The University of Minnesota

AGRICULTURAL EXTENSION DIVISION*

Special Bulletin No. 8

University Farm, St. Paul July 1916

Published by the University of Minnesota, College of Agriculture, Extension Division, A. D. Wilson, Director, and distributed in furtherance of the purposes of the coöperative agricultural extension work provided for in the Act of Congress of May 8, 1914.

SOME INSECT ENEMIES OF CORN

By Warren Williamson, Division of Economic Zoology

COMBATING INSECT ENEMIES

The most important factors in the control of insect enemies of corn and other field crops are crop rotation, clean cultivation, and timely plowing. There are, of course, special cases which require special treatment, but we must rely principally on methods which can be carried on at small expense and which fit in with the ordinary farming operations.

To combat them intelligently, the farmer should know insect pests when he sees them and have a practical knowledge of their habits and life history. Familiarity with scientific names and other technical details is not necessary, but, as one writer has said, the farmer should have a "business acquaintance" with the insects which attack his crops.

SYNOPSIS OF INSECTS AND INJURIES

Injuring Seed in Ground

Wireworms.—Slender, hard, wiry, shiny, brown or yellowish six-legged larvae, about one inch long. They gnaw or bore through the kernels.

Seed-corn maggots.—White, footless larvae about one-fourth of an inch long. They bury themselves in the seed.

Injuring Roots

White grubs.—Large, fat, white worms, or larvae, with six legs, a large brown head and stout jaws; body curved. They eat the roots of the corn.

Corn root-lice.—Bluish green lice, about one-sixteenth of an inch long, found on the roots. Many small brown or yellowish ants usually are found with them in the hills. They cause the roots to wither or become dwarfed, but do not eat them.

Corn root-worms.—Slender, white, six-legged larvae with brown head and neck and brown patch on the last segment. They burrow in the roots, and may be found by peeling or splitting the roots.

Injuring Roots and Underground Part of Stalk

Wireworms.—Previously described. They eat the roots or penetrate the stalk.

*State Entomologist's Circular No. 39.

Injuring Plant above Ground

Cutworms.—Plump, smooth, greenish gray caterpillars, from one inch to two inches long. They usually work at night, cutting off the young plant close to the ground, and hide during the day in the soil or under cover near the injured plant.

Bill-bugs.—Hard, oval, black or clay-colored beetles having a long snout or beak. Usually they are found head downward on the stalk, which they puncture with the beak. When the leaf unrolls rows of holes are seen across the blade.

Grasshoppers.—Too well known to need description. They eat leaves, husks, and silks about the borders of the field, in summer or fall.

Ear-worms.—Brownish or greenish striped caterpillars. They eat the kernels.

Chinch bugs.—Black-and-white bugs, smaller ones red, found in large numbers on outer surface of the stalk or beneath the leaf-sheaths. Those on corn usually come from wheat after cutting. They leave the plant in a wilted or sickly condition from loss of sap.

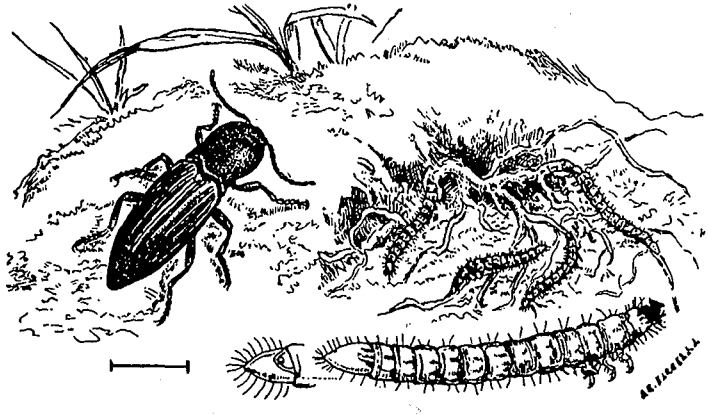

Fig. 1. Click Beetle and Wireworms (Brehm)

WIREWORMS

Wireworms often destroy the seed in the ground by boring into the kernel and frequently kill the young plants by eating the roots and by burrowing into the stalk. When full grown they are about one inch long, dark brown, and shiny, with a hard, smooth, jointed outer skeleton. They wriggle and bend vigorously when held in the fingers. They have six jointed legs just behind the head and an additional proleg or prop on the last segment of the body. They eventually transform to the rather common medium sized, elongate, dark brown click beetles, so called because when placed upon their backs they spring into the air with a sharp, clicking sound.

Life History

The beetles come out of the ground early in the spring and lay their eggs in the soil, usually in grass lands. The eggs hatch into wireworms, which require at least two years to complete their growth. About midsummer of the year in which they become full grown they form little cells in the soil in which they transform to the pupal or resting stage and again change, three or four weeks later, to the adult beetles, most of which remain in the soil until spring.

