grown and harvested under specified conditions in fields soil-treated with 10 pounds of DDT per acre may be certified for movement without further treatment. Materials to which beetle eggs might be attached—building timbers, junk, and scrap metal, for example—may be treated with spray consisting of 1 pound of technical grade DDT in 7½ gallons of kerosene. Lumber, poles, and pulpwood may be stored by stacking them off the ground in order to prevent the beetle from depositing eggs on them. Under such conditions of storage and when weeds and other vegetation are controlled on the storage premises, the materials may be certified for movement without further treatment.

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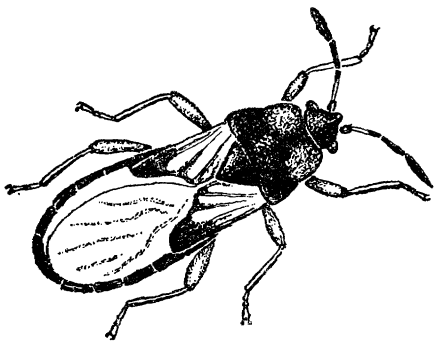
Sixteen insects that attack cereal and forage crops are illustrated in the section of color drawings. Opposite the drawings are descriptions and life histories of the insects and recommendations for their control.



Chinch bug.

The Chinch Bug

Claude Wakeland

The chinch bug is widely distributed in the United States but rarely is it abundant enough to cause serious crop losses except in Illinois, Indiana, Iowa, Kansas, Missouri, Ohio, Nebraska, Oklahoma, and Texas. It occasionally damages crops in Michigan, Minnesota, Wisconsin, South Dakota, North Carolina, and South Carolina. The chinch bug increases rapidly under favorable weather conditions. In outbreak stages it is one of the most completely destructive insects to corn and sorghum plants in the United States.

Chinch bug adults in the fall fly from cultivated crops to bunchgrasses, where they rest during the winter. In spring they fly to fields of small grain in the cooler areas of their habitat or directly to corn and sorghums in the warmer areas, such as in Texas and southern Oklahoma. After reaching cultivated fields, they mate and lay their eggs on the leaves of the plants or on the soil near the bases of the plants. After the eggs hatch, the young bugs feed on the plants and, in grainfields, most of them crawl to nearby crops such as corn and sorghum when grain plants lose their succulence or begin to ripen. A second generation usually is produced while bugs infest corn or other susceptible crops, and the adults from this generation fly to bunchgrasses for the winter.

The bug feeds by sucking the juices of plants. When the insects crawl from grainfields they concentrate on the outer rows of young corn or sorghum plants, which soon wilt and die. As the outer rows are killed, the bugs migrate inward until an invaded field becomes infested throughout. Chief reliance for protection of cornfields from bugs invading them from grain fields is

placed upon the use of barriers to intercept migrations or to kill migrating bugs before they can reach susceptible crops.

When the overwintering adults fly directly from bunchgrasses to corn, the entire cornfield may be infested more or less uniformly. An economical and practical control has not yet been established to cope with that situation.

Chinch bugs feed successfully only on plants of the grass family. In years of severe infestations, when their normal food plants become scarce, they may try to feed upon legumes or other nongrass plants, but only rarely in numbers sufficient to cause injury.

Particularly susceptible among the small grains are barley, spring and winter wheat, rye, and oats. Barley is especially preferred and so is a hazardous crop to grow during a period of chinch bug outbreaks.

Most favored of the larger crop grasses are corn, sorghums, broomcorn, Sudangrass, and millet. Young corn plants are choice food for the bugs.

Chinch bugs also feed upon many forage and wild grasses, including foxtail, timothy, crabgrass, kafircorn, quackgrass, and ticklegrass. Bentgrass, bluegrass, and other lawn grasses may be attacked.

CONDITIONS PERMITTING, the most economical and effective way to prevent losses from chinch bugs is by crop rotation and by the location of susceptible crops with relation to small-grain fields. The first generation of chinch bugs, except in the southern part of their habitat, depends at first on small grains for its food; second-generation bugs feed mainly on corn and sorghums. Eliminating or reducing acreages of grain crops or avoiding planting susceptible crops near small-grain fields materially scales down losses due to chinch bugs.

