and Relative Frequency

From the number and types of insects that were obtained in 18 observations using golden snail carcass traps, the values for absolute density, relative density, absolute frequency and relative frequency were obtained as seen in Table 2. The results of the highest AD and RD values were in the application of carcass traps

Table 3.AD, RD, AF, RF values on rice fields treated with the application of vegetable pesticides using papaya leaf extract

Order	Family	Genera	Papaya leaf pesticide application			
			AD	RD	AF	RF
Coleoptera	Coccinellidae	*Coccinella*	6	0.80	3	2.17
	Coccinellidae	*Verania*	10	1.34	5	3.62
	Chrysomelidae	*Dicladispa*	12	1.61	5	3.62
	Staphylinidae	*Paederus*	7	0.94	5	3.62
	Coccinellidae	*Epilachna*	17	2.28	5	3.62
Diptera	Muscidae	*Musca*	23	3.09	6	4.34
	Muscidae	*Atherigona*	12	1.61	6	4.34
	Cecidomyiidae	*Orseolia*	6	0.80	4	2.89
	Calliphoridae	*Chrysomya*	9	1.21	5	3.62
	Calliphoridae	*Lucilia*	14	1.88	5	3.62
	Drosophilidae	*Drosophila*	18	2.42	6	4.34
	Ephydridae	*Hydrallia*	10	1.34	6	4.34
	Tipulidae	*Tipula*	2	0.26	2	1.44
	Sarcophagidae	*Sarcophaga*	9	1.21	4	2.89
	Stratiomyidae	*Hermetia*	11	1.48	5	3.62
Hemiptera	Alydidae	*Leptocorisa*	202	27.18	8	5.79
	Alydidae	*Riptortus*	45	6.05	6	4.34
	Pentatomidae	*Scotinophara*	29	3.90	6	4.34
	Cicadellidae	*Recilia*	35	4.71	5	3.62
	Cicadellidae	*Nephotettix*	53	7.13	7	5.07
Hymenoptera	Pompilidae	*Auplopus*	6	0.80	4	2.89
	Apidae	*Xylocopa*	8	1.07	5	3.62
Orthoptera	Pyrgomorphidae	*Atractomorpha*	83	11.17	8	5.79
	Tettigoniidae	*Tettigonia*	5	0.67	3	2.17
	Acrididae	*Oxya*	75	10.09	8	5.79
	Tettigoniidae	*Conocephalus*	36	4.84	6	4.34
	Total		743	100	138	100

for golden snails, namely in the order Hemiptera, Family Alydidae, Genera Leptocorisa, namely *L. oratorius* with a value of AD = 1024 and RD = 39.49%, while the lowest was in the Order Coleoptera, Family Chrysomelidae, Genera Dicladispa with a value of AD = 20 and RD = 0.77%. Based on the data obtained, the order Hemiptera, family Alydidae, genera *L.oratorius* was the largest population on white sticky rice fields treated with the application of carcass traps for golden snails. This could be caused by the "walang sangit" being very attracted to the rotten smell produced by the golden snail carcass, so the pest came to the source of the smell coming From the trap. This was supported by research conducted by Roja (2009) which stated that the sangit grasshopper was attracted to the rotten smell coming from the carcass. In attracting stink bugs, one of the ways is to use golden snail carcasses. In its application, the golden snail shell was broken, then pierced with a wire.

Table 2 showed that the Order Coleoptera, Family Chrysomelidae, Genera Dicladispa got the lowest AD and RD values, which caused by the Order Coleoptera, Family Chrysomelidae, Genera Dicladispa were the fewest insects caught in white sticky rice fields with the application of golden snail carcass traps, suggesting that dicladispa caused no harm for rice paddy plantation. This findings was in accordance with Kuswardani and Maimunah (2013), stating that that potential pests are pest species which, under normal conditions in the agricultural ecosystem, never cause significant losses. Nurhadi (2012) have stated that

Table 4. AD, RD, AF, RF values on rice fields treated with *B. bassiana* spraying

