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CORN INSECTS.
THEIR INJURIES AND HOW TO TREAT THEM.

HERBERT OSBORN.

The corn crop is one of the most important crops of the state, and will doubtless remain so for many years to come. It is, therefore, of importance to know something of its insect enemies and the method of treating them. From the nature of the injuries to corn, particularly on account of the difficulty of any direct examination of some forms, and the difficulty of making any exact estimate, their injuries are, I think, very generally under-estimated. Probably the most serious losses come from those working under ground, the injuries of which are to be found simply in the lessened crop, and which consequently pass unnoticed by most farmers. At times the destruction of seed in the ground by wire worms, or injury to the newly sprouted plants by cut worms, wire worms or sod worms, which necessitate replanting, attract general attention. Sometimes, also, the general destruction of the crop by the corn root worm is noted, but when any or all of these insects simply destroy undeveloped plants or parts of plants, or when there is a gradual drain upon the growth of the plant, as occurs from the presence of the root lice in corn fields, it is naturally unnoticed, and the shortage in the crops is charged to other agents.

We do not propose here to give a complete monograph of corn insects, treating of all the species known to affect the plant; but to collect the facts relating to important species under the heads of injury to the crop at different seasons and on different parts of the plant, and discuss such methods of treatment as we believe to be practicable under general farm operations, and that do not involve any unusual labor, or the use of methods not available in the ordinary farm cultivation in this state.

Corn is subject to insect attack at every stage of growth and on every part of the plant, but the most effective treat-
ment for most corn insects must be applied before the crop is planted.

INSECTS WORKING UNDER GROUND.

As soon as the seed is planted it may be attacked by underground insects. A species of thousand legged worm sometimes devours the germ, while the wire worms attack the seed as soon as the sprouts begin to push forth, and as soon as the plant has begun to grow the stalk may be cut off by different kinds of cut worms or attacked by sod web worms; and not only these species, but perhaps different kinds of them working in the same field, may destroy a large portion of the first planting, necessitating the delay and the vexation of replanting, or in many cases a short stand, resulting in reduced crop. Later in the season the corn root worm, working on the roots, devouring them from the tip towards the stalk, cuts off the food supply of the plant and causes it to wither, and if the worms are plentiful a large portion of the plants may be destroyed. During summer and autumn the root lice, of two or three different species, locate upon the roots and pump the juices which should go to the growth of the plant and the formation of corn.

TREATMENT FOR UNDERGROUND SPECIES.

Almost all of these underground species are to be dealt with entirely by treatment previous to the planting of the corn.

The wire-worms, cut-worms, and sod web-worms are almost entirely confined to land which has been the previous season in grass, and their injury can be almost entirely prevented by early fall plowing of the land which it is intended to plant in corn. This applies as well to cut-worms that may occur on land which has been in small grain the previous year and is plowed late in the fall, after an abundant growth of weeds.

The habits of these insects, and the experience of planters generally, favor the plowing of sod land as early as the first of September.

For the corn-root worm, and to some extent for the root-plant lice, except perhaps on ground where fox-tail has been
plenty, the most important recommendation is the rotation of crops, these insects causing little or no trouble in corn fields which have followed some other crop, while they may be very destructive in fields which may have been for some years in corn. Thorough cultivation may also be recommended for the root-lice, as it is known that these insects depend largely, if not entirely, upon ants, to place them upon the roots of the plants, and the ants are disturbed in this work by cultivation breaking up their nests.

INSECTS WORKING ABOVE GROUND.

For the insects which work above ground in corn fields we have perhaps few available measures of treatment, as it is hardly practicable to go over the fields to apply any direct treatment; fortunately, however, there are very few insects in this state which are causing any serious injury from attacks on the stalks, leaves and ears of corn. To mention a few, we have the stalk borer, a small, worm-like insect, which bores into the stem, usually near the ground, and causes the stalk to wither. This has at times appeared in some numbers and has caused some injury, but for a number of years has been scarcely noticeable. No method of treatment to save the affected stalk can be recommended, but if they are pulled up and the worm destroyed it will assist the reduction of future injury. Chinch bugs may infest the field from adjacent fields of wheat, rye, barley or oats, but can be excluded by proper barriers at time of migration.

