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WHITE-FRINGED BEETLE IN TENNESSEE

EDWARD T. CHERRY

Department of Agricultural Biology, University of Tennessee Agricultural Experiment Station Knoxville, Tennessee 37916

ABSTRACT

Thirty-three counties in Tennessee have become infested with white-fringed beetles since 1948. Development and emergence occur later in Greene County than in other areas in Tennessee. The first adults emerge in West Tennessee around the last of May. In Greene County, emergence does not begin until July. The average incubation period for eggs collected in the laboratory was twenty days. Based on head capsule measurements the larvae have four instars. Field observations and outdoor cage rearings indicate that the insect exhibits a two-year, as well as a one-year, period of development in Greene County.

INTRODUCTION

The white-fringed beetle, *Graphognathus leucoloma* Buchanan, as a member of the snout-beetle family Curculionidae. The adult and larva feed on more than 400 species of plants, several of which are of economic importance. It is a native of South America and was accidentally introduced into the United States around 1936, when it was discovered in Okaloosa County, Florida. Since discovery, it has spread over much of the Southeastern U. S.

Following the discovery of an infestation in Greene County, Tennessee, in 1962, a biological study was conducted from 1963 to 1966 in Greene County by The University of Tennessee Experiment Station in cooperation with the Plant Pest Control Division of the U.S.D.A. The project was undertaken to reveal the life history of the insect in Tennessee and to develop better control methods.

Figure 1. Distribution of the races of *Graphognathus leucoloma* in Tennessee.

STATE DISTRIBUTION

Thirty-three counties in Tennessee are (or have been) infested with white-fringed beetles (Fig. 1). The race *striatus* (Buchanan 1947) is found in 32 counties, while *fecundus* is present in Roane County. As of December, 1965, 115,362 acres were infested with the greatest area of infestation in the Western sector of the state.

MATERIALS AND METHODS

Outdoor Rearing. Field-collected adults were maintained in cages placed over 5-inch clay pots (Fig. 2) filled with soil which served as a medium for oviposition. Open bottles filled with water were partially buried in the soil. Cuttings of peanut foliage, which served as food for the adults, were kept fresh by submerging their cut ends in the bottles of water. New foliage was added three times weekly. Small pieces of wooden, plot stakes were placed flat on the soil. Eggs were deposited by the beetles between the wood and the soil. Egg masses were stored in a dry environment to prevent hatching until larvae were needed for field and laboratory studies. Because the egg masses were covered with soil, it was difficult to count the individual eggs. Accurate egg counts were not necessary because only larvae were used for artificially infesting soil for life history studies in the field.

Screened cages (Fig. 3 (A)) placed over galvanized metal chambers (Fig. 3 (B)), which were buried in the soil, served as rearing compartments for field studies. Seeds of barley and rye were sown in the cages. One hundred and fifty newly hatched larvae were introduced into each of 20 compartments during August, September and October of both 1963 and 1964. These months were selected to coincide with natural egg hatching in Greene County. Because of low survival in the 1963 introduction, clover was also sown in the cages the following year and the soil was disturbed as little as possible when the cages were positioned.

Figure 2. Oviposition cage removed from clay pot.

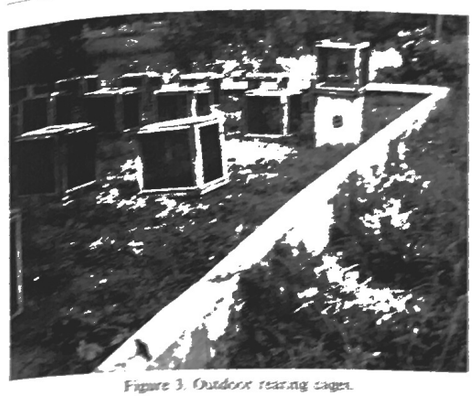

Figure 3. Outdoor rearing cages.

The cages were inspected for emergence of adults three times each week from June until October of the year following each introduction. Beginning the last two weeks in November, the soil in the cages was examined for larvae which were undergoing development requiring more than one year. Larvae found in these examinations were placed in non-infested cages which were inspected the following summer to determine if a two- or three-year period of development was occurring.