Injury Caused

Wireworms do their greatest injury to corn when it is planted in newly broken sod land. While they are feeding on the abundant vegetation of grass lands the damage to the corn is seldom noticed, but when forced to concentrate on the comparatively few plants of a cornfield the effect of their work is soon apparent. The second year's planting suffers more than the first, because the grass roots in the soil which furnish food for many of the wireworms during the first season have decayed by the second season, forcing the wireworms to attack the corn.

Methods of Control

If old sod infested by wireworms is to be broken up, the plowing, followed by a thoro harrowing, should be done in the late summer or early fall. At this time the full grown wireworms are in the pupal stage, and are delicate and easily killed. If any of the beetles have developed they are sure to be in a somewhat helpless condition. In addition to killing some of them directly, the plow and harrow will turn many up to the surface and break their earthen cells, so that they will be exposed to the weather and to natural enemies. If hogs are allowed to run in the field before the plowing is done they will destroy many of the wireworms, as well as white grubs, cutworms, and other grass-eating insects. Clean cultivation and a short rotation will help to keep the pest in check. Small grain is injured less than corn by wireworms, while clover, peas, flax, and buckwheat are not injured at all.

If the depredations of wireworms make it necessary to replant corn it might be worth while to try the following method of treating seed recommended by the Massachusetts Agricultural Experiment Station,

Prepare a mixture of road dust and Paris green, using enough of the latter to give the mixture a greenish color. Put half a bushel of seed corn, or any amount convenient to handle, in a tub, and cover with water as hot as the hands can be held in. Dip a stick into tar, then stir it briskly in the corn. Repeat until the corn is black. Then take the corn out of the liquid and put it in the mixture of dust and Paris green already prepared. Stir the corn until all the kernels have a coating of the dust. When dry it is ready for the planter. It is claimed that this treatment will not prevent the germination of the seed and will repel wireworms.

THE SEED-CORN MAGGOT

The seed-corn maggot frequently destroys seed corn in the ground. It penetrates the kernel, killing the germ or the growing shoot and often hollows out the interior.

The full-grown maggot is about a quarter of an inch long. The posterior half of the body is nearly cylindrical and about as thick as a small pin head. The anterior part tapers to a point. The head is very small. The color is dirty white or yellowish. It has no legs.

Life History

After reaching its full growth the maggot becomes shorter and thicker, the skin hardens and becomes reddish brown in color, forming a barrel-shaped case about one-fifth of an inch long, in which the larva transforms to a pupa. From this stage it transforms to a fly which resembles a house fly but is smaller, being about one-fifth of an inch in length. It is brownish gray with black hairs and bristles.

Methods of Control

As injury often occurs where stable manure has been turned under, it has been suggested that the flies may be attracted to it to lay their eggs. Therefore it seems advisable to apply the stable manure the previous fall or long enough before