The leaves of corn are sometimes eaten off by grasshoppers, but this is always along the sides of the field and adjacent to sod-land, where the eggs of the grasshoppers have been deposited, and can be avoided by destroying the grasshoppers during July, by spraying the grass along side of the corn field with arsenical preparation, or by catching them with hopper dozers.

Plant-lice sometimes affect leaves, but this is seldom, and it is very rare that they cause serious injury or demand any attention in particular, except in plantings of sweet corn, where the injury may warrant special treatment, and spraying with kerosene emulsion will be effective. The ears of corn are injured sometimes by the beetle of the corn root-worm.
attacking the silk, cutting it off and preventing fertilization, and consequently preventing the formation of corn; this loss, however, is not usually important, and will not occur in fields where the corn root-worm has been avoided by proper rotation of crops.

The corn worm, or "Boll worm" of the South, which works on cotton, corn and other crops, is sometimes quite common in this state, but almost always the injuries of any extent occur upon sweet corn, or varieties of early corn, and are of scarcely any importance in general field crops. This is fortunate, as it is difficult to adopt any measures of general effectiveness against this species.

For sweet corn, the principal injury may be avoided by planting a portion of the crop with rather early varieties and the rest with later varieties, the principal damage occurring on the varieties maturing in the latter part of July or early in August.

Sometimes corn ears are penetrated by the Indian cetonia (Euphoria inda), discussion of which appears in Bulletin 15, page 255.

INSECTS AFFECTING STORED GRAIN.

As a general thing corn is not held long enough in cribs to be damaged by insects which affect the stored grain, but in some localities there is considerable loss, through the attacks of various insects upon the stored grain. This may prove of importance in this state where corn is held over for any length of time.

DISCUSSION OF IMPORTANT SPECIES.

We will now consider some of the species of most importance to Iowa farmers, more fully than in the preceding summary, so that those who may wish to determine the particular kinds at work in their fields may be able to do so.

THE CORN-ROOT LOUSE.

This species has been a destructive one in adjacent states, but as far as observation goes has not been troublesome in this state, unless within the last year or two. Since there are related species which occur upon corn roots, it may still
be a question whether the destructive species in Illinois occurs in any abundance with us. This species was considered for some time as identical with the leaf-feeding species of corn lice, but the investigations in Illinois have shown it to be distinct, and have shown that the lice are in the ground continuously, being cared for by ants and assisted in finding the roots of plants upon which they feed.

The Root-Louse is a small, soft-bodied, greenish-white insect, and will be found adhering to the roots of the corn plant, the head attached to the roots by the beak, which is inserted in the tissue in order to pump out its food. The antennae are composed of seven joints and are rather long, reaching to beyond the thorax. The number of joints in the antennae and the length will readily separate this species from the other form which is found upon the corn roots. Almost always this root-louse will be found accompanied by ants, and they are quite dependent upon these ants to place them upon suitable roots upon which they can feed, and especially for care over winter. It is evident that since they are confined year after year to the soil, that rotation of the crop will be useful in avoiding their injuries; but it will be most effectual if the corn crop is followed by some crop distinctly different, so that it would fail to furnish any sustenance for the lice. It hardly seems probable that the species has become very much distributed in this state, but it would be wise to examine the roots of the corn which show a tendency to turn yellow or to wither, and ascertain what kind of injury they may be suffering from. It would often happen that the determination of the kind of insect affecting the roots would determine the best method of cultivation for the next season.
THE CORN-ROOT WORM. (Diabrotica longicornis, Say.)

