

## Variety of Pests and Arthropods in Organic and Non-organic Rice Cultivation in South Sumatra

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### Abstract

The system of cropping pattern and the use of fertilizer will be different to the diversity of pests and arthropods in paddy fields. The objective of this research is to determine the pest and arthropod pests in non-organic and organic paddy in paddy fields. The applied method is the plant observations that attacked pests by using 1 ha of organic paddy field and 1 ha of non-organic paddy field. The catching arthropods is the way to observed the insects by using insect nets, trap holes, yellow trays and light traps and analyzing the result by using the Shannon-Wiener equation. This research was undertaken on April 2016 to August 2016 in Sumber Suko village, BK. VIII, Gumawang district, regency of Ogan Komering Ulu east, South Sumatera. The result of this research pointed out that the variety of pest paddy crops is relatively diverse both in non-organic and organic paddy. The abundance and variety of arthropods in organic agriculture is higher at 1.39 than non-organic agriculture at 0.87 so it can affect the extent of pest attacks on organic paddy. The ecosystem of organic paddy. The ecosystems of organic paddy is more complex in the diversity of arthropods and the abundance of microorganisms than non-organic paddy systems.

### Keywords

Bioinsecticides, Ecosystems, Pesticides

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## 1. INTRODUCTION

Paddy cultivation aims to maximize the quality of paddy for the consumption needs of society. The efforts to increase paddy production are continuously enhanced by government and farmers to attain the national food needs and self-sufficiency (M.H et al., 2015). The increased paddy production has been done through non-organic farming systems so it can overcome the food shortages that is needed by society in large numbers (Aditama and N, 2013).

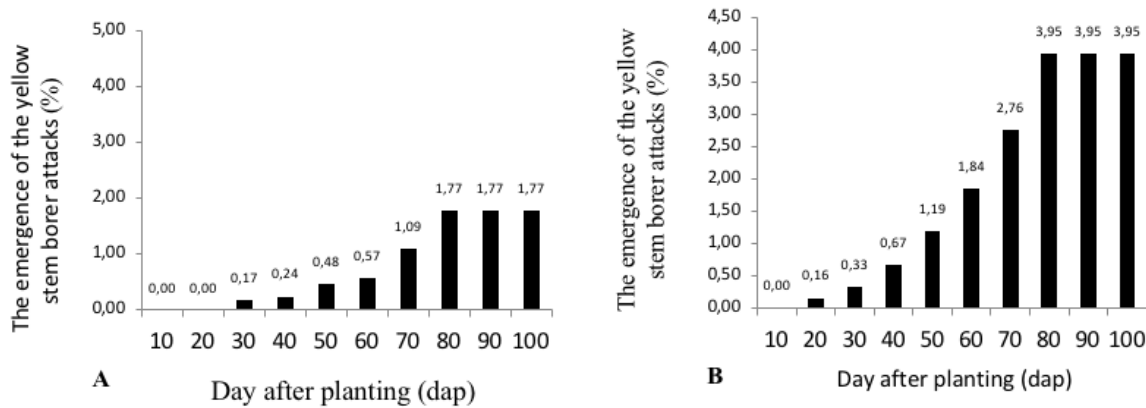
The non-organic paddy cultivation system uses chemical fertilizers and chemical pesticides continuously in the planting system. The deterioration of environmental quality, the arrival of new pests and diseases, the destruction of natural enemies and the presence of toxic compounds on the production of crops that adverse effects on human health are the impacts of these chemical uses (Wasito et al., 2014). The organic farming system is undertaken to reduce environmental pollution and adverse health impacts.

The organic farming system is a location-specific farming effort applied based on the soil interactions, plants, livestock, humans, ecosystems and the environment (Prihtanti, et al.,

2013). The organic farming uses many organic fertilizer as a source of nutrients and as a soil enhancer so the organic fertilizer can increase crop yield (Yuwono et al., 2013).

