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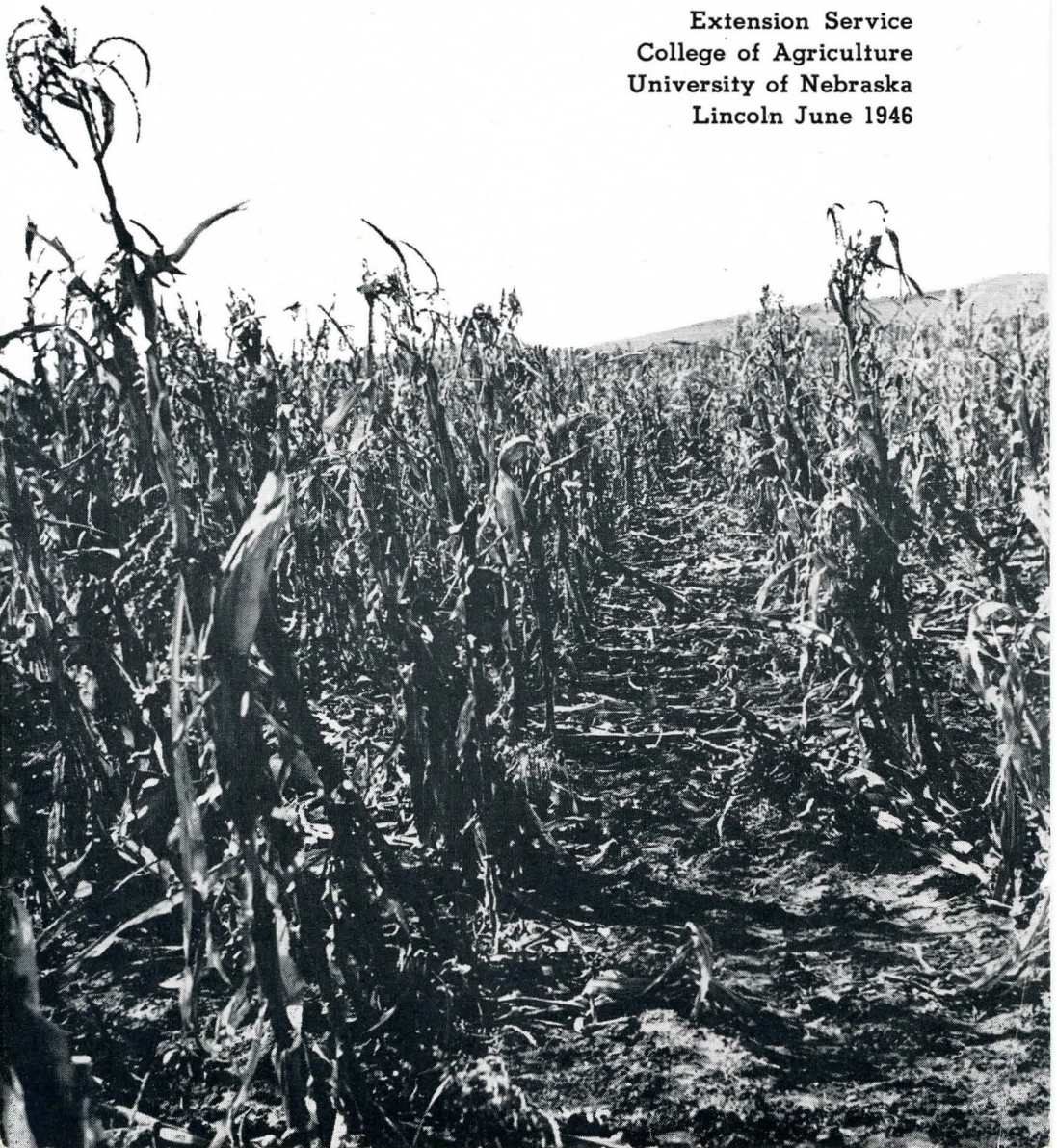
EC 1537

# Insects Injurious to Corn in Nebraska

**Extension Circular 1537**

Extension Service
College of Agriculture
University of Nebraska
Lincoln June 1946



## *Foreword*

CORN is the leading field crop in Nebraska, and the control of insects attacking it is of extreme importance. In 1944 about nine million acres of corn valued at over three hundred million dollars were grown in the state. Entomologists estimate that five to ten per cent of the corn planted in the United States is destroyed by insects. Although it is believed that the damage suffered annually in Nebraska more nearly approaches the five per cent figure, even such losses in the average year would run into millions of dollars. Notwithstanding the fact that the control of insects on corn is often difficult and that the value per acre of the crop is comparatively low, much can be done to profitably reduce this loss.

An attempt has been made in this circular to discuss not only the more serious or threatening corn pests, but also many of minor importance, and to present available practical control measures for each. To facilitate reference, the insects have been grouped according to the part of the plant that they attack and they are listed first in a simple key to their identification based on the part of the plant injured and the type of injury sustained.

# Insects Injurious to Corn in Nebraska

MARTIN H. MUMA, *Extension Entomologist*

## *Key to Corn Insects of Nebraska*★

### INSECTS ATTACKING THE SEED

1. Yellowish-white, legless maggots about one-fourth of an inch long tunneling in kernels or in ground around kernels. Seed produces weak sprouts or none. **Seed-corn Maggot. Page 5.**

2. Brown or brown-striped beetles about one-third of an inch long feeding in kernels in the ground. Seed does not sprout. **Corn-seed Beetle. Page 5.**

3. Hard, shiny, brown to yellowish-brown six-legged worms about one to 1½ inches long boring through kernels and young plant. Seed fails to sprout or sprouts weakly. **Wireworm. Page 6.**

### INSECTS ATTACKING THE ROOTS

1. Bluish-green to grey plant lice or aphids about the size of a pinhead sucking the sap from the roots. Red ants always present. Young plants weak, leaves yellowish or reddish. **Corn Root Aphid. Page 7.**

2. White, curved, fat-bodied, large-headed, six-legged grubs from one-half to one inch long chewing off roots. Plants make slow growth, die, and sometimes fall over. Injury often occurs in distinct patches. **White Grub. Page 7.**

