An Inquiry Into The Diversity Of Insect On Rice Cropping (Oryza Sativa L.) At Vegetative Stadia Applied By Liquid Organic Pestisides Derrived From Plants And Bio-Slurry Biogas

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An inquiry into the diversity of insect on rice cropping (*Oryza sativa* L.) at vegetative stadia applied by liquid organic pestisides derrived from plants and bio-slurry Biogas

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Abstract

This research is aimed at 1) comparing predator and pest composition on rice cropping treated by organic pesticides and bio-slurry biogas, 2) analyzing insect biodiversity on rice cropping treated by liquid organic pesticides derived from plants, 3) recognising the effects of plant-derived pesticides and bio-slurry biogas combination on insects biodiversity. This experiment was carried out in Warnasari Village Tamban Catur District Kapuas Regency. The results showed that 1) predator and pest composition of rice cropping treated by organic pesticides and bio-slurry biogas on P5 had the biggest comparison at 92%: 6% whilst P1 had the least comparison at 87%: 10%. 2) Index of Species Richness (R) was ranged from 1.61 (P2) to 2.01 (P6) ($R \leq 3.5$ considered low); Dominance Index (C) was ranged from 0.5330 (P6) to 0.6814 (P7) ($0.5 < C \leq 0.75$ considered medium); Diversity Index (H') was ranged from 1.13 (P7) to 2.33 (P6) which means that the diversity is categorised as medium with adequate productivity, balance ecosystem condition, moderate ecosystem pressure. The Evenness Index showed high evenness with stable community ranged between 0.7 – 0.8. However, P7 had a low index accounted for 0.3 which represent low evenness and pressed community. 3) Application of organic pesticides and *bio-slurry* had no significant effects on diversity, species richness, dominance, and evenness indexes.

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Introduction

Insects have an important role in agriculture. Humans often see insects as groups of organisms which are more harmful than beneficial to humans' life. The problems of insects in agriculture cannot be separated from the role of insects as pests. Insects are groups of animals that become the main pests for many types of cultivated plants. Besides being pests of a plant, some groups and types of insects can become carriers or vectors of plant diseases in the form of viruses or fungi (Untung *et al.*, 1997). Not all insects are harmful because some of them have a positive impact. Some insects are predators, parasitoids or natural enemies (Christian *et al*., 2000). Insects can act as natural enemies that are very helpful to humans in pest control efforts. Insects can also help to maintain the stability of food webs in an agricultural ecosystem.

The unwise use of chemical pesticides, such as using the excessive doses, making the dissolved pesticides by mixing several types of pesticides can cause resistance to pests, destroy natural enemies and make environmental pollution. Organic pesticides begin to be considered by farmers to reduce production costs and be more environmentally friendly when the price of chemical pesticides is increasing.

Vegetative pesticides are organic pesticides which are primarily derived from plants with active substances from secondary metabolite groups and containing bioactive compounds, such as alkaloids, terpenoids, phenolics and other secondary chemical substances. Those bioactive compounds can affect insect life, such as inhibiting the growth of insects (*insect growth regulator*), inhibiting feeding (*anti feedant*), repelling (*repellent*), attracting (*attractant*), decreasing the insects' ability to spawn, preventing the laying of eggs (*oviposition deterrent*) and directly influencing as toxin.

Vegetative pesticides are usually easily decomposed (*biodegradable*) in nature, so they do not cause environmental pollution and are relatively safe for human and livestock life, because the residue is easily lost. Future agriculture which ideally integrates traditional technology and modern technology can be recommended to be environmentally sound agriculture and can be applied by agricultural people.

Development of environmentally sound agriculture uses plants such as vegetative pesticides, local organisms content, and organic pesticides both manually or fermentation processing. One of the vegetative pesticides is mimba plant, both its leaves and seeds can be processed, it is because its active substances such as nimbin and triol can dispel pest organisms.