Legumes and other practically immune crops may be substituted to advantage for small grains or corn and sorghums during years of threatening outbreaks. Crops that may be grown without danger of serious injury by chinch bugs include alfalfa, beans, buckwheat, alsike clover, red clover, sweetclover, cowpeas, field peas, flax, lespedeza, peanuts, potatoes, pumpkins, rape, soybeans, squash, sugar beets, sunflowers, velvetbeans, vetch, and other field, garden, and truck crops not belonging to the grass family. During years of severe infestations, the farm cropping scheme should be so adjusted as to avoid, or reduce to a minimum, the planting of corn or sorghums next to small-grain fields. If it is impracticable to substitute immune crops for grains, injury may be lessened by planting some of the least susceptible or resistant varieties.

Hybrid corns and sorghums have been developed that have some resistance to second-generation bugs. Ruined fields of corn, sorghums, or small grains should be disked or plowed to destroy the bugs and replanted with an immune crop. Early planting of grains, corn, and sorghums helps to reduce injury. Chinch bugs are attracted more to thin stands of grain than they are to rank growth. All tillage, fertilization, and seeding practices that promote a vigorous growing grain crop therefore tend to lessen damage. Small-grain fields, with a dense growth of clover, which causes a damp, shady condition, also are unattractive to the bugs.

IN PREPARING TO COMBAT chinch bugs, surveys in the fall give a pretty good idea of how many to expect the following season and where they are most likely to be found.

Surveys, cooperative among State and Federal agencies, are made in November and December in several Central States. The bugs hibernate in several species of bunchgrasses, the principal of which are little bluestem, big bluestem, and broomsedge. By examining samples of the grass clumps hibernating bugs are detected, their abundance determined, and their locations mapped. Entomologists familiar with the insects make a survey each

year in the areas suspected of harboring infestations. In each county they visit they collect five samples of bunchgrass at widely separated points. Each sample consists of a bunch of grass, including the crown, from 3.5 to 4.5 inches in diameter. If possible, the samples are from places near corn or sorghum fields because those plants are among the insect's favored food plants. Bugs avoid clumps of grass containing ants; so, before a sample is taken, an inspection is made to ascertain that no ants are present. The sample is cut from the sod clump with a tiling spade and is trimmed with shears. It is then placed in a double paper bag on which the location, date, and other pertinent details are written. A group of samples is taken or mailed to the State college or university, where students or staff members count the numbers of bugs contained in each sample. The number in the sample is converted on the basis of the number of bugs per square foot. Each sample is rated according to the following table:

Classification	*Number of bugs per square foot*	*Rating*
Noneconomic	0–250	1
Light	250–500	2
Moderate	500–1,000	3
Severe	1,000–2,000	4
Very severe	2,000 or more	5

A rating is given to each county. It is based on the number of bugs present and the percentage of land under cultivation in the county. The reason for considering the percentage of cultivated land is that the greater the percentage of land that is farmed the less area there is to support protective cover for chinch bug hibernation and the fewer chinch bugs there will be in comparison to the crops that might be fed upon.

Having this information for infested counties, entomologists then proceed to plan their battle against the insects. They make estimates of needs for barriers for the next year on the basis of what would be considered the potential requirements. In doing so they realize that the hazards of prophecy are probably at their maximum when chinch bug infestations are being forecast and that weather conditions during the following crop season may produce an outbreak as serious as the potential or reduce the threat to noneconomic importance.

BARRIERS are used to protect susceptible crops from attack by bugs that migrate from small-grain fields. Three types of barriers are effective: Creosote line barriers, creosote paper barriers, and dinitro-*o*-cresol dust barriers.

