KnE Life Sciences

ICSAFS Conference Proceedings
2nd International Conference on Sustainable Agriculture and Food Security:
A Comprehensive Approach
Volume 2017

Knowledge E
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Conference Paper

Bio-ecology of Slender Black Rice Bug, *Paraeucosmetus pallicornis* in South Sulawesi

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Abstract

A study on the bio-ecology of slender black rice bug, *Paraeucosmetus pallicornis*, was conducted in the research farm of Lolit Tungro, Lanrang, South Sulawesi, Indonesia. This pest is considered as new rice pest, attacking rice plant especially during generative stage. This pest inserts its stylet and then sucks the sap of the developing rice grain. Light trap was used to catch this pest. Yellow sticky trap and pitfall trap were used to determine the insect population and to find out when the pest infests the plant. Fifteen yellow sticky traps were set diagonally on rice field, and 10 pitfall traps were placed on the ground. The traps were placed on three plots as replication. On the first week of the study, it was found that the number of captured insects from the light trap during harvesting was 193. On the 2^{nd} to 4^{th} weeks, during fallow stubble, the captured insects were 135–740. In the early of May, the field started to be ploughed as preparation for the next planting season. As the result, the number of insects captured decreased to 53–152 insects. The 2013 planting season was started in June. During this period, the bugs captured were only 1–3. This indicates that the bugs have already moved or migrated out of the rice field. The average number of eggs laid were 53.3 (1 pair), 124.8 (2 pairs), 142.5 (3 pairs), 202.3 (4 pairs), and 284 (5 pairs) and the average of hatch rate was 29.9%. The damaged rice grain was 38% grains/panicle (ranged 24.2-57.4%). This level of damage indicates that the *P. pallicornis* contributes to the reduction of rice yield.

Keywords: *Paraeucosmetus pallicornis*, rice pest.

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Received: 28 July 2017
Accepted: 14 September 2017
Published: 23 November 2017

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICSAFS Conference Committee.

1. Introduction

Rice dominates overall crop production and overall food consumption to a much greater extent in rice-producing Asia than elsewhere in the world. In Indonesia rice is the staple food of more than 200 millions of people. Rice is substantial commodity for the farmers. The common rice pests in Indonesia are rice stemborers, brown plant hoppers and rice field rats. However, a new pest has been reported in Sulawesi and then spread to Kalimantan, Sumatra and the latest was found in East Nusa Tenggara and North Mollucca. Indonesian Quarantine Agency put this pest under an A2 Group as

the pest species already found in Indonesia. The new pest that attacks rice plant was firstly reported in North Sulawesi [1]. Pelealu [2] stated that the insect which attacked rice plant in Bolaang Mongondow was *Paraeucosmetus pallicornis*. This insect species attacks by sucking the sap from the rice grains during the milky stage. Secondary infection by fungus causes the rice to have bitter taste [3]. A study in South Sulawesi reported that the secondary infection was assosiated with the fungus *Aspergillus* sp. The fungus had been isolated from the adult of *P. pallicornis*. Some endophytic fungi found in *P. pallicornis* were *Fusarium* sp., *Penicillium* sp., and *Aspergillus* [4].

Based on the identification of insect pests collected from Sidrap, this insect was *P. pallicornis.* Kalshoven [5] grouped this insect into family Lygaidae, however recent finding demonstrated that the insect belongs to the family of Riparochromidae [6]. Furthermore, the identification using the NCBI data base (2012), *Gyndes pallicornis*, *Pachybrachius pallicornis* Dallas (1852) and *P. pallicornis* are synonymous with taxonomy code 299307. These insects were found in Mindanao, Philippine, on grass *Imperata cylindrica* [7]. In Philippines this insect was reported as new pest of rice. These insects are also included in the list of quarantine pest Group 2, based on the Regulation of the Minister of Agriculture No. 3 / Permentan / OT.140 / 12/2011, of Plant Quarantine Pest (quarantine pest). *P. pallicornis* is grouped into pest category of class II 2A, meaning already exist in Indonesia but the distribution is still limited. The spread of this insect should be monitored as it has not been reported in Java.

P. pallicornis moves swiftly. The population could develop in a relatively short period. Early control with insecticides is recommended at the nymph stage in the morning and afternoon when *P. pallicornis* can be found on rice panicle grains. Research on feeding behavior and aggression of *P. pallicornis* on different rice varieties (Cisantana, Ciherang and IR66) indicated that the insect likes all the tested varieties [8]. This study aimed to identify the characteristics of biology and ecology of *P. pallicornis* as the basis for the control.