3. Slender, whitish worms about one-third to one-half of an inch long with distinct brown heads and six short legs. Worms tunneling and eating off roots. Corn falls over, particularly after rain or irrigation has softened ground. Not confined to old corn land. **Southern Corn Rootworm. Page 9.**

4. Same as 3, except confined to old corn land. **Northern or Colorado Corn Rootworm. Page 9.**

### INSECTS ATTACKING THE LEAVES AND STALKS

1. Small, active, reddish or black and white bugs clustered behind the leaf sheath of the lower leaves and over the entire lower part of the stalk sucking the sap from the plants. The corn wilts, dries out and falls down. Injury usually occurs on side of field next to small grain. **Chinch Bug. Page 10.**

2. Leaves of plant ragged or eaten entirely. Injury heavier along borders of field. **Grasshopper. Page 12.**

3. Dark-green worms with light stripes on the sides and down the middle of the back, measuring two inches or longer in length, often found in heart of plant or under clods of dirt. Corn leaves eaten entirely or with irregular holes, during night. **Armyworm. Page 15.**

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* Modified from "Destructive and Useful Insects" by C. L. Metcalf and W. P. Flint.

4. Bluish-green plant lice or aphids cluster in the whorl on tassel and often on the leaves sucking the sap. Corn covered with sticky honey-like material, plants may be stunted or pale in color, pollination may be reduced. **Corn Leaf Aphid. Page 15.**

5. Black or reddish brown snout beetles from one-fourth to one inch in length feeding on the tips of the young plants causing rows of holes in unfolding leaves, or white legless fat-bodied grubs burrowing in the stalks. **Billbug. Page 16.**

6. Fat, smooth-bodied worms of varying color, markings and size found under clods of dirt. Young corn plants cut off or eaten into at or near the surface of the ground at night. **Cutworm. Page 17.**

7. Short, dirty-colored, brown-spotted, coarse-haired worms from one-fourth to one-half of an inch long usually hidden in silken webs and tunnels. Corn eight to 10 inches tall eaten into or cut off near the surface of the ground. **Sod Webworm. Page 17.**

8. Active dark brown worms or caterpillars with two white stripes on each side that are interrupted for a short distance near the middle of the body, and a continuous white stripe down the middle of the body. When full grown, the caterpillars are white and about 1½ inches long. Tunnels in the stalk, especially those on the margins of fields and around weed patches. **Common Stalk Borer. Page 18.**

9. Greyish to yellowish white worms with a regular pattern of brown or black spots on the sides and back. Mature late summer or early fall. Worms may be white or greyish white with no markings and measure one to 1¼ inches long. Young larvae feed on leaves and growing tip causing dwarfed, ragged plants. Mature worms bore into stalk, girdling it on inside before hibernating in root stalk in fall. Girdled stalks often break over. **Southwestern Corn Borer. Page 19.**

10. White to flesh-colored worms from one-half to one inch in length, sprinkled with small brown spots, boring in all parts of the stalk. Tassels or stalks may be broken over at any place from weakening due to tunneling. **European Corn Borer. Page 19.**

## INSECTS INJURIOUS TO THE EAR

1. Rough-skinned, sparse-haired worms varying in color from brownish green to light green and measuring about 1½ inches long when full grown. Silks cut off and fouled with droppings, kernels chiseled and eaten. **Corn Earworm. Page 20.**

2. White or flesh-colored, brown-spotted worms about one-half to one inch long tunneling through the husk, kernels and cob of ear, leaving borings outside of the husk. **European Corn Borer. Page 19.**

3. Green or yellowish green beetles, black-spotted beetles or striped beetles feeding on silks, sometimes causing poor fertilization. **Corn Rootworm. Page 9.**

4. Ears chewed and gnawed back from tips. **Grasshopper. Page 12.**

## Insects Attacking the Seed

**The seed-corn maggot** * is probably the most serious pest of planted seed corn in the state. Adult flies are a greyish-brown color and measure about one-fifth inch in length. They emerge in the late spring and deposit their eggs on the seed, the newly germinated corn plant, or in moist soils and soil containing heavy deposits of decaying vegetable matter. The tiny, yellowish-white maggots (see Figure 1), upon hatching, burrow into and tunnel through the seed, often destroying the germ. Seed infested with the maggots fails to sprout or produces weak, sickly plants. After attaining full growth, the maggots pupate in the soil and emerge in about two weeks as adult flies. There are several generations a year.

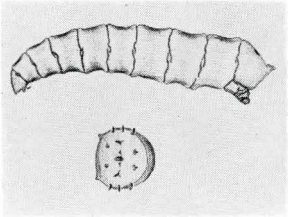

Figure 1. Seed-corn Maggot: Side and end view of larva. (Redrawn from U. S.D.A.)

No effective practical control of the seed-corn maggot is known. Prevention of infestation and injury may best be accomplished by planting late enough in a good seedbed to obtain quick germination and growth of the seed and plant. Later replantings seldom are damaged. Early fall plowing of heavily manured land or land where a cover crop is to be turned under tends to reduce egg laying the next spring.

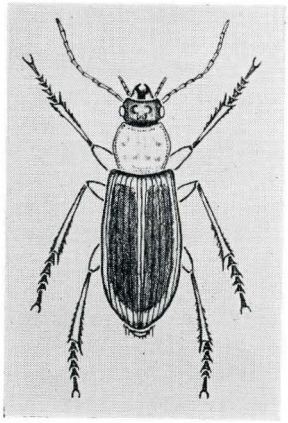

Figure 2. Corn-seed Beetle: Top view showing stripes.

**Corn-seed beetles.** Both the corn-seed beetle** (shown in Figure 2) and the slender corn-seed beetle,† occur in Nebraska. The first is dark brown with a light brown to yellow stripe on each side, while the latter is colored a uniform chestnut brown. Both species vary from one-fourth to one-third inch in length. The life history of corn-seed beetles is not fully known, but they overwinter in the adult stage as beetles and may be found around lights at night in the very early spring.

