Eco. Env. & Cons. 27 (3) : 2021; pp. (1236-1242)
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ISSN 0971–765X

Arthropods state in the swampy rice agroecosystem

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(Received 23 November, 2020; Accepted 13 January, 2021)

ABSTRACT

Research on pests in swamp rice agroecosystem was conducted in Sub district Tanjunglago, Banyuasin District, South Sumatra, Indonesia used survey method. This study was aimed to determine arthropods species found in this ecosystem. The survey was conducted in 2015 planting season. Sampling arhtropoda used insect nets, sticky traps and direct observation on the rice plants. Arthropods found stated as pests, natural enemies (predator and parasitoids), and neutral insects. Arthropods commonly found were of the class Insecta (insects) and Arachnidae (spider). Insects and pests which were found in tidal swamp agroecosystem at vegetative stage were leaf folder, grasshoppers and green leafhoppers. Brown plant hopper and green leaf hopper caught were very low, by insect nets and sticky traps attached. Predators found were from the Ordo Coleoptera, Odonata, Hemiptera, Orthoptera, and Araneae (Arachnida). The most common predator found were spiders and *Coccinella*, while other predators such as *Paederus, Ophionea, Dragonfly. Cyrtorhinus* found in several locations with relatively low population

Key words: *Arthropods, Rice, Swampy agroecosystem*

Introduction

Biodiversity in agricultural ecosystems such as rice fields can influence plant growth and production, namely in the system of nutrient cycle, microclimate changes, and detoxification of chemical compounds (Altieri, 1999). Insects as a component of biodiversity also have an important role in the food web, such as herbivores, carnivores, and detritivores. In Indonesia, rice is planted on different agroecosystems that have biophysical (especially climate) conditions, edaphic and biotic variations.

The area of swamps and coastal areas is very broad, which is divided into 3 large islands, namely Kalimantan, Sumatra and Papua, and Java especially for coastal land (affected by saline) which runs along the North coast of the island of Java. Both of these ecosystems have great potential in contributing to increased rice production, but the level of rice productivity is still very low. Moreover, it was reported that in Java there has been a decrease in planting area, harvested area and total rice production. The problem of rice in sub-optimal land is very complex, including abiotic and biotic stresses, becoming a limiting factor in farming systems in these two ecosystems. Tidal swamp land close to the river which is directly affected by sea water activity. Swamp rice fields have several biophysical constraints, including problems of pests and diseases, especially rodents, armyworms, stem borer and blas. Leaf and neck, tungro, rat and bird blast diseases are the dominant pests in swamps and coastal areas. In 2017 tungro disease attack reached 0.05% (5,300 hectares affected and 28 hectares puso) of the total area of rice plants in Indonesia (Directorate of Food Crop Protection, 2018). The green leaf of *N.*

virescens acts as an infectious or vector of tungro virus disease, having the highest population density occurring in generations of descendants of immigrant generations (Widiarta *et al*., 1999).

In this study it would be further observed in relation to insect pests and their natural enemies in the swamp paddy fields. By obtaining information about rice plant pests, and their natural enemies in the tidal swamp rice agroecosystem, it is expected that potential pests and the dynamics of their natural enemies could be identified, suitable the rice pest control technology.

Materials and Methods

The experiment was carried out in Telangsari and Purwosari Villages, Tanjunglago Sub-district, Banyuasin District, South Sumatra. In each village there are 2 observation sites. Direct observation was carried out on 20 sample rice hills from one paddy field area with the same rice stage. Insect sampling used insect nets and sticky traps at each observation point. Sticky traps were placed 10 per plot.

Arthropods were collected by using insect nets which were swung as many as 5 times a double swing in each plot. Samplings were carried out during the vegetative stage of rice plants, the booting stage, and generative rice stage. The small insects found in the field are preserved in collection bottles that contain 70% alcohol. Large insects were preserved dry, then labelled. Insect identification was conducted by using a stereo microscope, then identified using insect identification keys. Variables observed in pest component include pest population, pest attack intensity, and natural enemies. Variables observed were rice pest population, pest damage intensity, and population of natural enemies. The varieties include the type / composition of the variety planted, the planting area, and the rotation of the planted variety (if there was a rotation of the variety). In the biotic environment includes natural enemies. Predators were be observed visually in the same time with observations of pest populations, the intensity of pest attacks in the sample rice hills for each observation at each study location.