This species is now distributed pretty much over the entire state, and while it does not at present cause a great amount of damage, except where rotation of crops is neglected, it must be considered as a constant source of danger, and should be kept in mind in any line of crop distribution. The adult insect is a small green beetle, about one-quarter of an inch long and with long slender antennæ. This beetle is to be seen during autumn upon the blossoms of thistles and golden-rod and other fall flowers, sometimes causing decided injury to cultivated flowers in gardens. The eggs are deposited during October, and with scarcely an exception in the fields which have been in corn. It is on this account that rotation is so effectual a remedy. The eggs remain in the ground over winter and hatch during the latter part of May, or by the time that corn is getting started, and the larvæ feed on roots of corn, working from the tip towards the stalk, and as the roots become large enough, boring into the roots themselves. The effect on the plant is to produce wilting or sickly growth, and when the worms are present in any number a serious destruction of the crop.

The worms become grown by the early part of July and change at first to thicker fleshy grubs, and then to a chrysalis.
stage, and the beetles begin to issue from these as early as in July, but the majority of them do not appear until some time in August. So far this species has not been known to injure seriously any crop except corn, but there is a possibility that it may acquire a taste for other crops, and in that case the means of contending with it would be much more difficult. This makes it all the more important to guard against this insect by close attention to the rotation of corn crops.

CORN BILL BUGS.

In a previous BULLETIN we have discussed the work of some of the common species of Snout Beetles, known as Bill Bugs, and it will suffice here to simply indicate the manner of work and remedies.

![Fig. 3. Sphenophorus ochreus. a, larva. b, adult enlarged. c, work of Sphenophorus ochreus in roots of Scirpus, natural size. (From Insect Life.)](image)

The clay colored Bill Bug (Sphenophorus ochreus), which is figured herewith, is a rather common species, and has at times caused considerable injury to corn by puncturing the lower part of the stalk and devouring the tender tissues within. This species in the larval stage infests the roots of the club-rushes (Scirpus), and it is only in the adult form that it is injurious. As the food plant for the larva is limited in
most parts of the state, and is becoming less abundant as the swampy portions are drained and cultivated, there is little probability of this species being a serious pest in the future.

Another species, however — the little Brown Bill Bug (*Sphenophorus parvulus*) — has at times been quite injurious in the state, and since it lives in early stages upon the roots of grasses there is more danger that it will be a serious pest. Another species, which has been destructive in other localities, is the Sculptured Bill Bug (*Sphenophorus sculptilis*). This species is said to attack the tender shoot just at or below the surface of the ground, but if quite numerous the whole plant may be eaten to the root. It has been suggested that, sand saturated with kerosene be placed around each hill, as a remedy for this pest when it occurs in limited areas, as the rains will tend to wash the oil down through the soil and affect the beetles. It seems rather doubtful whether this would be effective unless enough oil was put upon the hill to saturate the insects at the time. But where they occur every effort possible should be made to destroy these beetles and prevent their further increase. It would even be good policy to saturate the infested hills with kerosene sufficiently to destroy the plants, and then replant rather than allow the beetles to deposit their eggs and provide for a still greater number the coming season.

**WIRE WORMS.**

Almost every season we hear of considerable loss or necessity of replanting from the presence of wire worms in corn fields; and, while it may be stated at the beginning that these wire worms are primarily grass insects, the loss that occurs in corn fields makes it necessary to consider them in this connection. There are a number of different species which have practically the same habit, and their histories have been carefully studied at the Cornell Experiment Station, with the result of determining that they live for several years in the worm or immature stage, and ordinarily change from larvae to adult stage in the latter part of summer. The adults, however, remaining in an underground cell until the following spring. According to Prof. Comstock this fact "indicates
that the fall plowing would destroy the beetles in the soil, and thus prevent their maturing and depositing eggs the following spring." This method will evidently lessen the number of eggs that may be deposited during the season following the plowing, but there may still be many immature wire worms on the same ground which may attack the corn; but if the ground has been plowed early and the larvæ deprived of food, it may assist in reducing their numbers.

The accompanying figure shows the general appearance of one of these species of wire worms and the adult form.