2. Materials and Method

The development of *P. pallicornis* population was studied and monitored regularly. The research was conducted at Tungro Research Station, Lanrang, South Sulawesi in April 2013 (at the end of 2012/2013 Wet Season and 2013 Dry Season). We collected the bugs using light trap, yellow sticky traps and pitfall traps. Experiments were carried out in the screen house and the field.

Figure 1: Rice panicles kept inside plastic tube to monitor the development of *P. pallicornis*.

2.1. Population Development

The study was conducted in the screen house. The first stage was a trial arranged in a randomized block design with 3 treatments and 5 replications. The population of *P. pallicornis* (1, 2, 3, 4, 5 pairs) maintained at panicle rice plants which were predominantly grown in South Sulawesi. Rice panicle in milky stage was put inside a plastic tube with 7 cm diameter and 20 cm high (Figure 1). Late nymph stage was placed inside the plastic tubes and they were allowed to develop. Observation was conducted on the number of eggs, mortality, and number of adult females and males.

2.2. Population Monitoring

Observation of *P. pallicornis* population was also performed with the installation of light traps, yellow sticky traps and pitfall traps at the experimental field of Rice Tungro Research Station. Fifteen yellow sticky traps were set diagonally on rice field, and 10 pitfall traps were placed into the ground. The traps were placed on three plots. Pitfall traps were made of a plastic cup of 450 ml. Plastic cups were then filled with water and detergents. Yellow sticky traps used were made of boards painted yellow and the surface coated with oil. Pitfall traps and yellow sticky traps were placed for 24 hours

for each observation. Light traps or light traps installed using 150 watt LED bulb were expected to attract insects in the area of 150-200 ha. Samples from the field preserved in 70% alcohol. The insects trapped were counted and identified. We also assessed the habitat at the adjacent of rice fields to identify the alternative hosts of this pests.

3. Results and Discussion

3.1. Survey

The study began with a survey of the presence of this bug in South Sulawesi. Survey started from Lanrang to Luwu Regency. This pest was expected to migrate from cocoa plantations, due to the conversion of cocoa plantations in the area of North Luwu. Therefore, we firstly carried out a survey in the area, but we did not find *P. pallicornis*. This pest was in fact found in Lamasi (2°46.520 S, 120°08.351 E) in famerr's field at ripening to harvest rice stage. According to the farmers, this pest could reduce 50% of yield. There was also a secondary effect of the bug where the attacked rice had a bitter taste. During the day, this insect would hide to avoid the sun, but in the morning and afternoon, it would be at the top or on the rice panicle. *P. pallicornis* is very responsive to any movement and be able to move very fast. During dry season, the bugs hide in soil cracks.

3.2. Population Monitoring

The slender black rice grain bug has characteristics of having slim body shape and coloured wings. It is very different from the rice black bug (*Scotinophara sp.*). This insect has a body length of 6-7 mm (imago) and piercing-sucking mouth apparatus. Body color was dominantly black with slight shades of golden yellow. Hind femurs were enlarged and strong. At rest, in the folded wings of a dorsal view, there are two very distinctive white spot near the wingtips [9]. The are 10 spurs at the front of the femur *P. pallicornis* found in Lanrang.

During field observations in Lanrang in April 2013, we found *P. pallicornis* on ripening stage of rice. *P. pallicornis* caught consisted of various stages from nymphs to imago. Trapping data from April to December 2013 using light trap is presented in Figure 2. During the first observations in April, most of rice field in the study area was at ripening stage to harvesting. In the first week of observation, the number of *P. pallicornis* in light trap was quite high. This indicates that there was high population of *P. pallicornis* in rice crops. In the 2^{nd} week to the 4^{th} weeks the number of *P. pallicornis* caught was still high ranging from 135-740 bugs. *P. pallicornis* could survive by hiding in the cracked soil, grasses and in the piles of rice straws in rice fields. During the fallow, this pest