The use of organic material is sourced from agricultural waste in the form of compost, manures, bokashi processed with the help of micro-organisms so that it can protect the plant from pests and diseases (IP2TP, 2000)

Based on the results of the organic fertilizer use from paddy straw, paddy husk and husk ash for paddy plants in lebak land can increase the yield from 0.69 to 1.98 t/ha or increased from 19 to 54.7% (Saragih et al., 2000). Bacillus thuringiensis Bioinsecticide application on paddy crops does not decrease the abundance and richness of predator like arthropod species in the soil surface and predominant plant predator insects (Sunariah et al., 2015). The results of (Yuliani and Sudir, 2017) showed that the application of organic fertilizer and application of mindi leaves, mahogany and soursop can decrease pest population and increase natural enemy density in organic paddy. This study aims to determine the pest and arthropod pests in non-organic and organic paddy in paddy fields.



**Figure 1.** Occurrence of Yellow Bioner Borers Attack on Paddy (A) Non-Organic and (B) Organic

**2. EXPERIMENTAL SECTION**

**2.1 Location and Time**

This research was conducted on April 2016 to August 2016 in Sumber Suko village, BK. VIII, Gumawang district, regency of Ogan Komering Ulu east, South Sumatera.

**2.2 Tools and Materials**

The tool used in this research is pitfall trap, yellow trap, insect net, light trap, sample bottle, detergent, 70% alcohol, strainer, and stationery. The materials used in this research are organic and inorganic paddy cultivation using the varieties of Ciherang and Inpari 30, compost fertilizer, manures, vegetable pesticide, NPK fertilizer.

**2.3 Methods**

The method used in this research is the case study methods on 1 hectares for each non-organic and organic paddy fields.

**2.4 The ways of working**

**2.4.1 The observation of Pests and Arthropods**

Observation of rat pest and yellow stem borer by the formula: Observation of the pest advents using the formula:

$$KP = \frac{n}{N} \times 100\% \tag{1}$$

KP = The disease advents (%) n = The number of plants affected by the disease N = Total plants observed

Observation of pest severities using the formula:

$$KeP = \frac{\sum_{i=0}^Z (ni \cdot xvi)}{Z \cdot N} \times 100\% \tag{2}$$

KeP = The disease severity (%) ni = The plant numbers or the sample of plant parts with the damage scale vi = The attack categories (scor) N = The number of plants or parts of plant samples observed Z = The highest damage scale value

The value of damage score: 0 = no symptoms of attack, 1 = level of damage > 0 - ≤ 5 %, 3 = level of damage > 5 - ≤ 25 %, 5 = level of damage > 25 - ≤ 50 %, 7 = level of damage > 50 - ≤ 75 %, 9 = level of damage > 75 %.

Arthropod observation was done by sampling at 06.00 - 08.00 WIB by using insect net tools on each plot with 10 double swing nets. Sampling is also done by using a trap hole made from 350 mL plastic cups that have been filled with 20 mL detergent liquid installed in the ground hole, the top is covered with a zinc plate as rain water cover. The captured arthropods are identified to the family level in the laboratory with reference to (Borrer et al., 1996) and Kalshoven (1981).

**2.4.2 Data Analyses**

Diversity index using Shannon-Wiener formula:

$$H' = - \sum_{i=1}^s pi \ln pi \tag{3}$$

where, H' = Shannon-Wiener Diversity Index Pi = The proportion of individuals in species (ni / N) ni = The number of individuals from species i N = Total number of all species

Diversity index values (H') < 1.0 then the diversity is categorized as low, if the value of diversity index (H') > 1.0 – 3.0 then the diversity is categorized as medium, whereas the value of diversity index (H') > 3.0 then its diversity is categorized as high.

