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Biology of Predatory Crickets (Metioche vittaticollis Stal.) (Orthoptera: Gryllidae) on the Brown Planthopper (Nilapavarta lugens Stal.) (Homoptera: Delphacidae)

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ABSTRACT

This research was studied biological aspects and survival rate of M. vittaticollis Stal. on brown planthopper. The experiment was conducted at the Laboratory of Entomology, Departement of Plant Pest and Disease, Agriculture Faculty, Brawijaya University in May to November 2005. The results showed that the percentage of the eggs M. vittaticollis that hatched was 70,5 %. Adult of M. vittaticollis color was dark brown to black. The forewings covers the abdomen. The long winged adults have hindwings almost twice as long as the abdomen. All legs were yellow to orange with tree segment of tarsus. The age of copulated adult was longer than the uncopulated adults. The age of female was longer than the male. The average of development period was 27,43 ± 3,32 days and the average of body length was 5,13 ± 0,34 mm. Adults female of M. vittaticollis consumed 7,89 ± 0,51 third instar nymphs of brown planthopper and the male consumed 6,02 ± 0,48 third instar nymphs of brown planthopper per day. The oviposition period was 17,1 ± 1,65 days and post oviposition period was iv 1,7 ± 0,66 days. The average fecundity was 42,72 ± 4,09 eggs. Female laid in average of 2,41 ± 05 eggs per day. The survival rate decreased during increasing the level of stage of M. vittaticollis. The survival rate of egg to the adult stage were 70,5 %, 55,5 %, 44 %, 35 % and 31,5 %. The survival rate of first nymph could not be attain 100 % due to the all egg did not hatch and continually decrease till fourth instar of nymph. The mortality of each instar of nymph usually occured during moulting or in few days after moulting.

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1. INTRODUCTION

Rice is a staple food for the majority of Indonesian people. In 1984, Indonesia had achieved a period of self-sufficiency in rice, but during the same period there was a decline in production due to attacks by brown planthopper pests. In 1998, rice production reached 4,924 million tons of dry milled grain. Subsequent production decreased by 0.28% (BPS, 1998).

The brown planthopper (Nilaparvata lugens Stal.) is a pest of rice. Brown planthopper causes rice plants to die from drought and look like they are on fire (hopper burn) until they become puso, because this pest attack can reduce rice production (Harahap and Tjahjono, 2000). In addition, the brown planthopper can act as a vector for grass stunt and hollow stunt disease caused by viruses.

One way to control pests is to use predatory insects. Predatory insects are one of the components of biodiversity in the rice ecosystem which have many roles as biological agents. Until now, approximately 37 types of planthopper predators have been found. Some of these predators are Cyrtorinus lividipennis, Paedeorus fuscipes, Anaxipha longipennis, M. vittaticollis and Ophionea negrofasciata (Settle and Ariawan, 1997). Predators that prey on insect pests in nurseries and rice plantations have an important role in suppressing pest populations (Kenmore et.al. 1987 in Rubia, Pena, Almazani and Shepard, 1990). According to De Kraker, Huis, Lenteren, Heong and Rabingge (2004), predatory insects are a group of controlling agents that can maintain the balance of the ecosystem in rice planting areas.

The cricket group is one of the many biological agents found in rice growing ecosystems. The results of research by Anonymous (1997) showed that in a habitat dominated by Paspalum conjugatum weeds, there were many species of crickets Anaxipha longipenis and M. vittaticolis living together. These crickets are effective predators for brown planthopper nymphs and eggs of several Lepidoptera species in rice cultivation.

M. vittaticollis is a type of cricket from the Gryllidae family which acts as a predator found in many rice plants. Nymphs and adults of M. vittaticollis are predators of stem borer eggs and leaf roller eggs (Wongsiri, et al., 1980, in Rubia and Shepard, 1987).

Until now, information on biological aspects, prey power and food needs of M. vittaticollis is still limited. By knowing the biological aspects and optimal feed requirements, it is hoped that it can help biological control activities against prey which are pests in cultivated plants.

2. METHOD

2.1 Place and time

The research was conducted at the Entomology Laboratory, Department of Plant Pests and Diseases, Faculty of Agriculture, University of Brawijaya, from May 2005 to November 2005.

2.2 Tools and materials

The tools used in this study included: Microscopes, petri dishes, mica tubes with a diameter of 10 cm and 5 cm, plastic trays, cages for the propagation of planthoppers and Metioche vittaticolis, aspirators, scissors and millimeter paper blocks.

Materials used include: rice seeds (grain), niphagen solution, tissue paper.

