

19,000,000 acres to 116,000 acres. By directing control against small concentrations of the insects in known infested areas, we can continue to decimate them so that they have no opportunity to band, migrate, and coalesce into large bands that grow to outbreak proportions. Mormon crickets increased in numbers in several States in 1950 and showed a banding and migrating tendency they had not exhibited in recent years. Unless many small bands are consistently controlled when they are found, another widespread outbreak may be in the making.

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For further reading on Mormon crickets, the authors suggest *Mormon Crickets and Their Control*, by F. T. Cowan, H. J. Shipman, and Claude Wakeland, U. S. D. A. *Farmers' Bulletin*, 1928, 1943; *Nature and Extent of Mormon Cricket Damage to Crop and Range Plants*, by Ralph B. Swain, U. S. D. A. *Technical Bulletin* 866, 1943; *Quantity of Food Consumed by Mormon Crickets*, by Frank T. Cowan and H. J. Shipman, *Journal of Economic Entomology*, volume 40, pages 825-828, 1947.

White-Fringed Beetle

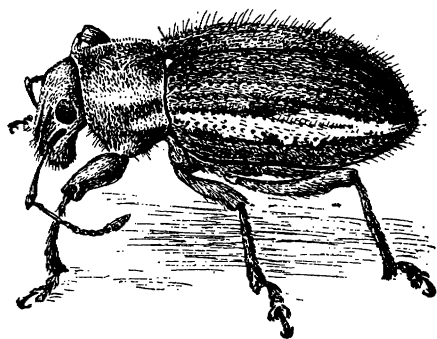
R. A. Roberts

The name "white-fringed beetle" is applied commonly in the United States to a group of species and races of beetles belonging to the genus *Graphognathus*. They are believed to have been brought accidentally from South America to the United States. They were first found in Okaloosa County, Fla., in 1936 and before long were discovered in adjoining counties in Alabama.

In 1937 their larvae did serious damage to cotton, corn, peanuts, and velvetbeans in the infested area. Entomologists and officials from several States who visited the area concluded that white-fringed beetles were a serious threat to a wide range of cultivated crops elsewhere in the United States. Representatives of the State Plant Board of Florida, the Alabama Department of Agriculture and Industries, and the Bureau of Entomology and Plant Quarantine agreed that a cooperative Federal-State program to attempt the control of the white-fringed beetle should be started immediately.

The beetles were found in Louisiana and Mississippi in 1937. In 1942 some were collected in North Carolina at Wilmington. In 1946 infestations were discovered in Georgia near Eastman, Fort Valley, and Macoq. Inspections during 1946 of properties landscaped with ornamental plants obtained from nurseries in the infested area in Georgia disclosed many additional infestations in that State, as well as two in Alabama and one in South Carolina. In 1948 the beetle was found in Tennessee. On January 1, 1952, nearly 340,000 acres (including 100,000 acres of farm land) were known to be infested.

The adult beetle is a little less than



White-fringed beetle.

half an inch long and brownish gray. It gets its name from the lighter band along the margins of the wing covers. Because the wing covers of the adult are fused together and the underwings are rudimentary, the beetle cannot fly. All adult beetles are females. A few days after emergence, after having fed on foliage, each can lay viable eggs. The beetles live 2 or 3 months. Under favorable conditions a female averages 600 to 700 eggs. The eggs are cemented in small masses to plant stems, sticks, debris, or soil particles. They begin hatching in about 15 days. The larvae enter the soil where they feed on plant roots. The larvae or grubs usually occur in the top 9 inches of soil but sometimes go deeper. They are white, legless, and about a half inch long when fully grown. The insect passes the winter in the ground in the larval stage. In the spring the matured grub forms a cell in the soil in which it pupates. The pupa transforms to an adult beetle, which then returns to the soil surface. One generation of the insect is produced each year.

WHITE-FRINGED BEETLES seriously damage many field crops and garden, ornamental, and wild plants. Most of the damage is caused by the larvae feeding on plant roots. The adults do some damage by feeding on foliage. The larvae eat parts of the soft outer tissues of the root and may completely sever the main root. The beetles feed on at least 385 species of plants. Some of the common host plants are peanuts, velvetbeans, soybeans, lespedeza, clover, alfalfa, cotton, corn, blackberry, strawberry, white potato, chrysanthemum, dahlia, cocklebur, coffeeweed, gallberry, and beggarweed.

When an abundance of favored host plants is available, the beetles build up rapidly to heavy populations, as when lightly infested fields are planted during the summer to such crops as peanuts and velvetbeans, which furnish good food and shelter. A farmer can prevent a rapid increase by the summer planting of small grains or other crops

that are not preferred food plants of the adult beetles and give less cover.