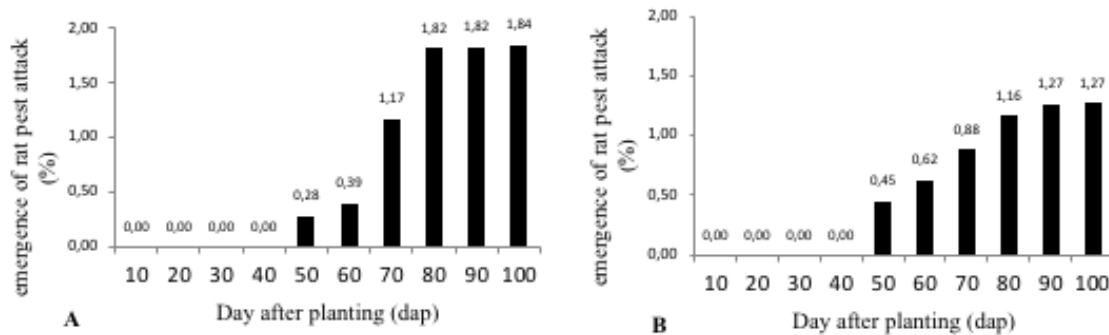
The abundance individuals using formula :

$$D = \sum_{i=1}^{El} \left\{ ni \frac{ni - 1}{N(N - 1)} \right\} \tag{4}$$

where, D = Individual Abundances ni = The number of individual species N = Total number of individuals

The Evenness Index Type:

$$E = \frac{H'}{\ln(S)} \tag{5}$$



**Figure 2.** The emergence of rat pest attacks on paddy: (A) Non-organic and (B) Organic

where, E = Diversity Index Types  $H'$  = Shannon-Wiener Diversity Index S = The number of types

### 3. RESULTS AND DISCUSSION

#### 3.1 Occurrence of Yellow Pest Bar Paddy Pest Attack

The results of the research in Figure 1 shows that the emergence of yellow stem borer attack on non-organic paddy starts at plant ages in 30 hst around 0.17% and the incidence of attack continues to increase until the plant ages of 80 hst around 1.71%. After 80 hst, the pest attacks remain stable in that age.

In the organic paddy, the incidence of paddy yellow stalk borer attack was seen at the plant age of 20 hst around 0.16% and continued to increase until the 80 hst of plant age around 3.95%. Symptoms of occurrence attacks did not increase until the plant ages of 100 hst.

From results of the research indicate that attack incidences caused pest of yellow paddy barrel rod in organic paddy were higher 3,95% compared to non-organic paddy 1,71%. It is assumed that non-organic paddy was controlled by using pesticide, so that the development of yellow stick borer attack on non-organic paddy is smaller than organic paddy. According to Yusri (2016), stem borer attacks on non-organic farming can be controlled by using contact poison pesticides, gastric toxins and systemic entered to the plant food network.

#### 3.2 Appearance of Rat Pest Attack

The analysis results pointed out that the emergence of attacks caused rat pests in non-organic paddy begin to occur at the plant ages of 50 hst around 0.28% and continues to grow until the plant ages of 80 hst around 1.82% shown figure 2. The appearance of the attack is not experienced a considerable increase until the plant ages of 100 hst around 1.84%. In organic paddy, the occurrence of pest attack began to occur at the plant ages of 50 hst around 0.45% and increased until the plant ages of 90 hst around 1.27%.

The emergence of rat pests attacks on non-organic paddy is higher around 1.84% than organic paddy around 1.27%. The distance of non-organic paddy between clumps of paddy

and other clumps of paddy is allegedly more dense and no more environmental sanitation of weed weeding on irrigation canals and paddy fields when paddy plants entering the age of 80 hst. Such environmental conditions strongly support the presence of rat pests in non-organic paddy fields. Anggara (2014) explained that one of the ways to control pest rats is by weeding weeds, cleaning irrigation channels and paddy fields.

#### 3.3 Severity of Yellow Paddy Offensive

Based on Figure 3 can be seen that the severity of yellow stem borer attacks on non-organic and organic starts was observed in the age of 30 hst and continued to increase until the age of 80 hst. Then, the severity of pest attacks did not increase until the age of 100 hst. The severity of yellow sticks borer attacks was higher in organic paddy around 56.61% than non-organic paddy around 36.50%.

The enhancement of paddy stem borer attacks on organic paddy than non-organic paddy was suspected by using biopestisida in organic paddy so that the reduction of pest attacks was more slowly. In the non-organic paddy using systemic pesticides which can be absorbed by plant tissue so, it can reduce the severity of yellow sticks borer attacks paddy fastly. According to Fensionita (2006), controlling with synthetic chemicals can decrease the stem borer population, but it also affects the natural enemy population.

