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THE SPECIES OF RICE BUG (*Leptocorisa oratorius* Fabricius) EGG PARASITOIDS IN RICE FIELD IN WEST SUMATRA, INDONESIA

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Abstract. *The species of egg parasitoid in rice bug is necessary to know to be used as biological agent in the field. The research aimed to determine spesies of parasitoid, diversity index, parasitization level and parasitoid mortality which found in rice bug eggs in rice fields in West Sumatra. Purposive random sampling was used in this research for determining the sampling locations. Collecting eggs sampling was conducted for 1 km along transect line in sampling location. The collected eggs of 12 sampling locations then observed and identified in Laboratory of Insect Bioecology, Faculty of Agriculture, Andalas University. The result showed that the kind of egg parasitoid found in the field were Hadronotus leptocorisae and Ooencyrtus malayensis with each parasitization level were 22.3 ± 11.1 % and 4.2 ± 5.3 %, each the mortality were 57.8 ± 26.4% and 30.6 ± 37%, the diversity of egg parasitoid was low with the index 0.3858 Based on Shannon-Wienner.*
Keywords: *species, Hadronotus leptocorisae, Ooencyrtus malayensis, parasitoid*

1. Introduction

Egg parasitoid is one of potential biological control agents. The parasitoid has advantages than conventional way which are not harmful for another organism, for environment and able to control the pest in the early stadia (Hidrayani et al., 2013) or before larval eclosion (Romani et al., 2001). The presence of egg parasitoid species that parasite the host on the land should be known for its use as a pest control to be effective and efficient. The species diversity of parasitoids in the field is influenced by agricultural conditions (farming landscape) whether classified as simple or complex landscape, habitat type and quality, spatial arrangement and interconnected linkages within a landscape (Kruess & Tscharntke, 2000). Whereas its parasitization is heavily associated with abiotic factors such as temperature (Schirmer et al., 2008); (Yashima & Murai, 2013), (İslamoğlu & Tarla, 2014); (Madbouni et al., 2017); (Joodaki et al., 2018), humidity and rainfall (Schirmer et al., 2008), and cropping pattern (Jamili et al., 2015). The application of this egg parasitoid optimally requires an understanding of the species as a whole. Therefore, the existence of parasitoid in cultivated land is crucial to be studied.

The presence of parasitoids in West Sumatra food crops has been reported with different levels of parasitization, species diversity and population abundance (Susiawan &

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Yuliarti, 2006)., (Maulina et al., 2018), but its application as a biological control agent has not been widely studied yet. Rice bug eggs are one of the main pests of rice plants have been reported to be attacked by parasitoids (Maulina et al., 2018), but the use of parasitoids as biological control agent of rice bug in rice cultivation needs a thorough review. Based on these descriptions, the study of egg parasitoids on the pest is important to do. Preliminary research on the parasitoid eggs of the rice bug was conducted especially about its presented in rice bug egg.

The experiments reported here designed to determine the species, diversity, parasitization and mortality of rice bug egg parasitoids on rice bug in West Sumatra rice field. This study is expected to be an initiation to assess the parasitoid propagation of eggs in the laboratory before being introduced into the field.

2. Methods

Sampel Collection

Purposive sampling was used to determine sampling locations. Six administrative districts were selected where the average incidence of parasitoid was greater than 3 ha. In each of these areas 2 sites at different altitudes were chosen (Fig. 1). At each location a 1 km transect line was measured in an area of 3 ha where the rice plants were flowering until the milky stage from January 2016 until December 2017. All rice bug eggs found in them transect along were collected and brought to the laboratory.

Figure 1. Incidence of rice bug attacks (*Leptocorisa oratorius*) in rice fields of West Sumatra (2009-2013). Sampling location were PB (Pasaman Barat), AG (Agam), TD (Tanah Datar), PP (Padang Pariaman), PS (Pesisir Selatan), dan DR (Dharmasraya).

