

altogether different. A contact insecticide is absolutely necessary, and, from the fact that the mite as a rule passes its entire existence upon the under side of a single leaf, it becomes plainly necessary in spraying to *hit the entire underside of every leaf* of an infested plant. It is obvious, therefore, that indifferent spraying is certain to yield unsatisfactory results. Furthermore, the absolute necessity for a second spraying to kill the hatched eggs adds to the difficulty. It is hoped that this discussion may clearly convey *the economy of prevention* of infestation.

In conclusion we will refrain, in this brief consideration, from an orderly summary or reiteration of the salient points herein contained. It should be emphasized once more, however, that the red spider, as a pest, presents phenomena of a biologic and economic nature which are rather unique. The winter activity of the pest, the rapid succession of many overlapping broods, the lack of flight, the extreme omnivorous and ubiquitous character, the limitation of dispersion chiefly to travel afoot and by water, the almost impervious protective web, the spray-proof character of the eggs, the restriction of infestation to the bottom of the leaves, the non-wandering nature of the individuals of the colonies, and, finally, the microscopic size of the creatures—all are characteristics which individually and collectively complicate the problem of control. A serious consideration of these factors cannot but impress one with the intricacy of the red spider's status within its environment.

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### THE GREEN SOLDIER BUG (NEZARA HILARIS)

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**OCCURRENCE AND EXTENT OF DAMAGE.** During 1911, peach growers along the Marblehead peninsula region of Lake Erie sustained a severe loss as the result of injuries caused by this insect. Although it has been commonly found in Ohio for many years, it had never been reported in any such abnormal numbers before, and so far as I am able to find out was never reported as a special enemy of the peach in this state. I understand *Nezara hilaris*, or more probably a closely related species, *Nezara viridula*, has at times done considerable damage to peaches in Georgia and oranges in Florida.

But little was accomplished during 1911 in determining the life history of this insect, as we were not informed of the severity of the attack until the first of September. On visiting the infested district the conditions were found to be fully as bad as one of the growers of peaches in that region had proclaimed them to be. He estimated his loss at fully \$500 and others professed similar losses. No one seeing

the quantities of worthless, gnarled fruit lying on the ground could doubt their statements in the least. Many of the Elberta trees showed a loss of two, three, or more bushels per tree.

**CHARACTER OF INJURY.** These bugs commence feeding on the small fruit during the last part of June and in early July, and continue working upon the fruit until late fall. They feed by puncturing the skin with the beak, and by sucking the juice from the flesh of the fruit. In a short time, a small droplet of gum appears at the injured point, which in time becomes irregular in outline, owing to the fact that the cells about the puncture are killed, thus making them incapable of further growth. The degree of irregularity, of course, depends upon the number of punctures. Where the fruit is badly punctured, it becomes entirely unsalable, while extra fine fruit showing but one or two punctures has to be graded lower, thus decreasing its value.

**INJURY OF 1912, AND NOTE ON LIFE HISTORY.** Practically no damage was done during the year, and so far as I was able to find out from the growers and by making a visit to the previously infested district, hardly a bug was seen. One egg-mass, however, was found of this species, while collecting at Wooster, on a leaf of *Viburnum prunifolium* (black-haw) the last week in June, which hatched on July 1. From this egg-cluster I was enabled to carry two specimens, a male and female, through five instars to the adult stage, which was reached on September 1 and 2.

**NOTES FOR 1913, AND A FURTHER ACCOUNT OF THE LIFE HISTORY.** The past season, these bugs were reported as occurring in small numbers on peaches in the previously infested district along Lake Erie, but the damage done was but slight compared to that of 1911. While collecting in and about Wooster, I found them particularly abundant on wild cherry in the latter part of June, and afterwards on elderberry, black-haw and dogwood (*Cornus alternifolia*), thereby enabling me to work out the life history in detail, both in the field and laboratory. The first appearance of the adult form, after hibernating through the winter in protected places under leaves and loose earth, was about the middle of June. The time of appearance is undoubtedly controlled by the season, probably occurring a little later than usual the past year, as it was comparatively backward. I found five adults on June 11, on wild cherry, and after that date found them in abundance up until the latter part of June, when the number of adults seemed to decrease until one could hardly find a specimen after the middle of July. The decrease in adults was marked by a corresponding increase in the number of immature bugs.