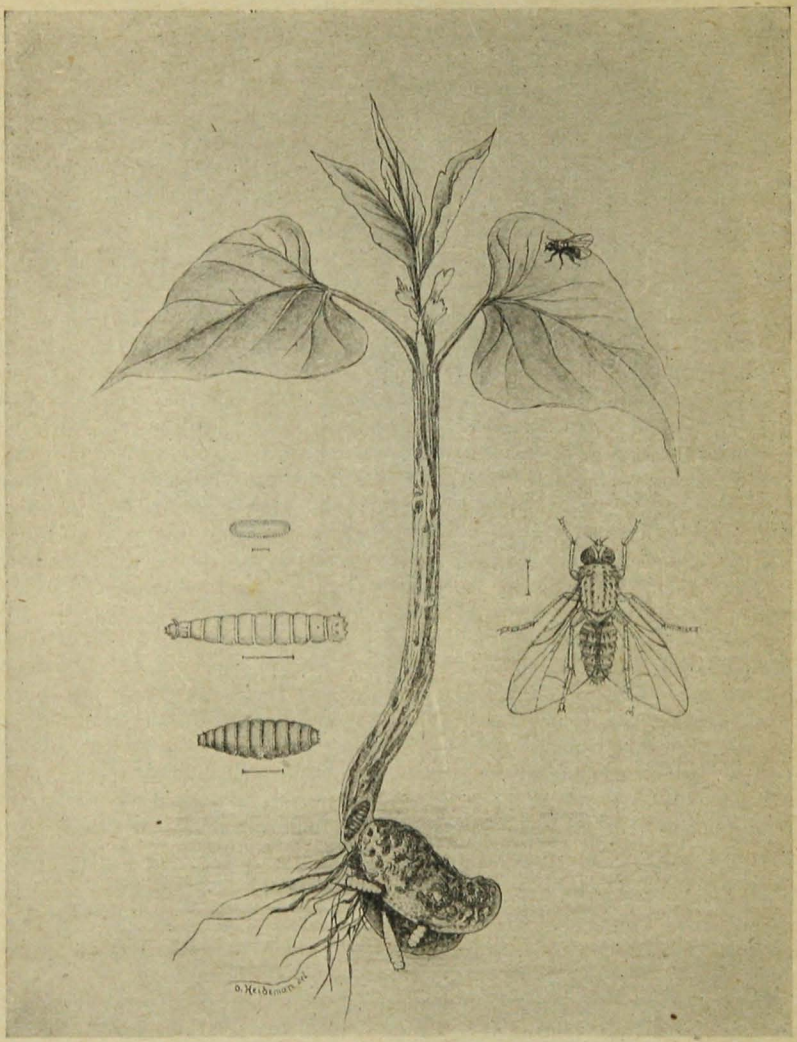

Fig. 2. Seed-Corn Maggot on Bean (Lugger)

planting time to allow it to become well rotted. Rolling the soil after planting also has been suggested to keep the flies from the seed. If it is known that the soil is infested, injury might be prevented by treating the seed with tar in the same way as recommended for combating wireworms.

WHITE GRUBS

The injury to corn caused by the grubs eating the roots may only slightly retard growth, or, if much of the root system is weakened or destroyed, the stalk may be easily blown over.

Life History

The grubs may be found if they are there by examining the soil around and under the roots. They are thick-bodied, strongly curved, dirty white, from an inch to an inch and a half long. Most farmers recognize them, but perhaps many do not know that the grubs require at least two years to complete their growth, and that they eventually transform into the common brown May beetles, or June bugs, which fly about at night in the spring and early summer. The beetles feed on the foliage of various trees at night and hide in the soil during the day. The eggs are laid in the soil, preferably in grass lands, altho sometimes in cornfields.

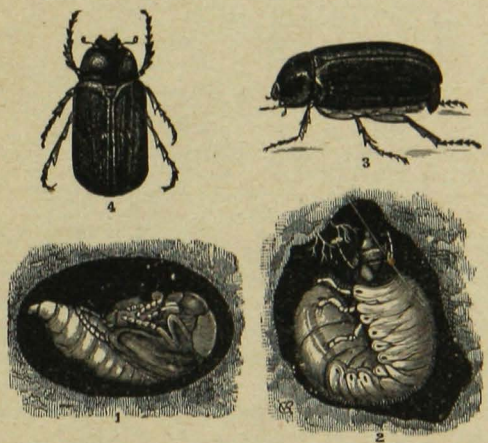

Fig. 3. White Grub, Pupa and Adults (Div. Ent. U. S. D. A.)

Methods of Control

There is no remedy that can be applied while the grubs are working on the corn, so one must use preventive measures.

Since grass lands, if allowed to run too long, furnish excellent breeding-places for white grubs, wireworms, and other pests, a system of rotation should be followed which includes clover, small grain, or flax, since these crops are not seriously injured by the grubs. Old sod land, especially if it is near woods, should be plowed in the fall. Hogs are very fond of the grubs and if allowed to root over infested fields will destroy great numbers of them. For this reason it is advisable to pasture hogs for a considerable time on meadows or pastures before plowing for corn, and the hogs should be allowed to run in the field while it is being plowed.

At the time of plowing the farmer can tell whether or not the land is badly infested. If thirty or forty grubs are turned out in a furrow a quarter of a mile long, the ground should be considered badly infested. If the land is found to be badly infested when plowed in the spring, it should not be planted to corn or any other hill crop.

Clean cultivation to keep down grass and weeds is recommended for preventing the beetles from laying their eggs in a cornfield.

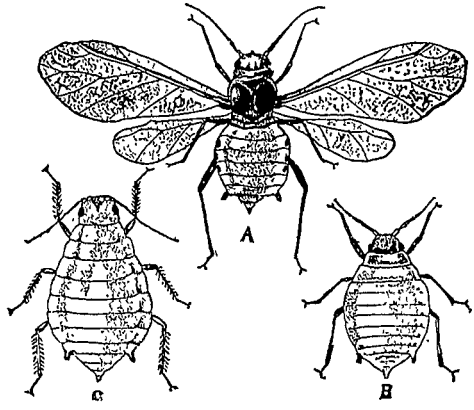

Fig. 4. Corn Root-Louse, Much Enlarged (Forbes)

THE CORN ROOT-LOUSE

The corn root-louse, or root-aphis, as it is sometimes called, is now recognized as a pest in Minnesota,.

If young corn plants on old corn ground are retarded in growth and unhealthy in appearance, and particularly if the burrows of ants are numerous in or near the hills, it would be well to examine the roots for lice which can be recognized by their small size, oval form, and bluish green color slightly whitened with a waxy bloom. They feed by sucking the sap from the roots and in this way rob the plant of nourishment. While the resulting injury may be slight, in many cases there is a partial or total loss over areas of half an acre each. Dry weather following the attacks of the root-aphis prevents the plant from recovering and increases the injury.

