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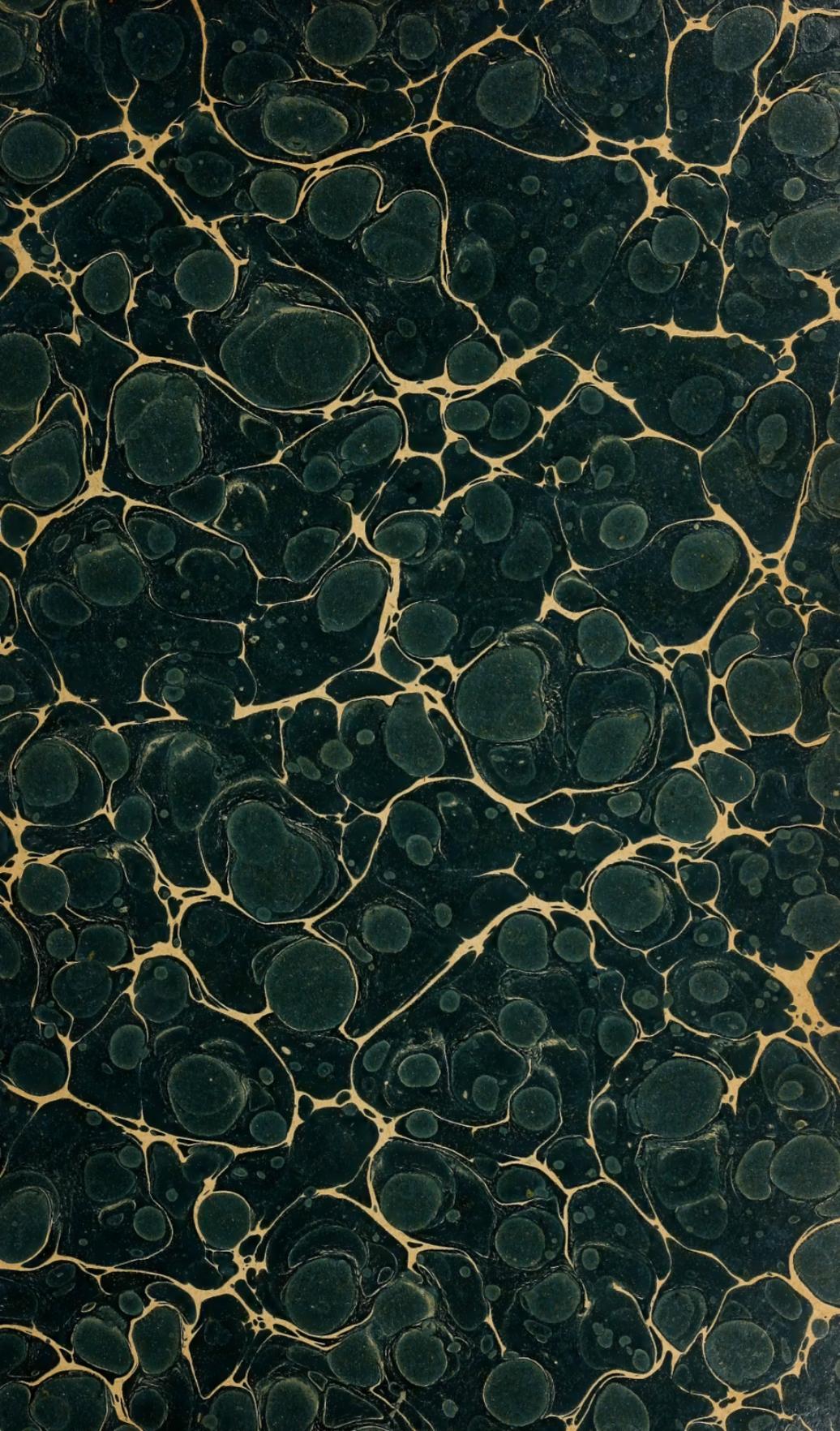
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United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

THE SPRING GRAIN-APHIS.

(Toxoptera graminum Rond.)

By F. M. WEBSTER,

In Charge of Cereal and Forage-Plant Insect Investigations.

The species which forms the subject of the present circular (see figs. 1, 2), and which is commonly known in the Southwest as the "green bug," is probably an imported insect.¹ It was first described by Dr. C.