The eggs laid by different females sometimes vary in color; commonly she desposits light, yellow-colored eggs, but occasionally will

deposit light-green eggs. This is an individual characteristic, the cause of which is unknown. The color of the eggs remains constant in each successive laying by the same female. From two to three days before hatching, both the yellow and green-colored eggs take on a pinkish shade which increases in depth until the cap-end becomes nearly red, just before hatching. The number of eggs laid by different individuals varies; one insect may deposit three clusters of eggs. The first laying is always the largest, usually consisting of between 40 and 50 eggs, although some individuals do not deposit nearly so many. The second laying of eggs contains commonly about half the number in the first, although this sometimes varies. The third cluster, when there is one, commonly contains from two to six eggs. They adhere to each other by a cement-like secretion deposited by the parent and are attached to the leaf by a similar substance. They are oval-shaped and are largest at the top, or cap-end. They measure about one-sixteenth of an inch high, by one thirty-second of an inch across. On looking closely, one will see a small circular cap, around which is a single row of rather stubby, clubshaped, spine-like processes. The eggs hatch in from seven to nine days. The period from the egg to the adult varies. The shortest period from the time of hatching of the egg to the adult stage, recorded during this season's experiments, was from July 23 to September 10, or a total of forty-nine days, the cluster of eggs having been laid on July 14. The longest period, which, by the way, was from this same egg cluster, was from July 23 to October 6, or a total of seventy-five days. The following is a record of the life history of the young bugs hatched from the above egg-mass. Eggs hatched July 23 during the forenoon, and the young nymphs remained in a mass beside the egg shells from which they hatched, without feeding, until 4.15 p. m., July 28, when they commenced molting. After having molted, they separated and started feeding on the berries, continuing to feed and resting at intervals until some time between 4.30 p. m., August 6, and 7.30 a. m., August 7, when most of them molted. The final specimen did not, however, molt the second time until August 8. August 13 two specimens molted the third time, carrying them into the fourth instar. They continued molting at intervals until sometime between 4.30 p. m., August 17, and 7.30 a. m., August 18, when the last two molted the fourth time and from this time on specimens molted at intervals until they had all molted the fourth time on September 2. On September 10, two specimens molted the fifth time, becoming adults, and the molting continued until the last specimen transformed some time between 4.30 p. m., October 5, and 7.30 a. m., October 6. This was, by the way, the latest record which I have for the maturing of this species in captivity.

After becoming adults, they continue to feed until cold weather, when they conceal themselves in some protected place, coming up on warm days, but returning to their hibernating quarters with each cold spell, and after real winter weather sets in, do not appear again in any noticeable numbers until the warm weather of the following year. The 11th of June was the first day of the past season on which I found any specimens. The scarcity of bugs up to this time, as I have previously mentioned, was undoubtedly due to the backward spring, as we did not have any real warm weather until the first of June. After this I had no trouble in finding the bugs. The latest date recorded for taking the adults, while collecting, is November 6; however, I did find one specimen resting on the wood-work in a breeding cage out of doors December 4; but I believe that most of the bugs seek sheltered places soon after the middle of October, as it is very hard to find any after that time.

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**Conical Grape Gall** (*Cecidomyia viticola* O. S.). The characteristic gall produced by this species is reddish or reddish green, one-quarter to a third of an inch long and occurs on the upper surface, sometimes in numbers, of the leaves of various species of grape. It is not common though occasionally locally abundant. The larva, though minute and difficult to discover in the gall, is an exceedingly interesting form, since the appendages at the posterior extremity are evidently used as prehensile organs, as was demonstrated by observation upon living specimens last summer. The interior of the gall is so smooth that there would seem to be little or no opportunity for the larva to use this grasping power while in the deformity it produces, though it is possible that its ability in this direction may be extremely serviceable after the maggot enters the soil, which latter is presumably the case.

Larva. Length 1 mm., moderately stout, pale yellowish green. Head broad, broadly rounded anteriorly, almost subglobose. Antennae moderately long, stout, biarticulate, the basal segment disk-like, the apical one with a length over twice its diameter. Conspicuous brownish, presumably ocular spots may be observed near the latero-posterior angles of the head. Skin smooth, segmentation distinct; breast-bone weakly chitinated, minute, reniform, the anterior margin with two small submedian teeth and more laterally a pair of smaller teeth; small scattering setae occur on the body; posterior extremity bilobed, the ventral portion bearing stout, submedian, chitinous, upcurved processes, each with an indistinct basal tooth anteriorly; the dorsal lobe broad, obliquely truncate as seen from the side and the face armed with an irregular series of moderately large, conical, chitinous teeth.

In life the hooks and this dorsal process are frequently apposed and evidently form an efficient grasping organ. The description was drafted from larvæ taken from the galls, the tips of which were turning brown, collected at Highland, N. Y., July 22, 1913. There were about seventy-five galls on one leaf.

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