Life History

The eggs of the root-lice are cared for in winter by ants in their burrows in the cornfield. After hatching, the young lice are placed by the ants on the roots of smartweed or foxtail grass from which they are later transferred to corn. They breed very rapidly and as they become crowded on the roots of one plant they are carried by the ants to fresh plants. From time to time winged individuals are produced which fly to other parts of the same field or to other fields. There they are taken by the ants into the ground and placed on corn roots where they start new colonies. They secrete a sweet liquid upon which the ants feed.

Methods of Control

Since the corn root-louse works under ground it is out of reach of any effective method of treatment after it has attacked the corn. The corn grower must rely on prevention.

The injury is never severe except in ground that has been planted to corn for several years in succession. A short rotation in which the field is not planted to corn for more than two consecutive years will prevent the root-lice from gaining a serious foothold.

If it is necessary to plant corn on land that is known to be infested with root-lice, the ground should be plowed six or seven inches deep, and the soil thoroly stirred by frequent deep disking before planting-time. The plowing may be done in the fall or early spring, but the disking, of course, must be done in the spring. This treatment will break up the nests of the ants and scatter the eggs or expose them

to destructive agencies. If any of the eggs hatch, the young will die unless the ants are able to take care of them, which is unlikely if the soil is repeatedly disturbed. Frequent cultivation will also destroy smartweeds, foxtail grass, and other weeds upon which the root-lice feed before the corn is up.

THE WESTERN CORN ROOT-WORM

Corn growing on land that has been in this same crop for several years in succession is sometimes injured by corn root-worms, which at first eat the smaller roots entirely and afterwards enter the larger roots, where they make longitudinal burrows beneath the outer layers. By peeling or splitting the roots one may often find the worm in the burrow.

In cases of slight injury the effect may be seen in the production of small ears. Greater injury is seen in dwarfed stalks or the absence of ears. If growing on rich loam the loss of the roots may cause the stalk to be blown over easily.

Life History

The worm, or larva, when full grown is about two-fifths of an inch long and one-tenth of an inch thick. It is white except the head, the top of the first segment of the body, and a part of the last segment, which are brown. Each of the first three segments behind the head has a pair of short legs.

After completing their growth the larvae abandon the corn roots and construct earthen cells in the soil in which they change to white pupae, and then, during August, to adult beetles. The beetles are at first yellow in color, afterwards becoming grass-green. They are about one-fifth of an inch long; and similar in size and shape to the common striped cucumber beetle. They may be seen during August and September feeding at first on the silks and pollen of corn and later on the pollen of various weeds and of clover, beans, squashes, and cucumbers. The eggs are deposited in the soil in corn fields and hatch the next spring.

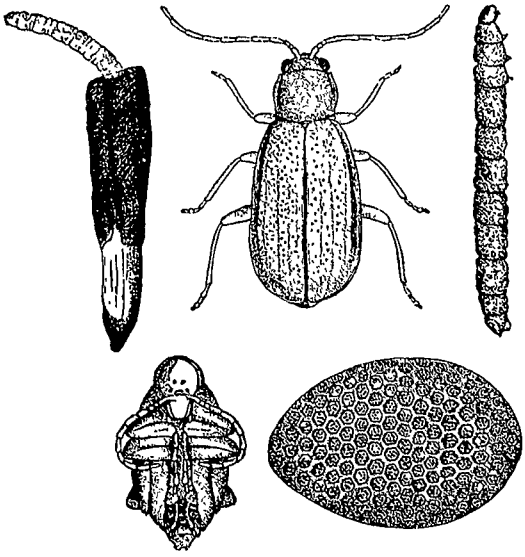

Fig. 5. Western Corn Root-Worm (Forbes)
Three stages, much enlarged. Egg much more enlarged
Corn root broken to show worm within.

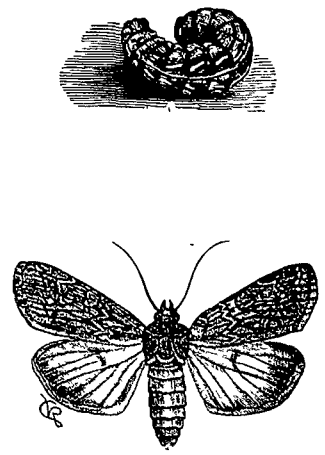

Fig. 6. Cutworm, Two Stages

Method of Control

The fact that the larvae feed only on the roots of corn makes it possible to starve them out by planting an infested field to some other crop the following year. If corn is not planted on the same land for more than two years in succession there will be no trouble with the pest.

CUTWORMS

There are several different species of moth whose larvae cut off young plants close to the ground, hence the name cutworm. There is some variation in the life history of the different species, but in general they do similar injury and the same methods of treatment can be applied to all.

