

and lectures as well as a question-and-answer booth. Books on the subject of tropical pomology are also available at this yearly event.

The Rare Fruit Council is a non-profit organization. Annual membership is \$15.00 a year and meetings are held at the Science Museum at 3280 South Miami Avenue, Miami, Florida. Membership entitles one to distribution of plants and trees, recourse to its library, the Yearbook, and the monthly Newsletter. This latter publication contains details of the meeting and often the complete lecture of the evening. In addition, articles of current interest written by noted horticulturists and important facts related to fruit growing are presented. News items about members, seed

and plant importations, book reviews, club activities such as the annual Plant Sale, and information unavailable from other sources make this publication a "keepsake" for each Council member.

The membership of this organization consists of backyard enthusiasts, scientists, tropical fruit experts, and plain dirt gardeners—all with a never-ending interest in rare fruits.

#### Literature Cited

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## ERADICATION OF CITRUS BLACKFLY, BIOLOGICAL AND CHEMICAL CONTROL<sup>1</sup>

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*Additional index words.* *Aleurocanthus woglumi*, control integrated control, *Amitus hesperidum* Silv., *Prospaltella opulenta* Silv., *Prospaltella clypealis* Silv.

**Abstract.** The citrus blackfly, *Aleurocanthus woglumi* Ashby, was first detected on January 28, 1976, in Wilton Manors, Florida; subsequently, it was found in Broward, Dade and Palm Beach counties. Federal and State quarantines were imposed and a 5-year eradication program was developed. Chemical control was begun by first using malathion applied by conventional hydraulic spray equipment. Later, acephate (Orthene) replaced malathion because it was more effective and also less phytotoxic to ornamental plants and posed a lesser hazard to non-target organisms. Helicopters for grove applications and back-pack mistblowers were added to the program in 1977. Three parasites of the citrus blackfly were introduced in April 1976. *Amitus hesperidum* Silv. and *Prospaltella opulenta* Silv. were further dispersed by release from laboratory-reared cultures and by the bouquet or leaf-transfer technique. The use of parasites has resulted in a significant 97% reduction of the citrus blackfly population.

The citrus blackfly, *Aleurocanthus woglumi* Ashby, is a serious pest in many of the citrus producing areas of the world. This insect completes its development on the undersides of the leaves, sucking fluids from its host plant. The copious amount of honeydew excreted by the larvae leads to the development of black sooty mold. The resulting reduction in respiration and photosynthesis of the plant can reduce fruit crop production up to 80%.

The main host of citrus blackfly is citrus, although it has been collected on more than 100 different plant species where heavy infestations occurred. Mango and Surinam cherry are secondary hosts, when populations are light to moderate.

This pest was first found in Key West, Florida, in 1934.

Inhibited from spreading by natural barriers, citrus blackfly was eradicated in 1939 with multiple oil spraying. The later infestation of citrus blackfly was detected in January 1976, in a residential area of Wilton Manors, Broward County, Florida. Since its outbreak, the citrus blackfly has been confined to residential areas, which pose innumerable difficulties for successful eradication. The Division of Plant Industry (DPI) of the Florida Department of Agriculture and Consumer Services (FDACS) and the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) began a cooperative 5-year eradication program with a projected cost of 5 million dollars per year.

The major objective during the first few months of the program was to delimit the area of infestation. Visual inspection of host plants was and is still being used, since no lure or trap has been developed that would detect citrus blackfly effectively. Visual survey is presently the most effective method of detection when repeated periodically.

The southern half of Palm Beach County, nearly all of inhabited Broward County, and the northern half of Dade County were determined to be infested after completion of the survey in August 1976. State and federal quarantines were established to prevent spread to the center of the citrus belt in central Florida.

State regulations require that all nurseries located within the citrus blackfly quarantine area be inspected every 30 days. Stock plants must be certified by a citrus blackfly specialist before being transported within or out of the quarantined area. Approved insecticide treatments of plants are witnessed by an inspector before certification is made.

Movement of fruit from citrus blackfly host plants is also regulated by quarantine laws. All shipments of bulk fruit which have not gone through a leaf-elimination process must be fumigated with methyl bromide without chloropicrin (at prescribed dosage per 1000 ft.<sup>3</sup> as follows: 28 oz at 70-74 F; 24 oz at 75-79 F; 20 oz at 80-84 F; 16 oz at 85 F-up). This regulation was necessary to prevent dissemination of citrus blackfly by infested leaves contained in shipments.