The active substances of mimba are relatively harmless to humans and animals and their residues are easy to decompose, so that they are safe and environmentally friendly. Research conducted by Tomayahu (2014), showed that the extract of gadung tuber as a vegetative pesticide can eradicate grasshopper. Setiawan's research (2010), using vegetative pesticides from mimba leaf extracts gave a real effect in inhibiting the spreading of insect pests of warehouses.

In addition, Subiyakto (2009) showed that vegetative pesticide from mimba seed extract has the potential to be larvacide to the death of caterpillars, and disturb the metamorphosis of grayak larva and caterpillar worms. Another research was conducted by Rahayuningtias *et al.* (2013), it showed that vegetative pesticides which are originally from mimba, gadung, laos and citronella have the potential to decrease the grayak caterpillar attack on cabbage plants.

Bio-slurry is a waste generated in the biogas fermentation process and has potential as an untapped bio-pesticide plant. Bio-slurry applications can effectively control the development of red spiders/mites and the like from attacking major vegetables, wheat and cotton. The use of bio-slurry with 15-20% pesticides to control pests has the same effectiveness with using pure pesticides (Handhaka, 2012).

In mid 2010 bio-slurry is slowly introduced to farmers and ranchers by the Biogas Team with the Biogas Rumah (BIRU) program through a process of utilization training and bio-slurry demos. In 2013, based on the results of laboratory research and biogas team field tests, bio-slurry contains nutritional and pro-biotic microbes as organic fertilizers, bio-pesticides and source of soil enhancers.

Research conducted by Citra *et al.* (2012), used biogas waste in the form of slurry and sludge. They were used as liquid fertilizer and can replace chemical fertilizer in coffee plant seeds. The result showed the growth influence of shoot number, plant height, leaf width, and leaf length. Another study conducted by Andianto *et al.* (2015) combined bio-slurry and NPK fertilizer to give effect to the growth and production of chili.

Bio-slurry also can be used as a basic substance in organic pesticide production and to prevent from pest and disease attacks which is combined with organic plant pesticide and bioactive content with bitter taste, foul or stinging and toxic. Types of plants are such as sambiloto leaves, mimba leaves and seeds, brotowali, mahogany seeds, soursop leaves and seeds, kenikir flowers, galangale tubers, ginger, gadung tubers and others (Hartanto *et al.*, 2013).

Warnasari Village Tamban Catur District is one of the developmental locations of Biogas program in Kapuas Regency, Central Kalimantan Province. Bio-slurry contained in Warnasari Village has not been utilized as an organic pesticide-making material to reduce pest and disease attacks. Only a few farmers who have been using this biogas waste to water vegetable crops especially chili, corn and ornamental plant. Based on this background the writer chose *An inquiry into the diversity of insect on rice cropping* (*Oryza sativa* L.) *at vegetative stadia applied by liquid organic pestisides derrived from plants and bio-slurry Biogas* as the title for this research.

Materials and methods

The research was carried out by experimental method and observation. The results of the insect observations were analyzed by the biodiversity index or Shannon index and the F test statistical analysis.

The design used in this study is Completely Randomized Design with three times of repetition by the treatment as follows:

P0 = without treatment (control)
P1 = *bioslurry*
P2 = mimba leaf extract
P3 = gadung tuber extract
P4 = mimba leaf extract + *bioslurry*
P5 = gadung tuber extract + *bioslurry*
P6 = mimba leaf extract + gadung tuber extract
P7 = mimba leaf extract + gadung tuber extract + *bioslurry*.

Place and Time of the Research

The research was conducted in rice cultivation area in Warnasari Village, Tamban Catur District of Kapuas Regency. The study was conducted for 6 months (September 2016 - February 2017).