Field Investigations. Larvae were collected throughout the year to determine the depth at which they could be found, and the host plants upon which they fed. In May and June of each year the soil was examined for pupae to determine the time of pupation and the length of time spent in that stage. An adult survey was conducted each year to determine the time of initial emergence, peak of adult population and the months of the year adults were found in the field. Host plant records were based on observations of adult feeding during the three-year study.

Laboratory Studies. Newly hatched larvae were maintained in salve tins with Irish potato pieces or iris roots. Others were placed in clay pots in which alfalfa had been planted. These larvae were observed periodically to determine survival. Adults were maintained in cages free of soil to obtain debris-free eggs which were used to observe embryonic development.

No published records of the number of larval instars of the white-fringed beetle were found at the time of this study. Instar determination was based on the measurement of the head capsule of field-collected and laboratory-reared larvae.

RESULTS

In the field-caging studies only fifteen adults emerged, all from August 5 to August 28, 1964. No 1964-hatched larvae emerged in 1965 and no surviving larvae were found in 1965. Three larvae from the 1963 infestation were found in December, 1964, and were placed in a noninfested cage. All of these emerged during August, 1965, thus they required a period of two years to complete their development—from August, 1963 to August, 1965.

Soil samples from the cages as well as from the field were collected and sent to the State Soil Laboratory at Nashville for analysis. This analysis revealed traces of chlorinated hydrocarbons in the soil from the cages, while the soil from the field was free of this type of residue. There was a difference in the texture of the two soils; the soil from the cages was clay, whereas the soil from the field was loam. It is generally known that well-drained loam produces greater populations of white-fringed beetles than do clay soils. Since the cages were in clay soil containing chlorinated hydrocarbons, this may have had some effect upon the low viability of the larvae.

Rearing of the insect from egg to adult in the laboratory was not accomplished. Laboratory rearings failed with newly hatched larvae. Humidity was the greatest problem encountered. The rearing medium was either too wet or too dry. The larvae survived better in dry conditions than in very moist ones.

Head capsule width of newly-hatched larvae were approximately 0.246 mm; last instar capsules were approximately 1.340 mm. Knowing these definite first and last instars, second (0.765 mm) and third (1.30 mm) instars were established from the measurements of the head capsules of field collected larvae.

DESCRIPTION OF LIFE STAGES

Egg. The egg of the white-fringed beetle is small and oval. Its measurements are 0.825 mm in length and 0.499 mm at its greatest width. It is white when first laid and gradually turns yellow. The eggs are laid in masses. The number of eggs per mass varies from less than ten to more than fifty. The female emits a sticky substance on the eggs which causes them to be cemented to one another and to soil, sand or other debris (Fig. 4). The average incubation period for eggs deposited by adults in Greene County was twenty days. These eggs were maintained under natural conditions in contact with soil.

Henderson and Padget (1949) observed that eggs remained viable for seven months, when they were kept in a dry condition. The maximum period of viability observed for eggs collected in Greene County and stored in dry containers free of soil was two months.

Larvae. The larval stage of the white-fringed beetle is the most destructive. Its entire life span is spent underground. It feeds on the roots and underground stems of many cultivated and wild plants. Young *et al.* (1950) reported that the larvae have been found feeding on 240 species of plants in the field. Wilting or dead plants throughout fields, as well as gaps in row crops, are symptoms of larval feeding. The larvae feed by gnawing large cavities out of stems and roots of the host plant (Watson 1937).

The larva is c-shaped and yellowish-white. It is legless and exhibits a somewhat telescopic motion. Its strongly sclerotized mandibles are well-developed. Ex-

cept for the head, the body is very soft. The larvae in Greene County ranged in length from approximately 1.4 mm when first hatched to approximately 14.0 mm at the last instar. Larvae of varying sizes (Fig. 5) could be found in the soil at all times during the year. They were found at depths ranging from near the surface to eleven inches below the surface. Effects of larval feeding in Greene County were minimal in comparison to reports from other areas in the Southeastern U.S. Some feeding was observed on smartweed, broadleaf plantain, clover, barley, rye, iris and tobacco.