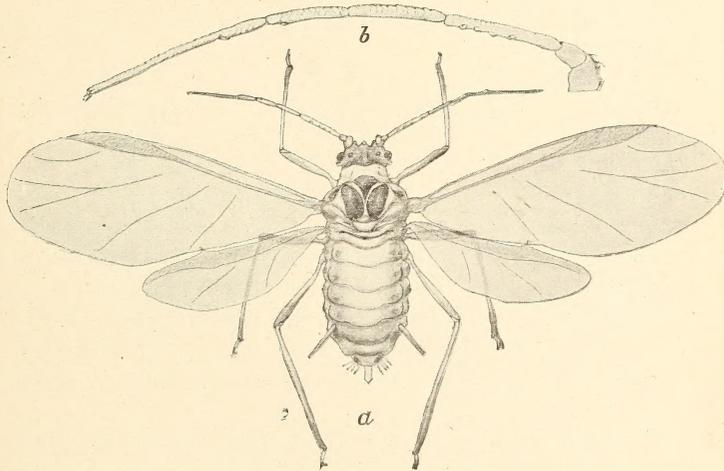


FIG. 1.—The spring grain-aphis (*Toxoptera graminum*): *a*, winged migrant; *b*, antenna of same. *a*, much enlarged; *b*, highly magnified. (Original.)

Rondani—probably from Bologna, Italy—in 1852, just thirty years prior to its discovery in America. Rondani states that in June the winged migrants were so abundant in the streets of Bologna as to cause the inhabitants great annoyance. The first time the insect came to notice in America, specimens were sent to the Department of Agriculture, but from what locality is not known. In June, 1884, it was found in some abundance near Cabin John, Md., on wheat. A few days later, that is, about the first of July of that year, the writer found it infesting the wheat in his breeding cages at Oxford, Ind., where he was temporarily located as a field agent of this Department.

¹For technical descriptions in English of the winged and wingless females of this grain-aphis see Pergande, Bul. 38, Div. Ent., U. S. Dept. Agric., p. 18, 1902.

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This pest seems to be rather erratic in its outbreaks in both Europe and America. To the agriculturist it suddenly appears in immense swarms on the grain in the fields in spring, ruins the crop over large areas of country, and does not reappear in destructive numbers, perhaps, for many years. The fact is, however, that it can be found in the grain fields during any year, throughout the region it infests, although it may not be sufficiently abundant to work serious injury. The extreme rapidity with which this insect multiplies, unless restrained by natural checks, gives color to the farmer's belief in its sudden appearance, for within a few weeks, from numbers too few to be readily noticeable, it will develop myriads that swarm over the green plants, turning whole fields of thrifty grain to brown, dwarfed plants that produce no heads, or else, reaching a height of not more than 6 to 8 inches, have heads that are foreshortened and nearly devoid of kernels. Thus it is that within the short space of less than twenty years this aphid has come to be one of the worst pests of its kind in the grain fields of the south-central portion of our country.

SEASONAL HISTORY.

The life cycle of this insect does not appear to differ from that which is usual among aphides. The single generation of males and sexual or egg-laying females appears, as far north, at least, as latitude $40^{\circ} 27'$, in October, but possibly earlier to the south. The egg-laying female is wingless and may be easily distinguished by her position on the plant, the body being held almost at right angles instead of parallel to the leaf. She may be further identified by the eggs, which show through the skin, their outlines appearing like lateral oblique lighter lines on the abdomen.

The eggs, which are glossy green immediately after deposition, but later turn jet black, are laid among the grain plants in the fields. Possibly some are placed elsewhere, but if so the writer has failed to find them. While these aphides overwinter in the egg state, they also pass the winter as viviparous females in the fields as far north as latitude $40^{\circ} 27'$, where the writer has found them reproducing by the first of April. The writer has kept them breeding within doors where the temperature during the night frequently fell below the freezing point and ink was frozen in the inkstand on the desk. In this way they were reared throughout the entire winter of 1889-90 at Lafayette, Ind. In the same locality, in 1884, they were breeding in the fields until after the middle of December. There is no doubt whatever that in the South, and even as far north as St. Louis and Cincinnati during mild winters, the species breeds in this way during the entire winter, though the eggs deposited in fall probably do not hatch under such low temperatures, but remain unhatched until spring.

When the foliage of the cultivated grains becomes too old and toughened to afford them sufficient nourishment, the young—as is usual among aphides—develop to winged viviparous females (i. e., winged females that give birth to living young, fig. 1, *a*) and forsake the grain fields. Thus it is that the migration from the grain to the alternate food plant takes place in June, while in the fall of the year the aphides return to the fields instead of leaving them, although the latter is the rule with most of the other species whose habits are well known. It is this variation from the usual habits of allied species that renders this particular aphid so destructive in grain fields and its control so exceedingly difficult.