Although these small ground beetles are mainly predators of insects and scavengers of insect remains, they occasionally attack seeds, eating all or nearly all of the kernel. The most serious damage occurs when cool wet weather has delayed germination of the corn seed. For this reason corn planted on low river bottom land is more frequently attacked.

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* *Hylemya cilicrura* Rondani
** *Agonoderus pallipes* Fabricius
† *Clivina impressifrons* Leconte

No practical control is known. Damage may best be prevented by planting good seed late enough to assure quick germination. Packing or firming the soil at planting time has also been suggested as a control measure.

**Wireworms** are the young or larvae of the familiar click-beetles or snapping beetles (family—Elateridae). Several different species attack corn in Nebraska. Wireworms are easily identified as six-legged, elongate, slender, hard, round-bodied "worms" with flattened heads that are provided with large jaws. Several larvae of a species that attacks corn are shown in Figure 3. Most of the species are yellowish brown or reddish brown in color. Adult beetles of the species injurious to corn are usually brown or grey. Most farm children are familiar with the elongate flattened adult beetles that are attracted to lights and which, if caught and placed on their backs, snap into the air with a distinct click in attempts to regain their feet. Female beetles of the species attacking corn lay their eggs in the soil around the roots of grasses. The larvae that hatch from the eggs feed on the roots of the grass and other plants for two to six years before pupating, and emerge in the spring as adult beetles. Damage is caused by the worms boring through the seed, destroying the kernels and preventing germination, or young plants may wilt down because the wireworms bore through the roots and underground parts of the stalk.

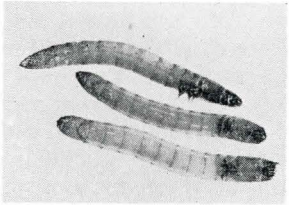

Figure 3. Wireworm: Several larvae of a species that attacks corn.

Although chemical control measures have been devised for wireworms, especially on irrigated land, cultural methods for prevention still appear to be the most practicable on field crops. They include late summer or fall plowing to kill the pupae and adults, proper drainage to prevent damage from species that live in poorly drained soil, and crop rotations that make use of legumes and small grains for at least two years after sod land or meadow land has been plowed.

Chemical methods that have been devised for the control of heavy infestations of wireworms are expensive. They are given here as a matter of interest. One ounce of carbon disulfide applied at a depth of two inches at points not over two feet apart will give control of wireworms in the spring. Approximately 900 pounds of carbon disulfide should treat an acre and in light soils crops can be planted 10 days after application, provided that the land has been given a second plowing several days after treatment. Crude naphthalene, applied to the surface of the soil at the rate of 500 pounds to the acre and deeply plowed under and disked, will control wireworms. Crops may be planted within a few days following napthalene treatment without risk of injury. Several other chemicals have been suggested for use in soil treatments, one of these, D-D (1,3-dichloropylene-1,2-dichloropropane), is promising.

## Insects Attacking the Roots

**The corn-root aphid** * is one of the more important pests that attack the roots of corn in Nebraska. It is distributed throughout the state and, although losses are often not obvious, it does much damage. Sandy soil seems to be the most favorable for the development of infestations of this aphid. Infested corn plants are usually stunted and the leaves often have a yellowish or reddish tinge.

The corn-root aphid appears to be entirely dependent on the cornfield ant † or related ants, for its survival. In the late fall the overwintering eggs of the aphids are stored by the ants in their nest. Upon hatching from the eggs in the spring, the young aphids are placed by the ants on the roots of several host plants, including corn, where they feed by sucking the juices of the plant. Successive generations of wingless aphids produced during the summer by unfertilized females are transferred to the roots of other plants by the ants. Summer spread of the aphids is accomplished by winged females which fly to other fields where they are again cared for by ants. In the fall a generation of winged males and females is produced and, after mating, the females lay the overwintering eggs. This association of ant and aphid is apparently of mutual benefit as the ant depends for its food, to a large extent, on a sweet sticky material known as "honey dew" that is given off by the aphid.

Because of the close relationship of the ant and aphid, any measure that will control the ant or disrupt the association will in turn control the aphid. The most effective practice is a deep plowing and disking of infested fields in the early spring to disturb the ant colonies and prevent the growth of weeds, such as smartweed, crab grass, etc., on which the aphids feed before corn is planted. In order to be effective, the furrow should be about seven inches deep and the disc should be set deep. Early fall plowing and disking to reduce the number of aphid eggs that carry through the winter will also serve as a means of reducing the infestation. Other control measures include rotating to some other field crop for a season or two in order to starve out the aphids, and using fertilizers to enable the corn to outgrow the damage. The last is suggested purely as a supplementary measure.

**White Grubs.** Although few cases of heavy infestations of corn by white grubs have been reported in the state, these insects can cause considerable loss. White grubs are the young or larvae of the well-known brown or gray June bugs or May beetles which are represented by several species. When full grown the grubs measure from one-half to one inch in length, but normally they lie in a curled position. (See Figure 4.) They are greyish or yellowish white in color, rather robust in appearance, and have distinct brown heads that are provided with strong jaws. Injury to corn is caused by the grubs feeding on and

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* *Anuraphis maidiradicis* (Forbes)

† *Lasius niger americanus* Emery

cutting off the roots. Corn fields attacked by white grubs often contain irregular patches of dead and dying corn outlining the infested areas.

The life cycle of these insects in this region usually takes three years, although the length of time may vary one to four years, depending upon the species. They overwinter in both the grub and adult stage. In the spring the adults emerge, feed on the foliage of trees, and lay their eggs, either in moist sod-land or in low moist cropland containing patches of grassy weeds. The eggs hatch in two or three weeks and the grubs feed on the roots of grasses, and crops such as potatoes, beans and corn. In the winter, the grubs go down below the frost line in the soil and hibernate, returning to just below the surface to feed for the second summer and the spring and early summer of the third season. They then descend to six or eight inches, change to the pupal stage, and transform to the adult. The adult hibernates during the third winter and emerges in the spring, completing the cycle.

