

Biology of *Coccinella transversalis* Muls. (Coleoptera: Coccinellidae)

Brenda C. Balbarino and Ma. Juliet C. Ceniza

Department of Pest Management,
Leyte State University, Baybay, Leyte, Philippines 6521-A

ABSTRACT

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The biology of *Coccinella transversalis* reared on black bean aphid, *Aphis craccivora* was studied in the laboratory. The beetle passed through the egg, 4 larval instars, pupa and adult stages. The eggs were spindle-shaped and had an incubation of 2-3 days with an average of 2.85 days. The larvae which were typically black with orange bands or tinge on the methoracic region and some part of the abdomen had a total development period of about 6-9 days, with an average of 7.27 days. The pupal period lasted for about 3-4 days, or 3.83 days on the average. The total developmental period from egg to adult emergence took about 13-15 days. The adults which were typically red orange with black inverted v markings on the elytra lived for an average of 51.34 days. The female laid an average of 1000 eggs under laboratory conditions.

Keywords: Coccinellidae, *Coccinella transversalis*, biology of coccinellid beetle, *Aphis craccivora*

INTRODUCTION

Ladybeetles or coccinellids are a well-known group of small, oval, convex and often brightly colored insects. They have a red orange or yellow elytra, frequently spotted with black stripes. Coccinellids are of major economic importance either because of their beneficial activity in controlling pests or because of their own pest status. Many species are well known for their biological control potential and have been distributed to various parts of the world to combat insect pests of agricultural crops (De Bach, 1974).

Coccinella transversalis is one of the many coccinellids commonly encountered in the field. This species has been observed feeding on aphids attacking bush bean plants. However, its efficiency as a mortality factor to some pest populations, especially bean aphids has not been investigated. To have a better assessment of the efficiency of these predators as biological control or natural agents in the field and develop a mass rearing technique, it is important that a study on its biology and reproductive potential should be done. This study was thus conducted to determine the duration of the different life stages of *Coccinella transversalis* Mulsant.

MATERIALS AND METHODS

Maintenance of host plant for the prey species

Three bush bean plants were planted in each pot (12 cm dia.) to serve as host for the prey species of *Coccinella transversalis*. Planting was done at one week interval with five pots per planting time. The plants were watered regularly. One-month old plants were infested with black bean aphids (*Aphis craccivora* Koch) as prey species to mass rear the coccinellids.

Maintenance of stock culture of the beetle

Adults of the *C. transversalis* beetles were collected from the field. They were confined in rearing jars provided with bush bean heavily infested with aphids for food and as oviposition substrate. Larvae were likewise placed

in separate glass jars, provided with aphids as food and allowed to emerge as adults. Cotton ball soaked in water was placed in the jars to provide moisture.

Eggs laid by the adults were collected daily, incubated and allowed to hatch for the biology studies.

Life history studies

One hundred newly-hatched larvae of *C. transversalis* were reared individually in vials (5 cm long and 2 cm dia.) covered with nylon sheer and tied with a rubber band to prevent the larvae from getting out. The development of the larvae was noted including the morphological characteristics and duration of the different larval instars. Body measurements were also taken. The sex of the emerging adult from the individual cultures was determined by ocular examination of the genitalia and the male to female ratio was computed. The newly emerged adults were allowed to mate and each pair was kept in separate rearing bottle to determine their mating behavior, longevity and fecundity of the female. The paired beetles were provided with prey species for food. As soon as the eggs were laid, the number of eggs per female was counted. The eggs were incubated in petri dishes and the percent hatchability was determined.

RESULTS AND DISCUSSION

Life history studies

Developmental period. Table 1 shows the duration of the different developmental stages of *C. transversalis* reared on *Aphis craccivora*. The beetle passed through the following stages: egg, 4 larval instars, pupa and adult. The incubation period of eggs lasted for 2-3 days with an average of 2.85 days. The total larval development lasted for only 7.27 days on the average, which ranged from 2 to 3 days during the first two instars and about 1 to 2 days during the later instars. Pupal period lasted for three days, after which the adult emerged. The total life cycle of the beetle, from egg laying to adult emergence took about 13 to 15 days with an average of 13.95 days, and the adults lived for 38 to 62 days with an average of 51.34 days. This