Order	Family	Genera	Application *Beauveria bassiana*			
			AD	RD	AF	RF
Coleoptera	Coccinellidae	*Coccinella*	12	2.27	6	4.37
	Coccinellidae	*Verania*	14	2.65	5	3.64
	Chrysomelidae	*Dicladispa*	7	1.32	5	3.64
	Staphylinidae	*Paederus*	5	0.94	4	2.91
	Coccinellidae	*Epilachna*	9	1.7	5	3.64
Diptera	Muscidae	*Musca*	10	1.89	4	2.91
	Muscidae	*Atherigona*	4	0.75	3	2.18
	Cecidomyiidae	*Orseolia*	10	1.89	5	3.64
	Calliphoridae	*Chrysomya*	8	1.51	3	2.18
	Calliphoridae	*Lucilia*	14	2.65	6	4.37
	Drosophilidae	*Drosophila*	10	1.89	6	4.37
	Ephydridae	*Hydrallia*	7	1.32	4	2.91
	Tipulidae	*Tipula*	6	1.13	4	2.91
	Sarcophagidae	*Sarcophaga*	9	1.7	6	4.37
	Stratiomyidae	*Hermetia*	7	1.32	5	3.64
Hemiptera	Alydidae	*Leptocorisa*	111	21.02	8	5.83
	Alydidae	*Riptortus*	56	10.6	7	5.1
	Pentatomidae	*Scotinophara*	9	1.7	4	2.91
	Cicadellidae	*Recilia*	22	4.16	6	4.37
	Cicadellidae	*Nephotettix*	26	4.92	6	4.37
Hymenoptera	Pompilidae	*Auplopus*	11	2.08	5	3.64
	Apidae	*Xylocopa*	6	1.13	4	2.91
Orthoptera	Pyrgomorphidae	*Atractomorpha*	47	8.9	8	5.83
	Tettigoniidae	*Tettigonia*	8	1.51	4	2.91
	Acrididae	*Oxya*	92	17.42	8	5.83
	Tettigoniidae	*Conocephalus*	8	1.51	6	4.37
	Total		528	100	137	100

Diclandispa armigera is a potential pest on rice plants that attacks young plants, eats the green parts of the leaves on the epidermal membrane and produces irregular, white, longitudinal bite marks. It causes damage starting from the top of the leaves and moves downwards, so that the plants become stunted, weak and yields decrease by 10 – 63%. Moreover, from the number and types of insects that were obtained in 8 observations with the application of vegetable pesticides using papaya leaf extract, the absolute density, relative density, absolute frequency and relative frequency values obtained can be seen in Table 3.

The application of papaya extract showed the highest value of absolute density (AD) and relative density (RD), as shown in the order Hemiptera, Family Alydidae, Genera Leptocorisa, namely with a value of AD = 202 and RD = 27.18%, whereas the lowest was found in the Order Diptera, Family Tipulidae, Genera Tipula, namely with a value of AD = 2 and RD 0.26%. It might be attributed to the presence of insects in an ecosystem can be influenced by several factors such as the availability of food and a suitable physical environment for the insect to live. Suin (2012) has stated that the presence of insects in an environment is influenced by environmental factors consisting of biotic and abiotic factors. Abiotic factors include soil, water, temperature, and light penetration. Meanwhile, biotic factors are other organisms that are also found in their habitat. The order Diptera, Family Tipulidae, Genera Tipula got the lowest AD and RD values. It might be caused by the Order Diptera, Family Tipulidae, Genera Tipula caught from the least on white sticky rice fields with the application of the vegetable pesticide papaya leaf extract. This findings was in line with Panjaitan (2020) statement that factors that can influence organism populations can include habitat suitability, environment, food integrity, the presence of natural enemies and other factors that support the life cycle.

From the number and types of insects that were obtained in 8 observations with the application of *B. bassiana* spraying, absolute density, relative density, absolute frequency, and relative frequency values obtained (Table 4). The absolute density (AD) and relative density (RD) values were highest in the Beauveria bassiana spray application treatment, namely in the order Hemiptera, Family Alydidae, Genera Leptocorisa, namely with values AD = 111 and RD = 21.02%, while the lowest was in the Order Diptera, Family Muscidae, Genera Atherigona with a value of AD = 4 and RD = 0.75%. The data showed that the order Hemiptera, Family Alydidae, Genera Leptocorisa was the largest population found from the white sticky rice fields treated with *B. bassiana* spray. This was in accordance with the literature of Yunianti (2016), stating that the stink bug attacks rice plants by piercing the grains of rice.

The Diptera Order, Muscidae Family, Atherigona Genera found the lowest AD and RD values. The Diptera Order, Muscidae Family, Atherigona Genera were the fewest insects caught on white sticky rice fields with spraying applications *B. bassiana* (Table 4).

This was due to the lack of abundance of these insects and they were rarely present in the observation area. This was in accordance with the literature of Riyanto et al (2015) which states that the value of insect diversity and abundance was influenced by surrounding environmental factors such as temperature, rainfall and nutrient availability. Changes in environmental conditions would cause changes in the ecosystem which can affect the diversity and abundance of insects in it.