Chemical control was begun in August 1976, at the outer boundaries of the infestation in Palm Beach and Dade counties. Six applications of malathion, at the rate of 20 ounces (oz.) of actual ingredient per 100 gallons of water<sup>3</sup>,

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<sup>3</sup>1 oz/100 gals = 0.743 g/liter. For other metric conversions see Table at front of this Volume. Ed.

were applied to each citrus tree with conventional hydraulic equipment at 14-day intervals. Two moving chemical buffer zones, each 3 miles in depth, were established. The one in Palm Beach County ran from the Atlantic Ocean to the conservation area and progressed southward. The buffer zone in Dade County ran from the ocean to the conservation area and moved northward.

State and federal research agencies are working cooperatively to assist in this difficult undertaking of blackfly eradication. These groups include: the University of Florida Institute of Food and Agricultural Sciences (IFAS); the USDA Science and Education Administration (SEA, formerly the Agricultural Research Service, ARS); USDA, APHIS Methods Development, and the FDACS, DPI Methods Development.

Early in the program, insecticide screening isolated an alternative chemical to the cumbersome treatments of malathion. Acephate (Orthene 75S) proved to be more effective and was less toxic to nontarget organisms such as fish, birds, and some of the more sensitive nonhost plants. It also provided a longer residual by its localized systemic action, which reduced the number of applications and allowed a longer interval between applications. In October 1976, the United States Environmental Protection Agency (EPA) granted a specific exemption for its use in the citrus blackfly program. The exemption allows 3 applications of acephate (Orthene) applied annually to all host plants at the rate of one-half pound of actual ingredient per 100 gallons of water, with an interval of not less than 21-days between applications. The new insecticide alone could not solve all of the problems associated with the method of treatment. Alternate methods of application had to be developed, if progress toward eradication was to continue without incurring the excessive costs of additional hydraulic equipment.

In July 1977, on the basis of data generated by APHIS and DPI Methods Development, the use of helicopters was approved by the EPA for applying acephate to commercial and abandoned groves where hydraulic equipment was impractical. When applied by air it is necessary to deliver one pound of actual ingredient in 15 gallons of water per acre. The backpack mistblower, the second tool, was approved for use in November 1977. This mode of application uses an air blast as a carrier of the insecticide. Although a higher rate of pesticide is used (one pound of acephate actual ingredient per 100 gallons of water) when compared with the hydraulic equipment, a lower volume is applied to each plant. These 2 additional methods of application contributed to improving the eradication program economically and environmentally.

Biological control studies were also being conducted in conjunction with research on insecticides. Of the 3 introduced tiny parasitic hymenoptera, *Amitus hesperidum* Silv.,

*Prospaltella opulenta* Silv., and *Prospaltella clypealis* Silv., *P. clypealis* was only released at one site and was not recovered. Over a period of 8 months beginning in April 1976, 26,000 laboratory-reared parasites were imported from Mexico and released at 135 sites in Broward County. Monitoring studies of citrus blackfly and parasite populations indicated that these biological control agents were effective under Florida conditions. A bouqueting method was also used to aid the natural spread of parasites wherein leaves, taken from trees with parasitized citrus blackfly pupae, were transferred to areas where parasites were not established. Well over 1,000 sites in Broward County were inoculated with parasites by this method by February 1977.

Host plant preference research indicated that hosts other than citrus would have to be treated to eradicate citrus blackfly. Mango and Surinam cherry were added to the list of host plants to be treated in October 1977. By this time, parasites had reduced much of the once heavy infestation by as much as 97%. The additional effort to treat these hosts made the maintenance of 2 buffer zones economically infeasible. Therefore, the buffer zone in Dade County was discontinued. All equipment was moved to the northern buffer zone. A large scale parasite release project was begun to protect the treated areas in Dade County. Approximately 50,000 parasites were imported from Mexico and released north of these treated areas. Present monitoring in Dade County indicated that the citrus blackfly is not spreading southward.

The natural spread of this insect is relatively slow. However, the task of eradication is complicated by the fact that citrus blackfly is easily transported on uncertified plant material. Continual monitoring of the entire citrus producing area will be necessary until the last individual citrus blackfly in Florida is eliminated. Since April 1978, isolated light infestations have been detected in Okeechobee, St. Lucie, Indian River, Martin and Collier counties. In each case chemical control was begun immediately, following delimiting surveys.

The citrus blackfly had originally infested approximately 1,254 square miles. The eradication spray buffer, presently nine miles south of the Broward-Palm Beach county line, has completed treatment of 625 square miles. This is approximately one-half of the infested area. As anticipated, some reinfestations have occurred. These areas are also treated as soon as they are detected.

Combined biological and chemical control efforts have eliminated citrus blackfly in areas once heavily infested. Parasites reduced the population up to 97% with insecticides eliminating the remainder. The success of this program will depend on the integration and coordination of available chemical and biological control methods.