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United States Department of Agriculture,

DIVISION OF ENTOMOLOGY.

THE PEAR SLUG.

(*Eriocampoides limacina* Retzius.)

CHARACTERISTICS AND HISTORY.

The damage to the foliage of the pear, cherry, plum, and allied trees from the slimy slug-worm is familiar to every fruit grower. Two or three generations of these slug-worms, or "slugs," as they are also termed, appear during the summer and frequently in such extraordinary numbers, with the later broods, that the leaves of the attacked plants turn brown, die, and fall to the ground in midsummer, and the new growth of foliage which is afterward thrown out is often similarly destroyed. Trees thus denuded are much checked in growth or greatly injured, if not killed. When the slugs are very abundant, as they frequently are in July during the second brood, the sound of the eating of myriads of mouths resembles somewhat the falling of fine mist or rain on the leaves, and instead of one or two larvæ at work on a leaf there may be upward of thirty. Under such circumstances a very distinct and disagreeable odor is disseminated by the multitudes of slimy slug-like creatures.

The slug-fly is a small, glossy black insect, considerably less in size than the house fly, measuring only about one-fifth of an inch in length. The wings, which are four in number, are transparent, iridescent, and have a smoky band across the middle, which varies in intensity in different specimens. It belongs to the family commonly termed "saw-flies," (*Tenthredinidæ*) on account of the saw-like instrument or ovipositor with which the female insect places its eggs in the leaves or other soft parts of the plant.

FIG. 1.—PEAR SLUG: *a*, adult saw-fly, female; *b*, larva with slime removed; *c*, same in normal state; *d*, leaves with larvæ natural size; *a*, *b*, *c*, much enlarged (original).

The pear slug is an old enemy of fruit trees, and while it has been known in this country for over a hundred years as an American species, the interesting fact that it is the familiar slug-worm pest of the pear and plum trees of Europe has not hitherto been definitely ascertained. In Massachusetts, toward the latter part of the last century, this insect became very destructive, and Prof. Wm. D. Peck prepared an admirable, illustrated account of it under the title of "Natural History of the Slug Worm," which was printed in Boston in 1799 by the Massachusetts Society for the Promotion of Agriculture. The author obtained for the production the society's premium of \$50 and a gold medal. The account of this insect given by Professor Peck is fairly complete and accurate, but for fifty years it has been out of print and inaccessible, and I have not been able to consult it. Harris abridged and condensed it for his account of the slug-worm in his "Insects Injurious to Vegetation," published in 1841, and later writers have generally followed Harris.

In Europe this insect was one of the first of the injurious species that attracted attention, and one of the earliest of the economic writers on insects, Réaumur, in the fifth volume of his bulky work published in 1740, gives a short account of it, together with recognizable figures of the insect in different stages, illustrating also the effect of its work on leaves. The first description and name which stands out unquestioned is by Retzius (1783), who describes the species as *Tenthredo limacina*.

Linné, in describing what seems to have been an entirely distinct insect, which he called *Tenthredo cerasi*, quotes Réaumur's account of the slug-worm, which he erroneously took as belonging to his species, and very generally since, therefore, the former has been called *cerasi* Linn. (Cameron.)

Professor Peck in describing the insect gave it the name suggested by Linné, and was of the belief that the species occurring about Boston was at most a mere variety of Linné's species, meaning, however, the common pear-slug fly of Europe. Later American writers have treated it as a native species, and under the generic name of *Selandria* or *Eriocampa*, Peck has had the credit for it in this country, and the fact that Peck himself associated it with Linné's species has been generally overlooked.

That the species so common in this country is identical with the slug-fly of Europe has been fully established by a comparison of specimens from Europe with abundant American material.

In Europe this insect has been the subject of description by innumerable authors, having received at least nine different specific names and having been referred to some eight genera. In this country it has also been the subject of many short notices, but of very few full accounts other than the one published by Peck.

The pear slug is an insect which is easily distributed with the soil about the plants which it infests, and it has been so carried about the world until it has made its way into practically every civilized country. It is known at least to occur throughout Europe and America and in many of the British colonies. The slugs have been found on a great many different plants, Réaumur recording them on the plum and cherry, and especially pear, but also on the oak, and a recent catalogue by Dalla Torre indicates their occurrence on over thirty different plants in Europe. Certain stone fruits and the pear, particularly the latter, are their especial favorites.

