

BIONOMICS OF HIPPODAMIA TRIDECEUM-PUNCTATA L.

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In working with the Coccinellids, one will soon find that the larvæ of the different species are very hard to separate by a superficial examination. There is one species, however, to which this statement will not apply, this being the common 13-spotted Lady-bird beetle, *Hippodamia 13-punctata*. Due to its distinct coloring considerable interest in the species was aroused, and a brief review of the literature dealing with it was undertaken. This showed that while the species was mentioned frequently, and had been used as a subject in morphological studies, very little was known in regard to its life history.

HISTORICAL AND DISTRIBUTION.

Professor C. M. Weed, working at Ohio State University, in 1889, described the pupa and noted that the beetle was frequently found in aquatic situations. Mulsant has observed that in Europe it is frequently found on water plants infested with aphids. Gage, '20, has published a technical description of the larva and Professor Comstock has used the beetle in working out his system of wing venation.

It has a wide range, extending throughout the more northernly parts of the northern Hemisphere in Europe, Asia and North America.

LIFE HISTORY.

Individual larvæ and beetles were successfully reared under the inverted halves of petri dishes placed on a smooth surface. Aphids were fed to them daily, either attached to leaves or stems, or free from any plant tissue.

The eggs are found on the underside of leaves, usually in groups of from ten to forty. They are typically Coccinellid as to individuals and to groups, and bear no characters by which they can be distinguished from the eggs of other related species. In confinement, the females attach their eggs usually to the most convenient surface, but utilize shaded locations, if these are available. Under the usual summer temperatures eggs

hatch in three days, differences of from twelve to twenty-four hours from this period having been noted. Six to ten hours make up the hatching periods of large groups of eggs.

In hatching, the chorion cracks irregularly along the dorsal side, and the first part of the larva to appear and free itself is the prothorax. This is then bent backward and the head is released. By bending backward and forward, the legs and other thoracic segments are freed in order. This will have taken place in about ten minutes. The larva now rests for about an hour, then attaches its legs, and crawls out of the shell. After hatching, the larvæ spend from six to twelve hours grouped on the empty shells feeding on the inner and outer surfaces. At the end of this time they have become very black, and soon leave the shells in search of other food which they must have if they are to pass successfully the first instar. Four or five aphids will enable them to do this.

The larvæ are to be found in the same habitat as the aphids on which they feed. This species seems to be better adapted to prey on aphids on aquatic plants than other Coccinellids, at least they are found there in greater numbers. The larvæ are very active in their search for food, and after touching an aphid exhibit great excitement in securing it. A first instar larva will use several hours in devouring an adult aphid, while a mature larva will need only five to ten minutes for the same purpose.

The larvæ have four instars. A large number of larvæ were reared from hatching to pupation during July and August, and the following average lengths of the different instars were compiled from this source.

INSTAR	AVERAGE	MAXIMUM	MINIMUM
First.....	3 Days	4 Days	2 Days
Second.....	1½ "	3 "	1 "
Third.....	2 "	3 "	1 "
Fourth.....	4½ "	6 "	3 "

When ready to moult the larva attaches itself by the tip of the abdomen and remains in this position for from one to six hours. The skin then cracks along the dorsal surface and the larva crawls out. The actual operation of moulting occupies only a very few minutes.

The feeding habits of the larvæ and the number of aphids that they destroy is of great interest from an economic standpoint. Seventeen larvæ were used to secure the feeding records, which are summarized as follows:

INSTAR	AVERAGE NUMBER OF APHIDS DESTROYED	MAXIMUM	MINIMUM
First.....	17	38	7
Second.....	16	31	5
Third.....	32	56	10
Fourth.....	55	82	25

Average total—120.

This feeding record shows that the species may be of considerable economic importance in the immature stages though not to the degree that exists in some other Coccinellids. *Myzus persicæ* was the aphid used in feeding tests.