With the appearance of the young grain in the fields in autumn the aphides again appear, being represented by winged females that soon begin giving birth to young, and various sizes of the latter according to age may frequently be observed surrounding the mother on the leaves.

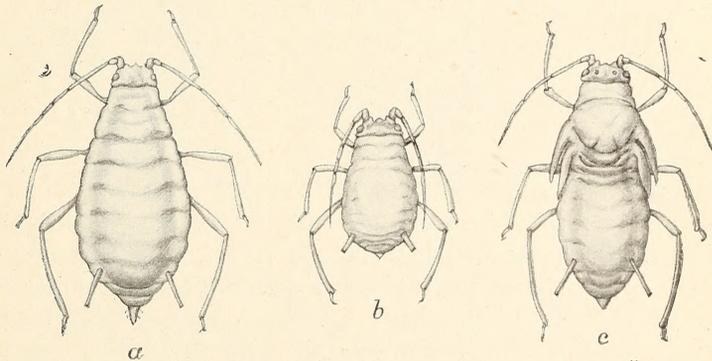


FIG. 2.—The spring grain-aphis (*Toxoptera graminum*): *a*, wingless female; *b*, larva; *c*, pupa. Much enlarged (original).

Young develop to adults and themselves begin to reproduce within the space of a week, so that in favorable weather several generations may be fully represented on the same plant by young of all ages and winged and wingless females.

RAPIDITY OF INCREASE.

In experiments with a winged female in April, in Indiana, the writer obtained 37 offspring within the period of eighteen days, and at the end of this time some of her firstborn were themselves grandmothers. From the writer's experience with allied species it is probable that the wingless female is much more prolific than the winged female, so that it would be entirely within reason to suppose that a wingless mother would be capable of producing at least double the number of young mentioned above within a slightly more extended period of time. It will thus be seen that within a brief period, under favorable circum-

stances, a comparatively few females may become the progenitors of the enormous swarms of these insects that overrun and destroy fields of grain over vast areas of country.

FOOD PLANTS.

The writer has found this grain aphid breeding freely on wheat, rye, oats, barley, and corn, though it seems to prefer wheat and oats. Orchard grass (*Dactylis glomerata*) seems to suit the taste of these insects almost as well as wheat, and it is probably to this and some other grasses that the winged females migrate when they forsake the grain fields in June.

Although the writer failed to rear the insect from *Eragrostis*, *Panicum*, *Ixophorus* (*Setaria*), *Agrostis*, and *Bromus*, it is quite probable that it may be found on some of these, as it is known to occur on some of these grasses in Europe. Rondani gave as food plants oats, wheat, spelt, couch grass, *Hordeum murinum*, soft chess (*Bromus hordeaceus*), and corn. In 1863 Passerini added sorghum, and in 1900 Del Guercio gave the food plants as wheat, barley, oats, corn, orchard grass, *Bromus* sp., and *Lolium perenne*. It seems quite likely, therefore, that the present list of this insect's food plants in America may in future be considerably enlarged.

DISASTROUS OUTBREAKS IN AMERICA.

While more or less common every year, the occurrences of this grain aphid in such destructive abundance over such a large area of country at such long intervals of time are somewhat puzzling phenomena. When first met with by the writer, in 1884, the insect in question was not at all injurious, and it was more than five years later that it was again encountered—this time as a serious pest. This was the outbreak of 1890, which proved so disastrous to wheat and oats over a section of country extending from Texas to northern Missouri, through southern Illinois and Indiana to eastern Kentucky and Tennessee. Oats were destroyed as far north as Franklin, Ind., latitude 39° 30'. Though quite abundant at times, this aphid did not again cause serious injury until in 1900, when the Southwest again suffered an outbreak which, while even more serious in Texas than was the one in 1890, did not extend so far northward. The present year (1907) there is every indication of a recurrence of the pest, for as early as January this insect was reported by Mr. W. D. Hunter, of this Bureau, as destroying the fall wheat and oats in northern Texas.

NATURAL ENEMIES.

Not only is this aphid enormously parasitized, but toward the last of May and in early June both young and old are devoured by lady beetles and their larvæ, great numbers of which can be observed at work in

infested fields. The species that have been most conspicuous in this work are *Coccinella 9-notata* Hbst., *C. sanguinea* L., *Hippodamia parenthesis* Say, and *H. convergens* Guer. (fig. 3). *Megilla maculata* De G. is rarely seen with the preceding in infested fields.