Life History

The moths lay their eggs in midsummer in grass lands or places grown up in weeds. The larvae feed on the growing vegetation until cold weather when, being partially grown, they go into the soil to pass the winter. They come out in the spring and resume feeding. If grass lands, especially those of long standing, are plowed up and planted to corn, the cutworms, deprived of other food, will attack the young corn plants soon after they are up, cutting them off just above the ground. They feed at night and hide during the day. When full grown they are an inch and a half or two inches long, rather plump, and vary in color, being dull brown, gray, or black, sometimes tinged with green, either with or without obscure markings. Their dull color harmonizes with the color of the soil. They have three pairs of jointed legs just behind the head besides five pairs of short appendages called prolegs. When mature the cutworm forms a cell a few inches below the

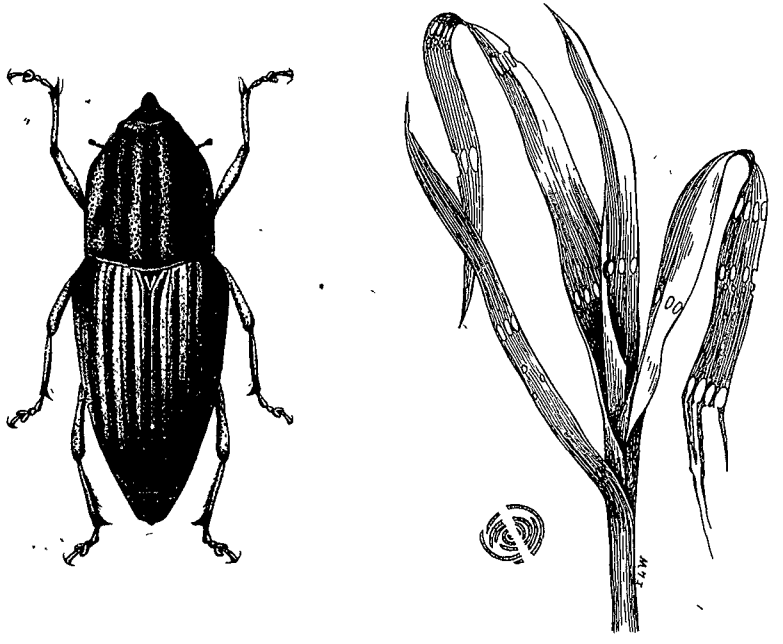

Fig. 7. Bill-Bug, Much Enlarged
Work of Bill-Bug

surface of the soil in which it changes to a brownish or reddish brown pupa. A few weeks later it changes to a grayish or brownish night-flying moth.

Methods of Control

Grass lands intended for corn should be plowed in midsummer or early fall. The earlier the plowing is done the fewer will be the eggs in the soil. Pigs pastured on such lands will root out and destroy many cutworms.

The use of poison bait a few days after planting is beneficial. The kind recommended for the control of grasshoppers may be used, with or without the fruit flavoring. It should be applied in the evening so that it will be moist when the cutworms feed at dusk.

BILL-BUGS

Corn bill-bugs are snout beetles. The largest of our species are clay-colored bugs about five-eighths of an inch long, while the smaller species are about one-fourth of an inch long and black. They often kill young corn, by puncturing the stem of the plant with the beak and eating its inner tissue.

Where bill-bugs are working in a cornfield many of the leaves have circular or oblong holes running in rows across the blade. Each row is the result of a single puncture made by the beetle when the leaves were rolled together in the plant. The injury may be very little, or it may be severe enough to cause a total loss of the crop over areas of several acres. In 1912 one Minnesota cornfield of twenty acres was destroyed by bill-bugs.

Life History

The beetles hibernate on the ground under rubbish or in other protected places and in the spring lay their eggs in or about the roots of rushes, sedges, or grass plants, which furnish food for the larvae. The larva is a thick, white, footless grub with a hard brown or blackish head.

If swampy land containing sedges, rushes, or large grass plants is plowed up in the spring and planted to corn the crop is almost certain to be attacked by the swamp-inhabiting species. If the vegetation is not kept down the first season by thoro cultivation, the injury will be repeated the second year. If timothy meadows of several years' standing are plowed in the spring and planted to corn there is danger of attack by the smaller species of bill-bugs, which inhabit grass lands.

Methods of Control

Late summer or early fall plowing of grass lands or recently cleared swamp lands intended for corn the following year will probably prevent a great amount of injury from bill-bugs. It would be safer, however, for the first year to plant some crop not attacked by bill-bugs, as flax or potatoes or garden truck. The burning over of grass and swamp lands infested with the beetles is also beneficial.

GRASSHOPPERS

Corn is sometimes injured by grasshoppers which come into the field from grass lands near by. They usually begin in the outer rows, eating the silks and kernels from the tip of the ear, the leaves, and sometimes even the husk of the young ear.

Methods of Control

The time to kill grasshoppers is in the spring, while they are without wings and before they have left the grass lands.