2.3 Research procedure

This research begins with:

a. This is so that the brown planthopper always gets sufficient and fresh food, and has a place to lay eggs. Propagation and supply of M. vittaticollis: M. vittaticolis was obtained from paddy fields in Pakisaji District, Malang Regency. The caught M. vittaticolis was brought to the laboratory where it was reared in a glass cage measuring 25 cm x 40 cm in which rice plants were provided at about 20 days after planting. Every day M. vittaticolis was fed ± 100 brown planthoppers. As additional nutrition, M. vittaticolis was given additional food in the form of grated carrots. M. vittaticolis is reared until it lays eggs and these eggs will later be used in biological observations. vittaticolis obtained from paddy fields in Pakisaji District, Malang Regency. The caught M. vittaticolis was brought to the laboratory where it was reared in a glass cage measuring 25 cm x 40 cm in which rice plants were provided at about 20 days after planting. Every day M. vittaticolis was fed ± 100 brown planthoppers. As additional nutrition, M. vittaticolis was given additional food in the form of grated carrots. M. vittaticolis is reared until it lays eggs and these eggs will later be used in biological observations. vittaticolis obtained from paddy fields in Pakisaji District, Malang Regency. The caught M. vittaticolis was brought to the laboratory where it was reared in a glass cage measuring 25 cm x 40 cm in which rice plants were provided at about 20 days after planting. Every day M. vittaticolis was fed ± 100 brown planthoppers. As additional nutrition, M. vittaticolis was given additional food in the form of grated carrots. M. vittaticolis is reared until it lays eggs and these eggs will later be used in biological observations. vittaticolis fed ± 100 brown planthoppers. As additional nutrition, M. vittaticolis was given additional food in the form of grated carrots. M. vittaticolis is reared until it lays eggs and these eggs will later be used in biological observations. vittaticolis fed ± 100 brown planthoppers. As additional nutrition, M. vittaticolis was given additional food in the form of grated carrots. M. vittaticolis is reared until it lays eggs and these eggs will later be used in biological observations.

a. presence or absence of wings and ovipositors or cerci. Body length and antenna length were measured using a ruler and millimeter paper. Imago: Imago M. vittaticolis were fed 15 juvenile brown planthopper nymphs instar 3 or 4 per day. Mated M. vittaticolis adults were reared in pairs in mica tubes with a diameter of 10 cm so that mating and egg laying occurred. While the parts that are not mated are kept separately between male and female imago. Parameters observed at imago included morphology, feed requirements, pre-oviposition, oviposition and post-oviposition periods, number of eggs produced each day and length of life. Feed requirements are calculated by finding the difference between the amount of feed given and the remaining feed. The pre-oviposition period is the time before the female imago lays eggs. counted from the time M. vittaticollis became an adult until the first day the female imago laid eggs. The oviposition period was calculated from the first day the female imago laid eggs until the last day she laid eggs. While the post-oviposition period was calculated from the last day the female imago laid eggs until the imago died.

3. RESULTS AND DISCUSSION

3.1 Research result

3.1.1 Biology Metioche vittaticollis Stal

a. Egg

The results of observations from eggs to adults are presented in Table 1. M. vittaticollis eggs are cylindrical in shape, have a hook at one end which functions as a tool to attach to plant tissue. Eggs are laid one by one in the rice stalks vertically, some of the eggs are visible from the outside, namely the end where there is a hook. Eggs are transparent white, smooth and shiny when newly laid. The color of the eggs changes to clear yellow and becomes darker or brownish as the eggs get older.

Table 1. Cycle and life span of male and female M. vittaticollis.

Development Stage	n	Mean ± SE (Days)	Range (Days)
Egg	141	15.57 ± 1.50	13 – 19
nymph	111	7.86 ± 0.87	7-10
Instar I	88	7.66 ± 0.71	6-10
Instar II	75	10.65 ± 2.79	8 - 13
Instar III	63	8.71 ± 1.26	7 - 13
IV instars	63	62.13 ± 3.93	53 - 71
Life cycle			
Imago	20	27.50 ± 1.82	25 – 30
Female (mating)	17	30.29 ± 4.12	26–36
Female (not mated)	20	24.45 ± 2.56	20 – 30
male (mating)	6	28.00 ± 1.55	26-30

The eggs that will hatch are brownish yellow and have black spots which are eye candidates. The average egg age was 15.57 ± 1.50 days with a range of 13 to 19 days (Table 1) and a hatchability of 18.70.50%. Eggs that don't hatch are thought to be due to water or humidity in the hatchery or possibly due to pathogens (fungi). Rice stalks become dry if there is a lack of water and become moist and grow mold if too much water is given. Eggs that do not hatch usually become dry and wrinkled due to lack of water or humidity in the place is too low. Some of the eggs that did not hatch turned black in color due to the presence of a fungus growing on the rice stalks and where the eggs were hatched.

b. nymph

At the time of hatching, the first instar nymph has a head that is larger than the thorax. Nymphs are transparent white. First instar nymphs that have just come out are more silent or if they move, their movements are slow. Nymphs will 19 start moving after a few hours later. The first instar nymphs are actively looking for food starting from the first instar nymphs 2 days after hatching. The average nymph length is 1.42 ± 0.09 mm. The average age of first instar nymphs was 7.86 ± 0.87 days with a range of 7-10 days (Table 1). Every day the first instar nymphs were

able to prey on the brown leafhoppers of the first instar nymphs on average as many as 2.33 ± 0.31 individuals (Table 2).