Work Procedures

a. Making crop plots
   Planting plot is made of size 5 x 10m2 counted 24 plots (use of area of 1,200m2).
b. *Seedling of rice seed*
   Size of seed seedlings is 4% of planted area of the Soak seeds with liquid bio-slurry for 24 hours, then drain before spread to the seedbed.
c. *Planting seeds*
   Removal of rice seedlings is done after 15 days after seed stocking, then they are soaked with liquid bio-slurry. Planting seeds done with 2 two stems per clump in rice cultivation plots.
d. *Dose*
   Applications are done with a dose of 2.5 liters / plot. Organic pesticide spraying was conducted on the 17th day after planting. The afternoon spraying time starts at 15.00pm on the experimental plot according to the research treatment code. Repeated spraying done 6 times with spraying distance 6 days (implemented on the day 23rd, 29th, 35th, 41st up to 47th).
e. *Observation*
   Observation and data were collected when vegetative stadium rice was done in the morning, one day after spraying organic pesticide according to treatment and repeating observation was done 6 times.
f. *Work mechanism*
   Catching insect using a net (sweep net) used with 15 double swings in the center of the experimental plot.

Light trap and yellow trap installed from 17.00pm - 05.00pm. The process of identifying insects is done by using the Borror identification book (Borror *et al*., 1992).

Presentation of Research Results

The diversity of insect species is calculated using the following biodiversity indices:

1. Index of Species Richness is determined by the formula according to Margalef (Ludwig and Reynold, 1988):

$$R = (S-1) / \text{Ln } N$$

Where:

R = Species Richness index

S = Number of Insect Species

N = Total Number of individual insects

Ln = Natural logarithm

Assessment criteria / criteria:

R <3.5: indicates the richness of the species is low

R = 3.5 - 5.0: indicates the richness of the species is moderate

R> 5: indicates the richness of the species is high

2. Index of Diversity is determined by Shannon-Wienner type diversity index:

$$H' = - \Sigma \{(ni / N) \text{ Ln } (ni / N)\}$$

Where:

H '= Index of species diversity

ni = Number of individuals of each type

N = Total number of all individuals

Ln = Natural logarithm

The criteria of the diversity index (H ') by Odum (1971) as the benchmark values of the H' diversity index are:

Low species diversity when H '<1, productivity is very low (poor) as an indication of severe ecological pressures, unstable ecosystems. Medium species diversity when 1 <H '≤ 3.32, productivity is sufficient, ecosystem conditions are sufficiently balanced, moderate ecological pressures. High species diversity when H '> 3.32, stable ecosystem stability, high productivity

3. The dominance index is determined by Simpson's dominant index (Ludwig and Reynold, 1988) using the formula:

$$C = \sum_{I=1}^{s} (ni / N)$$

Where:

C = Simpson's dominant index

s = Number of species

ni = Total number of i-type individuals

N = Total number of individuals in total n

Pi = ni / N = as proportion of type i, with criterion 0 <C <0,5: Low dominance, 0.5 <C ≤ 0.75: moderate dominance and 0.75 <C ≤ 1.0: high dominance

4. The Index of Evenness is determined by the formula

$$e = H' / H_{max}$$

Where:

e = Evenness index

H = Index of species diversity

$H_{max} = \text{Log } 2^s = 3.32 \log s$

Criteria: 0 <e ≤ 0.4: Evenness is low, depressed community; 0.4 <e ≤ 0.6: Evenness is moderate, unstable community; 0.6 <e ≤ 1.0: High equity, stable community

Statistical analysis is done by Test F with the formula:

$$\text{F-arithmetic} = \frac{R^2 / k}{(1- R^2) / (N - K-1)}$$

Where:

N = Number of samples

K = Constant

R^2 = Coefficient of determination

Results and discussion

The results of observation and identification of insect diversity on rice cultivation applied by organic liquid pesticide are presented in Table 1 below:

Table 1. Types of insects in vegetative stadium rice cultivation with application of organic liquid pesticides (treatment P0 s / d P7).