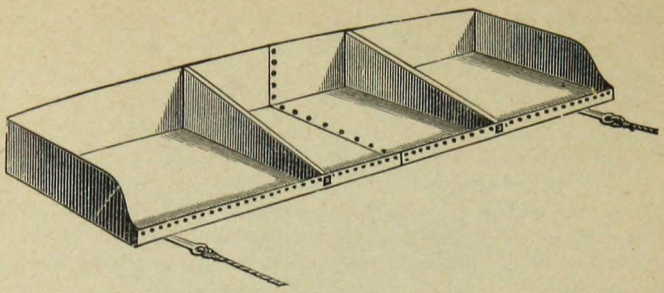

Fig. 8. Hopperdozer

The hopperdozer has been used for some time to catch grasshoppers in their wingless stages. This consists of a long shallow pan mounted on runners so that it can be drawn sidewise over the ground. The pan is partly filled with water and a small quantity of kerosene is poured on the surface of the water. Partitions may be placed in the pan to keep the water from slopping out. At the back of the pan is fixed a shield of canvas three feet high and this is wet with kerosene. The hopperdozer is pulled across the field by horses. The grasshoppers jump when it reaches them and are killed by coming in contact with the kerosene in the pan or on the shield. The hopperdozer is effective only after the grasshoppers are big enough to jump into the pan and before they can fly.

Poison Sprays.—Grasshoppers may be destroyed by a sweetened poison sprayed on the grass which serves as their first food. The spray should be applied as soon as the hoppers are hatched. Delay may prove fatal as they often move very quickly into the crops, where it is not so easy to carry out repressive measures. Promptness of action means saving of time, labor, and money, because the work

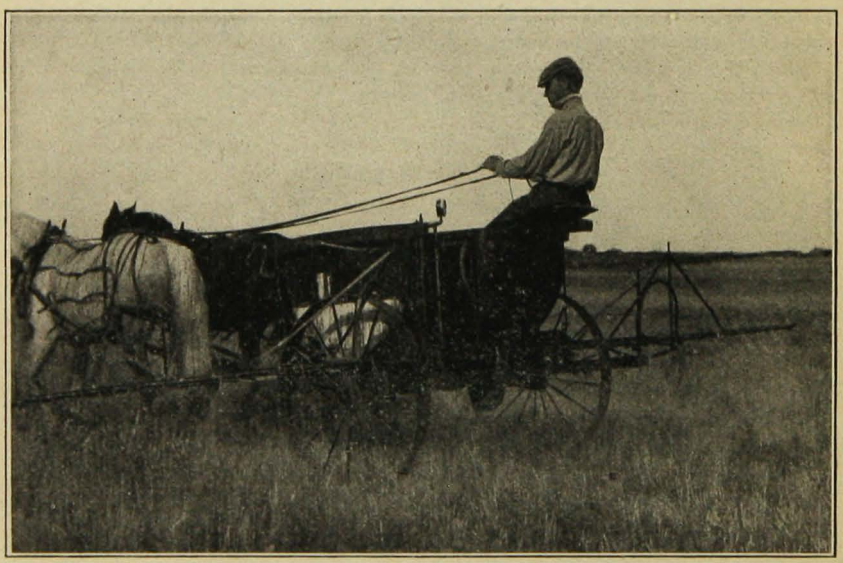

Fig. 9. Field Sprayer

can be done on a comparatively small area with the same eventual results. The spray is made as follows:

		Smaller amounts	
Sodium arsenite	3 lbs.	1 lb.	4 oz.
Water	180 gals.	60 gals.	15 gals.
Molasses	1½ gals.	2 qts.	1 pt.

Any spray pump can be used, altho the field sprayer is best. The spray should be applied in the form of a fine mist, early in the morning, before the 'hoppers feed, leaving the grass and weeds with a dewlike covering of the solution. If the area is small it should be entirely covered with spray. If large, a border from 2 to 4 rods wide around the exterior may be sprayed, and also several strips through the field, checker-board fashion. Grasshoppers are extremely fond of sweet substances, and are sure to eat grass or other plants covered with this sweetened poison.

Effective spraying must be done as soon as the grasshoppers hatch, while they are still very small, say a quarter of an inch long, as they soon move away from their nursery areas.

Poison Bait.—Another remedy for grasshoppers, known as the Kansas mixture, consists of a poisoned bran mash flavored with fruits, preferably oranges or lemons. An amount sufficient to cover five acres is made as follows:

Bran or shorts	20 lbs.
Paris green (or sodium arsenite)	1 lb.
Syrup	2 qts.
Oranges or Lemons	3
Water	3½ gals.

