OBSERVATIONS ON THE LIFE HISTORY OF THE CHERRY LEAF BEETLE

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INTRODUCTION

The cherry leaf beetle (Galerucella cavicollis Lec.), which attracted much attention during the season of 1915, is a native insect that has adopted several new food plants, at least in the beetle stage. Not since the first record of its work on cultivated plants, in 1894, has its injury been as great or as widespread as during the summer just past. It would seem that the early prediction of Davis (2), who first recorded the beetle's work on cherry (Prunus spp.), was about to be fulfilled, that as it was a northern and widespread species we might expect it to become increasingly injurious from year to year.

HISTORICAL REVIEW

The cherry leaf beetle was originally described by Le Conte in 1865 (5, p. 216) from a single specimen received from North Carolina. Nothing further is recorded of this beetle till 1890, when Packard, who found this species in large numbers at Berlin Falls, N. H., eating holes in the leaves of wild cherry, probably the pin cherry (Prunus pennsylvanica), refers (7, p. 529) to it under the name "Galeruca sanguinea." The next reference is by Davis (2), who reports it as being abundant at Bellaire, Mich., during the summer of 1894 and destroying the foliage of cultivated cherries. This is the first record of this beetle's attacking the foliage of cultivated trees, and Davis makes the suggestion that as this insect is a northern species it may yet become quite injurious. The larvae were found in this same locality; but it is not stated on what plants they were feeding, though the writer states that wild cherries were only a short distance away.

Lintner (6) records this beetle as occurring in thousands on June 10, 1895, at Ausable Forks, N. Y., feeding on the foliage of the cherry left uninjured by late frosts. He also states that his correspondent found this same insect at work early in July on the foliage of young chestnut trees, but that he did not verify this observation.

Felt (3), in 1898, records outbreaks of this insect at Corning, N. Y., the beetles occurring in such numbers as to threaten the destruction of the trees. Smith was the first to record the occurrence of this beetle on peach, having found it in Pennsylvania during the summer of 1898.

1 Reference is made by number to "Literature cited," p. 949.
Johnson (4) reports an extensive outbreak on "fire cherry" (Prunus pennsylvanica) at Ricketts, Wyoming County, Pa., during September, 1897, the beetles and larvae occurring in immense numbers.

Chittenden (1) reports outbreaks of this beetle in June, 1898, at St. Ignace, Mich., on cherry and at Spruce Creek, Huntington County, Mich., on young peach trees. He states that larvae are known to feed on cherry and probably also on peach, but mentions no definite records of such occurrences on the peach.

Since the publication of Chittenden's article, nothing has been recorded of this insect, and undoubtedly during all the years since 1898 no injury of any consequence has been committed by it.

OUTBREAKS IN NEW YORK IN 1915

During the summer of 1915 several severe outbreaks occurred in New York, the beetles defoliating cherry, peach (Amygdalus persica), and plum (Prunus spp.). On June 3 Mr. E. P. Putnam, of Jamestown, N. Y., wrote the Entomological Department, inclosing specimens of beetles, saying that they were defoliating wild cherry and peach trees in the park and also reported them as seriously defoliating cherry and peach trees throughout the town and neighboring districts. On June 11, Mr. H. B. Rogers reported them as injuring cherry and peach and later wrote that this beetle had done considerable injury throughout Chautauqua County. Reports of injury have been received from the following localities: Sonyea (cherry, peach, and plum); Perry, Scio (cherry); Olean, Honeoye Falls (cherry); Bath (cherry); Holland (cherry); Collins, Gowanda, Wyoming, Batavia (cherry and peach); Perrysburg (cherry); Jamestown (cherry and peach); Chautauqua (cherry and peach); Kennedy, Fredonia, Ripley (plum and peach); Castile (cherry); Elmira (cherry and peach); Hornell (cherry); and Ithaca (cherry and peach). All these reports came during the month of June and early in July and nothing has been heard of later injury. Evidently the beetles have not bred locally in such numbers that the work of the adults would attract attention in August and September.

The causes which brought about so widespread an outbreak of this insect can not at present be determined. Practically all the injury was restricted to western and southwestern New York. It has been suggested that the beetles migrated northward from Pennsylvania, but this does not seem plausible, as the native host, Prunus pennsylvanica, is a northern tree, occurring southward only as far as Pennsylvania and in the mountains to North Carolina and Tennessee. Conditions must have been favorable for the increase of this beetle in 1914 and hibernation must have been attended with little loss of life, resulting in such large numbers of the overwintering beetles as to cause overcrowding of the normal food plants. Should favorable conditions prevail during any year, we may again look for a sudden and perhaps more widespread outbreak.
LIFE HISTORY AND HABITS

The cherry leaf beetle is a pretty, dull-red beetle measuring 4.5 to 5.5 mm. in length (Pl. LXIV, fig. 1). The antennae are black, and the legs vary from almost black to nearly reddish in color. There are no strikingly distinguishing characters, but the coloring will nearly always serve to separate it from the more closely related northern species. The beetle is widely distributed, occurring from Canada through the New England States southward into Pennsylvania and west to Wisconsin. Chittenden (1) also records it from Texas and Vancouver, British Columbia. The original specimen described by Le Conte (5, p. 216) is from North Carolina.

