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Characteristic Morphology and Biology of Sycanus aurantiacus Ishikawa et Okajima, sp. nov. (Hemiptera: Reduviidae) on the Larvae of Tenebrio molitor L. (Coleoptera: Tenebrionidae)

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Abstract
The study on the Characteristic Morphology and Biology of *Sycanus aurantiacus* on *Tenebrio molitor* larvae was conducted in the Integrated Pest Management Laboratory, Program Study of Agroecotechnology, Udayana University, Bali, Indonesia. This research aims to identify the development and predation capacity of *S. aurantiacus* as a predator of *T. molitor* in the laboratory. Development of *S. aurantiacus* was monitored by observing the egg incubation period, the development stages and number nymph, and the longevity of the adult. Predation capacity of *S. aurantiacus* was observed by exposing five different densities of *T. molitor* larvae to an adult predator. The density of the prey exposed to the predator was 2, 4, 6, 8, 10 nymphs. Experiments on the development and predation capacity were conducted with ten replications. This study revealed that the egg incubation period of *S. aurantiacus* was 12-14 days. The development time of the 1st, 2nd, 3rd, 4th, and 5th instars were 13,8 ± 1,39; 9,3 ± 1,77; 10,4 ± 1,58; 11,0 ± 1,76; and 19,1 ± 2,88, respectively. The longevity of *S. aurantiacus* adults were 82,7 ± 11,7days. The females laid eggs 8-14 days after copulation. A female could lay 5-11 egg clusters containing 35-73 eggs each. Predation capacity of *S. aurantiacus* when fed with *T. molitor* was 6,6 larvae per day.
Keywords: Sycanus aurantiacus, Reduviidae, predator, Tenebrio molitor

1. Introduction

Sycanus aurantiacus, a subfamily of Harpactorinae, order Hemiptera is a new species discovered by Isikawa *et al*., on cabbage leaves and greenhouse walls in an experimental field located in Pancasari village, Buleleng regency, Bali in 2004 (Isikawa et al., 2007). *S. aurantiacus* was found preying on a number of Lepidoptera larvae, one of cabbage pests. *Sycanus* is commonly known as predator that feed on bagworms on oil palms by piercing the worm's coat with its long rostrum (de Chenon et al., 1989; Zulkefli et al., 2004 in Ahmad et al., 2011). To date, information regarding the biology of *S. aurantiacus* remains nil. According to DeBach (1971), the successful utilization of natural enemies in integrated pest management is based on the basic knowledge of the biological aspects of natural enemies. Thus, information about the biology of *S. aurantiacus* is required. A study of *S. aurantiacus'* biological aspects (life cycle, longevity, and fertility of adult) is conducted to obtain the needed information.

Rearing was done by using *Tenebrio molitor* larvae. *T. molitor* beetle. *T. molitor* belongs to order Coleoptera, which falls under the family Tenebrionidae (Frost 1959). Naturally a postharvest pest, humans have been benefiting from *T. molitor* cultivation for bird feed as well as for various laboratory experiments object. The worms easily multiply and requires simple maintenance.

The result of this study will become one of the latest methods in rearing *S. aurantiacus* for research related to biological control, especially for biological control research on *Plutella xylostella* L. and *Crocidolomia pavonana*, prominent cabbage pests.

2. Materials and Methods

This study was conducted from October 2012 to July 2014 at Plant Protection Laboratory, Department of Agroecotechnology, Faculty of Agriculture, Udayana University. The temperature during the experiment was between 25-30^{0}C with relative humidity ranging from 70% to 80%. The materials consisted of *S. aurantiacus*, *T. molitor* larvae, plastic jars, Petri dishes, plastic cups, plastic lids, cotton, tissue and gauze.

S. aurantiacus was discovered on greenhouse walls and around the cabbage farm in Pancasari village. *S. aurantiacus* was kept in laboratory and reared. *S. aurantiacus* was placed into a plastic box (15 cm high and 10 cm in diameter). Each plastic box containing a pair of *S. aurantiacus* was given *T. molitor* larvae as prey every day. The *S. aurantiacus'* development was observed from the eggs, nymphs, the life span of imago, and its fecundity. Ten pairs of *S. aurantiacus* imago reared in the laboratory were used for this experiment.