#### 3.4 Rat Attack Severity

The severity of rat pests occurred at the age of 50 hst and increased until the age of 100 hst. In non-organic paddy, the attack severity was higher around 38.25% than organic paddy around 29.25% in Figure 4.

The decreased attacks of rat pest on organic paddy allegedly used organic paddy planting system used legowo 4: 1 row planting system. It can inhibit the attack of rat and in organic paddy routine done weed cleaning, because weeds used to make compost to be used in the season planting the next paddy. According to Irsan (2014), legowo row planting system is a wider line of crops and cleared land, this enables the sun to

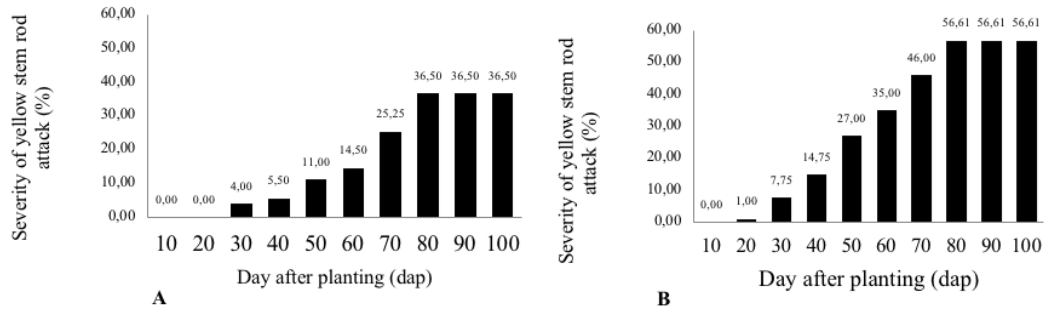


Figure 3. Severity of yellow stem borer attacks on paddy: A. Non-Organic and B. Organic

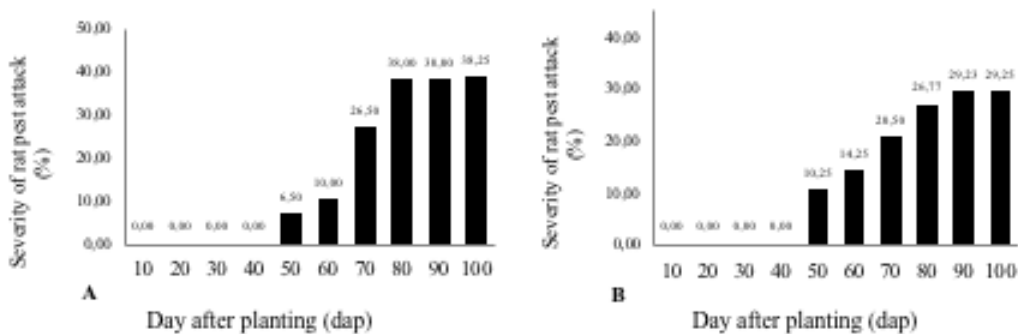


Figure 4. Severity of rat attacks on paddy (A) Non-Organic and (B) Organic paddy

penetrate the bottom of the plant and become brighter. This environmental condition causes rats do not like it, so the rat pest attack is lower.

### 3.5 Arthropods Population

The existence of natural enemies in non-organic paddy ecosystems and inorganic paddy fields is one component that supports the stability of wetland ecosystems. From the results of the study in Figure 5, observations of arthropods on non-organic paddy fields conducted with various insect traps such as insect webs, yellow trays, pitfall traps, and light traps. The results showed 2,406 individuals from 22% insect webs, yellow trays 49% , Pitfall trap 7% and light trap 22%. In organic paddy was 2,716 individual individuals from 20% insect webs, 49% yellow trays, 10% Pitfall traps and 21% light traps.