Results and Discussion

Banyuasin Regency, South Sumatra Province is one of the centers of rice production in Indonesia. The research activities were carried out in the tidal swamp agroecosystem in Tanjunglago Subdistrict, Banyuasin District, South Sumatra. The tidal rice fields in this location were very broad and could represent tidal areas in Banyuasin District.
The varieties commonly grown by farmers were Ciherang and Mekongga. The farmers used the direct seed planting method, rice planted spacing 30x30 cm. The result of the study devided into three rice stages

Vegetative rice stage

Observations in the village of Purwosari in vegetative stage revealed that leaf folder damage was relatively high, in both locations respectively 33.3% and 15%. Whereas locust pests were 7 and 9 respectively per 20 rice hills. The most common natural enemies were the spiders and the coccinellid beetles. The observation results of pests in both locations of Telangsari Village were relatively the same as

Table 1. Arthropoda population on swamp paddy fields based on direct observation of vegetative rice stage, South Sumatra, 2015

No	Arthropoda	Purwosari		Telangsari	
	Rice pests	Location 1	Location 2	Location 1	Location 2
1	Rice yellow stemborer damage (%) (*Scircophaga incertulas*)	0	0	0	7.9
2	Leaf folder damage (%) (*C. medinalis*)	33.3	15	19.2	10.5
3	Brown planthoppers (*Nilaparvata lugens*)	0	0	0	0
4	Green leafhopper *(Nephotettetix* sp.)	0	0	0	0
5	Grasshoppers (*Oxya chinensis*)	7	9	7	4
	Natural enemies				
6	Spiders (*Lycosa* sp., *Oxyopes* sp.)	10	4	2	0
7	Coccinelids (*Menochilus sexmaculatus*)	3	3	8	5
8	Tomcat (*Paederus fuscipes*)	3	0	7	7
9	Ground beetle (*Ophionea nigrofasciata*)	0	0	0	1

Purwosari, especially leaf folder and grasshoppers. The intensity of leaf folder damage were 19.2 and 10.5% respectively while grasshoppers were 7 per 4 rice hills. In addition, a rice stem borer damage intensity of 7.9% was found at location 2 of Telangsari. Natural enemies that were found were also relatively similar, such as spiders, Coccinelid beetles and *Paederus sp*.

The use of nets to catch insects is very effective for trapping arthropods that are in the canopy of plants. With a greater capacity, arthropods are generally trapped more than the use of sticky traps. But the advantage of sticky traps is that they can catch small-sized insects that escape the net, such as species of parasitoids. Based on identification of arthropods caught with insect nets and sticky traps as in Table 2.

Brown plant hoppers were found in location 1 Telangsari village, both the results of insect nets and sticky traps. While white-backed leafhopper found in location 2 Purwosari village and location 2 Telangsari village insect nets. Relatively green leaf hoppers were found in all the locations, both from insect nets and sticky traps. Rice stemborers moths were found in location 2 of Purwosari village, location 1 and location 2 of Telangsari from insect nets. Whereas leaf folder moths were found in the location 1 Purwosari from sticky traps, locations 1 and 2 of the Telangsari Village caught by insect nets. Stinky bugs have begun to be found in location 1 village Purwosari and location 1 village Telangsari. Grasshoppers were found in all locations, most at location 1 and location 2 of Purwosari village.

Natural enemies that caught by insect nets and sticky traps were dominated by spiders and Coccinelid (Table 3). *Paederus* also available in all locations, even though the population was less compare to population of spiders and Coccinelid. Ophionea and dragonfly found in a few locations, as well as the *Cyrtorhinus* found only in locations 2 of Telangsari. Spiders are very important predators in maintaining pest insect populations low.

The hunter spiders, *Lycosa* sp. and *Oxyopes* sp., that actively look for prey such as imago and nymphs of planthoppers. *Lycosa* sp. is a predator that consumes relatively more prey every day than other predators. *Coccinella* , *Ophionea* and Dragonfly were active predators in seeking prey. *Coccinella* as

Table 2. Rice insect pests from insect nets (Sweepnet) and sticky traps in vegetative stages, South Sumatra 2015

No	Arthropods	Purwosari				Telangsari			
		Lokasi 1		Lokasi 2		Lokasi 1		Lokasi 2	
		Sw	St	Sw	St	Sw	St	Sw	St
1	Brown planthopper (*Nilaparvata lugens*)	0	0	0	0	6	1	0	0
2	White-backed planthopper (*Sogatella furcifera*)	0	0	2	0	0	0	2	0
3	Green leaf hopper (*Nephotettetix* sp.)	6	3	5	0	25	7	16	4
4	Rice stemborer (*Scircophaga incertulas*)	0	0	4	0	5	0	2	0
5	Leaf folder (*Cnaphalocrocis medinalis*)	0	3	0	0	2	0	1	0
6	Stinky bug (*Leptocorisa oratorius*)	1	0	0	0	2	0	0	0
7	Rice grasshopper (Acrididae)	15	0	28	0	9	1	10	0