A creosote line barrier is made by plowing a furrow with a moldboard plow around the field to be protected. The soil is thrown toward the corn. A narrow line of creosote is then poured on the smooth ridge of soil thrown up by the plow and on the side of the ridge toward which the bugs will approach. Post holes about 2 feet deep are dug in the trench next to the creosote line and several feet or yards apart. The spacing of the post holes depends on the abundance of the migrating bugs. Creosote repels chinch bugs. As they encounter the creosote, their direction of march is diverted as they seek to get around the line. They fall into the post holes, where they may be killed by pouring a small amount of kerosene or dinitro-*o*-cresol dust over them. Ordinarily 1 gallon of creosote is used for erecting and maintaining 1 rod of barrier.

The creosote-treated paper barrier is made by plowing a shallow furrow and digging post holes as for the creosote line barrier. A strip of tough paper 4 or 5 inches wide is placed against the vertical side of the furrow and the soil then tightly packed against the lower edge of the strip so it is in an erect position with the upper edge protruding 2 or 3 inches above the ground level. The paper used is cut and rolled and then thoroughly soaked in creosote. The Iowa Agricultural Experiment Station developed a machine for plowing the furrow and placing the paper at one operation. Farmers in Iowa and elsewhere have made similar

machines. About one-half the creosote is required for a paper barrier as for a line barrier, but savings in the cost of creosote are more than compensated for in the cost of the paper and barrier construction.

Dinitro-*o*-cresol dust makes an effective barrier. It is prepared by mixing thoroughly 4 pounds of dinitro-*o*-cresol and 96 pounds of pyrophyllite dust. The mixed dust is applied in a strip 2 inches wide along the field that is being invaded. This barrier is easily disturbed by winds and the feet of animals. Its advantages are the saving of time in applying it and the fact that it kills the bugs that crawl through the dust in the barrier line. From 1 to 2 pounds of mixed dust is required to erect and maintain 1 rod of dinitro-*o*-cresol dust barrier.

Regardless of the kind of material used to construct a barrier, additional material must be applied to maintain an effective barrier for 10 days or 2 weeks or until the invasion ceases.

Direct control of chinch bugs by the application of sprays or dusts to infested crops may be practical now in some instances, using the newer insecticides. Insecticides have not been tested extensively against field-wide infestations, because infestations of chinch bugs have been nearly noneconomic since the chlorinated hydrocarbons became available.

Populations of chinch bugs fluctuate from year to year, as indicated by the fact that nearly 9,000,000 rods of barrier were constructed in 1934 and only 94,000 rods in the following year. Another year of high populations was 1940, when 2,221,000 rods of barrier were used to protect crops. After a survey in 1944, it was estimated that 7.5 million rods of barrier would be needed in 1945. Only 273,000 rods of barrier were constructed, however, because weather unfavorable to chinch bugs abruptly reduced their numbers.

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The European Corn Borer

Wm. G. Bradley

A research worker of the Massachusetts Agricultural Experiment Station in 1917 discovered several pinkish-brown worms on sweet corn in market gardens near Boston. Specialists examined the larvae and found them to be a species that was a pest of corn in Europe. A bit of sleuthing disclosed that they had sneaked into this country a few years earlier in broomcorn imported probably from Italy or Hungary for use in broom factories in Medford, Mass.

Sometimes quickly, sometimes more slowly, the insect, the European corn borer, spread outward from its original point of infestation. By 1952 it had been found in 37 States east of the Rocky Mountains, in which are most of our main corn-growing sections. The losses it caused in field corn were estimated at 314 million bushels in 1949.

From studies of the biology and habits of the insect we learned that two strains of the borer now exist in the United States. The single-generation, or univoltine, strain passes through one life cycle a year. The multiple-generation strain has two or more complete cycles every 12 months, depending on environment.

The multiple-generation strain flourishes in nearly all of the infested area, although its proportion to the single-generation strain varies in different localities, reaching its maximum in the southern sections and diminishing toward the north.

Observation of hundreds of species of plants in the field and tests in experimental plots on plants from many parts of the country showed that the borer can live on more than 200 different kinds of wild and cultivated