We might emphasize here the general advantage of not allowing pastures to become old, but to change every three or four years, and thus avoid the multiplication of the species infesting sod, and the injury these may cause to the crop following.

THE SOD WORM (*Crambus interminellus*).

This species has at times proven very destructive in this state, on land which has been in sod during the preceding season. The larva in this case works among the roots of the corn, and attacks the stalks either beneath or at the surface of the ground, cutting the stalks entirely off or gouging into them to such an extent as to destroy them. They may be distinguished from cut worms by their smaller size, more slender form, and the fact that they build a silken web among the roots near the surface of the ground. This injury to corn may be avoided by plowing the sod early in fall, or, if plowed in spring, by plowing it between the first and middle of May, when the land may be planted to sod corn without danger to it from this species. Here, again, the greatest injury is likely to occur on land that has been a number of years in sod.

CUT WORMS.

It is unnecessary to give a particular description of the method of work of cut-worms, for they are so familiar that to mention the name is sufficient to call to mind the fleshy
worms that are annually so annoying in cutting off the leaves or stems of sprouting corn, and so destructive to gardens.

There are a great many different varieties which work in much the same manner; and Bruner enumerates 14 different kinds that have been recorded as working upon corn. Space will not permit description of each of these, and probably little would be gained in method of treatment by a full description. Most of them pass the winter as larvae, being partially grown by spring, and in spring attack with great voracity whatever plants may be found in the immediate vicinity of their place of hibernation. They occur in grass plats and on land which has previously been in sod and on which there was a rank fall growth of vegetation, serving to supply them with food and shelter; and an important means of avoiding their injury in corn fields, is to plow early and secure a clean field during autumn and early spring; further than this, in general corn fields, perhaps the only practical plan is to plant a little heavy and watch closely for injury, and replant as soon as missing stalks indicate that the cut-worms are at work.

THE STALK-BORER.

This species has at times caused considerable injury in this state. Its method of work is to bore into the stalks near the ground and eat out the pith, causing the death of the stalk, and, in some cases, by attacking the ear to destroy it and prevent its maturing. Aside from corn, it attacks a variety of plants, particularly garden flowers; and it has been observed here puncturing the twigs of Ash trees; also feeding upon plantain and other weeds.
The moth and borer are shown in the accompanying figure, and it need only be said that the former is of a dark brown color, sprinkled with yellowish dots, and with a whitish band across the wings, a little beyond the middle, while the caterpillar is a dark brown with three white lines on the back, the central one being continued from the head to the end of the body, while the others are interrupted on the sides. The adults occur in early summer, and the borers are destructive during midsummer, the plants affected wilting and falling down, the injured stalks being usually distinguished by the presence of a small opening where the larva has entered. Probably the best method that can be suggested regarding the species is to pull up the injured stalks and carry them out of the field, feeding them to the pigs so the worms will be destroyed; and if this is adopted regularly there is little danger of the moth becoming so abundant as to be a serious pest. When it is noticed upon other plants, weeds or garden plants, these may be collected and fed to hogs or burned.

THE CHINCH BUG.