Table 2. The average feed requirement for each individual M. vittaticollis

Development Stage	n	Mean ± SE (tail)
nymph		
Instar I	111	2.33 ± 0.31
Instar II	88	3.82 ± 0.76
Instar III	75	5.15 ± 1.57
Instar IV	63	5.95 ± 1.23
Imago		
Female (Med)		
Female (Not Mating)	20	*8.17 ± 0.55*
Male (Med)	17	*7.89 ± 0.51*
Male (Unmarried)	20	*6.51 ± 0.49*
	6	*6.02 ± 0.48*

Table 3. Average body of M. vittaticollis

Development Stage	n	Mean ± SE(mm)
nymph	111	
Instar I	88	1.42 ± 0.09
Instar II	75	2.17 ± 0.05
Instar III	63	2.89 ± 0.67
IV instars	37	3.85 ± 0.25
Imago	26	5.28 ± 0.307
Female		4.92 ± 0.30
Male		

M. vittaticollis 4th instar nymphs are brown in color, with longer wings than 3rd instar nymphs and have covered half of their abdomen. The ovipositor in the female nymph is clearly visible, its size is longer and is black (dark brown). The femurs have stiff spines. The average 4th instar nymph lived for 8.71 ± 1.26 days with a range of 7-13 days (Table 1). Average body length 3.85 ± 0.25 mm (Table 3). Every day the 4th instar nymphs were able to prey on 5.95 ± 1.23 brown planthopper 2nd instar nymphs (Table 2).

c. Imago

Adult M. vittaticollis has a dark brown-black body. It has longer wings than the previous instar. The wings cover the entire abdomen. In long-winged adults, the forewings are almost twice as long as the abdomen. The legs are reddish yellow. The spines on the femur appear stiffer and harder. The tarsus consists of 3 segments. The average male body length is 4.92 ± 0.27 mm and that of the female is 5.28 ± 0.30 mm (Table 3).

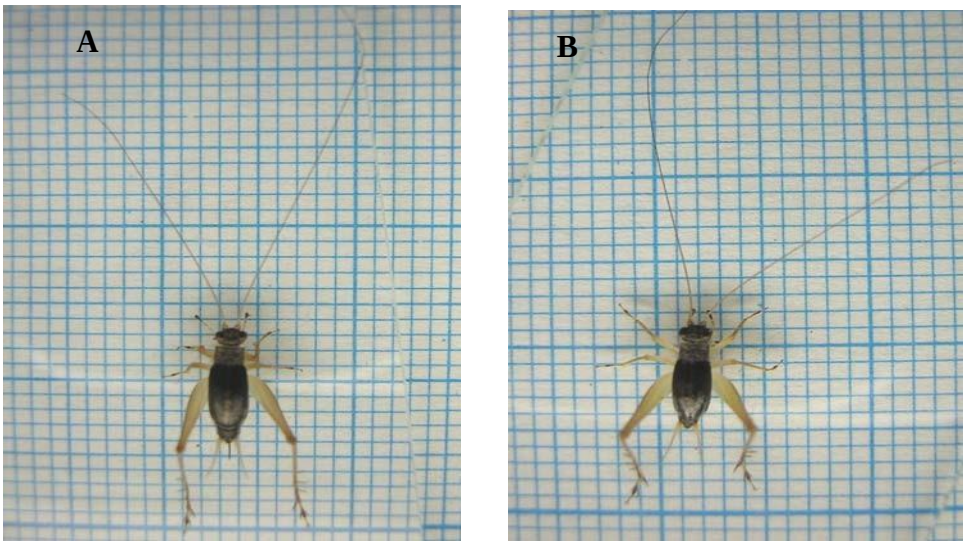

Image 1. Short-winged imago M. vittaticollis. (a) female imago, (b) male imago

The life span of M. vittaticollis imago was affected by the species that did not mate, which was longer than the mated imago, for both male and female imago. The lifespan of female imago is

longer than that of male imago. The average life span of male adults was 25.27 ± 0.27 days and the average lifespan of female adults was 28.95 ± 2.81 days (Table 2). Every day male imagos were able to prey on an average of 6.40 ± 0.53 brown planthopper nymphs instar 3 and female imagos were able to prey on an average of 8.04 ± 0.54 female brown planthopper nymphs instar 3.

d. Egg Laying Period

Some time after being paired, the male M. vittaticollis imago started chasing the female imago. The male imago continues to follow the female imago until the female imago is silent. Mating is done back to back, the male imago facing up and the female facing down. The results of observations of the egg laying period are presented in Table 4.