Table 1. Duration (days) of the different stages, longevity and fecundity of adults and egg hatchability of *C. transversalis* reared on black bean aphid, *Aphis craccivora**

Developmental period	Range	Mean \pm SD		
Incubation period	2-3	2.85	\pm	0.36
<u>Larval period</u>				
First stadium	2-3	2.86	\pm	0.35
Second stadium	2-3	2.11	\pm	0.31
Third stadium	1-2	1.17	\pm	0.37
Fourth stadium	1-2	1.11	\pm	0.31
<u>Total larval period</u>	6-9	7.27	\pm	0.63
Pupal period	3-4	3.83	\pm	0.38
Egg laying to adult emergence	13-15	13.95	\pm	0.65
Longevity of adults (pupa to mortality)	38-62	51.34	\pm	8.66
Egg laying period	25-57	51.34	\pm	8.66
Eggs laid	1000.50			
Percent hatchability	95.53			

* Data based on 100 individuals reared for two generations

observation was longer compared to a species of *Scymnus trukensis* reared on abaca aphid, *Pentalonia nigronervosa* (Garcia and Calilung, 1996).

However, in comparison to other species of coccinellid, *Curinus coeruleus* Muls. reared on Leucaena psyllid, *H. cubana*, the total development of *C. transversalis* period was relatively shorter than the former by about 14 days (Villacarlos and Robin, 1992). Similarly, comparing *C. transversalis* to a species of *Pseudocymnus* reared on *Aspidiotus destructor*, the latter has a longer developmental duration by about one week or so (Cadapan, *et al.*, 1984). This shows that species of coccinellids do vary in the duration of their developmental period and may depend greatly on the host species on which they are reared.

Table 2. Body measurements (mm) of the different developmental stages of *C. transversalis* reared on black bean aphid, *Aphis craccivora* Koch.

Developmental period	Range	Mean \pm SD		
Eggs	1-1.5	1.15	\pm	0.24
Larval period				
First instar	1-2	1.35	\pm	0.34
Second instar	3.5-5	4.15	\pm	0.47
Third instar	5-6	5.30	\pm	0.48
Fourth instar	6-8	5.90	\pm	0.57
Pupa				
Length	3-4.5	3.90	\pm	0.40
Width	2-2.5	2.31	\pm	0.25
Adult				
Body length	4-5.5	4.65	\pm	0.68
Body width	3-4.5	3.71	\pm	0.52
Elytra length	3-4.5	3.70	\pm	0.52
Elytra width	2-3	2.42	\pm	0.40

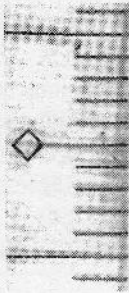
Characteristics of the different life stages

Egg (Figure 1a). Eggs were yellowish to reddish-orange in color, oval and spindle-shaped and measured about 1 mm long (Table 2). They were laid mostly in clusters on the underside of a bean leaf or stem, even in the rearing bottle itself, with each egg attached to the substrate by their narrower end. Each cluster consisted of 20 to 25 eggs on the average. One to two days after they were laid, the color changed into light yellow coloration, and especially the tip of the egg turned almost white in color. On the third day, the eggs became grayish, as they were about to hatch. This incubation period or duration is comparable to that of *Coelophora inaequalis* observed by Mora *et al.* (1995) to hatch in 3 days.

Larval instars (Figure 1b). Eclosion of the larva from egg was gradual, and after hatching the larva stayed near or even on the top of the egg shell for a day. The larva then became active and crawled in search for food. The different larval instars were characterized as follows:



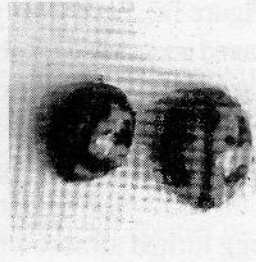
a



b



c



d

Figure 1. A) Eggs, B) Larval instars, C) Pupa, and D) Adults of *Coccinella transversalis* reared on black bean aphid, *A. craccivora*

First instar. The newly emerged larva measured about 1 to 2 mm in body length (Table 2). It has uniform grey body coloration. The head portion had a conspicuous curvature line or lyre-like mark. The spines on its body were not yet developed and were inconspicuous. The larva was less mobile.