Laboratory Observation

Parasitoids were observed emerging from egg of *L. oratorius* and were identified using a binocular microscope Carton *SPZ50* and the insect identification books. The following data were collected; number of eggs per sampling location, number of parasitized eggs (adult of parasitoid and death parasitoid in eggs), number of un-parasitized eggs, number of non-fertilized eggs and the species of parasitoid present. The laboratorium activities are carried out from January 2016 until December 2017.

Data Analysis

Data were analyzed descriptively and using the following formula :

Diversity index of rice bug eggs

$$H = -\sum_{i=1}^{S} pi\ (\log e\ pi)$$ ………........... (1) Shannon-Wienner (Krebs, 2000).

Note : H = diversity index

S = number of parasitoid

Pi = proportion of parasitoid to number of population

Criteria of insect diversity :

H < 1 diversity is low

H = 1-3 diversity is medium

H > 3 diversity is high

Level of parasitization

$$P = \frac{A}{B} \times 100\%$$ ....(2)

Note : P = percentage of parasitoid parasitization

A = eggs parasitized (parasitoid emerges, un-hatched, abnormal)

B = number of rice bug eggs in the sample

Parasitoid mortality

$$M = \frac{Pm}{Tp} \times 100\%$$ ....(3)

Note : M = percentage of parasitoid mortality

Pm = number of dead parasitoids

Tp = number of all parasitoids

3. Results and Discussion

Identification of Egg Parasitoid of The Rice Bug

Two species of egg parasitoids found in the samples, *Hadronotus leptocorisae* (Scelionidae) and *Ooencyrtus malayensis* (Encyrtidae). Distinguish between parasitoids were observed in number of segments and antenna color, hair in thoracic dorsal, leg color and body size (Figure 2). Both parasitoids were previously reported in rice field in Tanah Datar regency and West Pasaman, West Sumatra (Maulina et al., 2016); (Maulina et al., 2018).