Date and number of eggs laid were recorded to determine the egg laying pattern and the period of incubation. The number of egg clusters, egg laying pattern, and egg hatching are parts of egg development observation, which began since the eggs were laid.

The nymph development was observed from the eggs hatched, the number of nymphs, the nymph's first molting, until it became an imago. The one-day old nymphs were moved into a wet cotton based Petri dish. On the second day, the first nymphs were transferred to plastic boxes (7 cm in height and 5 cm in diameter), which each containing three nymphs that were exposed to *T. molitor* larvae prey. Observation was made every day to identify the development of nymph becoming imago. The longevity of imago was monitored since the nymph's last instar until its decease. Fecundity was observed from the number of eggs laid by the females during ones' lifespan.

3. Result and Discussion

3.1 Eggs

Eggs were laid in clusters, attached to each other, and were placed below the surface of the plastic lid (Figure 1). The female adult of *S. aurantiacus* can lay 5-11 egg clusters within one's lifespan. One egg cluster consisted of 35-73 eggs, which hatched on the same day. The incubation period was 12 – 14 days. The eggs were brown in colour. Of ten pairs of *S. aurantiacus,* each laid 7, 5, 6, 8, 11, 8, 9, 10, 6 and 7 egg clusters. According to Zulkefli et al. (2004), the egg incubation period of *Sycanus dichotomus* is 11-39 days. Syari, *et al*. (2011) reported *Sycanus dichotomus* lays 1-4 brownish egg clusters throughout its lifespan. Considering *S. aurantiacus* lays more eggs (5-11 clusters) than *Sycanus dichotomus* (1-4 clusters), *S. aurantiacus* can be considered as a more prospective predator. An indicator of a predator is potentially becoming a superior predator is if one spawns a large number of offspring.

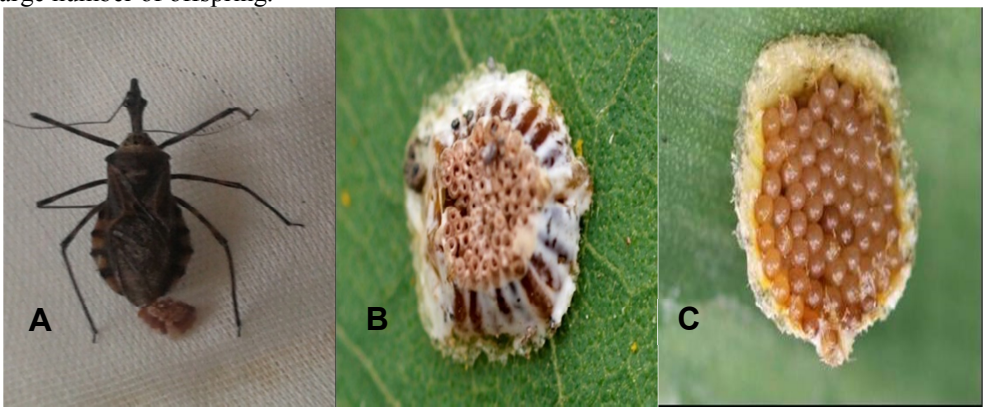

Figure 1. *S. aurantiacus* lays eggs (a), an egg

Figure 1. *S. aurantiacus* lays eggs (a), an egg cluster (b) and an egg cluster (c)

4. Nymph

Nymphs underwent five instars (Figure 3). The newly hatched nymph had an orange color. After three days, the nymph would move quickly to find its prey (Figure 2). The average stadia of nymph I was 13,8 ± 1,39 days with 1,93 ± 0,03 mm body length. The average stadia of nymph II was 9.3 ± 1.77 days with physical length approximately 2,8 ± 0,24 mm. Nymph II had an orange colour with dark or black abdomen. Nymph III had average stadia of 10.4 ± 1,58 days, 4,4 ± 0,50 mm long, with dark colour. Nymph IV average stadia was 11,00 ± 1,76 days and the body length measured 10,4 ± 0,46 mm. The average stadia of nymph V was 19,1 ± 2,88 days, with 17,3 ± 0,54 mm body length. The lifespan of a female imago lasted for 82,7 ± 11,75 days. The female adult could grow 21,0 ± 0.82 mm long. Meanwhile, male imago lived for 110,4 ± 10,03 days with 17,8 ± 0,63 mm length.

