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NOTES ON TWO STRAWBERRY SLUGS.
EMPRIA FRAGARIAE ROHWER.
EMPRIA MACULATA NORTON.

R. L. WEBSTER.

The literature of economic entomology has many references to slugs that feed on strawberry foliage, discussed for the most part under the name of *Harpiphorus maculatus* Norton, but also as *Monostegia ignota* Norton. That there were two common species of these slugs affecting strawberry plants was shown by the work of F. W. Mally (1889). During the five years 1910-1914 inclusive, the writer has studied both these species in the insectary at Ames. The present paper is based on a study of the literature, as well as from additional notes of the writer. S. A. Rohwer, of the U. S. National Museum at Washington, examined all the saw-flies reared, and has recently described *Empria fragariae*. The life history notes are from the files of the entomological section of the Iowa Agricultural Experiment station at Ames. These insects are discussed in a recent bulletin from the Iowa station but some matter is incorporated here that is not mentioned in the bulletin.

Dr. C. V. Riley (1867), first mentioned *Emphytus maculatus* in the economic literature in the *Prairie Farmer*. This was followed by an account by Walsh and Riley (1869) and later by Riley (1877). These refer to slugs feeding on strawberry foliage in May (Missouri). The eggs are said to be deposited in the stems of the strawberry leaves and a second brood of slugs are said to appear in July. The slugs are described as having a yellowish head, with two dark brown spots above, one of these to the front, as well as two smaller ones at each side.

Dr. Riley (1868) said that slugs had injured strawberry plants at Rockford, Illinois, and Cedar Bluffs, Iowa. He remarked that these slugs were probably a variety of *Emphytus maculatus*, since they had but one black spot on each side of the head. This corresponds to the description of *Empria fragariae*, later discussed by F. W. Mally under the name of *Monostegia ignota*.

Forbes (1884) gave a general account of *Emphytus maculatus*, adapted from previous accounts by Riley and others. Here doubt is expressed concerning a second generation, since, aside from Riley, none had been seen by other observers.

In the same year Forbes (Ill. Hort. Soc. Rep.) treated briefly a strawberry slug under the name of *Emphytus maculatus*. In breeding this insect only one generation was found. The eggs were deposited beneath the epidermis of the leaf. Probably the insect concerned was *Empria fragariae*, which places its eggs in the leaf tissue.

F. M. Webster (1888), recorded the abundance of larvæ supposed to be *Emphytus maculatus* at Richmond, Indiana, in October, 1887. This appeared to indicate a second generation.

F. W. Mally (1889) was the first to point out clearly the presence of a second species of strawberry slug, differing in several respects from that discussed by Riley. Specimens sent by Mally to E. T. Cresson were determined as probably *Monostegia ignota* Norton. That the species reared by Mally is really *Empria fragariae* will be shown later on.

The main points established by Mally's work are these: (1) that two species of slugs are found on strawberry foliage in Iowa, (2) that these are easily distinguished in the larval stage and (3) that the eggs of the second species (*Empria fragariae*) are placed in the leaves, not in the stems. Later (1890) Mally showed that only one generation of this insect occurred in central Iowa.

F. M. Webster (1894) secured larvæ from strawberry plants at La Porte, Indiana, July 5, 1893. These entered the soil in an insectary cage, remained there all winter, and adults emerged the next March. Adults deposited eggs in stems of strawberry plants and specimens were determined by Dr. L. O. Howard, as *Harpiphorus maculatus*.

Dyar (1896), described seven larval stages of *Harpiphorus maculatus* and recorded rearing adults of that species from larvæ with immaculate heads, apparently contradicting Mally's observations. From these descriptions, however, it seems probable that Dyar had only the one species, *maculata*, and may not have seen specimens of the insect considered by Mally as

In Michigan R. H. Pettit (1899) recorded larvæ that he called *Harpiphorus maculatus* occurring at Stevensville and elsewhere in the state in the late summer of 1898. Larvæ about mature were reported for September 22.

J. M. Stedman (1901) gave a general account, under the name of *Harpiphorus maculatus*, of a strawberry slug occurring in Missouri. An examination of this bulletin, however, shows that it was not that species which Stedman studied. The life history and habits agree precisely with those of *Empria fragariae*, as described by F. W. Mally and as determined more recently by the writer. The deposition of eggs in the leaves and the appearance of adults and larvæ in early spring (about strawberry blossom time) shows that Stedman was writing of this insect under the wrong name. I have attempted to obtain reared specimens of the saw-fly from Columbia, but Dr. L. Haseman writes that he finds none in the collection there.

S. A. Rohwer (1914) described *Empria fragariae* from specimens reared or collected by the writer in Iowa. That this is the same insect discussed by F. W. Mally is shown by the facts (1) that most of the material was collected in the same locality, about Ames, (2) that the life history is the same; the saw-flies appear early in spring (before strawberry blossom time) and the eggs are placed in the leaves. Moreover, the writer found only one generation, as did Mally with his *Monostegia ignota*. Unfortunately, there are no specimens reared by Mally in the collection at Iowa State College, so that an actual comparison of specimens is not possible.