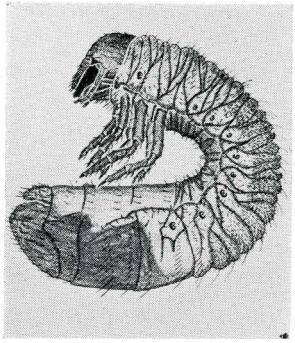

Figure 4. White Grub: Side view of grub in typical curled position.

Control of white grubs on cropland is largely a matter of cultural practices. Newly turned sod-land, heavily infested with white grubs, should not be planted to corn. Early fall plowing before the grubs have worked down below plow line will crush many of them and expose them to birds and other natural enemies. Pasturing infested fields with hogs in the late summer or early fall the first season after heavy beetle flights will reduce serious populations of grubs. As beetles usually do not lay their eggs in fields of clover or alfalfa unless the fields are weedy, corn can be grown with comparative safety

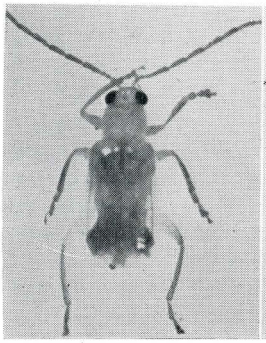

Figure 5. Northern Corn Rootworm: Adult beetle.

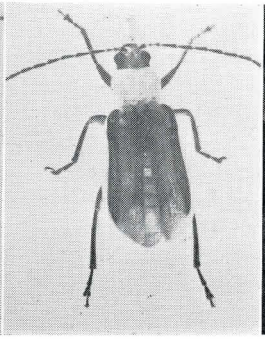

Figure 6. Colorado Corn Rootworm: Adult beetle.

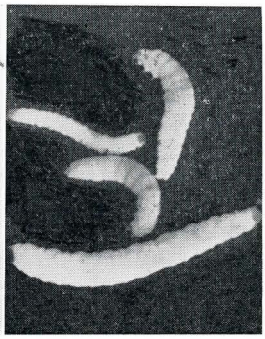

Figure 7. Colorado Corn Rootworm larvae.

following these crops. Clean-cultivated, wide-row crops can also be followed with corn even after years of heavy beetle flights.

Many animals and birds eat white grubs and in some cases may reduce an infestation considerably. Several of the more important grub feeders are hogs, moles, chickens, ducks, blackbirds and crows.

**Northern and Colorado corn rootworms.** Two of the three corn rootworms occurring in the state, the northern corn rootworm * (Figure 5) and the Colorado corn rootworm† (Figure 6), have similar habits and life histories and therefore may be discussed under the same heading. The Colorado species damages corn in the southwestern and central parts of the state, especially on irrigated land, while the northern rootworm is a problem mainly in the eastern third of the state. The adult beetle of the Colorado rootworm is about one-fifth of an inch long and varies in color from yellowish-green to light green, while the northern species is green with prominent black bars or longitudinal stripes on the back and is slightly larger. The young or larval stage of both pests is a slender white worm about one-half inch long with a brownish yellow head. Several larvea of the Colorado corn rootworm are shown in Figure 7. It is the worm that causes the most serious damage to corn by tunneling through and cutting off the roots of the plants. Corn with heavy root damage will often fall over, especially after a rain accompanied by wind.

Adult beetles may also cause some damage by feeding on the silks and preventing proper pollination; the Colorado corn rootworm adults also feed on the leaves between the veins and in some instances reduce considerably the leaf surface of a plant. The adult beetles lay their eggs in the fall in old corn fields. Worms hatching in the late spring feed on the roots of the newly planted corn and, upon maturing, pupate and emerge as adults. The adults feed upon pollen, corn silk and corn leaves, and lay eggs in the fall to complete the cycle.

The facts that the eggs are laid in old corn fields and the larvae feed as far as is known only on corn roots make this pest relatively easy to control with crop rotation practices. One year of any crop other than corn will effectively eliminate it from a field. In areas heavily infested with rootworms, corn should not be grown more than two or three years in succession on the same land.

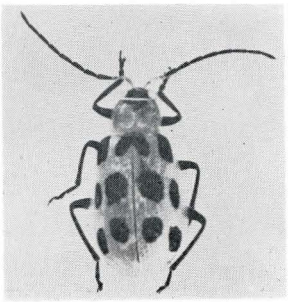

Figure 8. Southern Corn Rootworm: Adult beetle.

**The southern corn rootworm**** (Figure 8) occasionally is injurious to corn in the southern part of the state, particularly the southeast section. It is green in color and marked with 12 black spots arranged in

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* *Diabrotica longicornis* Say

† *Diabrotica virgifera* Gillete

** *Diabrotica duodecimpunctata* (Fabricius)

four rows down the back. The larvae or worms are slightly larger than those of the northern and Colorado corn rootworms but otherwise are quite similar in appearance. Adults of this species also tend to be slightly larger than the other two forms. Unlike the other two rootworms, adults of this species pass the winter in hibernation under trash and around the bases of plants not entirely killed by frost. Adults do not survive the winter in Nebraska but infestations arise from beetles that migrate northward in the early spring and deposit their eggs in the ground around the bases of plants. Upon hatching, the worms tunnel through and damage the roots. They may also burrow into small plants and destroy the developing buds. Maturing in midsummer, the worms change to the pupal stage and emerge as adult beetles. In some seasons a second or partial second generation may be produced.

Because the eggs are laid in the spring, often after the corn is up, this insect is extremely difficult to control. About the only effective measures that can be advised are early spring plowing and clean cultivation. Plowing and cultivation kills weeds that may attract the adults and provide early food for the worms.

## Insects Attacking the Leaves and Stalk

**The chinch bug** * probably causes more damage to corn in the southeastern quarter of Nebraska than does any other insect. Except in extremely heavy infestations, losses usually occur on the margins of corn fields next to small grains. Figure 9 illustrates marginal corn dam-

Figure 9. Chinch Bug: Marginal damage to young corn.