Figure 2. *S. aurantiacus* Nymphs I

Figure 3. *S. aurantiacus* Nymphs and Adult

Figure 4. The process of *S. aurantiacus* Nymph V becoming an adult

Table 1. The Average Period of Development of *Sycanus aurantiacus* Nypmhs and Adult

Nymph	Period (Days)
I	13,8± 1,39
II	9,3± 1,77
III	10,4± 1,58
IV	11,0± 1,76
V	19,1± 2,88
Female imago	82,7± 11,75
Male imago	110,4± 10,03

5. Imago

Newly molted instar V nymph turned imago had a pale orange color; 2 hours and 30 minutes later they became darkish again (Figure 4). At the time of molting, the nymphs were not active and very weak. During this process nymphs can sometimes become the prey to other adults when their preys are not available. The longevity of the female adult observed starting from the latest nymph until its decease was 82,7 ± 11,75 days.

The female adult can be distinguished from the male by looking at the tip of the imago's abdomen (Figure 5). The tip of the abdomen of the adult male is rounded while the female's looks more pointed. The female is larger than the male (Figure 5). After 20 days of the last molting, the male and female imagos of *S. aurantiacus* copulate to reproduce the next generation. The egg laying pattern of female *S. aurantiacus*, starting from the first cluster until the eleventh cluster was recorded: 4, 5, 5, 5, 6, 6, 6, 6, 7, 7 and 8 days.

Figure 5. *S. aurantiacus*: male (A) and female (B)

6. The Predation Capacity of *Sycanus aurantiacus* on the Larvae of *Tenebrio molitor*

The behavior of S. *aurantiacus* when it preys on its target: first, *S. aurantiacus* approaches its prey; then it pierces the prey with its stylet, lift it, and then sucks the liquid of its prey until it perishes. *S. aurantiacus* kills by piercing its stylet through the thorax or body of its prey. If the prey is larger, *S. aurantiacus* will hold its prey with both of its front legs prior to perforation. Predation capacity of *S. aurantiacus* when fed with *T. molitor* was 6,6 larvae per day. Predation capacity of *S. aurantiacus* on *T. molitor* with density of 8 and 10 larvae was 85% and 72%, respectively.

Table 2. The Predation Capacity of *S. aurantiacus* on the Larvae of *T. molitor*

Prey Density (Individual)	Repetition					Average	Predation Level (%)
	I	II	III	IV	V		
2	2	2	2	2	2	2	100
4	4	4	4	4	4	4	100
6	6	6	6	6	6	6	100
8	6	6	7	6	7	6,4	85
10	7	6	6	7	7	6,6	72

Figure 6. Nymph II of *S. aurantiacus* preys on *T. molitor* (A), Nymph V of *S. aurantiacus* preys on *T. molitor* (B) and the female adult of *S. aurantiacus* preys *on T. molitor* (C).

7. Conclusion

Female *S. aurantiacus* laid 5-11 egg clusters, containing 35 to 73 eggs each in 8-14 days after copulation. The egg incubation periode of *S. aurantiacus* was 12-14 days. Eggs were laid in groups and parallel to each other (Figure 1). The eggs were brownish. Of ten pairs of *S. aurantiacus*, each laid 7, 5, 6, 8, 11, 8, 9, 10, 6 and 7 clusters of eggs. Nymphs underwent five stages instars to become adults. Newly hatched nymphs were orange in color. The average stadia of the nymphs I, II, III, IV and V were 13,8 ± 1,39 days; 9,3 ± 1,77 days; 10,4 ± 1,58 days; 11,00 ± 1,76 and 19,1 ± 2,88 days respectively. The lifespan of *S. aurantiacus* adult female was 82,7 ± 11,75 days, whilst adult male reached 110,4 ± 10,03 days. Predation capacity of *S. aurantiacus* when fed with *T. molitor* was 6,6 larvae per day.

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