No	Order	Family	Species	Status
1	Coleoptera	Carabidae	Ophionea nigrofasciata	Predator
2			Calosoma reticulatum	Predator
3		Dysticidae	Dytiscus latissimus	Predator
4		Staphylinidae	Paederus fuscifes	Predator
5		Coccinellidae	Micraspis sp	Predator
6	Diptera	Culicidae	Culex sp	Parasite
7	Homoptera	Delphacidae	Nilaparvata lugens	Pest
8			Sogatella furcifera	Pest
9		Cicadelidae	Nepphotettix spp	Pest
10	Lepidoptera	Pyralidae	Scirpophaga innotata Walker	Pest
11			Cnapalocrosis medinalis	Pest
12	Hymenoptera	Formicidae	Monomorium sp	Predator
13	Hemiptera	Pentatomidae	Scotinopora coarctata	Pest
14		Reduviidae	Rhinocoris fuscifes	Predator
15		Gerridae	Gerris remigis	Predator
16	Orthoptera	Acrididae	Oxya chinensis	Pest
17		Pyrgomorphida	Atractomorpha crenulata	Pest
18		Tettigonidae	Conocephalus longipennis	Predator
19		Grylidae	Metioche vittaticollis	Predator
20	Odonata	Isostictidae	Ischnura heterosticta	Predator
21		Labellulidae	Neurothenus sp	Predator
22	Isoptera	Rhinotermitidae	Coptotermes curvigrathus	Pest
23	Thysanoptera	Crusiferae	Scirtotrips dorsalis	Predator

Source: Primary Data that is processed, 2017.

Based on the Table 1 above, insects caught using yellow traps, light traps and sweep net were 10 orders, 20 families with 23 species. Predatory status of 13 species were *Ophionea nigrofasciata, Calosoma reticulatum, Dytiscus latissimus, Paederus fuscifes, Micraspis* sp, *Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Conocephalus longipennis, Metioche vittaticollis, Ischnura heterosticta, Neurothenus* sp and *Scirtotrips dorsalis*. Pest status of 9 species, with a total predator ratio was 90% and pest was 8% (see Table 2). Pests found in the study location were 5 main pests of rice plants namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix* spp, *Scirpophaga innotata, Cnapalocrosis medinalis* and 4 secondary pests namely *Scotinopora coarctata, Oxya chinensis, Atractomorpha crenulata* and *Coptotermes curvigrathus*. The insect diversity of each treatment is presented in Table 2 below.

Table 2. Results of observation and identification of insects by treatment.

No	Treatment	Number of Individuals	Order	Family	Species	Status		Number of Ratio Predator Pest: Parasite (%)
						Predator	Pest	
1	P0	1093	9	17	20	11	8	89 : 9 : 2
2	P1	1294	9	18	20	11	8	89 : 9 : 2
3	P2	1287	9	16	18	10	7	91 : 8 : 1
4	P3	1472	10	17	19	9	9	90 : 8 : 2
5	P4	1012	9	16	18	8	9	90 : 9 : 1
6	P5	1404	9	14	17	8	8	92 : 6 : 2
7	P6	965	9	16	18	8	9	87 : 10 : 3
8	P7	946	9	15	17	8	8	91 : 6 : 3

Source: Primary Data that is processed, 2017.

From the Table 3 above, it can be seen that in the treatment of P5 the use of gadung tuber extract + *bio-slurry* was 92% of the number predator ratio and 6% of pest. While in the treatment of P7, the use of plant extract (mimba leaf + gadung tubers) + *bio-slurry* showed comparison of predator numbers which were 861 individuals from 8 species or 91% and pests which were 52 individuals from 8 species or 6%.

Utilization of Organic Pesticide on P7 treatment can increase predatory insect populations and suppress insect pests. Compared with the control treatment (P0), the numbers of predator were 974 of individuals and 101 of individual pests with 89% of predator ratio and 9% of pest. The percentage ratio of the predator and pest numbers can be increased by reducing unwise use of chemical pesticides, so that the existence of natural enemies found in the study location is not killed and can grow according to the expected conditions.

According to Subiyakto (2009), the use of vegetative pesticides is relatively safe to the environment. The use of chemical pesticides is the last alternative if non-chemical ways do not show the results. The use of irrational chemical pesticides can kill natural enemies of pests. The killing of natural enemies will lead to worse conditions because natural enemies as pest controls cannot function properly. According to Lilis (1992), in the rice field there are many insect pests from Depalcidae family, brown plant hopper (*Nilaparvata lugens*) and white-backed leafhoppers (*Sogatella furcifera*).

