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IDENTIFICATION OF SOIL BUGS (PENTATOMIDAE) ON RICE PLANTS (*ORYZA SATIVA* L.) FROM SOLOK CITY, WEST SUMATRA

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ABSTRACT

Soil bugs or rice black bugs are one of the insects that like to suck rice plants. These insects suck rice plants in the vegetative and generative phases and have caused huge economic losses. This research aims to identify and study the appropriate of Soil Bugs species from several rice fields in Lubuk Sikarah District, Solok City, West Sumatra. This research uses a sampling method using light traps at night. Morphological identification of rice black bug samples using a light microscope with the weakest magnification (4x10). The results showed that there were five species of soil bugs obtained, namely *Scotinophara coarctata, S. zamboanga, S. trifurcata, S. alegria and S. manguindanaoana*. Soil bugs are more commonly found in generative rice plants due to the suitability of food and environmental factors. The amount of *S. coarctata* are the most dominant because it is the most phytophagous of other species of rice black bugs. The characteristics of soil bugs observed were different distance between the ocelli, length of the third and fourth segments on the antennae, shape of the tubercle antiniferous, shape of the anterolateral pronotum, in the amount and shape of longitudinal veins and closed marginal cells in the forewing venation and different shape of abdominal tergit X.

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INTRODUCTION

Soil bugs (Hemiptera: Pentatomidae) are among the rice plant pests commonly found in the rice fields of Solok City, West Sumatra. The soil bug species *Scotinophara* spp. is frequently encountered on rice plants in several Asian countries (Catinding & Kong 2007; Nurhadi *et al*. 2011). The presence of such plant-feeding insects, like soil bugs, in large numbers can cause significant damage and hinder the development of rice plants (Sari *et al.* 2017). Soil bugs feed on rice plants during both the vegetative and generative growth phases, which can lead to substantial economic losses, ranging from 15-23% (Joshi et al. 2007). Rice plants infested by soil bugs will become stunted during the tillering phase, and in the pre-harvest phase, the rice grains may become empty (Syam *et al.* 2011). This condition is a major concern for Indonesian rice farmers, as it can significantly reduce the quality of rice production.

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The presence of soil bugs is commonly found throughout agricultural areas in Indonesia, including in West Sumatra. Rice is the largest food commodity in West Sumatra, with one of the most well-known products being rice from Solok City. In Solok City, specifically in Lubuk Sikarah District, rice harvesting reached 14,787 tons from a harvested area of 404.79 hectares in 2019 (BPS Solok City 2020). However, rice production has been steadily declining year by year due to several cases of soil bug infestations in the area. Until now, the specific species of soil bugs that infest rice plants in the rice fields of Lubuk Sikarah District, Solok City, West Sumatra, remain unknown.

Control measures need to be implemented to reduce the growth rate of soil bugs infesting rice plants in the area. However, chemical control would be detrimental to the environment, soil conditions, and the health of nearby humans. Additionally, it could lead to resistance in the target insect, the soil bug (Manuaba 2007; Saputri *et al*. 2016). The use of natural enemies could serve as a biological control method. Therefore, it is necessary to identify the correct species of soil bugs to ensure that natural enemies are more specifically targeted. Several natural enemies of soil bugs, from the egg stage to adulthood, include predators and parasitoids (Pracaya 2010).

Soil bug identification can be carried out by first examining its morphological characteristics, including general features such as the head, thorax, and abdomen. More detailed morphological characteristics can be observed in the wings, femur, tarsus, tibia, antennae, pronotum, and scutellum. The commonly found species of soil bugs, *Scotinophara* spp., have a dark brown body, a black head, which is wider than the length of the eye and shorter than the pronotum. The compound eyes are round and black, while the ocelli are orange (Ahmad *et al.* 2007).

Information on the species of soil bugs in Indonesia is still very limited. Some species, such as *Scotinophara coarctata*, *S. lurida*, and *S. vermiculata*, have been identified and are reported to cause significant damage to rice plants in North Sulawesi (Harahap & Tjahyono 2003; Moonik *et al*. 2015). In contrast, soil bugs found in other rice-producing countries, such as the Philippines, include 24 species, 19 of which are endemic (Barrion et al. 2007). Therefore, it is interesting to conduct an identification of soil bug species in Solok City, West Sumatra. Besides the limited information on soil bug species in Indonesia, accurate identification can facilitate biological and environmentally friendly control measures for soil bugs.