Note: Sw=*Sweepnet* , St=*Sticky trap*

Table 3. Natural enemies caught by *sweepnet* and *sticky trap* in the rice vegetative stage, South Sumatra 2015

No	Arthropods	Purwosari Village				Telangsari Village			
		Location 1		Location 2		Location 1		Location 2	
		Sw	*S t*	*Sw*	*St*	*Sw*	*St*	*Sw*	*St*
1	Spiders *(Lycosa* sp., *Oxyopes* sp.)	49	17	17	3	16	4	27	4
2	Paederus Beetle (*Paderus fuscipes*)	2	1	7	1	10	1	2	2
3	Ground Beetle (*Ophionea nigrofasciata*)	1	0	3	0	4	0	0	1
4	Coccinelid beetle (*Menochilus sexmaculatus*)	14	2	28	3	18	3	17	1
5	Dragonfly *(Agriocnemis* sp.)	5	0	0	0	2	0	1	0
6	*Cyrtorhinus lividipennis*	0	0	0	0	0	0	4	2
7	*Oligosita sp.*	0	0	0	1	0	0	0	0

Note: Sw = *Sweepnet*, St = *Sticky traps*

predators feed on brown plant hopper, white-backed plant hopper, green leaf hopper, zig-zag planthopper, Aphis, leaf folder and stemborers. These predatory larvae actively prey in groups. While *Cyrtorhinus*, is a special predator for planthopper by sucking into eggs and young nymphs. This predator has a body size of 2.5 to 3.25 mm with bright green color. *Cyrtorhinus* could reach 29% predation rates for brown *plant* hopper (Octarina, 2009). We found 1 parasitoid, *Oligosita*, that was caught with a sticky trap

Booting rice stage

In general, arthropod populations in booting rice stage in all locations were lower than populations in rice vegetative stages. In booting stage of rice, neither yellow stemborer nor leaf folder were found (Table 4). The population of brown plant hopper, green leafhopper and grasshopper were also not found at the time of observation. Only the black. bugs was found with a low population. Whereas natural enemy populations, such as spiders, ground beetles (*Ophionea*), coccinellid beetles and Cyrtorhinus are also found to be relatively low compared to spiders.

The booting stage is usually a critical stage for rice. If pest damage occurred during this stage especially by stemborer, it would cause white head symptom, that rice could not produce filled grain. In agro-ecosystems, diversity of natural enemies has a positive correlation with agricultural production within a certain range: as the biodiversity increases, the agricultural production also increases. On the contrary, when biodiversity decreases, the agricultural production also will decrease. One of the main reasons is that it can effectively control the number

Table 4. Arthropoda population on tidal paddy fields based on direct observations on the booting rice stage, South Sumatra, 2015

No	Arthropods	Purwosari Village		Telangsari Village	
		Location 1	Location 2	Location 1	Location 2
Rice pests					
1	Yellow stemborer damage (%) (*Scircophaga incertulas*)	0	0	0	0
2	Leaf folder damage (%) (*C. medinalis*)	0	0	0	0
3	Brown planthopper (*Nilaparvata lugens*)	0	0	0	0
4	Green *leafhopper (Nephotettetix* sp.)	0	0	0	0
5	Grasshopper (*Oxya chinensis*)	0	0	0	0
6	Black bugs	6	4	6	3
7	Stinky bugs	0	0	0	0
	Natural enemies				
8	*Spiders* (*Lycosa* sp., *Oxyopes* sp.)	49	31	27	43
9	*Coccinelid beetle* (*Menochilus sexmaculatus*)	2	2	15	12
10	*Paederus fuscipes*	11	11	13	8
11	*Ophionea nigrofasciata*	8	6	12	3
12	*Cyrtorhinus longidipennis*	9	13	8	4

Table 5. Rice insect pests from sweepnet and sticky traps in booting stages, South Sumatra 2015