LIFE HISTORY AND HABITS.

The parent fly may be seen on the pear or other trees which serve as food for the larvæ very early in the spring. In Washington, D. C., the present season they were observed on the newly-expanded leaves by the middle of April actively engaged in laying their eggs. In the latitude of Boston and northward the flies do not appear much before the middle of May, and the egg-laying is chiefly during the latter part of May and first of June. Judging from our experience here many of the eggs laid by the flies which appear in April perish during the cold wet weather which often characterizes this month. This was notably the case the present season, few, if any, of the eggs first deposited producing larvæ.

But one egg is deposited in a place, and it is always inserted from the under side of the leaf. The ovipositor is thrust obliquely through the leaf to the upper epidermis, but not piercing the latter, and shows there distinctly through the transparent upper skin of the leaf, as represented in the accompanying illustration (fig. 2), while the insect otherwise is completely hidden. The saw-like instrument, when brought into the position noted, is moved rapidly with a swinging lateral motion from side to side, cutting the upper epidermis free so as to form an irregular cell or pocket of peculiar flattened ovoid outline. The egg is quickly passed down between the plates of the ovipositor and dropped into the pocket thus made, the time occupied being a little over one minute for the entire operation.

FIG. 2.—PEAR SLUG, illustrating method of oviposition and emergence of larva: *a*, cutting of cell beneath epidermis, with ovipositor; *b*, same after egg has been deposited; *c*, same after escape of larva—enlarged (original).

Usually before placing the egg the fly runs about rapidly over the upper surface of the leaf, examining it carefully, and then goes over to the under side to insert an egg, after which she reappears on the upper surface of the leaf and rests for a minute or so before flying to another leaf.

It often happens that a good many eggs are deposited in a single leaf, but I am convinced that this is usually by different flies or at different visits by the same individual. The loosened epidermis about the egg dries somewhat, and the egg-cell soon appears as a minute brownish spot with the almost colorless egg showing at the center. The egg is oval, slightly flattened on one side, and remains in its peculiar cell (see fig. 2, *b*) for a period of about two weeks before the larva escapes. It is so placed in the leaf that it can be readily watched and its gradual increase in size by absorption from the leaf and the development of the young larva can be easily studied with a hand lens.

FIG. 3.—PEAR SLUG: *a*, last moulted larval skin; *b*, larva after casting last skin—somewhat enlarged (original).

The larva emerges on the upper surface of the leaf through a very regular semicircular cut which it makes near the center of the cell. At first it is clear or free from slime and in color nearly white, except the yellowish-brown head; but almost immediately the slimy or gluey olive-colored liquid begins to exude over its entire body, giving it the appearance of a minute slug, or soft snail, from which it gets its name. Its head is dark brown, appearing black under the slime, and the body also becomes almost equally dark. The anterior segments are much swollen, covering up and concealing the head and thoracic legs. In common with other saw-fly larvæ it has a great number of false legs or prolegs on the abdominal segments; in this species there are fourteen such prolegs, the terminal pair being wanting, and the tapering tip of the body is usually slightly elevated.

As soon as the larva emerges from the egg it begins feeding on the upper surface of the leaf, eating out small holes or patches about the size of a pin head or smaller, but never eating entirely through the leaf. The larvæ feed almost invariably on the upper side of the leaves and the minute eaten spots which they make at the start rapidly increase in size until much of it, but not the entire surface of the leaf, is denuded, leaving merely a network of veins, or a leaf skeleton, held together by a nearly intact lower epidermis. Leaves thus eaten turn brown, die, and fall to the ground, the tree being frequently defoliated, except for the effort it usually makes to put out a new growth.