The application of golden snail carcass traps found in the families Muscidae (Musca), Muscidae (Atherigona), Calliphoridae (Chrysomya), Calliphoridae (Lucilia), Sarcophagidae (Sarcophaga), Alydidae (Leptocorisa), and Acrididae (Oxya). Meanwhile, in the plant pesticide application treatment of papaya leaf extract, the highest AF and RF values were found in the Alydidae (Leptocorisa), Pyrgomorphidae (Atractomorpha), and Acrididae (Oxya) families, while in the Beauveria bassiana spray application treatment, the AF and RF values. The highest values were shown by Alydidae (Leptocorisa), Pyrgomorphidae (Atractomorpha), and Acrididae (Oxya). This was might be caused by the large number of these insects in the research land, influenced by the abundance of available food that was suitable for the digestive system of pest insects in the research land, so that the insect population develops well (Azima et al., 2017). Previous study showed that the diversity of insect species is influenced by their food.

The application of golden snail carcass traps found in the Chrysomelidae (Dicladispa) and Drosophilidae (Drosophila) families. Meanwhile, in the application of plant-based pesticides using papaya leaf extract, the lowest AF and RF values were found in the Tipulidae (Tipula) family. And in the *B. bassiana* spray application treatment, the lowest AF and RF values were found in the Muscidae (Atherigona) and Calliphoridae (Chrysomya) families. This is due to the small number of these insects in the research land, this can be influenced by the lack of availability of food suitable for the digestive system of pest insects in the research land, thus affecting the development of the insect population. This is supported by Yasin (2009), that food quality greatly influences insect breeding. In good food conditions in sufficient quantities and suitable for the digestive system of insect pests, it will support the development of the population, whereas food that is limited and not suitable for the digestive system of insect pests will hinder the development of the insect population.

Richness Index Value (R), Evenness Index Value (E'), Dominance Index Value (C), Diversity Index Value (H')

Based on observations in research fields for white sticky rice (Oryza sativa L. Var glutinosa), the richness index value (R), evenness index value (E'), and dominance index value (C), diversity index value (H') (Figure 1). The use of various method showed different values of species richness. It was 7.57 for golden snail carcass traps, 7.67 for papaya leaf extract, and 2.64 for *B. bassiana.* Margalef

(1958) have divided species richness into 3 categories, which were R<2.5 indicates low species richness, 2.5>R>4 indicates medium species richness and R>4 indicates high species richness.

The application of golden snail carcass traps was found to be 7.57 and with the papaya leaf extract botanical pesticide application treatment the value was found to be 7.67. This value is included in the high species richness index category, while differences in species richness values can be caused by several factors such as physical environmental factors, planting patterns, and research location. This is supported by research by Siregar (2018) which states that in ecosystems, insect populations or other organisms in natural ecosystems never experience explosions because there are many control factors, both biotic and abiotic. In contrast to agricultural ecosystems, there are many controlling factors that can cause population explosions and ultimately become pests.

Beauveria bassiana spray was found to have a richness value of 2.64. This value is included in the medium type wealth index category. The moderate value of the species richness index can be caused by the balance of the ecosystem, so that the number of species in the insect community is balanced. This is supported by Tarihoran (2020) literature which states that the Richness Index will be higher in communities with more species than in communities with few species. Thus, the more species identified, the higher the species richness.

The evenness index value in the study with the application of carcass traps for golden snails had a value of E' = 0.80 and the evenness index with the plant pesticide treatment with papaya leaf extract had the same value as with the application of golden snail carcass traps, which has an E' value = 0.80. The evenness index with the B. bassiana spray application treatment was found to have a smaller value, namely E' = 0.75. Based on these results, the three treatments obtained high evenness index values, because these values were in the range E'>0.6, which is classified as a high evenness index. This is supported by the literature of Odum (1996) which states that the criteria for the species evenness index are divided into 3, namely, E'<0.3 indicates species evenness which is included in the low category, 0.3>E'>0.6 indicates the medium category and E' >0.6indicates a high category where the maximum evenness index of this type is 1.

The results obtained in Figure 1 show that the evenness index value with the application of carcass traps for golden snails was found to have a value of E' = 0.80 and the evenness index value with the application of vegetable pesticide using papaya leaf extract was E' = 0.80, which means that the two treatments have the same evenness index value. This can be caused because the two treatment blocks are next to each other and close to each other, so that insects can actively move quickly from one place to another to look for food and prey to survive. This is supported by the literature of Nurindah (2006) which states that plant populations The height and close spacing of the plants will result in the plants growing very densely, resulting in a microclimate in the plants and being vulnerable to the development of herbivore populations and also affecting the development of predators .