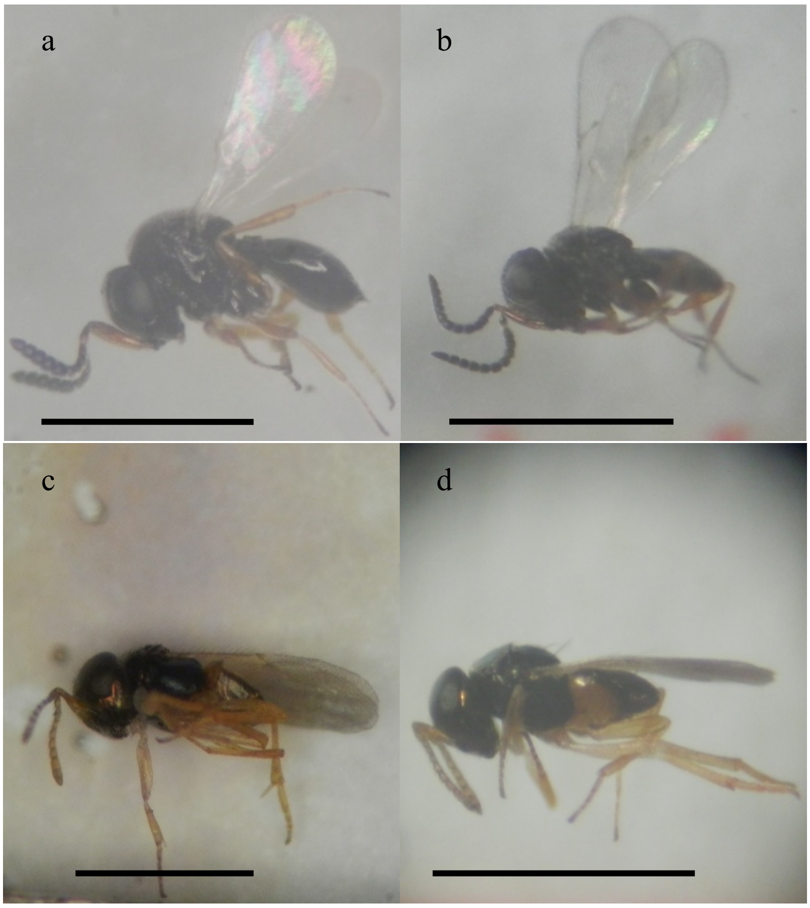

Figure 2. Freshly emerged rice bug (*Leptocorisa oratorius*) egg parasitoids from West Sumatra rice fields. *Hadronotus leptocorisae* (panels a and b, female♀ and male♂. *Ooencyrtus malayensis* (panels c and d, female♀ and male♂. The bar representative 1 mm.

Species Diversity

The diversity index of rice bug eggs parasitoids in all samplings in West Sumatra (12 locations) was low (mean H' 0.39) (Table 1). This value caused by species of egg parasitoid found in the field was few, even in a few locations, just found one species of parasitoid. At higher altitude (> 700 m above sea level) only one species of egg parasitoid was found, *H. leptocorisae* (Figure 2a, 2b), (Figure 3). This may be due to the adaptive capacity of *H. leptocorisae* to survive at cooler temperature. Parasitoid *H. leptocorisae* survive at low temperatures and the best temperature to longevity in laboratory test is 25^{o}C (Maulina et al., 2018). However, the ideal or optimum temperature for the longevity of adult parasitoids depends on the species of parasitoids or variability among individuals (Régnière et al., 2012) such as longevities of *Aphelinus varipes* were 27.0 days at 20^{o}C and 20.6 days at 25^{o}C (Yashima & Murai, 2013).

Table 1. The diversity of rice bug (*Leptocorisa oratorius*) egg parasitoids in rice field in West Sumatra. Altitude is shown relative to sea level

Locations	Altitude (m)	Number of species	Abundance		Index Shannon Wienner Biodiversity (H')
			H.leptocorisae	*O.malayensis*	
WKPB	58	2	33	2	0.22
BLAG	81	2	5	30	0.41
SSDR	89	2	97	39	0.61
SKPS	100	2	20	1	0.19
KKPP	107	2	32	14	0.61
SPDR	108	2	80	13	0.40
PBPS	206	2	63	5	0.26
PKPP	248	2	57	2	0.15
BTPB	547	2	125	14	0.33
LBTD	634	2	24	11	0.64
PBAG	703	1	6	0	0.00
RSTD	888	1	10	0	0.00
Total					***3.82***
Average					***0.39***

WKPB: Wonosari Kinali Pasaman Barat, BLAG: Bawah Simpang Tigo Lubuk Basung Agam, SSDR: Sitiung Sitiung Dharmasraya, SKPS: Siguntua Koto IX Pesisir Selatan, KKPP: Kepala Hilalang 2 x 11 Kayu Tanam Padang Pariaman, SPDR: Sungai Dareh Pulau Punjung Dharmasraya, PBPS: Pulut-pulut Bayang Utara Pesisir Selatan, PKPP: PasaTembok 2 x 11 Kayu Tanam Padang Pariaman, BTPB: Banjar Kuning Talamau Pasaman Barat, LBTD; Lubuak Bauak Batipuah Tanah Datar, PBAG: Padang Tarab Baso Agam, RSTD.: Rao Sei Tarap Tanah Datar

Lack of host abundance was also the factor lack of parasitoid abundance. (Jamili & Haryanto, 2014) reported in East Mataram, East Nusa Tenggara that the abundance of parasitoid in Sempalun was very low, (H' = 0). This is because the research location is far from the sea.

Parasitization and Mortality of Rice Bug Egg

The egg parasitoid *H. leptocorisae* was found in all sampling locations (12 locations) (Table 2) with an average parasitization of 22.3 ± 11.1 %. The *O. malayensis* was only found in 10 locations with an average parasitization of 5.9 ± 6.9 %. The longevity of *H. leptocorisae* was longer from lowland (23 days) (50 m asl) compare to highland (10 days) (900 m dpl) and *O. malayensis* which can not survive in highland (> 700 m asl) (Figure 3).