Pests are important and always talked in agricultural cultivation. Pests are considered as enemies of farmers in obtaining rice production. Most of the pests are coming from the insect species (Channa *et al.*, 2004). Different types of insects have natural enemies. Natural enemies of insect pests are generally Arthropods from insects and spiders species, and can be classified as predators and parasitoids. Predators are animals that prey on other animals (Untung, 2006). The existence of natural enemies becomes very important in the control of insect pest populations.

The diversity of insects in the rice cultivation (treatment P0)

The numbers of insects caught on the control treatment were 1,093 individuals consisting of 9 orders, 17 families and 20 species. The predator status of 974 populations consists of 11 species, namely *Ophionea nigrofasciata, Calosoma reticulatum, Dytiscus latissimus, Paederus fuscifes, Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Metioche vittaticollis, Ischnura heterosticta, Neurothenus* sp, and *Scirtotrips dorsalis*. The pest status of 101 individuals comprised 8 species of *Nilaparvata lugens, Sogatella furcifera, Nepphotettix spp, Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis* and *Atractomorpha crenulata*. The ratio was 89% of predator percentage and 9% of pest.

The diversity of insects in the rice cultivation that has been applied with liquid organic pesticide from plant (Treatment P2, P3, P6)

The numbers of insects caught on the P2 treatment were 9 orders, 16 families and 18 species. The populations of 10 predatory species were 1,166 individuals, namely *Ophionea nigrofasciata, Dytiscus latissimus, Paederus fuscifes, Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Metioche vittaticollis, Ischnura heterosticta, Neurothenus* sp, and *Scirtotrips dorsalis*, and 7 pests namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix spp, Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis* and *Coptotermes curvigrathus*. The population of pest was 103 individuals with 91% of predator percentage and 8% of pest.

The numbers of insects caught on the P3 treatment were 10 orders, 17 families and 19 species, with 9 predator species namely *Ophionea nigrofasciata, Dytiscus latissimus, Paederus fuscifes, Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Metioche vittaticollis, Ischnura heterosticta* and *Scirtotrips dorsalis*, with population of 1,331 individual insects and 9 species of pests namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix* spp, *Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis, Atractomorpha crenulata* and *Coptotermes curvigrathus*. The population of pest was 111 insect individuals with 90% of predator percentage and 8% of pest.

The numbers of insects caught on the P6 treatment were 9 orders, 16 families and 18 species. The predator population of 840 individuals consists of 8 species, namely *Ophionea nigrofasciata, Dytiscus latissimus, Paederus fuscifes, Monomorium sp, Rhinocoris fuscifes, Gerris remigis, Metioche vittaticollis,* and *Ischnura heterosticta*. The pest status was 9 species, namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix spp, Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis, Atractomorpha crenulata* and *Coptotermes curvigrathus*. The population of pest was 95 insect individuals with 87% of predator percentage and 10% of pest.

Vegetative Pesticides of Mimba leaves contain alkaloid substances called azadirachtin, Salanin, meliantriol, nimbin and nimbidin which do not kill insects directly because of how it works is inhibiting the growth and breeding and decreasing the insect appetite. The results of Nining's research (1999) explained that mimba leaves contain azadirachtin which can lead to decreased appetite and interfere the process of insect metamorphosis.

The process of metamorphosis is the process of skin change, the process of turning eggs into caterpillars / larvae, larvae into higher larvae (instar changes), the larvae become cocoons and cocoons into adulthood. Due to the failure of this metamorphosis process insects become weak and eventually die and it takes 4-5 days. In the Mimba leaves there is also an alkaloid called salanin which also function as an antifedant or a decrease of appetite, so that the damage to rice plants is weak (sick) and the insects were not dead. Other meliantriol alkaloids function to dispel the insects to not get closer to plants (repellent) and other alkaloid substances, such as nimbin and nimbidin function as antibiotics, antimicrobial and antivirus.

Vegetative pesticides have been developed as insecticides directed to the discovery of compounds that are not only effective in pest control but also have selective activity against certain insect pests.