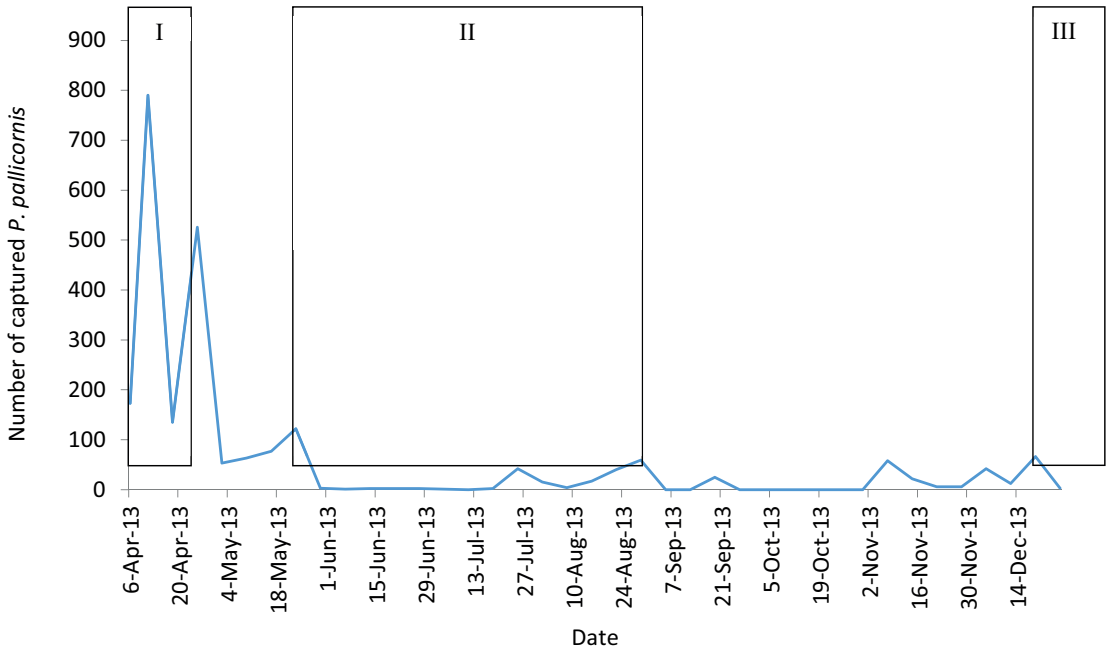

Figure 2: *P. pallicornis* caught in light traps, 6 April to 26 December 2013. Notes: I = WS II 2012/2013, II = DS I 2013, III = WS II 2013/2014

was still be caught in light traps. *P. pallicornis* may also live around rice field on grass or weeds. In early May, there was field preparation for Dry Season planting of 2013, but the number of *P. pallicornis* caught in traps dropped to 53-152 bugs. On the 9^{th} week until the 14^{th}, during vegetative stage, the number of *P. pallicornis* caught was very low ranging from 1 to 3 bugs. Dry season of 2013 started at the end of May 2013. *P. pallicornis* caught in light trap were 0-59 bugs. Feeding activities of this insect occured in morning and afternoon on the young panicles.

During Planting Season I, the sticky trap was not effective in trapping *P. palicornis* (Table 1). Based on observations and identification of the insects caught, sticky trap was not effective because only the adult insects which were active to fly. When the rice in the generative stage, they did not actively fly. However, at night they were attracted to light, so that light trap was more effective in catching this pest. Most Hemiptera captured were green leafhopper and *Cyrtorhinus.*

3.3. Development of *P. pallicornis*

P. pallicornis has oval-shaped eggs, orange, about 1 mm long. It consists of five instar nymphs. First instar is 1.5-2 mm long with reddish color, 2^{nd} instar is 3-4 mm, 3^{rd} instar is 4 mm, 4^{th} instar is 5 mm, while the 5^{th} instar has the length of 6-7 mm, and imago 7 to 7.5 mm (Figure 3). Males *P. pallicornis* have a slender/narrower abdomen, while females have larger abdomen. Both nymphs and imago feed on sap especialy on the grain at

Table 1: Insects trapped on *sticky trap* in experimental field of Tungro Research Station, Lanrang, South Sulawesi.

Observations	Date	Captured insects			
		Hymenoptera	Diptera	Coleoptera	Hemiptera
1	18-Jun-13	0	305	0	0
2	26-Jun-13	0	552	0	0
3	3-Jul-13	0	104	0	0
4	10-Jul-13	49	0	0	70
5	17-Jul-13	40	0	0	54
6	24-Jul-13	0	0	0	25
7	31-Jul-13	0	0	0	21
8	7-Aug-13	12	0	0	0
9	14-Aug-13	0	0	0	18
10	21-Aug-13	0	0	0	21
11	28-Aug-13	0	0	0	11
12	4-Sep-13	0	0	0	17
13	11-Sep-13	0	0	34	0
14	18-Sep-13	0	0	0	0

Figure 3: Life stages of *P. pallicornis* (1 blue square = 1mm).

milky stage of rice. Seed are essential nutrition, required to complete the development of the life cycle [9]. This behaviour similar to *Leptocorisa* that secrets a liquid to form a stylet sheath that hardens around the point of feeding and holds the mouthparts in place.