GENERATIONS OF EMPRIA FRAGARIAE.

From the literature it is very apparent that *Empria fragariae* has only one generation. The work of Forbes (1884) which apparently refers to this insect, of Mally (1890), and of Stedman (1901), all show this. Life history experiments by the writer more recently show but one generation in central Iowa. The insect has been carried through to the adult stage each year during four years, and in no case was there any evidence of a second generation.

Briefly, the life history of *Empria fragariae* is as follows: The adults emerge very early in spring, in April in central Iowa, deposit their eggs singly in strawberry leaves, and larvæ ap-

pear at the blossoming time of the strawberry. The slugs mature in about a month, enter the soil, where they remain until the next spring, pupating shortly before the adults emerge.

GENERATIONS OF *EMPRIA MACULATA*.

Here the situation is more complicated. In the literature we have the definite statement by Riley that the insect has two generations in Missouri, and the statements of F. M. Webster (1888) and Pettit (1899) that larvæ were found in abundance in the fall in Indiana and Michigan. On the other hand, no other writers have been able to discover a definite second generation. In fact, F. M. Webster (1894) determined a single generation from larvæ collected at La Porte, in northern Indiana.

The writer has bred this saw-fly in the insectary at Ames during four years, and each year there was but a single generation. According to these notes the life history in central Iowa is as follows: The adults emerge in late April or early May and deposit their eggs in the stems of strawberry plants. The larvæ hatch in late May and are present during June, mature and enter the soil about a month after hatching. Larvæ spend the winter in the cocoons, pupating the next spring shortly before the adults emerge. Adults reared in the insectary have been identified by S. A. Rohwer as *Empria maculata* Norton.

Eliminating references in the literature that clearly refer to *Empria fragariae*, the following generalizations are offered:

- (1) Riley claimed two generations for Missouri. This may be possible, since it has not been proved otherwise.
- (2) F. M. Webster determined only one generation from larvæ from La Porte in northern Indiana, in 1894.
- (3) Only one generation is present in central Iowa, according to notes by the writer.
- (4) This does not dispose of the statements that this insect has been seen in the fall in southern Indiana (Webster) and Michigan (Pettit).
- (5) There still remains a possibility that there is a third species of saw-fly, the larvæ of which attack strawberry plants in the fall, but which has not been recognized in the economic literature as a separate species.*

**Emphtus gillettei* MacG. feeds on strawberry foliage in Colorado but the eggs are placed in the leaf tissue and larvæ appear in late May and early June.

TWO STRAWBERRY SLUGS

The following table shows certain characteristics that distinguish these two species of strawberry slugs. The time of the season applies to central Iowa.

	<i>Empria fragariae</i>	<i>Empria maculata</i> .
Generations	One	One
Adults appear	Early April	Late April
Eggs deposited	In leaves	In stems
Larvæ appear	May (blossoms)	June (as fruit ripens)
Larvæ begin feeding	On upper epidermis	On lower epidermis
Head width stage I	.51 mm.	.32 mm.
Head markings	None	Dark markings above and at sides

ENTOMOLOGY SECTION,
IOWA AGRICULTURAL EXPERIMENT STATION.

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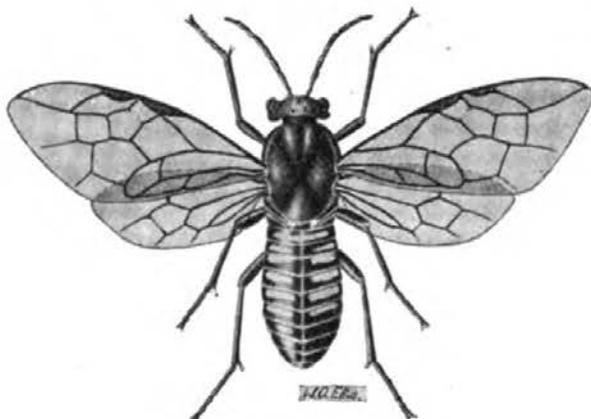


FIG. 1.



FIG. 2.

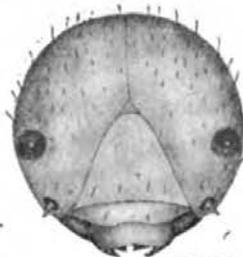


FIG. 3.



FIG. 4.

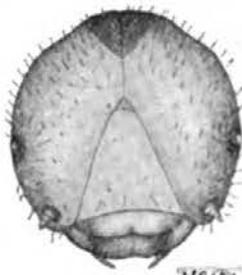


FIG. 5.



FIG. 6.

FIG. 1—The adult saw-fly. *Empria fragariae*. Enlarged 5 times.
 FIG. 2—*Empria fragariae*. Eggs on a strawberry leaf. Enlarged.
 FIG. 3—*Empria fragariae*. Head of mature larva. Enlarged.
 FIG. 4—*Empria maculata*. Head of larva from side. Enlarged.
 FIG. 5—*Empria maculata*. Head of larva from front. Enlarged.
 FIG. 6—*Empria fragariae*. The adult saw fly. Enlarged 5 times.