The gadung tuber plant also contains cyanide acid which can be used as an anti-feeding substance to control pests. Anti-feedant compounds do not kill, expel or trap insect pests, they are specific to the targeted insects, do not interfere with other insects, but only inhibit the appetite, so that the growth and the survival of other organisms are protected. Vegetative pesticide is one of the pest control methods that are environmentally friendly. Feeding deterrent or anti-feedant is a chemical compound that prevents or blocks the eating behavior of an insect (Tjokrongoro, 1987). The gadung tuber extract has a toxic substance called dioscorin. Dioscorin is one of the alkaloids that is toxic to insects, caterpillars, worms (nematodes) and even rats (Richana, 2012). Dioscorin sprayed against grasshopper pests affect the nervous system and disrupt the body's metabolism of grasshopper pests. The sprayed solution to the plant is also an anti feedant that prevents insects from feeding the sprayed plants, thus it is reducing appetite and disrupting grasshopper pest metabolism. Plants that have been sprayed by the gadung tuber solution cause the grasshopper condition to become increasingly unstable, weaker and unable to react as usual until it dies.

The diversity of insects in the rice cultivation that has been applied with liquid organic pesticide from bio-slurry biogas (treatment P1)

The numbers of insects caught on the P1 treatment were 9 orders, 18 families and 19 species. Status of predator insects was 10 with population of 1150 individuals or 89% of *Ophionea nigrofasciata, Dytiscus latissimus, Paederus fuscifes, micraspis* sp, *Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Conocephalus longipennis, Ischnura heterosticta*, and *Neurothenus* sp. Insect pests were 8 species with populations of 118 insect pests or 9% of *Nilaparvata lugens, Sogatella furcifera, Nepphotettix* spp, *Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis* and *Atractomorpha crenulata*.

The diversity of insects in the rice cultivation that has been applied with liquid organic pesticides from plants and bio-slurry biogas (treatment P4, P5, P7)

The numbers of insects caught on the P4 treatment were 9 orders, 16 families and 18 species with the status of 8 predators namely *Ophionea nigrofasciata, Dytiscus latissimus, Paederus fuscifes, Monomorium* sp, *Rhinocoris fuscifes, Conocephalus longipennis, Ischnura heterosticta,* and *Neurothenus sp* with population of 914 individual insects and 9 pests namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix* spp, *Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis, Atractomorpha crenulata* and *Coptotermes curvigrathus* with a population was 88 individual insect pests with 90% of predator percentage and 9% of pest.

The numbers of insects caught on the P5 treatment were 9 orders, 14 families and 17 species with the status of 8 predators namely *Ophionea nigrofasciata, Calosoma reticulatum, Dytiscus latissimus, Paederus fuscifes, Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis* and *Ischnura heterosticta* with population of 1,291 individual insects and 8 species of *Nilaparvata lugens, Sogatella furcifera, Nepphotettix spp, Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Oxya chinensis* and *Atractomorpha crenulata*. The population was 83 individuals insect pests with 92% of predator percentage and 6% of pest.

The numbers of insects caught on the treatment of P7 were 9 orders, 15 families and 17 species with the status of 8 predators namely *Dytiscus latissimus, Paederus fuscifes, Micraspis sp, Monomorium* sp, *Rhinocoris fuscifes, Gerris remigis, Conocephalus longipennis,* and *Ischnura heterosticta*, with a population of 861 individuals predator insects and 8 pests namely *Nilaparvata lugens, Sogatella furcifera, Nepphotettix* spp, *Scirpophaga innotata, Cnapalocrosis medinalis, Scotinopora coarctata, Atractomorpha crenulata* and *Coptotermes curvigrathus* with populations were 52 insect pest individuals with 91% of predator percentage and 6% of pest.

Index of species richness, index of species diversity, dominance index and evenness index of insects found

Species diversity is the nature of the community that shows the level of diversity of the organisms in it. To obtain this type of diversity it is quite necessary to recognize and distinguish species although it can not identify the pest species (Putra, 1994). In a stable ecosystem condition, the population of an organism type is always in an equilibrium with the population of other organisms in the community. This balance occurs because of a control mechanism that works in a negative feedback that runs in between species level/predation competition and inter-species level / territorial competition (Rosalyn, 2007).