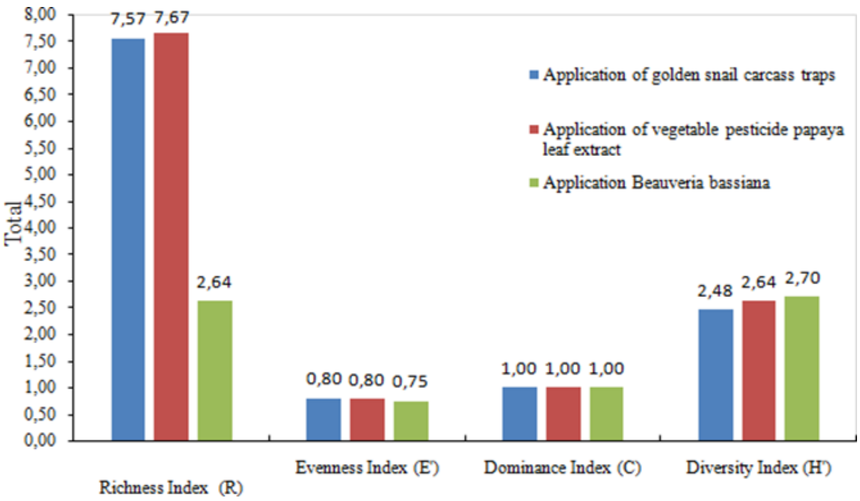

Figure 1. Richness index value (R), evenness index value (E'), dominance index value (C), diversity index value (H')

The evenness index value obtained in Figure 1, in the application of vegetable pesticides using papaya leaf extract, found a value of E' = 0.80, where this value is included in the high category because this value is in the range of E'> 0,6 which is classified as high evenness index. This value is almost similar to Siregar et al. (2021) research in Soporaru Village, North Tapanuli, Indonesia, where the evenness index on rice fields treated with vegetable pesticides was found to have a high evenness index value, namely E'=0.78.

The evenness index in the three treatments has a high evenness index value, which indicates that the ecosystem in the three treatments on the rice fields is classified as stable. This is supported by the literature of Ibrahim and Mugiasih (2020) which states that if the evenness index in an ecosystem in the high category shows that the ecosystem condition in rice is stable where natural enemies can reduce pests, if there is an increase in the insect pest population, this will be followed by an increase in the population of natural enemies. namely increased eating power and parasitization.

The dominance index value was the same for each treatment, whereas in the research with the application of carcass traps for golden snails the value C = 1 was found and in the treatment with the application of the vegetable pesticide papaya leaf extract the value C = 1 was found. with the *B. bassiana* spray application treatment, the C value = 1 was found, From these results it can be concluded that there are certain insect species that dominate, this is proven by the statement of Odum (1996) stating that the dominance index ranges From 0 to 1, where the smaller the index value dominance then shows that there is no species that dominates, conversely, the greater the dominance, it shows that there is a certain species.

The dominance index value for the three treatments in this study was found to be a dominance index value of 1, this indicates that there has been competition between insect species in the research area. This can occur due to the suitability of the environment as a place for insects to live, as well as competition and predation that occurs between species. thus causing insect dominance in the environment. This is supported by the literature of Suin (2012) which states that the dominance of insects in a habitat is influenced by the appropriate environment to support their life.

There are certain insect species that dominate in the research land in each treatment, this is due to adaptations that enable these insects to live and dominate in the research land. This is in accordance with the literature by Hasriyanti et al.(2015) which states that adaptability is the key for insects to survive in a habitat. The higher level of habitat disturbance results in competition for resources, the creation of new habitats, loss of native species, differences in insect composition and more adaptive species will be better able to survive.

The diversity index of insects caught in research on rice fields treated with carcass traps for golden snails was found to have a value of H' = 2.48, where this value is included in the medium value condition, and in research on rice fields treated with the application of vegetable extract pesticides papaya leaves found a value of H' = 2.64, where this value was included in the medium value condition, and in research on rice fields with *B. bassiana* spray application treatment, the value H' = 2.70 was found, where this value was included in the high value condition. currently. Based on these results, the three treatments obtained a medium diversity index value, because this value was in the range H' = 1 - 3 which is classified as a medium diversity index. According to Michael (1995), if H' = 1 - 3, it shows moderate diversity, namely the presence of pests and natural enemies almost shows balance.