DDT MIXED in the soil will eliminate or reduce the beetle populations materially. DDT applied to cropland at the rate of 10 pounds of the technical grade per acre in an emulsion spray or an equivalent amount (such as 20 pounds of 50 percent DDT wettable powder) in a water suspension spray will control the pest. The DDT also may be broadcast as a dust at the rate of 20 pounds of 50 percent DDT powder or its equivalent per acre. Regardless of how applied as a soil treatment, the DDT must be cultivated thoroughly into the top 3 inches immediately after application. The treatment will give adequate control of the insect for at least 5 years. Between 1946 and 1951 about 45,000 acres of farm land were so treated.

A similar treatment is recommended for nurseries, except that the dosage is increased to 50 pounds of technical grade DDT or its equivalent per acre. The higher dosage of DDT insures the elimination of larvae and permits the certification of plants for movement from regulated areas without further treatment. Applications of DDT are made to vegetation in the environs of the nursery regularly in spring and summer. Between 1948 and 1951 approximately 2,500 acres of nursery land in the infested areas were soil-treated with 50 pounds of technical grade DDT per acre or its equivalent.

TO CONTROL THE BEETLES in margins of treated fields, in fence rows, or on adjacent border lands, a foliage spray is applied. One pound of technical grade DDT per acre in an emulsion or 2 pounds of 50 percent DDT per acre in a water suspension spray is applied. Applications are made at intervals of 2 or 3 weeks during the season when adult beetles are present. Foliage sprays should be repeated yearly as long as beetles are present in the non-soil-treated lands in the environs of those which have been soil-

treated. DDT also is applied as a foliage spray in city and rural areas where the beetles threaten to spread. Such areas usually include industrial sites, processing plants, mills, gins, railroad rights-of-way, roadsides, vacant lots, school yards, or cemeteries. In 1950 approximately 40,000 acres in the infested areas received foliage applications.

Because of the relatively heavy dosages of DDT, no applications are made on any crop used for human food or for animal forage or to any pasture used for grazing by dairy or beef cattle.

The DDT sprays or dusts may be applied by several types of equipment. For soil treatments, a tractor-mounted power sprayer with nozzle outlets on a boom located close to the ground has been successful in dispensing concentrated sprays. DDT dust may be mixed with sand and broadcast by hand. Dilute dust may be spread on the soil surface by drill or spreader-type fertilizer distributors. Concentrated foliage sprays have been applied by power sprayers that have special oscillating discharge nozzles. This type of sprayer may be mounted on a tractor or a jeep. Turbine blowers mounted on trucks or jeeps also are used. Airplanes have been regularly employed in making foliage applications.

Home owners with gardens or flower beds infested with white-fringed beetles may apply a simple treatment. A 10 percent DDT dust, which may be bought at seed stores, may be applied to the soil at the rate of 1 ounce to 27 square feet of soil surface or 1 pound to 432 square feet. It should first be mixed with moist sand and then broadcast on the plot. Even distribution is important to get effective control. The insecticide should be worked into the soil with a potato fork or another tool. The dust may be applied at any season, but to be immediately effective the application should be made in the fall when the beetle larvae are small.

WHITE-FRINGED BEETLES are spread in farm and industrial commodities or

through the movements of man and his belongings, or incidentally by automobiles, trains, and other public carriers. Since all beetles are females, each potentially able to start a new generation, spread can result from the movement of a single egg, larva, pupa, or adult.

Soon after the discovery of the beetle in the United States, Federal and State quarantines were promulgated to regulate the movement of many articles known to be potential carriers of the insect in one or more of its stages—certain agricultural crops, nursery stock, forest products, grass sod, scrap metal, and soil. The quarantines, which have been revised from time to time, provide three conditions under which certificates may be issued for the movement of regulated articles: That they have been inspected and found to be free of white-fringed beetles; that they have been treated, processed, fumigated, or sterilized in an approved manner; or that they have been grown, stored, manufactured, or handled in a manner which would prevent them from becoming infested.

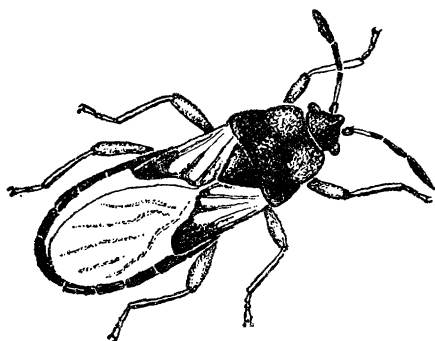
EFFECTIVE METHODS have been developed for treating regulated articles. Nursery stock may be bare-rooted when such a procedure will not result in injury to the plants. Stock that cannot be bare-rooted may be fumigated with methyl bromide at atmospheric pressure or under partial vacuum. Plants that will not tolerate methyl bromide fumigation may be treated by soaking or dipping them in a solution of pyrethrum-piperonyl butoxide. Peanuts may be shelled to eliminate egg masses attached to the outside. Unshelled peanuts may be fumigated with methyl bromide. Peanut hay may be fumigated with methyl bromide or passed through a hammer mill to destroy any eggs present. White potatoes may be fumigated with methyl bromide to make them safe for movement.

Some crops, such as white potatoes, small grains and legumes for seed, including lupine and soybeans, that are

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