Based on observations seen the number of arthropods on individual non-organic land is lower than the number of arthropods on organic land. It is suspected that in non-organic paddy fields using synthetic insecticides can affect the abundance of active arthropod populations on the surface of paddy fields.

From the results of Herlinda et al. (2008), the number of active arthropods on the surface of paddy fields without the application of insecticides and bioinsecticides applications is higher than the application of synthetic insecticides. The low

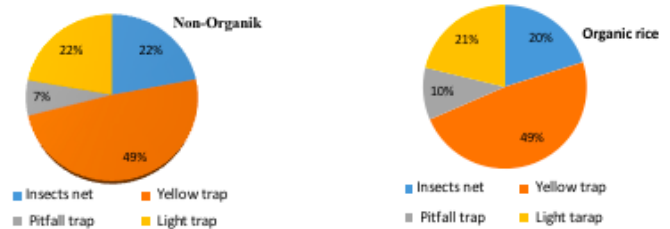
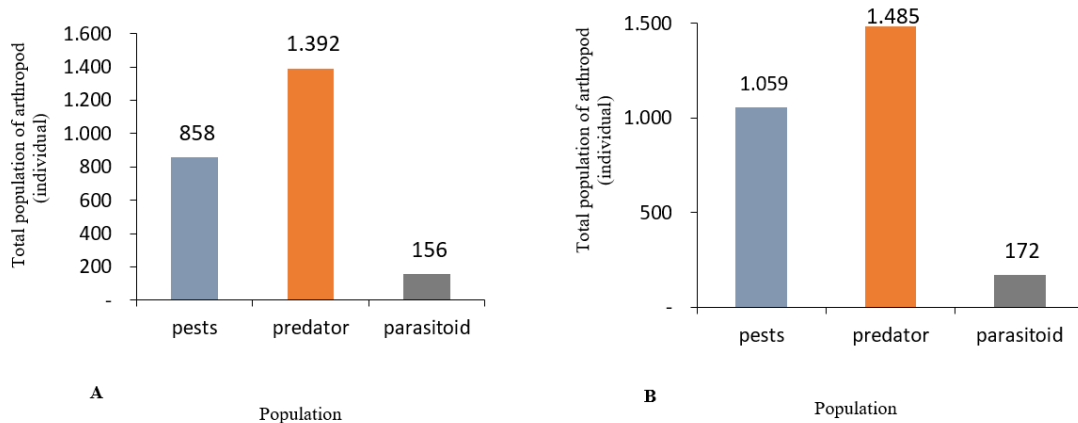


Figure 5. Percentage of arthropods in various catching equipment of paddy Insects

population of arthropods on the surface of synthetic paddy fields is affected by the susceptibility of arthropods to synthetic pesticides. Widiarta et al. (2006) described that the exposure of insecticides in paddy fields can decrease the diversity of speises and decrease the number of insects, as many insects die from the effects of synthetic pesticides.

Based on Figure 6, the number of pest populations caught with different traps is higher in organic paddy than in non-organic paddy. It is suspected that organic farming does not use pesticides, so the pest control process is slower than in non-organic paddy using pesticides that directly contact with



**Figure 6.** The number of pest populations at Paddy (A) non-organic and (B) organic

pests. [Kartohadjono and Arifin \(2011\)](#) explained that the use of pesticides is very effective to control pests partially but it also has a negative impact on environmental balance.

The number of predators and parasitoids in non-organic paddy is smaller (1,392 individuals and 152 individuals) than organic paddy (1,485 individuals and 172 individuals) is seen in Figure 6. It is suspected that the use of pesticides on non-organic farming not only killing pests but also causing the beneficial insects killed as natural enemies. This condition was equal to the opinion of [Kartohadjono and Arifin \(2011\)](#), the application of pesticides is very effective in controlling pests partially, but it also kills the parasitoid predators simultaneously that actually have the potential to be biological pest control. [Winasa and Rauf \(2005\)](#) added that the low population of predators in paddy fields applied by pesticides, because the body of the predators are soft and sensitive to insecticides and their way of life is active on the surface of the soil cause arthropoda is easily exposed to synthetic insecticides.