Pupa. The pupa is found underground, usually in the upper 6 inches of soil, in a compact "soil cell" from which the adult emerges. It (Fig. 5) is white and is approximately 11.5 mm long. It is fragile and easily destroyed unless carefully removed from the soil and is the most difficult stage to collect in the field. It appears that pupation begins after the first week in June in Greene County and pupae exist for three to four weeks.

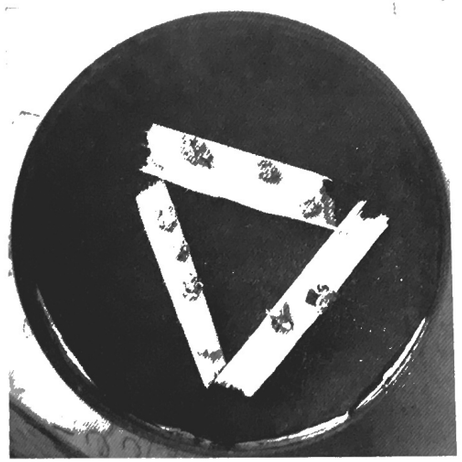

Figure 4. Plot stake pieces inverted to show debris-covered egg masses.

Adult. The adult (Fig. 6) is 9.0 to 12.7 mm long, and is light grayish-brown to almost fuscous (Buchanan 1942). The body is covered with fine hairs or setae, which are longer on the dorsum of the abdomen. Along the outer margins of the elytra these setae form light gray bands. Two lighter bands of setae run longitudinally along each side of the thorax and head. From this coloration the common name, white-fringed beetle, originated.

The adults have been observed feeding on 170 species of plants in the field (Henderson and Padget 1949). In Greene County, feeding by the adults was slight. The most favored cultivated plants were soybeans and alfalfa. The wild plants on which noticeable feeding was observed were blackberry, smartweed, buttonweed, goldenrod and ragweed. When feeding, the adult makes a characteristic semicircular, saw-toothed cut on the leaves

Figure 5. Pupa (extreme left) and larvae of *Graphognathus leucoloma.*

of the host plants which can be used as an aid in surveying for adults. Adults appeared to feed mostly in the early morning and late afternoon. Egg-laying was most frequently observed in the late afternoon.

The adults are all females; thus, reproduction is accomplished by parthenogenesis; so a single individual can start an infestation. Because of a fusion of the elytra they are unable to fly, slowing natural dispersal. Often they are transported into new areas through commerce, frequently in soil or upon plants (Young *et al.* 1950).

Figure 6. Adult of *Graphognathus leucoloma.*

The average life span of caged adults was nearly seventy days. Mortality occurred after one month for some, while others lived for more than one hundred days. There was a decline in egg production with age.

In the present study, the first adults were found in early July. The peak population occurred during the first two weeks in August. In warmer climates, such as that of the Gulf Coastal area, adults are found throughout the winter (Livingstone and Swank 1940); however, in Tennessee, adults were collected no later than the first week in November.

Literature Cited

Buchanan, L. L. 1942. Four new species of white-fringed beetles (subgenus *Graphognathus*) from the southeastern part of the United States (Coleoptera: Curculionidae). Brooklyn Ent. Soc. Bul. 37(3):107-110.

Buchanan, L. L. 1947. A correction and two new races in *Graphognathus* (white-fringed beetles) (Coleoptera: Curculionidae). Jour. Wash. Acad. Sci. 37(1):19-22.

Henderson, C. F. and L. J. Padget. 1949. White-fringed beetles, distribution, survey, and control. U.S. Dept. Agr. Bur. Ent. and Plant Quar. E-779. 19 p.

Livingstone, E. M. and G. R. Swank. 1940. Activities of the adult white-fringed beetle in New Orleans and vicinity from September 1938 to May 1939. Jour. Econ. Ent. 33(1):203-204.

Watson, J. R. 1937. *Naupactus leucoloma* (Coleoptera: Curculionidae). Fla. Ent. 20(1):1-3.

Young, H. C., B. A. App, J. B. Gill, and H. S. Hollingsworth. 1950. White-fringed beetles and how to combat them. U.S. Dept. Agr. Cir. 850. 15 p.