Of the hymenopterous parasites *Lysiphlebus tritici* Ashm. is especially useful. In southern Indiana, in 1890, this little slender, black, four-winged fly became excessively abundant and destroyed myriads of the pest. When at work this diminutive enemy of these aphides may be seen running over the plants, thrusting its ovipositor into their bodies. Soon thereafter the body of the parasitized aphid becomes swollen and rounded, and at the same time the skin hardens and changes in color to a leather-brown. Shortly after, a circular disk is cut by the parasite in the body wall of its host, and pushing this out the fully developed

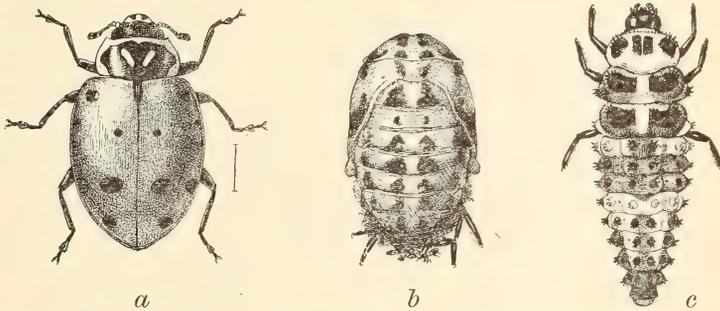


FIG. 3.—*Hippodamia convergens*, a lady beetle which devours the spring grain-aphis: a, adult; b, pupa; c, larva. All much enlarged (from Chittenden).

insect makes its way forth to at once begin laying eggs in the bodies of others of its host, both old and young. In southern Indiana, in 1890, these parasitized individuals became so abundant on the leaves of the grain as to add materially to the brown color due to the effects of their own feeding on the plants, and their presence could be noted from a considerable distance. Prof. E. Dwight Sanderson, while at the Texas Experiment Station, came to the conclusion that in Texas the natural enemies ordinarily destroy such large numbers of this pest that it is held in check thereby. The writer came to a similar conclusion many years ago, and concluded, further, that the abundance of these parasites throughout the area in which this aphid is destructive is primarily regulated by the weather during the time intervening between November and May.

METEOROLOGICAL INFLUENCES.

Attention has already been called to the fact that the spring grain-aphid can breed in the fields during the prevalence of a temperature that would render most insects inactive. It seems almost equally clear that serious and widespread outbreaks of this insect are due to a lack

of a sufficient number of parasites to hold it in check. Added to this is the fact that disastrous outbreaks have followed mild winters, succeeded by a spring that was below the normal in temperature and more or less stormy. The writer has observed, in the case of other aphides, that seasons of unusual abundance are preceded by cold, wet, and usually "backward" springs. The situation, then, is probably this: The pest is ordinarily kept down by its natural enemies, but during open winters—not sufficiently mild, however, to render these enemies active—it breeds unrestrained, and the exceptionally cold, wet spring enables it to continue breeding while the parasites are still inactive; thus the pest is enabled to get the advantage in point of numbers and work its devastation before the natural enemies can become sufficiently abundant to overcome it.

It can be seen, therefore, that although the farmer's interests are involved, he is unable to determine for himself just what is going on in his fields. He can not foretell the weather months in advance and has no way of knowing when to expect a recurrence of a serious outbreak of the aphid until it is too late to ward off its consequences. The reader will correctly infer from the section on preventive and remedial measures which follows that when spring approaches there is little that can be done by the farmer to improve the situation in case the insects are present in great numbers; but the outlook is by no means the gloomy one that may appear from this statement. Following the spring rains there usually comes, sooner or later, a period of dry, warm weather, and whenever such a period comes the aphides very soon disappear. The reason for this is that their parasites and natural enemies, no longer deterred from activity by cold and wet, immediately begin to breed with extraordinary rapidity and bring about their practical destruction. Should this warm, dry period come later than usual, greater damage is inflicted by the aphides; should it come earlier than usual, serious injury is correspondingly obviated.

PREVENTIVE AND REMEDIAL MEASURES.

We really know far too little of this pest to be able to deal with it satisfactorily. It would seem that the later in the fall grain were sown the less attraction there would be for the pest to invade the fields in fall. Late sowing, then, is about the only preventive measure that can be suggested.

On the subject of treatment for these insects there is not much more to be said. It is probable that a great many of the aphides could be destroyed by rolling the fields as soon as the pests appeared on the leaves in any considerable numbers. Brushing over the fields with a brush drag, made by fastening the ends of limbs or bushes in holes made in a rail or a piece of 4-by-4-inch timber, might also prove beneficial. These two practicable measures are all that can be advised with

any encouragement at present for general relief from the ravages of this insect. In the case of small isolated fields, however, it is possible that some benefit might be derived from dusting with slaked lime at a time when the pest is clustered on the leaves.

Approved :

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *March 14, 1907.*

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