The characteristic features of the larva are its swollen anterior seg-

ments and its olive-colored slimy covering, which last is probably a protection furnished by nature against the attacks of parasitic insects. It is very sluggish in movement, but has an enormous appetite. Its growth is rapid, full size being attained within considerably less than a month, usually about twenty-five days, the time varying a little with the nature of the weather. It does not alter much in appearance during growth, and ultimately reaches a length of nearly half an inch. It sheds its skin four times during its larval life, and usually eats its cast skin for its first meal after each moult. When full grown it moults a fifth time, but on this occasion leaves its cast skin as a slender line of slime attached to the leaf. The dark olive-green slimy appearance which has hitherto characterized the larva is lost with this last moult (see fig. 3, *a*, which shows last moulted skin), and in its stead it appears as a light orange-yellow worm, perfectly clean and dry, with the head light colored and only the minute circular eye-spots black (fig. 3, *b*). A greenish area shows along the posterior two-thirds of the body, which is merely the remains of the last meal appearing through the transparent skin. The larva does not feed after this moult, but crawls down the plant to the ground, which it burrows into actively, disappearing beneath the surface in a very short time. It penetrates to a depth of from half an inch to two or three inches, usually the lesser distance, and at the extremity of the burrow presses the soil away from itself so as to form a little cell or chamber, the sides of which it moistens with saliva. The drying and hardening of the walls of the chamber form a sort of cocoon of firm texture and more or less impervious to water (see fig. 4, *a*).

During the heated season of July and August the transformation from the larval to the pupal stage and from the latter to the adult insect is quite rapid, the pupal stage being assumed in from six to eight days, and the adult flies transforming and digging out through the soil some twelve or fifteen days after the larva entered it.

It seems from the studies by Peck, and in part confirmed by my own observations, that all of the larvæ of the spring brood do not transform at once, but some few of them remain unchanged as contracted dormant larvæ over winter to transform the next spring. It is true also of the second broods of larvæ that some of them come out the same season, while others remain over winter and do not pupate until shortly before the appearance of the adults in April and May. The holding over to the next year of certain larvæ of each brood is doubtless a provision of nature to prevent the extermination of the species by any untoward accident, such as the absence of food, unfavorable climatic conditions, or

FIG. 4.—PEAR SLUG: *a*, cocoon; *b*, contracted larva; *c*, pupa—all enlarged (original).

abundance of natural enemies which might prove disastrous to the species should all appear at once.

In the latitude of Washington, D. C., the first brood of larvæ practically all disappear from the trees by the end of June, and the first flies of the second brood begin to appear about June 20 and are out in greatest number about the first of July. It is the progeny of this second brood of flies that is particularly disastrous to the trees, although the spring brood of larvæ is often sufficiently abundant to do very serious injury.

NATURAL ENEMIES.

The slimy repellent covering of the larva does not altogether prevent its being preyed upon by parasitic insects, and in Europe some half dozen parasites have been reared from it. In this country Peck mentions a minute parasitic fly, determined by Westwood as a species of *Euclyptus*, which stings the egg of the slug-fly through the upper epidermis of the leaf, placing in each egg of its host a single one of its own—much more minute. The little parasitic maggot when it hatches finds food enough within the egg of the slug-fly for the needs of its full development, changes to the chrysalis therein, and ultimately emerges a perfect fly like its parent. So abundant is this parasite at times, as reported by Peck, that the second litter of eggs is sometimes nearly all destroyed. I have found evidence of the occurrence at Washington, D. C., of this or some related parasite, but failed to secure the adult insect.

REMEDIES AND PREVENTIVES.

In the effort to exterminate this insect the slimy covering exuded by the larvæ in such copiousness was formerly taken advantage of and applications of various powders and dusts were made to them, such as ashes, lime, or road dust, with the object of having it adhere to their viscid surface and kill them. Under this treatment, however, the larva usually merely sheds the incumbered skin and starts in life afresh with a new coat.

The best means of destroying the slug-worm is to spray the plants with an arsenical wash or with a simple soap solution. The larvæ are delicate and easily killed, and as they eat almost exclusively on the upper surface of the leaf where the poison can be most easily placed, they get the greatest amount of it and are the easiest of all larvæ to be thus exterminated. The plants may be sprayed with Paris green or other arsenical wash at the rate of 1 pound of the poison, mixed with an equal amount of lime, to 250 gallons of water.

The soap wash to be effective must be applied at a strength of one-half pound of soap to a gallon of water, first dissolving the soap, preferably whale oil, by boiling in a small quantity of water.

Where one has but few plants to spray and does not care to employ an arsenical or the soap wash, hellebore may be used either as a dry powder or as a wet spray. The powder may be applied with a bellows or dusted lightly over the plants from a cloth bag, making the application preferably when the plants are wet with dew.

So sensitive is the slug-worm that very heavy rains will often destroy it, and it is much less apt to be injurious in wet seasons. For this reason it may often be possible to rid plants of it by subjecting them to a forcible water spray.

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Approved:

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WASHINGTON, D. C., *August 28, 1897.*

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