No	Arthropods	Purwosari Village				Telangsari Village			
		Location 1		Location 2		Location 1		Location 2	
		Sw	*St*	*Sw*	*St*	*Sw*	*St*	*Sw*	*St*
1	Brown planthoppers (*Nilaparvata lugens*)	1	0	0	0	0	0	1	0
2	White-backed stemborer (*Sogatella furcifera*)	0	0	1	0	0	0	0	0
3	Green leaf hopper (*Nephotet tetix* sp.)	3	1	1	1	3	0	2	0
4	Rice yellow stemborer (*Scircophaga incertulas*)	0	0	0	0	0	0	0	0
5	Leaf folder (*Cnaphalocrocis medinalis*)	0	0	0	0	0	0	0	0
6	Stinky bugs (*Leptocorisa oratorius*)	0	0	0	0	0	0	0	0
7	Grasshopper (*Oxya chinensis*)	0	0	0	0	0	0	0	0
8	Black bugs (*S. coarctata*)	5	0	7	0	6	0	9	0

Note: Sw = *Sweepnet* , St = *Sticky traps*

of insect pests (Luo *et al.*, 2014).

Trapping the Artrhopods by sweep nets and sticky traps caught brown plant hopper insects in location 1 of Purwosari Village and location 2 of Telangsari Village , white backed planthoppers were only at location 2 of Purwosari Village, and green leafhoppers were found in almost all locations, whereas black bugs population were more common in the insect nets at both locations Purwosari village (Table 5). Other insect pests such as rice yellow stemborers, leaf folder moths, stinky bugs and grasshoppers were not found from insect nets and sticky traps method.

The population of natural enemies on rice booting stage such as spiders, beetles *Paederus* and *Ophinonea* were found both by sweep nets and sticky traps in all locations (Table 6). *Telenomus* parasitoids were found in location 1 of Purwosari Village and Location 1 of Telangsari Village. *Tetratichus* was found at location 2 Purwosari Village and Location 1 Telangsari Village. The population of natural enemies in the booting stage were relatively lower than the population in the vegetative stage.

Rice generative stage

In the generative stage, the high rice damage caused by yellow stemborer was 2.5 to 11.2% (Table 7). The number of natural enemy populations such as spiders, *Paederus* beetles and coccinelid beetles were found relatively high. The genus *Paederus* is a mem-

Table 6. Natural enemies of rice pests from *sweepnet* and stickytraps in the rice vegetative stage, South Sumatra 2015

No	Arthropods	Purwosari Village				Telangsari Village			
		Location 1		Location 2		Location 1		Location 2	
		Sw	*St*	*Sw*	*St*	*Sw*	*St*	*Sw*	*St*
1	Spiders (*Lycosa* sp., *Oxyopes* sp.)	1	1	1	0	0	1	0	0
2	*Paederus fuscipes*	4	2	4	0	3	4	4	1
3	*Ophionea nigrofasciata*	2	2	5	0	4	3	3	1
4	Coccinellid (*Menochilus sexmaculatus*)	0	3	0	1	0	2	0	2
5	Dragonfly (*Agriocnemis* sp.)	0	0	0	0	0	0	0	0
6	*Cyrtorhinus lividipennis*	0	0	0	0	0	0	0	0
7	*Oligosita*	0	0	0	0	0	0	0	0
8	*Telenomus*	1	1	0	0	0	1	0	0
9	*Tetratichus*	0	0	0	1	1	0	0	0

Note: Sw = Sweep net, St = Sticky traps

Table 7. Arthropoda population on tidal paddy fields based on direct observations on rice generative stage, South Sumatra, 2015

No	Arthropods	Purwosari Village		Telangsari Village	
		Location 1	Location 2	Location 1	Location 2
	Rice pests				
1	Damage intensity of rice yellow stemborers (%) (*Scircophaga incertulas*)	2.5	11.2	0	2.8
2	Damage intensity of leaf folding pests (%) (*C. medinalis*)	0	0	0	0
3	Brown planthoppers (*Nilaparvata lugens*)	0	0	0	0
4	Green leaf hoppers (*Nephotettetix* sp.)	0	0	0	0
5	Grasshopper (*Oxya sinensis*)	0	9	0	0
6	Black bugs (*Scotinophara coarcata*)	10	13	26	12
7	Stinky bugs	0	1	0	0
	Natural enemies				
8	Spiders (*Lycosa* sp., *Oxyopes* sp.)	14	19	28	33
9	Coccinelid (*Menochilus sexmaculatus*)	13	0	11	9
10	*Paederus fuscipes*	40	45	47	35
11	Ground Beetle (*Ophionea nigrofasciata*)	3	0	1	1
12	*Cyrtorhinus longidipennis*	0	0	0	0

Note: Sw = *Sweep net*, St = *Sticky traps*

ber staphylinid which spread across the American continent, Sri Lanka, Burma, Malaysia, the Philippines, India, and Indonesia. Around 600 species of the genus *Paederus* have been described. *P. fuscipes* beetle is an important predator for plant pests soybeans, like Helicoverva armigera Hübner (Winasa *et al.*, 2007). This beetle also plays a role as an important predator in rice cultivation, but this beetle is sensitive against pesticides (Kanamitsu and Frank 1987 in Atmowidi *et al.*, 2016).