Based on the research results, it can be seen that the diversity value (H') of insect pests in the three treatments was in the range 1<H'<3, where this value was classified as moderate because it obtained a value of 1<H'<3. Moderate diversity indicates that the distribution of the number of individuals of each type and the stability of each population are also moderate. This is supported by research by Alwi et al. (2020) which states that a community in an agroecosystem can be said

Table 5. Physical and chemical data

Week-	Rainfall (mm)	Temperature (°C)	Humidity (%)	Wind velocity (m/s)	pH
1	7,5	29	85	1,2	8
2	5,2	33	76	1	7,5
3	3,3	31	77	1,9	7,8
4	2,6	28	77	0	7,7
5	7,8	30	81	0,9	7,6
6	5,3	29	77	1,7	7,8
7	8,1	28	82	1,6	7,8
8	1,2	31	77	0	8,4
9	3,4	30	78	0	7,5
10	6,8	28	81	0	7,3
11	7,4	30	80	1	7,9
12	0,2	31	77	0	7,2
13	7,9	30	80	1,5	7,5
14	8,4	32	77	1	7,2
15	8,1	27	80	1,1	7,7
16	7,9	26	79	0	8

to have high diversity if the community is composed of many species with the same or almost the same abundance of species, and community is composed of few species and if there are few species that dominate, the diversity in the agroecosystem will be low.

The diversity index values that were not much different were found in the three treatments, presumably because the rice fields with the three treatments were still in the same environment and were only 1 meter apart. The total number of families with the three treatments had the same number of families, namely 19 families. This is because the distance between the two fields is not too far which allows insect mobility in both areas. According to Siregar and Matondang (2017) that the distance between adjacent land will have the same community index. The level of insect diversity can also be influenced by environmental conditions or the condition of the ecosystem where the insects live. This is supported by Untung's (2001) research that the diversity of insect species will always follow the condition of the ecosystem they live in because the ecosystem will not be the same From time to time and will tend to change if the physical environment also changes.

Physical Chemical Factors

Physical chemical data measurements are carried out every day from final vegetative phase until just before the harvest period. Physical chemical data measurements (rainfall, temperature, humidity, wind speed and pH) are carried out 3 times every day, namely in the morning every 08:00 am, in the afternoon at 12:00 am, and in the afternoon every 16:00pm.

The highest rainfall data in week 14 was 8,4 mm and the lowest rainfall in week 12 was 0.2 mm. From this data, differences in rainfall resulted in differences in the populations of insects caught in each observation. This is because rain can have an effect on insects. If there is heavy rain, many pest insects will die, which will affect the growth and activity of insects, even causing the death of insects, especially insect pests (herbivores). This is supported by research by Elphinstone et al (2008) which states that rain can directly affect insect populations, if there is heavy rain many insects die, this can affect the growth and activity of insects.

The average air temperature during the experiment was varied form 16^{o}C to 26^{o}C, with the highest was 33°C. This range of temperature was considered favorable for the insect to grow (Handani et al. 2015). Previous study by Siregar (2021) showed that Walang sangit actively attacks in the morning and evening, while during the day it takes shelter under damp and cool trees. Good development of the pest L. oratorius occurs at temperatures between 27°- 30°C. According to Bale et al .,

(2002) the diversity and feeding intensity of insect pests will increase if the environmental temperature increases. Insects that are poikilothermic require heat From the environment to start their metabolism.

Relative humidity at the research location during data collection starting From week 1 to week 16 ranged From 76-85%. From these results it can be concluded that the air humidity in the research area is optimal for insect survival. This is supported by research by Riostone (2010) which states that good air humidity is in the range of 80-95%, thus supporting insects in their survival.

The wind speed in the research area was 0 – 1.9 m/second, which might affect the mobility of the insects, as already known that the higher the wind speed, the lower the insect mobility (Aryoudi et al., 2015). The soil pH of the rice paddy was 7.2 – 8.4, considered good for insect survival, as the best soil pH for those insects are Borror et al. (2005).

CONCLUSIONS

The study of pests in the white glutinous rice showed that the application of golden snail carcass traps was the best treatment, attracting 5 orders and 19 families of "walang sangit" with 2593 individual was collected by application by golden snail carcass trap, 743 individuals by spraying of papaya leaf extract, 528 individuals by spraying *B. bassiana.* The total value of AD and AF of the three treatments are AD1=2.593, AF1=359; AD2=743, AF2=138; AD3=528, AF3=137. Then the score of richness index (R): R1=7.57; R2=7.67; R3=2.64, while the evenness index (E) consist of : E1=0.80; E2=0.80; E3=0.75, then dominance index (C):are 1 in the three treatments. The diversity index (H) cosist of: H1=2.48; H2=2.64; H3=2.70. Three types of insect function status were identified are herbivores, predators and scavengers.

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