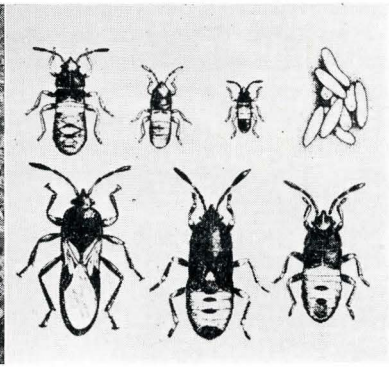

Figure 10. Chinch Bug: Adult nymphs and eggs. (U.S.D.A.)

age caused by chinch bugs. Second generation chinch bugs may cause damage throughout the fields. The corn plants wilt and dry up because both adult and young bugs suck out the juices. The adults measure about one-seventh of an inch in length and vary in color from

* *Blissus leucopterus* Say

grey and white to black and white, while the young vary from a bright red, marked across the back with a white bar in the newly hatched condition, to a deep reddish-brown in nearly mature specimens. Adult and young chinch bugs are shown in Figure 10.

Adult chinch bugs hibernate during the winter, preferably around the bases of bunch-grasses, but they may sometimes be found under leaves and trash in protected situations. In the spring, when the chinch bugs leave their winter quarters, they fly to fields of small grains where they begin feeding and laying eggs. The newly hatched young remain on the small grains, and feed until the grain is harvested and the stubble dries out. At that time the young, wingless bugs migrate on foot to other grasses or grain crops, such as corn, and feed until they reach maturity in the early or mid-summer. Occasionally, migrations will take place before the small grain harvest, especially if the straw dries out before harvest time. While feeding on corn, the bugs cluster around the bases of the plants and behind the leaf sheaths. In heavy infestations a large portion of the stalk may be covered with the bugs. When the first generation matures, the adults mate. Eggs are laid on grasses and corn. The second generation feeds on corn and grasses and matures before cold weather drives the bugs into hibernation.

Chinch bug control depends upon preventive as well as direct control measures. Chinch bugs attack crops that belong to the grass family. Although none of the grain crops is immune to attack, there is a wide range of susceptibility. Among the small grains, barley, spring wheat, and winter wheat, in the order named, are attacked more vigorously than oats or rye. Of the larger grains, sudan grass, millet, and corn are more susceptible than sorghum and broomcorn. Other crops such as alfalfa, clovers, soybeans, cowpeas, buckwheat, potatoes, etc., are immune. In years of heavy chinch bug populations, damage can be averted and populations can be greatly reduced by the growing of large acreages of immune crops. Sinch chinch bugs tend to avoid heavy growths of vegetation, any practice, such as the growing of clovers in small grain or planting corn early and thick, will reduce loss. Avoiding the planting of small grain side-by-side with corn or sorghum is recommended during years of heavy infestations.

Direct control measures for the chinch bug consist of building barriers between small grains and corn, and dusting and spraying. Barriers of several types are effective in stopping chinch bug migrations. Most commonly used is the oil-line furrow barrier or the barrier of treated paper.

The treated paper barrier is constructed by burying a continuous four-inch strip of paper in an upright position to a depth of two inches on a smooth surface of ground. The paper may be pre-treated or be treated later with creosote. After the barrier has been constructed, additional treatments with creosote are necessary whenever chinch bugs are noted crossing the line in numbers. Chinch bugs turned by the barrier may be trapped in beveled-top post holes four to six inches from the paper line, 20 inches deep, and 25 to 50 feet

apart. Two or three teaspoonfuls of kerosene, creosote or crankcase oil, placed in the holes each day, will kill the trapped bugs.

Although not as efficient as the treated paper barrier, the oil-line furrow barrier is cheaper, and is quicker and easier to construct and maintain. A narrow uninterrupted line of creosote is laid along the smoothed brow of a furrow ridge thrown away from the source of the chinch bug migration. Post holes should be placed as described above and stress should be placed on maintaining a film of dust on the beveled edge of the holes. As in the case of the treated paper barrier, the creosote must be renewed when the bugs begin crossing the line. From 50 to 60 gallons of creosote are needed to build and maintain one-fourth mile of an oil-line furrow barrier, and 25 to 35 gallons are needed for the same amount of treated paper barrier.

A dust barrier, constructed by dragging a log or weighted barrel several times a day up and down a plowed furrow, will check a chinch bug migration during dry weather. Rains destroy the effectiveness of such a barrier.

Experiments conducted on the use of poisonous chemical dusts for barriers have indicated several promising materials. Most promising is a dust known as DN (dinitro-o-cresol) and it may be that barriers using this or other poisonous materials will in the near future replace the creosote barriers now in common use. A DN dust barrier may be constructed by laying down a narrow band of the insecticide on smooth surface of ground. Wind and rain may destroy the barrier, so it must be watched and maintained.

Because of the high cost, spraying and dusting are not usually recommended. However, they may be used to advantage on valuable crops such as seed corn. A spray using one quart of 40 per cent nicotine sulfate, three pounds of soap and 50 gallons of water will control chinch bugs on corn if applied thoroughly. A dust composed of three pounds of 40 per cent nicotine sulfate and 47 pounds of hydrated lime is also reported to be of value. Recent experiments at the Nebraska Agricultural Experiment Station and in other states show that a 10 per cent sabadilla dust or a spray containing two pounds of sabadilla powder per 100 gallons of water is more promising than nicotine sprays and dusts.

**Grasshoppers.** Although many kinds of grasshoppers eat and damage plants, only four species cause serious damage to crops in Nebraska. These are the two-striped grasshopper,* the differential grasshopper,† the migratory grasshopper,** and the red-legged grasshopper.‡ The two-striped and differential grasshoppers are the larger species, measuring about 1½ inches in length; they are both colored yellowish to brown and may be distinguished by the two light stripes that extend from the head to the ends of the wings on the back of

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* *Melanoplus bivittatus* Say
† *Melanoplus differentialis* Thomas
** *Melanoplus mexicanus* Saussere
‡ *Melanoplus femur-rubrum* DeGeer

the former. The migratory and red-legged grasshoppers are yellowish-red to brownish-red in color, measure about one inch in length and are not easily distinguished.