Overall, the average number of eggs laid was quite high which were 53.3 (1 pair), 124.8 (2 pairs), 142.5 (3 pairs), 202.3 (4 pairs) and 284 (5 pairs). But, the percentage of eggs hacthed into 1st instar nymphs were only 88.7% (1 pair), 81.4% (2 pairs), 66.5% (3 pairs), 60.4% (4 pairs), and 48.0% (5 pairs) (Figure 4). The initial parent population of 5 pairs resulted in low number of their generations, probably due to the competition

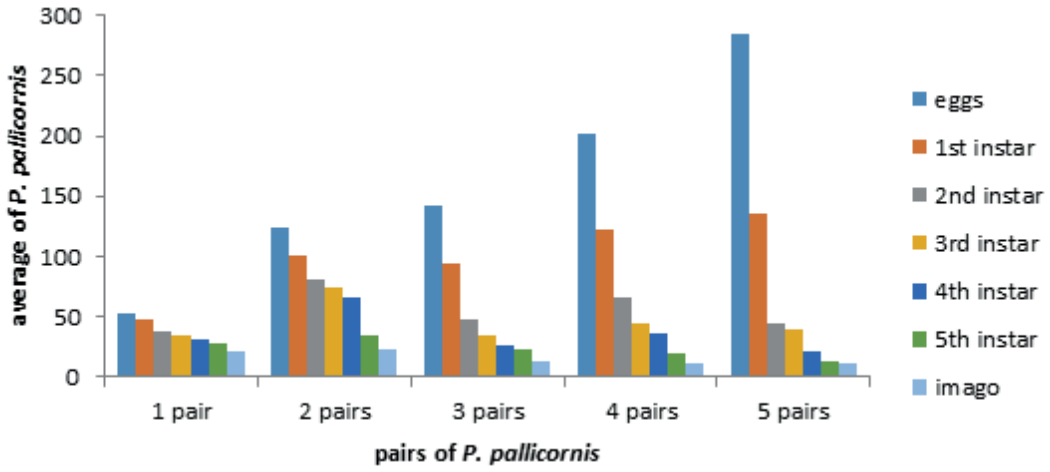

Figure 4: Development of *P. pallicornis* at different initial population size.

Table 2: Population Development of 1 Pair of *P. pallicornis*.

Stage	replication			
	1	2	3	4
Eggs	180	168	137	128
Nymphs instar 1	68	61	30	30
Nymphs instar 2	60	42	20	30
Nymphs instar 3	60	30	16	30
Nymphs instar 4	55	23	10	30
Nymphs instar 5	43	14	2	30
Imago	43	12	2	29

of food and place. In low initial populations, the competition for food and living space was lower. This in turn resulted in higher survival rate of the pest.

Insects in general have a survivorship curve of type III, i.e. a high mortality occurred at a young age. *P. pallicornis* had type III survivorship curve and tend to type II (Figure 5). It can be seen from the curve that many deaths occured at early age. This occurred as the insect obtain its food by sucking the contents of grain, so that its survival depends on the availability and quality of the food. In the field, the pattern was similar. This insect was abundant at milky to ripening stage of rice. *P. pallicornis* lived on rice crop as its host only in short period. After harvesting, the young nymph usually die due to food limitation/starvation.

From data on the development of egg to imago (Table 2), it was found that the average hatchability of *P. pallicornis* eggs was only 29.9%. In the next stages, however, the mortality rates were low. Therefore, the decline of *P. pallicornis* population in the filed was mainly due to lower eggs hatchability.