METHOD

The research was conducted in the rice field areas of Tanah Garam Village (0°47′29.62367″S, 100°38′7.03306″E), covering 18.7 hectares, and Simpang Rumbio Village (0°48′8.5820″S, 100°40′21.2070″E), covering 23.2 hectares, located in Lubuk Sikarah District, Solok City, West Sumatra. The sample collection was carried out using the light trap method, employing a Philips E27 LED 20-watt lamp. The traps were placed at a height of two meters above the ground. The traps were set between 18:00 and 23:00 WIB, as soil bugs are nocturnal. The traps were placed in each rice field location measuring 100 x 50 meters, divided into five subplots, each measuring 1x1 meter. Sample collection was conducted at locations where rice plants were in both the vegetative and generative phases. Sampling was repeated three times with a one-week interval. Environmental factors, such as temperature and humidity, were measured using a thermometer and hygrometer during trap placement and sample collection (Joshi *et al*. 2007; Baehaki 2009; Moonik *et al.* 2015; Ananda *et al*. 2016; Alamsyah *et al*. 2017; Sari *et al*. 2017; Julian 2020).

Preservation and Identification. The collected samples were prepared as dry specimens. The samples were pinned through the thorax using an insect pin. They were then dried in an oven at 37°C for seven days or adjusted according to the size of the sample (Fajarwati 2009; Oktarima 2015). Morphological identification of the soil bugs was carried out based on the identification key provided in Table 1 (Joshi et al. 2007; Torres et al. 2010). Data analysis was conducted descriptively by displaying images and tables of the number and morphology of the samples. Observations and photographs were taken using an Olympus CX41 microscope and a Canon 1300D camera. The identification and documentation of the morphological features of the samples were carried out at the Zoology Laboratory, Faculty of Mathematics and Natural Sciences, Riau University, Pekanbaru.

Table 1. Morphological Characteristics of Soil Bugs According to Joshi et al. 2007

No	Body Part	Character	Character Abbreviation	Unit
1	**Caput**	Distance between ocelli	JAO	More or less than the length of the eye
		Antennal segment	ASN	Color
		Proboscis	PBC	Length
2	**Thorax**	Lateral pronotum	LPR	Serrated or non-serrated shape
		Anterolateral pronotum	ALP	Swollen or not swollen shape
		Midanterior pronotum	MAP	Swollen or not swollen shape
		Postocular anterior pronotum	PAP	Wavy or straight shape
		Forewing venation	VSD	Type of wing venation
		Hindwing venation	VSB	Type of wing venation
		Tibia	TIB	Color
		Claval suture	CSU	Length (mm)
3	**Abdomen**	Posterior abdomen	PAB	With or without horns at the tip
		Tergite	TRG	Concave or V-shaped
		Clasper	CLP	Type of claspers
		Midanterior sternite	MST	V-shaped or concave shape

RESULTS AND DISCUSSION

A. Number of Individuals and Soil Bug Species

A total of 642 individual soil bugs were collected from two rice field locations in Solok City. In Tanah Garam Village, 414 individuals were obtained (106 from the vegetative phase and 308 from the generative phase). Meanwhile, in Simpang Rumbio Village, 228 soil bug individuals were collected, with 42 individuals from the vegetative phase and 186 from the generative phase. Based on the morphological identification of the samples from both rice field locations, five soil bug species were found: *Scotinophara coarctata, S. zamboanga, S. trifurcata, S. alegria,* and *S. manguindanaoana*. These five species were differentiated based on characteristics such as the distance between the ocelli, the length of the antennal segments, the shape of the antenniferous tubercle, the shape of the anterolateral pronotum, the shape of the tergite of the abdomen, and the forewing venation (Figures 1 & 2). The species *S. coarctata* was the most dominant in number at both rice field locations, regardless of the vegetative or generative phase (Table 2).

S. coarctata is the most phytophagous species among all *Scotinophara* genera, resulting in faster development compared to other species. Additionally, this species is the most adaptable to rice field environments due to its wide distribution in Southeast Asia. Therefore, *S. coarctata* has a high potential to cause damage to all varieties of rice plants (Joshi *et al.* 2007; Sharif *et al.* 2020).