The insect species found in the study location were calculated using the species richness index (R), the species diversity index (H '), the species dominance index (C) and the evenness index type (e) (data in the appendix). The mean of diversity index is presented in the Table 4 below. The mean of insect species (R) on the research area in Warnasari Village Tamban Catur District with the range of value 1,6 up to 2, showed low species richness based on criterion value R <3,5. The dominance index (C) with the range of value from 0.5 to 0.6 is moderate, with a criterion value of 0.5 <C ≤ 0.75. The value of the dominance index (C) is close to 1 if the commodity is dominated by a particular type or species and if the dominance index is near zero (0) then there is no species or species that predominates (Odum, 1971).

Table 3. The mean of species richness index (R), species diversity index (H'), species dominance index (C) and Evenness type index (e) treated with liquid pesticides from plants and bio-slurry biogas.

No	Treatment	R	H'	C	e
1	Control (P0)	1,8862	2,1937	0,5726	0,7140
2	Bio-slurry biogas (P1)	1,7937	2,1808	0,5563	0,8704
3	Mimba leaves extract (P2)	1,6102	2,0274	0,5876	0,7111
4	Gadung tubers extract (P3)	1,9276	2,2687	0,5532	0,7739
5	Mimba leaves extract + *bio-slurry* (P4)	1,8190	2,1566	0,5729	0,8860
6	Gadung tubers extract + *bio-slurry* (P5)	1,7739	2,0780	0,5785	0,8268
7	Mimba leaves extract + Gadung tubers (P6)	2,0144	2,3344	0,5330	0,8491
8	Mimba leaves Extract + Gadung tubers + *bio-slurry* (P	1,7162	1,1292	0,6814	0,3767

Source: Primary Data that is processed, 2017.

The diversity index (H') has a range of value from 1.1 to 1.3, which means diversity with moderate criteria, adequate productivity, equitable ecosystem conditions and moderate ecological pressures. The value of the evenness type index (e) with a range of 0.7 - 0.8 indicates high evenness and stable community. Only on the combination treatment of mimba leaf extract + gadung tuber and bio-slurry (P7) the value of the evenness index of 0.3 indicates small evenness and depressed community. Ummi (2007) mentioned that the value of evenness index (e) close to 1 indicates that habitat conditions in all observation stations are homogeneous, which means that the existance of natural resources that support the life of insects are evenly distributed in all habitats. According to Odum (1993), even distribution of individual numbers indicates no species dominance.

Data analysis of the influence of each treatment with test F

The analysis result of insect diversity data variance obtained from trap light, sweep net and yellow trap with each treatment using liquid organic pesticide application. On treatment P0, P1, P2, P3, P4, P5, P6, P7 it was obtained P-value ANOVA> α (0.05), which means no significant difference between treatments. The combined application of organic pesticides and bio-slurry has no significant effect on species diversity, species dominance, species richness and evenness type index.

Conclusion

1. Composition of predators and pests on rice cultivation applied with organic pesticides and bio-slurry biogas with comparison of predator and pest ratio composition was highest in treatment of P5 (Gadung tubers extract + bio-slurry) with the value of 92%: 6%, while the lowest was on the treatment of P6 (Mimba leaves extract + gadung tubers extract) with the value of 87%: 10%.
2. Value of insect diversity index:
   a. The Richness Type Index (R) with the highest value of 2.01 on P6 (mimba leaves extract + gadung tubers extract) and the lowest of 1.61 on P2 (mimba leaves extract) with criterion R ≤ 3.5 indicates low species richness;
   b. The species diversity index (H ') had the lowest value range with 1.13 at P7 and the highest with 2.33 on P6, which means diversity had moderate criteria, adequate productivity, equitable ecosystem conditions and moderate ecological pressures:c. The dominance index (C) with the highest value was 0.6814 on P7 (mimba leaves extract + gadung tubers extract + bio-slurry) and the lowest value was 0.5330 on P6 (mimba leaves extract + gadung tubers extract) with the criterion value of 0.5 < C ≤ 0.75 was categorized as moderate;
   d. The evenness index (e) with a range of 0.7 - 0.8 showed high evenness and stable community. Only on the combination treatment of mimba leaves extract + gadung tubers extract and bio-slurry (P7) the value of evenness index of 0.3 indicates small evenness and depressed community.