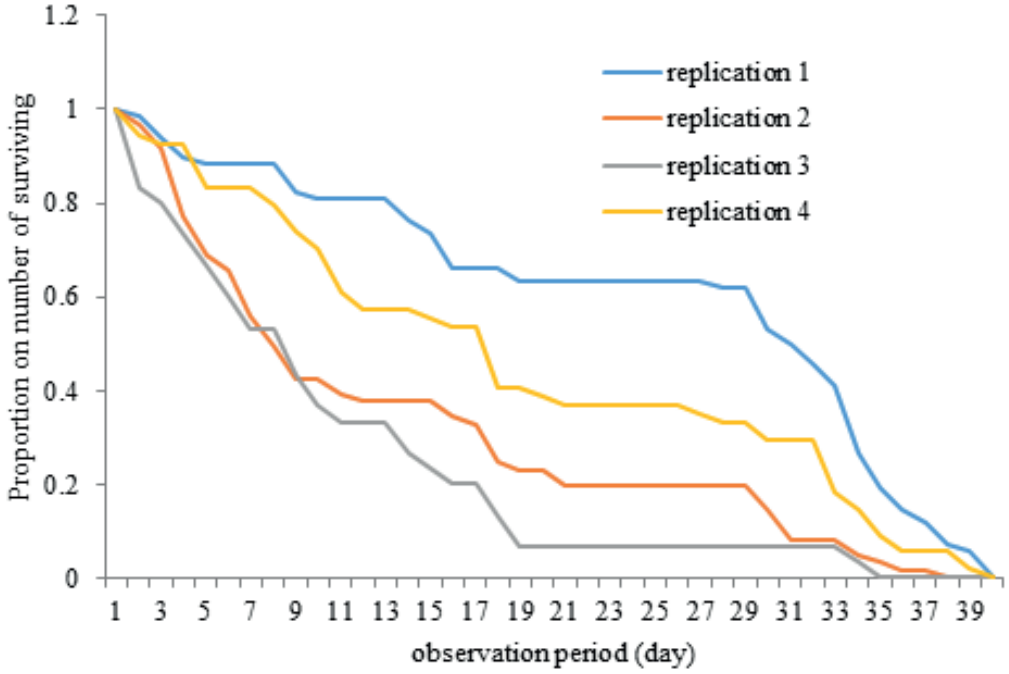

Figure 5: Survivorship of 1 pair *P. pallicornis*.

This insect deposits their eggs on the underside of leaves, singly or in groups, and they hatch after 6-7 days. Five nymphal stages were completed in 18-19 days. Development from eggs to adult required about 25 days. The nymphs, after hatching, moved to the panicle and preferred to suck the milky grain.

Similar to the stinky bugs, *Leptocorisa* (Family: Alydidae), *P. pallicornis* was mainly found on rice plant at generative stage. The stinky bugs have alternative hosts such as grasses *Echinocloa* and *Lersia*. Grasses are also the alternative hosts for *P. pallicornis* when there is no rice crop. Based on field observations, it was found that the alternative host plants for the black beetle were *Paspalum scrobiculatum* L, *Cinodon dactylon*, and *Paspalum distichum*. Further studies are required to investigate the possibility of grasses to be a source of *P. pallicornis* population infesting rice plants in generative stage. Van Vreeden and Ahmadzadibi [9] stated that Graminae was the alternative host for this species.

P. pallicornis could attack rice plants during generative stage from milky to ripening stage resulting in empty grains. The rice grains often turn black and have bitter taste. During the vegetative stage, *P. Pallicornis* also has been detected in rice plants. Damage caused by *P. pallicornis* is similar to the symptoms of damage by stinky bugs (*Leptocorisa*). The attacks of *P. pallicornis* caused an average damage of 38% grain /panicle ranging from 24.2 to 57.4%. Kaparang *et al.* [10] reported that the damage intensity of *P. pallicornis* was the highest at an altitude of 0-300 meters above sea level that is equal to 25.87% per hills, followed by the altitude of >300-600 meters

above sea level which was 24.12% per hills. The lowest was at altitude of >600 meters above sea level which was 23.77% per hills.

Further research on the population growth of black ladybugs on alternative host plants (grasses) that have been identified in this study will be very important. The distribution of this insect pest needs to be monitored due to its status as a quarantine pest insect.

4. Conclusion

It can be concluded from this study that: a) *P. pallicornis* was found in the area Lanrang and Luwu District, South Sulawesi, b) Light trap was effective to trap *P. pallicornis*, than sticky trap and pitfall traps, c) the highest population of *P. pallicornis* captured by light trap was during harvesting to fallow, d) during planting to vegetative stage of rice population declined sharply, e) the average number of eggs laid were 53.3 (1 pair), 124.8 (2 pairs), 142.5 (3 pairs), 202.3 (4 pairs), and 284 (5 pairs) and the average of egg hatching rate was 29.9%, f) the avarage damaged of rice grain was 38% grains/ panicle, ranging from 24.2 to 57.4%.

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