Table 2. Number and Species of Soil Bugs on Rice Plants from Two Rice Field Locations in the Vegetative and Generative Phases

No	Spesies	Number of Individuals				Total
		Tanah Garam village		Simpang Rumbio village		
		Vegetatif	Generatif	Vegetatif	Generatif	
1	*S. coarctata*	45	141	26	75	287
2	*S. alegria*	3	8	0	2	13
3	*S. manguindanaoana*	7	24	1	9	41
4	*S. zamboanga*	27	96	8	56	187
5	*S. trifurcata*	24	39	7	44	114
	Total	106	308	42	186	642

In Table 2, all species of soil bugs were found in fewer numbers on rice plants in the vegetative phase. This is due to the lack of suitable food sources. During the vegetative phase, the rice stalks are still soft, whereas soil bugs require more carbohydrates for their growth and development. In contrast, rice plants in the generative phase have organs such as panicles, grains, and flowers. The older parts of the rice plant, such as the leaf sheaths and stems, contain more carbohydrates compared to younger rice plants (Jumar 2000; Ananda *et al.* 2016).

In the generative phase, soil bugs feed on the rice grains while they are still in liquid form before they harden, causing the rice grains to become empty and unharvestable. As the rice plant matures, the presence of soil bugs increases because the food availability is higher in the generative phase than in the vegetative phase (Moonik *et al.* 2015).

B. Environmental Factors

In addition to food sources, the presence of soil bugs is also influenced by temperature and humidity, as this insect species is poikilothermic (Normasari, 2012). The optimal temperature for soil bug activity ranges between 27-29°C (Wulandari *et al.* 2016). The temperature measurements taken during the sample collection were between 26-28°C. Regarding humidity, the recorded values at the research site ranged from 66-78% at the start of light trap installation and 77-92% during the sample collection of soil bugs. These values fall within the optimal humidity range for soil bug development, as these insects prefer humid conditions (Kartohardjono *et al.* 2008). Therefore, the environmental factors in this study support the growth and development of soil bugs in the rice fields of Solok City, West Sumatra.

C. Morphological Characteristics and Identification Key

The characteristics of soil bugs include features of the head, thorax, and abdomen. In the morphology of the head or caput, differences are observed in the distance between the ocelli, the length of the third and fourth antennal segments, and the shape of the antenniferous tubercle. *S. alegria* has the longest distance between the ocelli, which is more than 1.84 times the length of the compound eye. The distance between the ocelli in *S. coarctata* is 1.8 times the length of the compound eye, and in *S. manguindanaoana*, it is more than 1.6 times the length of the compound eye. Meanwhile, *S. zamboanga* and *S. trifurcata* have the shortest distance between the ocelli, measuring 1.5 times the length of the compound eye.

Soil bugs have an antenniferous tubercle located at the base of the antenna. The antenniferous tubercle exhibits differences in the structure of the tubercle, which can be used for identifying several soil bug species. In *S. zamboanga* and *S. trifurcata*, the antenniferous tubercle has a slit at the front and resembles two small protrusions. *S. manguindanaoana* does not have a slit at the front of the antenniferous tubercle, so it appears as a single protrusion.

The differences in thoracic characteristics among the five soil bug species are mainly found in the shape of the anterolateral pronotum. The position of the anterolateral pronotum in soil bugs is located between the anterior pronotum and the lateral pronotum. In *S. zamboanga*, the anterolateral pronotum is straight and slanted, while in *S. trifurcata*, the anterolateral pronotum appears slightly concave.

In the abdomen, there are also differences in morphological characteristics, specifically in the shape of tergite X. This characteristic is one of the key identification features for soil bugs. Tergite X is located at the tip of the soil bug's abdomen. *S. coarctata* has a wide concave tergite X, while *S. alegria* has a V-shaped tergite X (Figure 1).

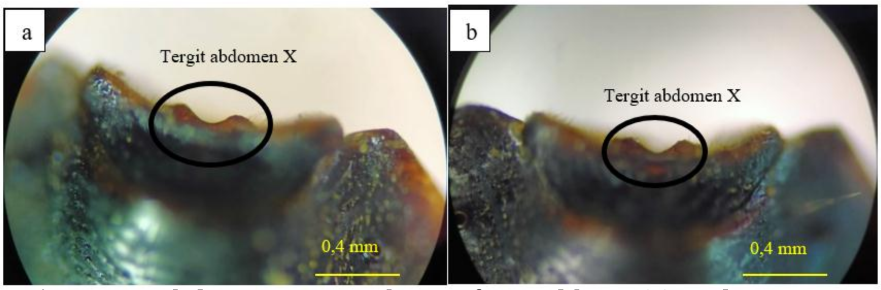

Figure 1. Abdomen tergite shape of X soil bug. (a) wide concave, (b) V-shaped.