This insect is one of our native beetles and up to 1894 had only been recorded on wild cherry. In that year it was found attacking the cultivated cherry, destroying the foliage. Later Smith (8) recorded it as injuring peach, and this year it has been reported as feeding on plum. How much more extended the feeding habits of this beetle may become cannot even be guessed, though its future destructiveness will depend largely upon whether the larvae can also adapt themselves to new and closely related food plants.

The beetles pass the winter in hibernation and, although the time of emergence has not been determined, they probably appear in May or, if the weather is favorable, during the latter part of April. They feed actively during May and June not only on the pin cherry but also on the peach, cherry, and in some instances the plum (Pl. LXV, fig. 5). In the field the beetles began to leave the cultivated food plants early in July and practically all had gone by the middle of the month.

In New York State there is only a single brood a season. The new brood of adults appears during the second week in August and becomes common during the latter part of the month and early September; they feed almost exclusively on the pin cherry and do not seem to migrate far from their host plant. In our rearing cages they began entering the soil or crawling under stones about the middle of September, but on fine days would return to feed on the pin-cherry foliage. In early October they had all entered hibernating quarters and did not leave them even on the finest or warmest days.

The work of the beetles is most noticeable during June and early July. After the middle of July the beetles had largely disappeared from the cultivated trees about Ithaca. Although many adults had been seen in copula, no eggs were observed, despite a close watch on all their new food plants. It was supposed that in accordance with the habits of closely allied species, as the elm leaf beetle (Galerella luteola), the eggs would be found on the host plant.

On July 21 Mr. Cotton, a student in the Entomological Department, found adults and what he considered larvae of this species on pin cherry.
On examination it was at once seen that there were larvae in all stages, but the closest search did not reveal a single egg on the foliage or trunk or branches of the tree. The youngest larvae, which seemed to us to have just hatched, were very active, running about over the trunk and branches, and a search at the base of the trees soon revealed immense numbers of eggs just below the surface of the soil, in the matted grass, under sticks, and among rubbish.

THE EGG

We did not observe the date of the first egg laying nor determine the number of eggs laid by a single female. At Ithaca egg laying occurs from June to August. If we judge from the length of the larval life and the egg stage, the deposition of eggs at Ithaca undoubtedly began the last week in June. The egg-laying period extended throughout July and the early part of August.

The egg is entirely different in shape from that of closely allied species. It is oval, of a light-straw color, and measures 0.72 to 0.84 mm. in length by 0.60 to 0.64 mm. in width. The entire surface is marked with rather regular hexagonal areas. Large numbers of these eggs were found at the base of the few pin-cherry trees located close to the Cornell University grounds. The eggs adhered rather firmly to each other and to the matted grass. Although close search was made, no eggs could be found at the base of any other species of Prunus (Pl. LXV, fig. 1, 2).

THE LARVA

During the latter part of July eggs hatched in from 14 to 18 days after they were laid. The young larva escapes from the egg by cutting a hole through one side with the mandibles. The young larvae are very active, running about rapidly. They soon find their way to the trunk of the tree and could be seen any time during the hatching period climbering actively over the branches in search of the young and tender foliage near the tips of the twigs. They are found most commonly on the under surface of the foliage skeletonizing the leaves. They feed ravenously, grow rapidly, and reach maturity in from two to three weeks. Where the larvae are abundant all the foliage may be so completely skeletonized as to turn brown and die, giving the trees a scorched appearance (Pl. LXV, fig. 3, 4). The length of the life cycle, with the number of molts, is given in Table I.
TABLE I.—Length of life cycle and number of molts of the cherry leaf beetle

<table>
<thead>
<tr>
<th>Eggs.</th>
<th>First stage.</th>
<th>Second stage.</th>
<th>Third stage.</th>
<th>Entered soil to pupate.</th>
<th>Emergence of adult.</th>
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1 From another series of experiments the length of the egg stage was determined. The eggs hatched as follows: 14, 18, 17, 20, 16, and 24 days after they were laid. The average is 20 days. If this were taken as the average length of the egg stage, the total length of the life cycle from the egg to the adult would vary from 48 to 53 days.

DESCRIPTION OF LARVAL STAGE

FIRST INSTAR.—The newly-hatched larva is depressed, fuscous in color, the head, thoracic shield, legs, and anal segment, black. Scattered over the larva are a number of setae. Length, 1.4 to 1.6 mm.; greatest width, 0.45 to 0.50 mm.