Each of these grasshoppers overwinters in egg stage. The eggs are laid in masses or pods about one inch long and are deposited about 1½ inches below the surface of the ground. In the late spring and early summer, the eggs hatch and the young hoppers begin to feed on nearby plants. Growth is completed in summer and early fall in field margins, roadsides, and uncultivated fields, such as pastures or alfalfa and clover fields. The lesser migratory grasshopper also lays many eggs in small grain stubble and abandoned fields.

Grasshoppers do little feeding on corn until they are mature; the adults then move into the margins of the field, eating the leaves, the tip of the ear, and often chewing on the stalk. In severe infestations, the plants may be entirely stripped and most of the field destroyed.

Figure 11. Grasshopper: Corn field showing typical grasshopper damage.

The control of grasshoppers consists of two separate and distinct measures. First, the eggs may be destroyed by cultural practices and second, the grasshoppers may be killed with poison bait. Eggs may be crushed or exposed to parasites, predators, and the weather in the winter and early spring by plowing and disking or sub-surface tilling to a depth of three to four inches in the fall in areas where the eggs are laid. Young and adult grasshoppers may be killed with a poison bait of the following formula:

| | |
|---|---|
| Mill-run bran, mixed feed or shorts | 25 lbs. |
| Sawdust (3 times bulk of bran) | about 75 lbs. |
| Sodium fluosilicate | 4 lbs. |
| Water | 8–10 gals. |

This bait, when eaten by the grasshoppers, will give an effective kill. Much depends upon the time that the bait is spread in the field, how it is spread, and rankness of plant growth. Any method of scattering the bait thinly in small particles should give good results. Because the bait usually falls to the ground, it should be applied when the grasshoppers are feeding on or near the ground. Grasshoppers do not feed at night and, during the hot part of the day, usually climb up on plants. For this reason, early morning is usually the best time to spread bait, but for best results a careful check on the activities of the hoppers should be made before the bait is spread. Care should be taken to see that poultry or livestock do not have access to bulk lots of poison bait; but once the bait is spread thinly, there is little need for concern.

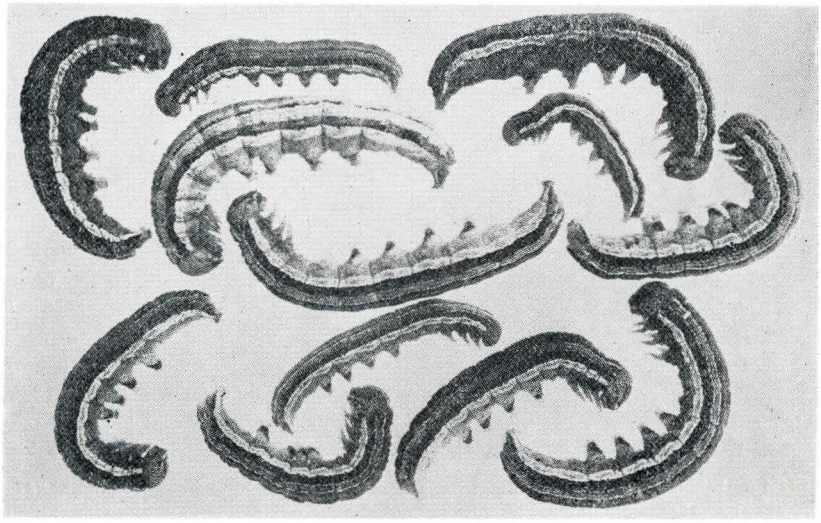

Figure 12. Armyworm: Larvae showing typical stripes. (U.S.D.A. photograph.)

**Armyworm.** Outbreaks of the armyworm * frequently occur on corn in this state. Often the worm escapes notice until serious damage is done. The tiny, light green, newly hatched worms feed close to the ground in shaded parts of the field and are easily overlooked. Mature or nearly mature worms measure about 1½ inches in length and are colored dark green or brownish-green with white stripes on the sides and back. Several mature worms are shown in Figure 12. The armyworms feed on the leaves and stalks at night, eating all of the leaves, or all but the midrib, and chewing out the centers of the young stalks. During the day, the worms may be found under trash or clods of dirt in infested fields.

Armyworms pass the winter as nearly mature larvae and also perhaps as pupae. The worms begin feeding very early in the spring, pupate in the ground and emerge in late April or early May as adult moths. The light brown or brownish-gray moths lay their eggs near the ground on the leaves of grasses, small grain or early corn, and they are attracted for egg laying to dense, rank growths that are musty or sour. The young worms feed on the plants near the place where the eggs were laid. If they destroy all of the food in the area, they move in masses to other fields. This mass movement gives the armyworm its common name. There may be two or three generations each year.

Perhaps the most effective method of controlling armyworms is to poison them with bait similar to that used for grasshoppers. Paris green or white arsenic is often recommended in armyworm baits, as well as sodium fluosilicate, and sweetening the bait with a gallon or two of molasses is also suggested. The bait should be scattered thinly on the ground in the infested field or in front of a moving army of the worms.

Moving masses or armies of worms may also be destroyed by plowing a furrow in front of the line of march and crushing the worms that fall into it by dragging a log or barrel back and forth. Worms may also be trapped in post holes in the bottom of the furrow where they may be crushed, or killed with kerosene or a light motor oil.

**Corn-leaf aphid.** This green or blue-green aphid or plant louse† (see Figure 13) is entirely different from the corn root aphid. Heavily infested plants may have the ear, terminal whorl of leaves, and tassel covered with these tiny insects. They damage the plant by sucking the juices, which may retard growth and cause the leaves to turn

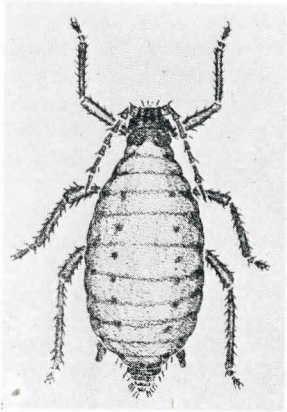

Figure 13. Corn-leaf Aphid: Wingless female.