Table 4. Period of pre-oviposition, oviposition, post-oviposition and the number of eggs produced by M. vittaticollis

Development Stage	n	Mean ± SE (Day)	range (Day)
Pre oviposition	20	7.75 ± 0.91	6 – 9
Oviposition Post Oviposition	20	17.1 ± 1.65	14–20
Average Number of Eggs per Female	20	1.7 ± 0.66	1 – 3
	20	42.72 ± 4.09	35 - 51

M. vittaticollis starts laying eggs (oviposition) on average the 8th day after mating. The average egg-laying period of 17 days is counted from the first day of oviposition with a range of 14-20 days. The average female egg laying ability is 42.72 ± 4.09 eggs. One to three days before dying, M. vittaticollis stops laying eggs. Eggs are laid one by one (not clustered) vertically on the lower rice stalks.

3.1.2 Feed Requirement of M. vittaticollis

Based on the results of the analysis using the t test to compare the feed requirements of male M. vittaticollis and female imago, it shows that the t count obtained is 7.834 greater than the t table of 2.262 at the 5% level. Thus it is proven that there is a significant difference between the feed requirements of male and female imago. The female M. vittaticollis requires more feed than the male M. vittaticollis. This is presumably because the female imago requires more feed which she uses for preparation or egg-laying period. Female M. vittaticollis who are deficient in feed will experience egg laying productivity or even stop laying eggs, because to be able to produce sufficient eggs requires a large amount of energy or feed.

3.1.3 Age of Metioche vittaticollis

The results of the analysis using the t test to compare the age of imago showed that there was a significant difference in the age of mating male and female imago mating. While the comparison between the ages of unmarried male imago and unmarried female imago obtained results that were not significantly different at the 5% level. Likewise, the comparison of male imago (married and not married) and female imago (married and not married) showed that the results were not significantly different at the 5% level.

3.2 Discussion

At the beginning of instar 3 the body color of M. vittaticollis nymphs was bright yellow, after a few days the body color changed to brownish yellow. The parallel brown line extending from the head to the abdomen is more pronounced than in the previous instar. Wings are starting to appear even though they are very short. Ovipositor has started to appear with a short size. But sometimes the ovipositor is not clear, so it is still difficult to distinguish the sex. The 3rd instar nymphal stage lasts an average of 10.65 ± 2.79 days, with a life span of 8-13 days (Table 1). The third instar nymphs had an average body length of 2.89 ± 0.67 mm (Table 3) and every day M. vittaticollis was able to prey on 5.15 ± 1.57 brown planthoppers instar 2 nymphs (Table 2).

The survival rate of M. vittaticollis decreased as the stadia increased. In the first instar nymph stage, the survival rate did not reach 100% because not all M. vittaticollis eggs hatched. In instars 2 to 4 the number continues to decrease, this is due to the death of the previous instar. The biggest death is in the first instar nymphs, where at this stage the insects must adapt to the conditions and feed. Death in each nymphal instar is usually a few days after molting or at the time of molting.

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4. CONCLUSION

Based on the results of the study, it can be concluded that: Metioche vittaticollis has a survival rate in the egg stage of 70.5%, in the nymph stage instars 1, 2, 3 and 4 respectively of 55.5%, 44%, 35% and 31.5%; Life cycle of M. vittaticollis was 62.13 ± 3.93 days, egg phase was 15.57 ± 1.50 days, 1st instar nymph was 7.86 ± 0.87 days, 2nd instar nymph was 7. .66 ± 0.71 days, the length of the 3rd instar nymph phase was 10.65 ± 2.79 days and the 4th instar nymph phase was 8.71 ± 1.26 days; Imago M. vittaticollis mated females lived for 27.50 ± 1.82 days and those who were not mated lived for 30.29 ± 4.12 days. Meanwhile, mated male M. vittaticollis lived for 24.45 ± 2.56 days and those who were not mated lived for 28.00 ± 1.55 days; The prey power of female imago was 7.89 ± 0.51 brown planthopper nymphs instar 3 per day and male imago was 6.02 ± 0.48 brown planthopper nymphs instar 3 per day.

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As a generalist predator, M. vittaticollis has a wide host range. To determine its potential as a predator, further research is needed on its host preferences..

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