Second instar. The body length measured about 3.5 to 5.0 mm. The head and the thoracic region including the three pairs of legs turned black, while all the abdominal segments were light grey. However, the lateral sides of the metathorax where the third pair of legs arose, were observed to be light orange.

Third instar. Two dorsal spots started to appear on the sub-lateral sides of the head near the eyes of the larva. The thorax including the 3 pairs of legs maintained the black coloration but the metathorax assumed a darker orange tinge than in the second instar. All the abdominal segments became darker grey with two black spots appearing on the dorsal medial portion of each segment, except the second segment which was orange in color. The third instar larva measured about 5 to 6 mm long.

Fourth instar. The orange spots on the head were now more obvious, and the thorax including the legs remained black in color. However, the lateral sides of the metathoracic segments became very pronounced and the orange coloration extended up to the meso- and prothoracic segments, although the color can only be seen as streaks. The abdominal segments were now uniformly black, so that spots on the abdominal segments were not anymore discernible. Furthermore, the spines on the body of the larva had become well developed.

Pupa (Figure 1c). Prior to pupation, the larva became sluggish and curled up and anchored its abdominal segments on the rearing jars or nylon tulle cover. The late instar larva was observed to have a whitish secretion on its apical abdominal segments which most probably made the anchorage possible, and the larva being glued on to a substrate in preparation for the pupal stage.

During ecdysis to pupa, the larval skin was sloughed off from the pupa right up to the point where the cauda was attached to the substrate. The pupa was not entirely immobile. If irritated or disturbed, the head region raised by upward jerks of the body several times.

The newly developed pupa had a light yellow color and turned dark with time. A day after pupal development, dark orange stripes appeared

primarily on the body region while black spot patterns also developed at the head and abdominal portions of the pupa.

Adult (Figure 1d). The adult measured 4.65 mm long and 3.71 mm wide on the average. The elytra of the newly emerged adults were at first soft, with uniform yellow color, devoid of wing patterns. Its normal color appeared gradually, becoming orange at first with its typical black wavy line markings. The changes occurred in a matter of hours. The beetle remained longer in this lighter shade for a couple of weeks or a month before its elytra projected the red orange hues contrasted with the black wavy line markings.

Sexual dimorphism in adults of this species was not very well pronounced. However, sexes were determined by examining the vertical apical segments of the abdomen. The sex ratio observed was 1:1.17, female and male respectively.

The adults of both sexes lived for about 38 to 62 days, with an average life span of 51.34 days. Based on the laboratory observations, the females succumbed to earlier mortality than the males, usually 5 to 6 days after final oviposition. Hodek (1967) mentioned that some coccinellids can even live up to a year.

Mating behaviour and copulation

Mating in the laboratory usually commenced with the male chasing the female. Usually copulation became successful only after a few to several attempts of the male to mount the female. Mating occurred only after one week of keeping newly emerged male and female adults together. Like any other coccinellid species, the male approached the female at its back, grasping the latter with its fore- and middle legs. The male then bent its abdominal apex down and its genitalia was extended out to mate with the female. The pair usually remained together in copula for three to four hours on the average. Mating occurred once or three times a day, and repeated mating occurred during the beetle's life. Drea and Gordon (1990) reported that some coccinellids remained in copula for hours.

Oviposition and fecundity of female

Egg laying was observed to occur two to three days after the adult females had been mated, or approximately 8 to 10 days after adult emergence.

The female beetles oviposited eggs once or twice a day, especially during early morning or late afternoon. Throughout its adult life span, the female laid an average of about 1000.5 eggs, or roughly 17 to 40 eggs daily per female during the average of 35 days of active egg laying period. In a report by Kaufman (1977), some species of *Chilocorus* produced more than 600 eggs in the laboratory during their lifetime. The eggs of mated female had about 95 % hatchability. On the other hand, unmated females rarely oviposited eggs and if there were, these eggs were unfertile and unable to hatch. It turned brown to black in color and became shriveled.

The fecundity potential of *C. transversalis* observed in this study was observed to be higher than some of the species of coccinellid beetles reported. For example, *S. trukensis* laid only a range of 21-152 eggs during its oviposition period or its life span. On the other hand, *C. coeruleus* females laid only 90 eggs during its lifetime of 61 days.

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