High population of predators and parasitoids in organic paddy suspected the use of organic materials in organic paddy before planting will have a good effect on plant growth which is a source of food for herbivorous insects. This insect is a natural enemy food source. [Widiarta et al. \(2006\)](#) described that neutral or herbivorous insects are sufficiently available it will have a good effect on the development of natural enemies, since neutral insects or herbivores are a source of food for predators.

### 3.6 Arthropoda Community On Paddy Cultivation Non Organic And Organic Paddy

The result of arthropod diversity index analysis that caught with various trap device on non-organic and organic paddy field is different, this is because of the difference of cropping system pattern that will affect the value of arthropod diversity.

Based on Table 1, it can be seen that the index of pest diversity on non-organic paddy from various trap tools used are larger than organic paddy. While the diversity of natural

enemies in inorganic paddy is lower than organic paddy. This suggests that the use of pesticides on non-organic paddy fields not only killing pests but also causing natural enemies to be killed. According to [Kartohadjono and Arifin \(2011\)](#), the application of pesticides effectively controls pests partially, but simultaneously also kills parasitoid predators that are actually potential biological pest control. This is equal to the opinion of [Budiarti \(2015\)](#) that the cultivation does not use chemical pesticides or other chemicals on organic farming to allow for high diversity of natural enemies.

The index value of pest dominance is generally the same between non-organic paddy and organic paddy. This value describes the pattern of dominance of insect species in a community. It is assumed that the location of adjacent non-organic and organic paddy farming influences the pest predominance index. According to [Rizali et al. \(2002\)](#), the adjacent paddy farming will have a high similarity in species composition

The dominant index of natural enemies in non-organic paddy is higher than organic paddy. High dominance index values indicate that the inorganic paddy ecosystem is controlled by one species or concentrated in one species species. This shows that the conventional land are dominant species in paddy ecosystems ([Pradhana et al., 2014](#)).

In Table 1 showed that the poverty and natural enemies index values of inorganic paddy in general are smaller than the organic paddy. This is assumed by the use of synthetic pesticides can decrease evenness of species in an ecosystem. [Widiarta et al. \(2006\)](#) described that paddy fields using synthetic pesticide has a low-evenness species than without application of pesticide.

## 4. CONCLUSIONS

The variety of pest paddy crops is relatively diverse both in organic paddy and in non-organic paddy. The abundance and variety of arthropods in organic agriculture is higher at 1.39 than non-organic agriculture at 0.87 so it can affect the extent of pest attacks on organic paddy. The ecosystem of organic

**Table 1.** Characteristic Arthropods Caught On Various Traps In Organic and Non-Organic Paddy

Cultivation System	Arthropod	Community Characteristics	Devices			
			Insects network	Yellow trap	Pitfall trap	Light trap
Non-organic	Pests	Total individual (N)	191	340	83	263
		Total spesies (S)	3	4	2	3
		Index diversity (H')	1.1	1.38	0.54	1.1
		Index domination (D)	0.35	0.27	0.77	0.34
		Index equality (E)	1	1	0.78	1
	Natural enemies	Total individual (N)	3	839	101	178
		Total spesies (S)	5	9	2	3
		Index diversity (H')	1.29	0.79	0.69	0.69
		Index domination (D)	0.22	0.13	1	0.54
		Index equality (E)	0.8	0.44	1	0.63
Organic	Pests	Total individual (N)	259	345	266	289
		Total spesies (S)	3	4	2	3
		Index diversity (H')	1.09	1.38	0.66	0.1
		Index domination (D)	0.41	0.29	0.62	0.32
		Index equality (E)	0.99	0.99	0.96	1
	Natural enemies	Total individual (N)	420	795	164	286
		Total spesies (S)	5	9	2	3
		Index diversity (H')	1.6	2.19	0.69	1.09
		Index domination (D)	0.23	0.12	0.56	0.36
		Index equality (E)	1	1	0.99	1

paddy. The ecosystems of organic paddy is more complex in the diversity of arthropods and the abundance of microorganisms than non-organic paddy systems.

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