* *Cirphis unipuncta* Haworth
† *Aphis maidis* Fitch.

yellow or red. In some cases the silks or tassels may be injured enough to interfere with pollination and hence result in poorly filled ears. The sticky secretion or honey-dew produced by the aphid is attractive to the corn ear-worm moths, and in this way the aphids may be the indirect cause of damage.

The life history and habits of this aphid have not been carefully studied in Nebraska. It appears late in the summer and approximately nine generations of living young are produced before heavy frost. The overwintering stage in this area is not known but it has been suggested that it migrates from southern states where adult females pass the winter in the terminal whorls of barley. Its late appearance in the North seems to confirm this suggestion.

No practical control measures for this insect are known when it is on ordinary field crops. However, as it appears late in this area, corn planted early would attain much of its growth before the aphids appear. Also, any practices that would produce vigorous plants would tend to cause the corn to outgrow possible damage. On valuable crops, such as seed corn, a nicotine sulphate spray or dust may be used.

**Billbugs.** There are two groups of billbugs that occasionally cause damage to corn in Nebraska. One group is known as the grass or rush billbug, the other as the corn or maize billbug. The grass billbugs * are black or clay-colored snout beetles that feed as adults in the terminal whorl or on the stalk of corn. The corn billbugs† (see Figure 14) and related species, although similar in color and appearance, feed on corn as both adults and grubs. Billbugs may vary, depending upon the species, from one-fourth to one inch in length.

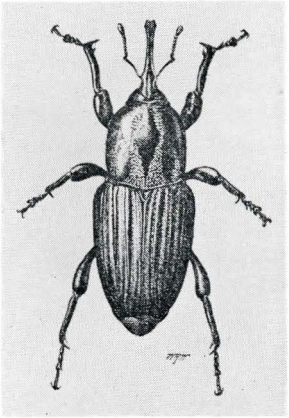

Figure 14. Adult corn billbug. (U.S.D.A.)

In general, billbugs overwinter as adults and begin feeding in the early spring on the stem or in the heart of the growing plants. Billbugs feeding on the growing tips of corn cause rows of rather regular holes or slots in the unfolding leaves. Because the eggs of the grass billbugs are laid on swamp grasses or rushes where the grubs feed in the stalk and roots, the adult is the only stage that causes damage to corn. In the case of the corn or maize billbug, the eggs are laid in feeding cavities in the corn stalks, and the white, fat-bodied legless grubs burrow through the stalks and crowns of the plants. The grubs grow rather slowly, mature in the late summer, pupate and change to adults in the fall, and emerge from the stubble the following spring.

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* *Calendra* spp.

† *Calendra maidis* Chittenden

Injury from grass billbugs can be avoided by not planting corn on land that has been in sod the previous year. Early fall or late summer plowing and disking of infested sod land will drive out the hibernating adults and reduce injury even if corn is planted the following year.

Crop rotations in which corn does not follow corn on the land will greatly reduce injury from the corn billbugs. Winter plowing of infested fields is also of value by causing the hibernating adults to be exposed, crushed, or driven out of the stubble.

**Cutworms.** A large number of cutworms known by such common names as greasy cutworm,* variegated cutworm,† glassy cutworm,** spotted cutworm,‡ etc., injure corn in the state.

Figure 15. Spotted cutworm. (U.S. D.A. photograph.)

Cutworms pass the winter as partly grown caterpillars in the ground, particularly in weedy fields or sod-land. Cutworms often lie in a half-curled position as shown in Figure 15. In the spring the cutworms feed on the stems of plants just above, at or beneath the surface of the ground. They mature in late spring and early summer, change to the pupal stage, and emerge as the greyish or brownish moths or "millers" that are often seen around lights at night in the summer months. The moths lay their eggs in weedy fields or sod-land in the late summer, and the newly hatched cutworms feed on grasses and weeds until cold weather. Most species produce only one generation each year.

Corn planted on fields that were weedy the previous season or on newly turned sod-land is liable to cutworm injury because the natural food has been eliminated and the worms concentrate on the corn. For this reason, cutworm damage may be reduced by any cultural practices that eliminate weeds from corn land or land intended for corn. Sod-land intended for corn the following season may be plowed in mid-summer to prevent the moths from laying eggs. Many hibernating cutworms may be destroyed by late fall or early winter plowing.

Serious infestations of cutworms in corn fields may be controlled with a poison bait similar to that recommended for armyworms. Bait may be scattered thinly over the ground, but best results are secured if it is distributed along the rows.

**Sod webworms.** Several species of sod webworms†† are injurious to corn in this state. The caterpillars most frequently encountered are short, thick-bodied, coarsely haired, spotted worms between one-fourth and one-half inch long. They are found in silken tubes or cases just below the surface of the ground around the bases of the plants. In-

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* *Agrotis ypsilon* Rottemburg
† *Lycophotia margaritose saucia* Hubner
** *Lideniia devastator* brace
‡ *Agrotis c-nigrum* Linnaeus
†† *Crambus* spp.

jury is caused by the worms cutting off the young corn plants at or near the surface of the ground.

The adult moths vary in length from one-half to one-inch, are usually pale brown in color and have a horn-like projection on the front of the head. They appear in late June or July and lay their eggs on the lower part of grass stems in weedy fields and sod-land. The young worms, upon hatching, feed for a short time before hibernating for the winter. A young webworm is illustrated in Figure 16. In the spring the partly grown caterpillars resume feeding, mature, pupate, and emerge as adults. Most species of webworms injurious to corn have two or three generations per year.

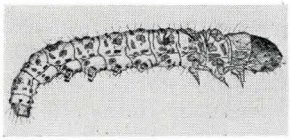

Figure 16. Sod Webworm: Half-grown larva.

Early fall plowing of sod-land or weedy fields before the planting of corn will remove egg laying places and effectively prevent damage. Where it is impossible to plow early, late plowing will expose the caterpillars to weather and natural enemies and reduce injury considerably. Replanting of heavily damaged early fields will be most effective if the first planting is left as food for the webworms and the second planting made between the existing rows.