Table 2. Parasitization and mortality of parasitoid emerged from parasitized rice bug (*Leptocorisa oratorius*) eggs from rice fields in West Sumatra. Altitude is shown relative to sea level

Locations	Elevation(m)	Parasitoid *Hadronotus leptocorisae*		Parasitoid *Ooencyrtus malayenensis*	
		Parasitization(%)	Mortality(%)	Parasitization(%)	Mortality(%)
WKPB	58	9.1	60.6	0.6	0.0
BLAG	81	3.4	20.0	20.5	10.0
SSDR	89	18.4	86.0	7.7	87.2
SKPS	100	38.2	55.0	1.8	0.0
KKPP	107	29.6	00.0	13.0	0.0
SPDR	108	33.9	78.8	5.5	69.2
PBPS	206	19.4	71.4	1.5	60.0
PKPP	248	25,2	64.9	0.9	0.0
BTPB	547	27.7	44.0	3.1	57.1
LBTD	634	31.2	50.0	15.6	83.3
PBAG	703	6.0	83.3	0.0	0.0
RSTD	888	27.8	80.0	0.0	0.0
Average		***22.3***	***57.8***	***5.9***	***30.6***
Standard of deviation		***11.1***	***26.4***	***6.9***	***37.0***

WKPB: Wonosari Kinali Pasaman Barat, BLAG: Bawah Simpang Tigo Lubuk Basung Agam, SSDR: Sitiung Sitiung Dharmasraya, SKPS: Siguntua Koto IX Pesisir Selatan, KKPP: Kepala Hilalang 2 x 11 Kayu Tanam Padang Pariaman, SPDR: Sungai Dareh Pulau Punjung Dharmasraya, PBPS: Pulut-pulut Bayang Utara Pesisir Selatan, PKPP: Pasa Tembok 2 x 11 Kayu Tanam Padang Pariaman, BTPB: Banjar Kuning Talamau Pasaman Barat, LBTD; Lubuak Bauak Batipuah Tanah Datar, PBAG: Padang Tarab Baso Agam, RSTD.: Rao Sei Tarap Tanah Data

H. leptocorisae was more dominant with parasitization level was higher than *O. malayensis* (Figure 3). The level of parasitization of rice bug egg parasitoids (*H. leptocorisae* and *O. malayensis*) in all locations in West Sumatra was higher than locations in Lombok island (18.03%) which the crop pattern was conducted 1 time in year (Jamili et al., 2015). Calculation of parasitization level in West Sumatra was conducted in one crop season, even though farmer's behavior planted rice plant 2 or 3 time in year which parasitization level was 31.47, so the parasitization level in West Sumatra was lower. It was caused in crop season 3 times in year the food source was always available for host (adult *Leptocorisa oratorius*).