The Arthropods caught by sweep nets and sticky traps were greenleafhoppers, stink bugs and grasshoppers were found to be more numerous than rice vegetative and booting stages in all locations (Table 8). Whereas brown plant hopper and white back plant hopper were only found in location 1 with very low population.

In the generative stage, the natural enemies caught by sweep nets and sticky traps were found natural enemies in all locations increased and the number was higher than in the rice vegetative and booting stages, especiallythe population of the Coccinelid was abundant (Table 9). Insects parasitoid, *Telenomus* and *Tetratichus* found in both locations Telangsari, in the Village Purwosari only found *Tetratichus.*. High population of natural enemies (as predators) in all observation sites results in low pests in rice plants. The presence of green leafhoppers as a vector of tungro disease must be monitored, but no symptoms of the disease during field assessment.Ecological sustainability can be achieved by restoring paddy field biodiversity through protecting the ecological environment surrounding the paddy fields

Conclusion

Insects and pest attacks that were found in tidal swamps in vegetative stages are leaf folding, grasshoppers and green leafhopper. Whereas arthropods of natural enemies (predators) of rice plant pests that are most commonly found were spiders and

Table 8. Arthropods caught by sweep net and sticky trap in rice generative stage, South Sumatra

No	Arthopods	Purwosari Village				Telangsari Village			
		Location 1		Location 2		Location 1		Location 2	
		Sw	*St*	*Sw*	*St*	*Sw*	*St*	*Sw*	*St*
1	Brown *planthoppers* (*Nilaparvata lugens*)	0	1	0	0	0	0	0	0
2	White-backed planthoppers (*Sogatella furcifera*)	1	0	0	0	0	0	0	0
3	Green *leah hopper* (*Nephotettetix* sp.)	7	18	2	10	17	2	4	3
4	Yellow stemborer (*Scircophaga incertulas*)	0	0	0	0	0	0	1	0
5	Leaf folder (*Cnaphalocrocis medinalis*)	0	0	0	0	0	0	0	0
6	Stinky bugs (*Leptocorisa oratorius*)	14	6	21	1	3	5	46	0
7	Grasshopper (Oxya *sinensis*)	13	1	22	3	20	2	13	0
8	Black bugs (*S. coarctata*)	0	1	0	0	7	0	1	2

Note: Sw = *Sweep net*, St = *Sticky traps*

Table 9. Natural enemies of rice pests from sweepnet and sticky traps on the generative rice stages, South Sumatra

No	Arthropods	Purwosari Village				Telangsari Village			
		Location 1		Location 2		Location 1		Location 2	
		Sw	*St*	*Sw*	*St*	*Sw*	*St*	*Sw*	*St*
1	Spiders (*Lycosa* sp., *Oxyopes* sp.)	2	5	0	29	4	13	1	10
2	*Paederus fuscipes*	4	3	7	10	32	7	14	19
3	Ground beetle (*Ophionea nigrofasciata*)	6	3	16	5	8	4	12	5
4	Coccinelid (*Menochilus sexmaculatus*)	91	12	22	7	48	8	54	1
5	Dragonfly needle (*Agriocnemis* sp.)	0	0	0	0	3	0	2	0
6	*Cyrtorhinus lividipennis*	1	3	2	3	14	8	2	4
7	*Oligosita*	0	0	0	0	0	0	0	0
8	*Telenomus*	0	0	0	0	2	2	1	4
9	*Tetratichus*	0	0	1	0	0	1	0	3

Note: Sw = Sweep net, St = Sticky traps

Coccinella, while other predators such as *Paederus*, *Ophionea* Beetle, Dragonfly Needles and *Cyrtorhinus* are found in several locations with relatively low populations. In general, the population of insect pests and natural enemies, decreases in the primordial stage population then increases again in the generative stage.

Acknowledgement

The authors gratefully acknowledge funding support from DIPA 2015. We thank for Nono Sumaryono and Endang Data for their assistances in the field.

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