Regarding the morphological characteristics of the wings, differences were also found among the soil bug species collected. The forewing venation displays two types: longitudinal veins and closed marginal cells. In *S. coarctata*, the forewing has 4-5 longitudinal veins and 3 closed marginal cells. *S. alegria* has 4-5 closed marginal cells and longitudinal veins. *S. manguindanaoana* has 2 closed marginal cells. *S. zamboanga* has a first longitudinal vein that splits and branches at the tip. Meanwhile, *S. trifurcata* has a first longitudinal vein that branches in the middle (Figure 2).

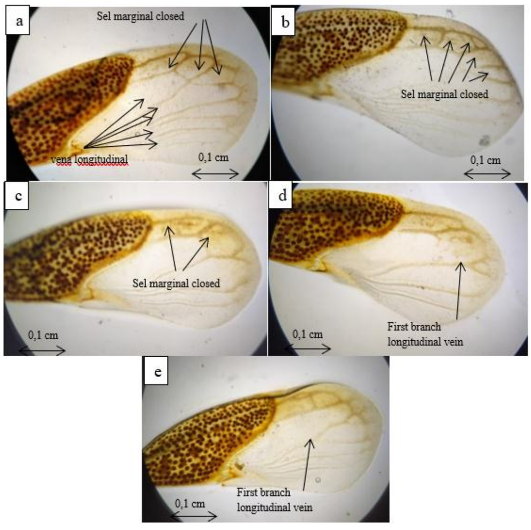

Figure 2. The venation pattern of the forewing of the soil bug. (a) 5 longitudinal veins with 3 closed marginal cells, (b) 5 closed marginal cells, (c) 2 closed marginal cells, (d) the first longitudinal vein branches into two at the tip, (e) the first longitudinal vein branches into two in the middle.

Based on its morphological characteristics and classification, the soil bug belongs to the genus *Scotinophara* within the family Pentatomidae. Soil bugs of the *Scotinophara* genus have the following morphological characteristics: The first proboscis segment is thin, almost entirely hidden beneath the bucculae. The lateral lobes of the head are nearly the same length as the tylus (the central lobe of the head) and do not cover the tylus in the front. The connexivum (posterolateral abdomen) lacks any prominent markings. The scutellum is spatulate, extending to the apex of the abdomen, with the body color ranging from brown to black. The body is dark brown to black, and the anterolateral edge of the pronotum lacks a knob (Joshi et al. 2007; Wangko et al. 2019). The identification key for species of *Scotinophara* genus is as follows:

1. a.The distance between ocelli (POL) is more than 1.8 times the length of the eye 2
   b. The distance between ocelli (POL) is less than 1.75 times the length of the eye 3

2. a. POL is 1.8 times the length of the eye, the forewing has 4-5 longitudinal veins, 3 closed marginal cells, tergite X of the abdomen is narrow and concave .... ***S. coarctata***
   b. POL is more than 1.84 times the length of the eye, the forewing has 4-5 closed marginal cells, tergite X of the abdomen is V-shaped or wide concave .... ***S. alegria***

3. a. POL is 1.5 times the length of the eye, the antenniferous tubercle has a gap...4
   b. POL is more than 1.6 times the length of the eye, the antenniferous tubercle has no gap .... ***S. manguindanaoana***

4. a. The anterolateral margin of the pronotum is straight, the first longitudinal vein on the forewing branches at the tip, the third antennal segment is shorter than the fourth .... ***S. zamboanga***
   b. The anterolateral margin of the pronotum is slightly concave, the first longitudinal vein on the forewing branches in the middle, the third and fourth antennal segments are of nearly equal length .... ***S. trifurcata***

CONCLUSION

Based on its morphological characteristics and classification, the soil bug belongs to the genus Scotinophara within the family Pentatomidae. Soil bugs of the Scotinophara genus have the following morphological characteristics: The first proboscis segment is thin, almost entirely hidden beneath the bucculae. The lateral lobes of the head are nearly the same length as the tylus (the central lobe of the head) and do not cover the tylus in the front. The connexivum (posterolateral abdomen) lacks any prominent markings. The scutellum is spatulate, extending to the apex of the abdomen, with the body color ranging from brown to black. The body is dark brown to black, and the anterolateral edge of the pronotum lacks a knob (Joshi et al. 2007; Wangko et al. 2019). The identification key for species of Scotinophara genus is as follows:

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