The fruit should be chopped fine and the bait scattered broadcast over the field where the grasshoppers are. It is best to do this in the early morning. Two or three applications may be necessary. The bait is attractive to the insects while it is fresh but is not eaten after it becomes dry and stale. It should not be spread just before a shower, as rain washes out the poison. If it is scattered evenly and thinly in small pieces there is probably no danger of poisoning birds or domestic animals. To be on the safe side it is advisable to keep stock and poultry out of the field for a few days.

Grasshoppers do not deposit their eggs in great numbers in well-tilled land. With increasing cultivation and the breaking up of reverted or raw lands the danger of grasshopper outbreaks is diminished. Fall plowing followed by thoro harrowing of land containing the eggs will help considerably.

THE CORN EAR-WORM

Damage is sometimes done to corn, more noticeably to sweet corn and popcorn, by worms, or caterpillars, working beneath the husks and devouring the young kernels still in the milky stage. In addition to the direct damage done and as a result of it, fungous growths gain a foothold and destroy much more of the ear.

The worms are about an inch and a half long when full grown. They are variable in color,—green, rose color, or dark brown—and are spotted, striped, or plain. The most common form is pale green with longitudinal white or gray stripes. They come from eggs laid by a moth which is about three quarters of an inch long, with a wing expanse of about one and three-fifths inches. The moths vary considerably in color. Most commonly the front wings are pale clay-color or olive-green with darker markings. The hind wings are pale with a blackish band on the margin.

Most of the eggs are deposited on the silks where the young caterpillars begin to feed and where they have easy access to the ear. When full grown they leave the ears and enter the soil where they change to the pupal, or resting stage, transforming later to moths.

Methods of Control

The remedy usually recommended for localities farther south is late fall plowing and thoro harrowing to kill the hibernating pupae in the soil, but as the insect is not yet know to survive the winter in Minnesota, it is uncertain whether or not the fall plowing in this state would be time and effort wasted as far as the corn earworm is concerned, altho benefit would be derived in the destruction of cutworms, grubs, etc.

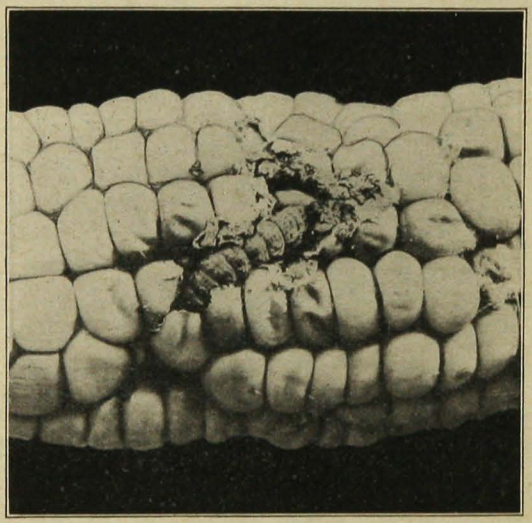

Fig. 10. Corn Ear-Worm

Recent work at the Kansas Agricultural Experiment Station demonstrated the value of dusting the silks with dry arsenate of lead. A mixture of 63 per cent of arsenate of lead and 37 per cent of sulfur is just as effective as pure arsenate of lead, and is cheaper. The dust was applied by shaking from an ordinary cheesecloth bag. This was done every three days as long as the silks were fresh. While the cost of dusting would prohibit its use where corn is raised in large amounts, the workers at the Kansas station recommend the treatment as profitable on corn raised for show purposes or for seed or table use.

THE CHINCH BUG

The chinch bug as a serious pest is usually active farther south than Minnesota, but, as there have been outbreaks in this state, there is no reason to believe that we will always be exempt.

The chinch bug is rather small, the adults being one-fifth of an inch long or less, almost black in color with white wings folded across the body when at rest. The immature bugs, often seen with the adults, are smaller, wingless, and red marked with yellow, becoming darker as they grow older. This species should not be confused with the false chinch bug, which is about the same size but is gray in color, its young also being gray.