References

Andianto ID, Armini Pupita F. 2015. Growth and Production of Chili (*Capsicum annuum* L.) with Liquid Liquid Waste and NPK Fertilizer in Tanah Gambut. JOM Faperta. Vol 2. No. February **1,** 2015.

Borror, Donald J, Charles A, Triplehorn, Norman, Johnson F. 1992. Introduction to Insect Lessons. Translated by Gadjah Mada University. Gadjah Mada University Press, Yogyakarta.

Christian W, Gottsberger G. 2000. Diversity Preys in Crop Pollination. Crop Science **40(5).**

Citra AK, Muryanto dan Pita Sudrajad. 2012 Assessment of Biogas Waste Utilization (Slurry and Sludge) on coffee plant seedlings. National Food Seminar 2012. Agricultural Technology Assessment Center, Central Java.

Handhaka W. 2012. Bio-slurry of biogas process for agriculture and environmentally friendly plantations. https://bengkulu2green.wordpress.com/2012/04/05/bio-slurry-of biogas -for-agriculture-environmentally-friendly-plantations / (March 25, 2016).

Hartanto YC, dan Haryanto Putri. 2013. User Manual and Supervisor of Bio-slurry Management and Utilization, Jakarta.

Isnaeni. 2000. Animal physiology. Erlangga, Jakarta.

Jumar. 2000. Agricultural Entomology. PT. Rineka Cipta, Jakarta.

Ludwig JA, Reynold JF. 1988. Statistical ecology. A. Primer on method and computing, John Wiley and Sons, New York.

Nining E. 1999. Azadiachitin analysis of callus and neem plants. Thesis. Graduate School, University of Indonesia, Jakarta.

Odum EP. 1971. Fundamental of Ecology. W. B. Sounders, Philadelpia.

Putra NS. 1994. Insects Around Us. Kanisius, Yogyakarta.

Rahayuningtias S, dan W, Sri Harijani. 2013. The ability of vegetable pesticides (Mimba, Gadung, Laos and Serai) to crop pests (*Brassic oleracea* L). Journal of Agricultural Sciences. Veterans University, East Java pp. 207-211.

Richana. 2012. Aracea & Dioscorea, Benefits of Indonesia tubers. Nuance Scholar, Bandung.

Setiawan D. 2010. Insectiviside Power Assessment of Mimba leaf extract (*Azadirachta indica* A. Jus) Against Development of Insect Pests *Sitiophilus orizae* Linn Warehouse. Journal of Science Research **10,** pp 6-12.

Setiawati W, Murtiningsih R, Gunaeni N, dan Rubiati T. 2008 Vegetable Pesticide Plant and its Preparation Method for the control of Plant Disturbing Organisms (OPT). Indonesian Vegetable Research Institute. Prima Tani Balitsa, Bandung.

Subiyakto. 2009. Mimba Seed Extract as a Bio-Pesticide: Potential, Constraints and Development Strategy. Journal of Perspectives. Indonesian Center for Tobacco and Fiber Crops Research, Malang. Vol **8(2)**, pp108-116.

Tjokronegoro RK, 1987. Search of Indonesia Plant Content Compound, Bioactive to Insects. Dissertation. Graduate School, Padjadjaran University, Bandung.

Tomayahu A. 2014. Formulation and Effectiveness Test of Biopesticide Solution from Gadung (*Dioscorea hispida* Dennst) Extract on Locusta migratoria. Essay. State University of Gorontalo, Gorontalo.

Untung K, Sudomo M. 1997. Sustainable Insect Management. Paper presented at Entomology Symposium, Bandung.

Untung K. 2006. Introduction to Integrated Pest Management. Second edition. Gadjah Mada University Press, Yogyakarta.

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