SECOND INSTAR.—Nearly cylindrical, slightly depressed, fuscous to brown in color, the head, legs, thoracic and anal shields black. The ground color is almost entirely obscured by the black areas as shown in Plate LXIV, figure 2. On each segment, except the prothoracic and anal, there are two oval, rather sharply defined, large, black areas separated from each other by a narrow line. Laterad of the black areas are angular black markings as shown in Plate LXIV, figure 2. Length, 2.5 to 3.5 mm.

MATURE LARVA, THIRD INSTAR.—Length, 6 to 8 mm., nearly cylindrical, somewhat depressed, with an average width of about 2 mm. (Pl. LXIV, fig. 3). The larva after the second molt measures 5 mm. in length and is black in color. As it feeds, the black spots and markings become separated and the brownish yellow ground color shows distinctly. Head black, narrower than thorax; mouth parts yellowish brown. Legs, prothoracic and anal shields black. Dorsally each segment, except the prothorax and anal segments, with two sharply defined oval to rectangular black areas separated by a brownish yellow line; laterad of each of these there is an angular black spot and beyond each of these a smaller rounded black mark. Along the lateral margin there is an elongate oval black spot on each segment. The venter of each abdominal segment is marked with five dark brown to black spots, the central one being largest. The prothorax is black; meso- and meta-sterna each with a narrow, elongate, black area in front and two black rounded spots just caudad of it.
FOOD HABITS OF THE LARVA

From a close examination about Ithaca we failed to find the larvae present on any trees but the pin cherry. The few trees of this species located near the campus were swarming with the beetles and larvae. However, on the other food plants of the adult we found, late in the season, only a few beetles and no larvae. To determine whether the larvae could survive and reach maturity on the other species of Prunus the following experiments were performed:

EXPERIMENT 1.—On July 23 six larvae, some almost mature, were placed on the leaves of Prunus avium. Two died on July 25, two more on the 27th, and the remaining two entered the soil to pupate on July 28, the adults emerging on August 15. The immature larvae did not feed, but the nearly mature forms fed slightly before entering the soil to pupate.

EXPERIMENT 2.—On July 23 two young larvae were placed on leaves of Prunus avium. Both died on the 26th without having fed at all.

EXPERIMENT 3.—On July 27 three half-grown larvae were placed on leaves of Prunus virginiana. On the 28th all had left and entered the soil in an attempt to pupate. Later all failed to pupate and died.

EXPERIMENT 4.—On July 27 five half-grown larvae were placed on leaves of Prunus virginiana. On July 28 one was dead and the others entered the soil. All failed to reach maturity.

EXPERIMENT 5.—On July 28 three half-grown larvae were placed on leaves of Prunus serotina. All failed to feed and died on July 31. On the same day four more half-grown larvae were placed on leaves of P. serotina. All failed to feed and died on July 30.

It will be seen from the above experiments that the larvae seem to be unable to survive on either the cultivated sweet cherry (Prunus avium) or the common two native varieties P. serotina and P. virginiana. It is unfortunate that through an oversight experiments were not made with the other species of Prunus. The food plants of the larvae are undoubtedly restricted at the present time to the wild red, or pin, cherry. Whether the larva can succeed in adapting itself to other host plants seems to be a doubtful question, so that in the future the abundance of the beetles will depend not so much on the presence of its enemies as on a goodly supply of the larval food plant.

THE PUPA

Pupation takes place at or slightly below the surface of the soil. No special preparation is made by the larva, the pupa often lying openly on the surface in the grass or under rubbish. The pupa is bright yellow, strongly convex, without any distinguishing markings. Scattered over it are small, short brownish tipped setae, which aid in preventing injury from the soil. The tip of the abdomen is furnished with two diverging strong black spines (Pl. LXIV, fig. 4).
CONTROL OF CHERRY LEAF BEETLE

On account of the comparatively small numbers of the beetles at Ithaca, we were not able to conduct control experiments. However, several of our correspondents have had good success with lead arsenate (paste) used at the rate of 4 to 5 pounds to 100 gallons of water and also with a spray containing 40 per cent nicotine. In the case of the nicotine spray our correspondent used it at the rate of 3 pints to 100 gallons of water and reported good success. He also reports failure with lead arsenate, though using treble and even quadruple the quantities generally recommended for foliage-feeding insects.

LITERATURE CITED

PLATE LXIV

Galerucella cavicollis:

Fig. 1.—Adult.
Fig. 2.—Larva, second instar.
Fig. 3.—Larva, third instar.
Fig. 4.—Pupa.

(950)
PLATE LXV

*Galerucella cavicollis:*

Fig. 1.—Eggs on ground at base of tree.
Fig. 2.—Eggs, enlarged.
Fig. 3.—Larvae feeding on leaf.
Fig. 4.—Work of larvae on foliage.
Fig. 5.—Work of beetles on foliage.