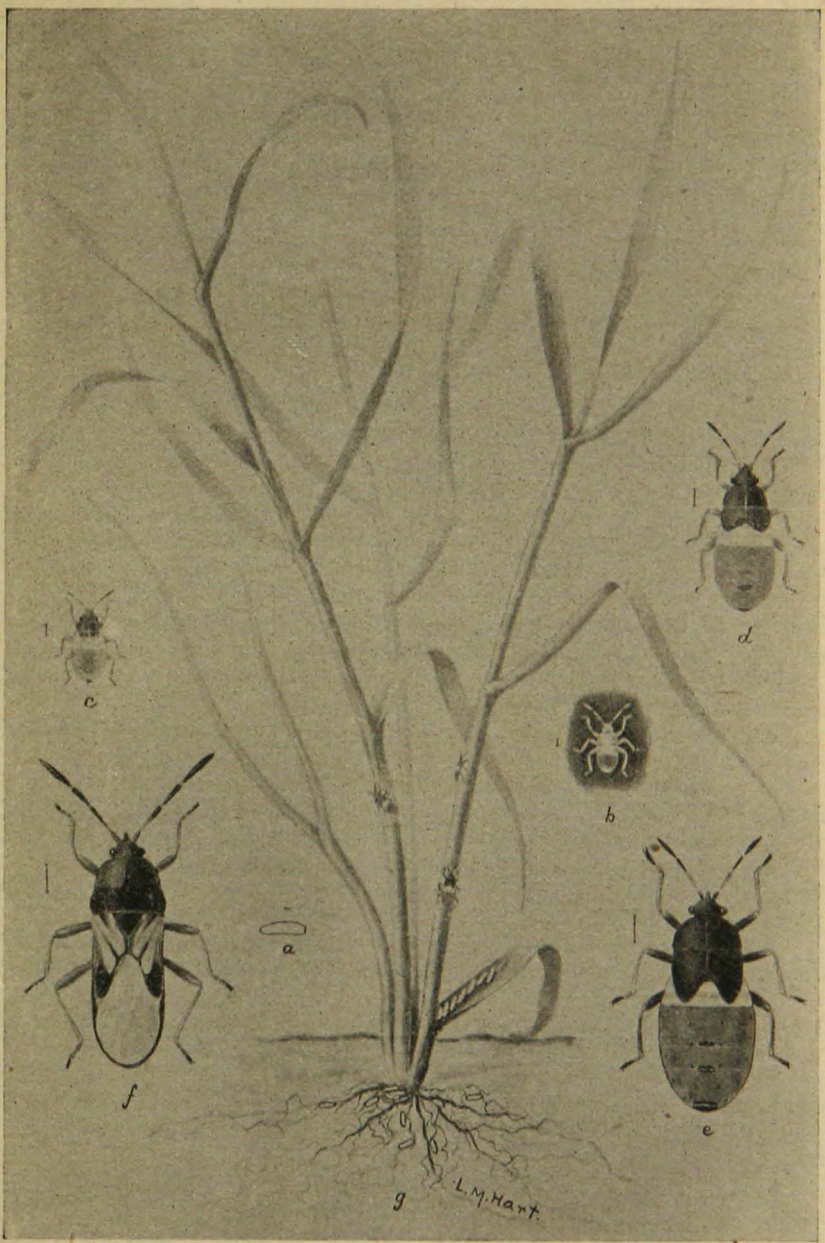

Fig. 11. Chinch Bug (Lugger)

The food plants of the chinch bug are the grains and grasses. They feed by sucking out the sap, and when present in enormous numbers they can rapidly drain a thrifty plant. During a serious outbreak they become excessively abundant in wheat until that crop is cut, when they migrate to adjoining cornfields.

Methods of Control

No effective remedy is known for chinch bugs while working in wheat, but cornfields can be protected from invasion if prompt and persistent action is taken.

In dry weather an effective barrier can be made by preparing a dust furrow around the field or on the sides threatened with attack. This is done by plowing several furrows and harrowing the ground thoroly to a fine mulch, then plowing a dead furrow through the middle and dragging this with a log, making the sides as steep as possible. Holes about a foot in depth should be made with a post-hole digger in the bottom of the furrow at intervals of about a rod to serve as traps for the bugs. The furrow must be continually watched and kept in repair with a hoe. The bugs exposed directly to the sun and struggling to climb out of the dusty furrow will be killed in great numbers by the heat while others will fall into the post-hole traps where they can be killed by kerosene.

Road-Oil Barrier.—A much better protection consists of a narrow line of coal-tar or road-oil. The road-oil is cheaper than the coal-tar and need not be renewed so often. To make a barrier, remove as much vegetation as possible from a narrow strip of land along the border of the field, then plow two deep furrows in opposite directions along the strip, throwing the dirt together to make a ridge. Make the ridge smooth and compact with a roller. Post-holes a foot or more in depth and about fifty feet apart should be dug in the edge of the ridge next to the field from which the bugs will come. Then pour a narrow line of road-oil or coal-tar (if road-oil is not obtainable) on the top of the ridge, making sure that it touches the edge of every hole on the side toward the corn-field.

This material may be poured from a watering-can with the sprinkler removed or from a coffee pot. The line should be at least an inch wide if road-oil is used. but may be narrower if tar is used. If it is kept fresh by occasional renewal and free from dirt and rubbish, the bugs will not cross it but will crawl along the barrier until they drop into the post-hole traps. It must be closely watched every day early and late as long as invasion threatens. Chinch-bugs on the outer rows of corn may be killed by spraying with a solution of cheap rosin soap using one pound of the soap to six gallons of water.

The importance of clean cultural methods cannot be too strongly emphasized. Most important is the destruction of hibernating places. Grass and rubbish where the bugs find winter cover should be raked and burned or otherwise destroyed. Neglected land along fences and the edges of woodlands may become the source of serious trouble.