The Chinch Bug is more generally destructive upon wheat and common grasses, but in the latter part of summer it may attack corn with very serious results; especially where corn fields lie adjacent to grain fields where the bugs have developed during the early part of the season. To give its life history, in brief, the adult bugs pass the winter secreted in rubbish of various plants, and in spring deposit eggs in fields of wheat, rye, barley, etc., the time of egg deposition lasting for about twenty days, extending through the latter part of April and fore part of May. The eggs hatch into minute red or yellowish bugs, that begin feeding upon the roots of the plant, and about the crown at or just below the surface of the ground. They grow rather rapidly, and change color with succeeding molts until they become quite dark, and are fully
grown by the latter part of June or early in July. As the wheat ripens, or after it is cut, the bugs are forced to migrate to fresh vegetation, and it is at this time that their attacks begin upon corn. This movement is almost always accomplished on foot, both winged and unwinged forms traveling over the ground without attempting to fly. It is, therefore, possible, by the use of any obstruction that will interrupt their migration, to keep them out of the corn fields and prevent the damage which they would cause there. For this purpose the dusty furrow is quite effectual, but it must be remembered that a dusty sloping surface is necessary to prove a barrier, as the bugs are able to crawl up a solid surface, but fall back if the earth is dusty or finely pulverized. If a deep furrow is plowed it should be kept with the sides finely pulverized by drawing a log or a V-shaped trough through it. If the stubble is dry enough to burn many bugs may be killed by setting fire to the stubble field, and the bugs may be destroyed as they collect alongside of the furrows by sprinkling them with kerosene emulsion, or by scattering straw alongside the furrow and setting fire to it; and if they have accumulated upon the first few rows of corn they may be destroyed by spraying with kerosene emulsion, which, though it may not destroy all the bugs, will destroy so large a portion of them that but little injury will follow.

CORN LEAF PLANT LOUSE.

This species closely resembles the root plant louse, but is found on the leaves. Investigations by Prof. Forbes have
shown the two forms to be distinct. This form has seldom occurred in any destructive numbers in Iowa, but it will be proper to introduce here a figure of the species, for comparison with the root louse:

In case of its undue increase and any serious injury it could be checked by an application of dilute kerosene emulsion.

**THE CORN WORM.**

It frequently happens in midsummer that ears of corn will be found in which the tips are invaded by a smooth, fleshy worm, which eats out the silk at the end and burrows channels along the cob, frequently following a single row of kernels, or making a burrow by eating along two rows of kernels; this damage extending sometimes to the base or the burrows being carried around the ear, and a considerable portion of the kernels destroyed and the whole ear practically ruined. In this state the damage has been more apparent upon early varieties of corn, especially of sweet corn in gardens, but early varieties of field corn are also sometimes attacked quite seriously. It may be said in passing that this species is known also as the Tomato Worm, from the fact that the worm bores in tomatoes; and it is also the same as
the notorious Boll Worm, which is so destructive to cotton in the southern states. With us its principal damage is to corn, and it is in this respect only that we will consider it. There are probably two broods in this latitude. The larvae of the first brood appear in the early part of the season and feed upon various plants, so that they do not attract much attention, while the second brood of larvae attack the corn at the time the ears are forming or soon after, in the manner already described. The second brood of larvae pupate and produce moths in the latter part of summer; and farther south, at least, it is stated that a third brood of larvae occurs, from which pupae are produced to pass the winter.

The attacks of the insect are such that it is a difficult matter to apply any direct remedy, but if it is remembered that the injuries occur mainly upon early varieties it will be seen that planting a few rows of particularly early corn the bulk of the injurious brood will be attracted to these, and as soon as the injury appears these rows may be cut up and fed to hogs, and thereby the later corn will be quite fully protected.

THE ANGOUMOIS GRAIN MOTH (Sitotrogo cerealella, Oliv.)

While there is probable but little danger of extensive injuries in Iowa from this species, it is perhaps one which is most likely to invade the state and prove injurious in stored corn, and a brief mention of the species and its characteristic work will serve to enable anyone to recognize it upon its first appearance. It can easily be seen that a prompt recog-
nition of the pest, and energetic measures for its extermination, would be of the greatest importance. It abounds particularly in the southern states and causes immense losses in stored grain. The appearance of its work is shown in the accompanying figure of an ear of corn which has been subject to its attack. The larva burrows into the kernel, hollowing out the interior, as shown at \( f \) in Fig. 12, and, when escaping, perforates the outer end of the kernels, making the ear of corn look as if it had been perforated by small shot. In open cribs where corn is stored in the ear, it is difficult to apply any remedy, and it would seem to be the best plan to shell and store the corn, if it shows any indication of the presence of this pest, putting the shelled corn in tight bins where it can be treated with bi-sulphide of carbon. There is, of course, practically no danger where corn is marketed during the winter or spring following its growth.