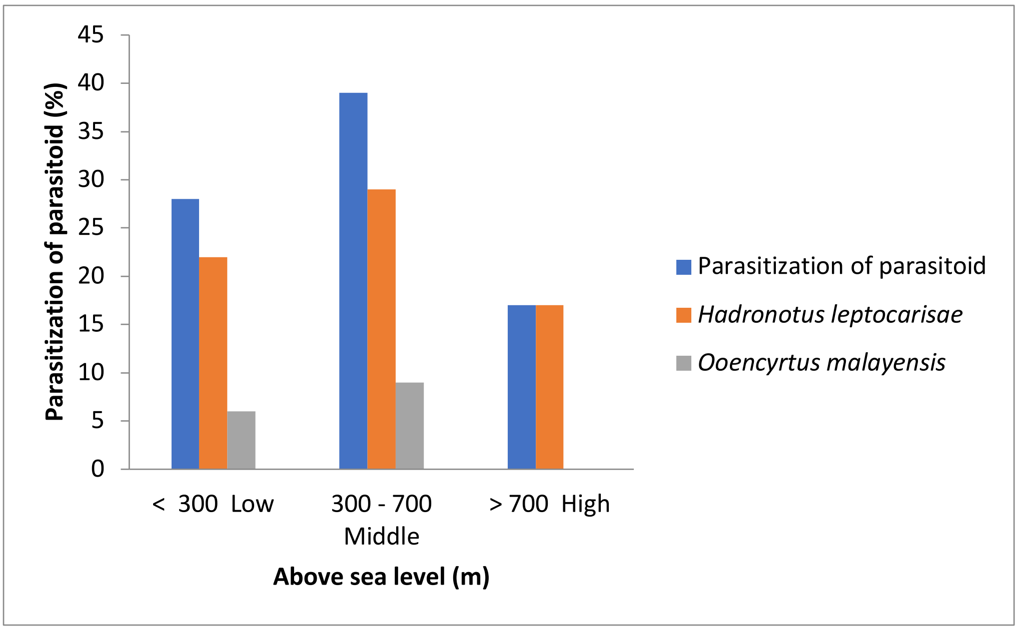

Figure 3. Proportion of parasitization of parasitoid *Hadronotus leptocorisae* (red) and *Ooencyrtus malayensis* (grey) in number of total parasitization of parasitoid (blue) in rice field in West Sumatra

Parasitization level of rice bug parasitoid in West Lombok (28.56%) with simple landscape (Aik Mel) (Jamili et al., 2015) was almost equal with West Sumatra (28.1%). It caused the wide of field for sampling locations was > 3 Ha so, it was identical to monoculture pattern in Air Mel. Effect of monoculture pattern was the sustainability of rice bug existence and it makes the eggs as host for *H. leptocorisae* and *O. malayensis* were available. Parasitization level of egg parasitoid was not more than 50% and it is assumed to relate to host condition which host has limited food source in rice plant which is only in grain on mature stadia of grain. This case makes the available of eggs existence in locations disappear (searching another plants) when the plants harvested. Existence and survival of parasitoid-herbivore depend on plant density (Fei et al., 2016). Parasitization by egg parasitoids tend to follow the development of its host population (Herlinda, 2004). And addition (Jamili et al., 2015) reported in East Mataram, East Nusa Tenggara, the abundance of parasitoid in Sempalun was very low, (H' = 0). It caused by the location was far away from the sea. Not many species of parasitoid found it makes the abundance of the parasitoid species is low (average 0,1844). Number of level parasitization of rice bug egg parasitoid

(*H. leptocorisae and O. malayensis*) in all location in West Sumatra was higher than location in Lombok island (18.03%) which the crop pattern was conducted 1 time in year (Jamili & Haryanto, 2014). In addition cropping patterns and locations from sea level, the parasitization of parasitoid depends on the stage of the instar in rearing at laboratory (Farahani & Goldansaz, 2013) and self- superparasitoid (Tunca et al., 2016).

The mortality of *O. malayensis* is higher than *H. leptocorisae* parasitoids caused that the size of it smaller than. So the resistance of them is lower than to insecticide impact. To avoid the negative impact of insecticides (Thubru et al., 2018) suggested that if necessary the insecticide was used 15 days after the parasitoids were released. The causes of the high parasitoid mortality include superparasitoid (Meilin et al., 2015).

4. Conclusions

There were 2 parasitoids that found in rice bug eggs in rice field in West Sumatra, *Hadronotus leptocorisae* and *Ooencyrtus malayensis* with low diversity index, 0.3858. *H. leptocorisae* was more dominant than *Ooencyrtus malayensis* with level of parasitization and the mortality were 22.3 ± 11.1 %, 4.2 ± 5.3 % and 57.8 ± 26.4%, 30.6 ± 37% respectively.

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