**The common stalk borer** * frequently causes marginal damage to corn in Nebraska. Corn plants attacked by the borer may have irregular holes through the unfolding leaves; they may be stunted, twisted or bent over; and frequently in young plants the terminal whorl will die back and dry up. The borers also tunnel through the stalks, and in some cases cause the plants to break over.

This insect apparently hibernates only in the egg stage on grasses and weeds. The small, brown, white-striped caterpillars (see Figure 17) bore into and feed on the smaller grasses and weeds on which the eggs are laid, moving to larger plants such as giant ragweed and corn only as they increase in size. When nearly mature, the borers lose their brown color and are a dirty greyish-white. Mature caterpillars measuring about two inches in length pupate in their tunnels in late July and early August. The greyish, white-spotted moths having a wing spread of about one inch, emerge in late September and lay their eggs on weeds and grass, completing the cycle. There is only one generation a year.

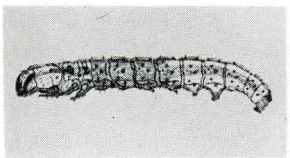

Figure 17. Common Stalk Borer: Side view of young borer.

No practical control is known, other than cleaning up and burning infested field margins in the fall to destroy eggs, cleaning and burning crop refuse, and clean cultivation to keep down early weeds.

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* *Papaipema nebris* Guennee

**The southwestern corn borer** * was first found in the state in 1942. Surveys have shown it to be present in three south-central counties. Although it may in time become established, Nebraska winters appear to be serving as a check. Corn attacked by the first generation of borers may be short and bushy with ragged leaves, because of feeding activities in the terminal bud. Second generation borers tunnel through and, before hibernation, girdle the stalks on the inside, just above the ground, causing them to fall over.

Adult moths are white to pale yellow and about three-fourths of an inch long. They fly at night and deposit their eggs singly or in chains on the leaves in late June. Young borers are dull white, marked with a regular pattern of black spots, and when nearly mature measure 1½ inches long (see Figure 18). The first generation of borers matures in July, the second in mid-September. Mature, dull, greyish-white, unmarked caterpillars of the second generation (see Figure 19) pass the winter in the base of the stalk. In the spring they pupate and change to adults.

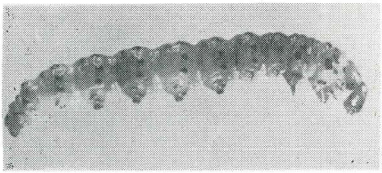

Figure 18. Southwestern Corn Borer: Mature larva of first generation.

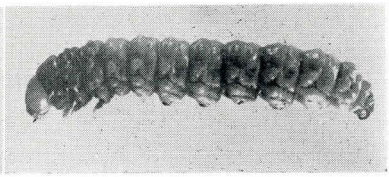

Figure 19. Southwestern Corn Borer: Mature larva of second generation. Hibernating form.

Control measures for the southwestern corn borer include the substitution of sorghum for corn, late fall treatment of uprooting the stubble to expose borers to the weather, and early spring plowing of stubble to destroy the borers.

**The European corn borer** † has been found only once in Nebraska, in Lancaster County. The moth or adult varies from a light yellowish-brown in the female to an olive brown in the male and averages about one inch in wing spread. Mature borers or caterpillars are about one inch long, light or dark flesh-colored, and marked with rows of dark spots. Figure 20 shows a light colored larva of the European corn borer. Young borers of the first generation feed on the leaves, whereas older borers and later generations tunnel through the stalks and ears leaving borings and droppings at the en-

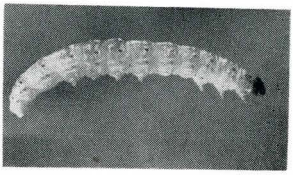

Figure 20. European Corn Borer: Light colored borer.

* *Diatraea grandiosella* Dyar
† *Pyrausta nubilalis* Hubner

trance and exit holes. Broken tassels, fallen ears, and lodged stalks may result from infestation of European corn borers.

Mature caterpillars pass the winter in their tunnels in the stalks. They pupate in the spring and emerge as adults in late spring and summer. Eggs are laid in masses on the lower sides of leaves. There are usually two generations a year, although in some places only one is recorded.

Control measures practiced in other states against this borer include cleaning up and destroying stalks and stubble in the fall or early spring, delayed planting to avoid early damage, the introduction of parasites of the borer, and the use of tolerant varieties of corn.

## Insects Attacking the Ear

**The corn earworm** * occurs throughout the state. Corn attacked by this insect will have the ears fouled with moist droppings at the silk end, and the kernels near the tip will be eaten. Ears attacked may also mold because of the exposing of the tip to rain. Mature earworms are from 1½ to two inches long and are brownish or greenish with stripes on the sides and back (see Figure 21).

The winter is passed in the pupal stage from two to six inches below the surface of the ground. Adult moths have wingspread of about 1½ inches and vary in color from a light greyish-brown to dark brown, with dark wavy lines along the edges of the wings. The moths fly at dusk or on cloudy days and deposit their eggs on the corn leaves or fresh silk. The caterpillars or worms feed on the ears until mature, then crawl down the stalks and change to the pupal stage in the ground. There may be two or three generations each year.

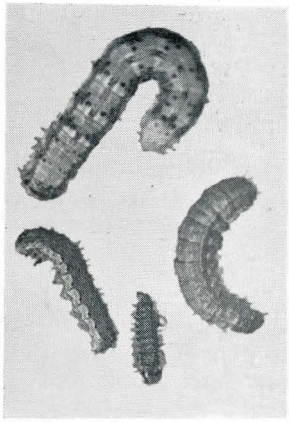

Figure 21. Corn Earworm: Larvae of several ages and coloration.

There is no known practical control for the corn earworm on field corn. Sweet corn may be protected by treating the ears with 12 to 15 drops of medicinal grade light white mineral oil. The oil may be inserted into the silk mass with an ordinary medicine or eye dropper. When available, a refined mineral oil containing two per cent pyrethrins is even more effective.

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* *Heliothis obsoleta* Fabricius

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