Near the end of the last larval instar, preparation for pupation is made by attaching the tip of the abdomen to any convenient surface. According to Gage, '20, attachment is secured by means of a sucking disk, which surrounds the anal opening and is formed by evaginations of the rectum. In from twelve to thirty-six hours the larval skin splits dorsally and the pupa by vigorous rocking motions succeeds in crowding it down about the tip of the abdomen, where it remains. The pupa at first is pale yellow, but in a few hours the characteristic black markings appear and are fully developed. The pupal period averages slightly over three days.

The adults emerge from the pupa case much as the larvæ do when moulting. They are pale yellow, but the black color pattern develops within the first hour. I have collected the beetles most commonly on crucifers, where they were feeding on *Myzus persicæ*, *Brevycorne brassicæ* and *Rhopalosiphum pseudo-brassicæ*. On aquatic plants I have taken them feeding on *Myzus nymphalæ*.

In hunting for food the adults are vigorous and more effective than the larvæ. They use their eyes, and have frequently been seen to pursue and capture aphids which were tumbling down the sloping surface of a leaf.

Feeding records were taken separately for males and females, each lot being carried over a ten day period, with the following results.

The males averaged a destruction of twenty aphids per day, while the females destroyed forty-two, thus giving an average of over thirty per day for the two sexes. This average is not as high as has been recorded for *Hippodamia convergens*, or *Coccinella 9-notata*, but exceeds the records of *Hippodamia parenthesis* and *Adalia bi-punctata*. There is no doubt that where food is abundant in the field, the females in particular, will exceed the record given above.

The pre-oviposition period was observed in only a few instances, where it varied from five to eight days. It is thought that a scarcity of food may have something to do with the length of these periods.

After females have been fertilized, fertile eggs will be laid for about three weeks, at the end of this time the eggs become sterile. If a male is again introduced the fertility of the eggs will be restored in from three to six days. Females will oviposit without having been fertilized, but the production of eggs is much less, scarcely a fourth of the usual number.

Egg laying records were taken for five females which averaged four hundred and seven eggs each for the entire oviposition period.

There was a definite effect on egg production due to varying amounts of food. When only five to ten aphids were available daily, as food, neither copulation nor egg laying occurred. If fifty or more aphids were at hand, egg laying proceeded at the maximum rate. By varying the amount of food between these limits, a proportionate decrease or increase in egg laying was observed. With abundant food, the first oviposition of the year will occur in late April or May and will continue until October, unless interrupted by food shortage or very cold weather.

In the laboratory adults lived through periods varying from two to eight weeks in length, the average being about thirty days, if sufficient food was supplied. Beetles of the summer generations that are free will undoubtedly live through a longer period. The hibernating adults must live at least seven months, and probably live longer. A period from egg to egg, twenty-five days indicates that there could be four or five generations during

the summer. However, field observations show that there are rarely more than three.

Individuals of the last two generations overwinter and are to be found in grass clumps and under refuse near old aphid-infested plants.

DESCRIPTIONS.

The eggs are typically Coccinellid in size, color, shape and grouping. They possess no distinctive features. The larvæ of the early instars are easily recognized in the field by their black and white color. Since a complete description of the fourth instar larva has been published, (Gage, '20), the early stages will not be treated technically here. Weed's description of the pupa is correct for the autumnal forms, but those of the summer are lighter in color and have almost the same color pattern as *Hippodamia convergens*. The most convenient description of the adult is in "The Coleoptera of Indiana."

NATURAL ENEMIES.

Very rarely an adult may be found parasitized by the braconid *Dinocampus americanus*, Riley, which is common on other Coccinellids. The larvæ have been found attacked by the same chalcids that are parasitic upon the immature stages of other species, namely, *Homalatyclus flaminus*, *Pachneuron aphidiorum*, and *Pachneuron* sp. I have found no parasites on either eggs or pupæ. These stages, however, are frequently attacked by the adults and larvæ of all the Coccinellids, in case other food is not abundant.

From the limited literature and from observation, I believe that there is no disease of any importance attacking the beetle.

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