

ly improved by approach grafting them to seedlings of *Garcinia tinctoria* and allowing the mangosteen top to develop on both root systems.

#### SUMMARY

The mangosteen can be grown in southern Florida only if special attention is given to cold protection and soil requirements. Plants which fail to grow well when these conditions are met can be rejuvenated by approach grafting to

seedlings of *Garcinia tinctoria* and allowing the mangosteen to grow on both root systems.

#### LITERATURE CITED

1. Hume, E. P. 1947. Difficulties in mangosteen culture. *Tropical Agriculture* 24: 32-36.
2. Oliver, G. W. 1911. The seedling-inarch and nurse-plant methods of propagation. U.S. Dept. Agr. Bur. Plant Industry Bul. 202.
3. Popenoe, W. 1927. The mangosteen and its relatives, p. 390-405. In Popenoe, W. *Manual of Tropical and Subtropical fruits*. MacMillan, New York.
4. Winters, H. F. 1953. The mangosteen. *Fruit Vars. and Hort. Digest* 8: 57-58.

## THE CARIBBEAN FRUIT FLY IN FLORIDA<sup>1,2</sup>

H. V. WEEMS, JR.<sup>3</sup>

*Anastrepha suspensa* (Loew) (Fig. 1), commonly called the Caribbean fruit fly, the Carib fly and the gauva fly, is a near relative of a major pest of citrus and other tropical and subtropical fruits, the Mexican fruit fly, *Anastrepha ludens* (Loew). *Anastrepha suspensa* is one of several species of fruit flies which are indigenous to the West Indies and the larvae of which attack tropical and subtropical fruits. Since its reappearance in Florida in April 1965, the Caribbean fruit fly has spread over 23 counties in southern and central Florida, and hundreds of thousands of specimens have been collected in traps. From the original infestation in Miami Springs near the Miami International Airport, the fly spread rapidly over much of Dade County before the end of June, and by the end of 1965 it had been found in seven counties in southern Florida. The natural dispersion continued during 1966, and to date *Anastrepha suspensa* has been found in 16 additional counties (Fig. 2). Despite a hurricane in the fall of 1965, freezing to near freezing winter temperatures throughout central and southern Florida, and a scarcity of host fruits during the winter, the Caribbean fruit fly has been collected every week since April 1965.

When the Caribbean fruit fly was rediscovered in the Miami area, it failed to cause great excitement, since this species had been studied extensively in Puerto Rico; despite its abundance there, it had never been a problem to commercial fruit growers. However, a species of insect, or a particular strain of that species, sometimes acts substantially differently when introduced into new areas and may become a serious pest in those new areas. For that reason *Anastrepha suspensa* was viewed with

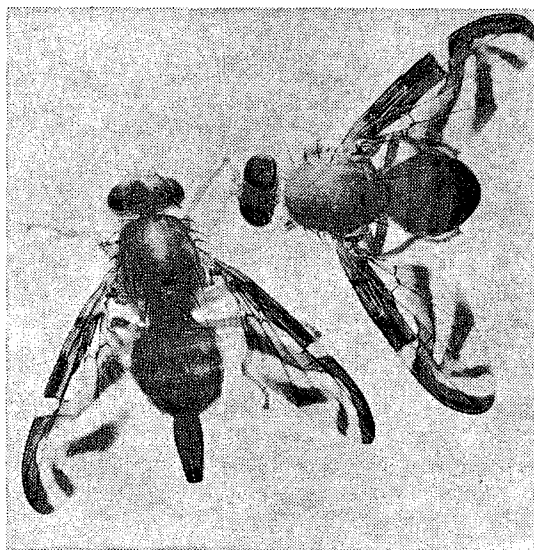


Fig. 1.—*Anastrepha suspensa* (Loew) adult fruit flies, female (left) and male.

<sup>1</sup>Contribution No. 91, Entomology Section, Division of Plant Industry, Florida Department of Agriculture.

<sup>2</sup>A 20 minute color movie prepared by Division of Plant Industry specialists was shown with the presentation of this paper.

<sup>3</sup>Entomologist, Division of Plant Industry, Florida Department of Agriculture, Gainesville, Florida 32601.



some concern as a potential pest of citrus, mangoes, and peaches in Florida. Several hundred traps were set to determine the extent of the new infestation in Florida. Trapping indicated a rapid population build-up and spread of the fly in the Miami area. Within the two months that followed, over 14,000 flies were trapped and were identified in the Gainesville office as the Caribbean fruit fly. Concern mounted among commercial fruit growers throughout Florida although the fly had not attacked commercial groves. Several meetings were held by state and federal agricultural officials and leaders of the citrus and mango industries. A decision not to attempt to eradicate the fly came after a presentation by federal officials of the fly's history in Puerto Rico. A program of extended and stepped-up research was instituted to determine what host fruits might be attacked in Florida; how rapidly the fly might extend its distribution and increase its population; how it might be affected by over-wintering conditions; and, most important, whether or not it would show any indications of attacking commercial fruit crops under Florida conditions. Also of prime importance were a search for a more effective lure to be used in the fruit fly detection program—an essential part of a sound program to eradicate the fly, if this were to become necessary—and laboratory and field tests to determine how to control the fly on a local basis and how to use the latest scientific methods to eradicate the fly, should this be undertaken.

Almost immediately after the Caribbean fruit fly was rediscovered in Florida in 1965, the Division of Plant Industry set up a temporary field laboratory at the United States Plant Introduction Station at Coconut Grove. Hundreds of traps were set out over a wide area in an effort to determine the extent and magnitude of the initial infestation. Collections from the traps were brought to the field lab for tentative identification and then sent to the Gainesville headquarters for authoritative identification by staff entomologists. Flies were separated by sex and counted. Daily records were posted to indicate a pattern of movement and density of the fly. State and federal inspectors collected and cut field samples of many kinds of wild and domestic fruits to search for Caribbean fruit fly larvae. Fruit samples were brought to the Division of Plant Industry regional headquarters at the University of Miami south campus and placed in cages as a part of

tests to determine what fruits might serve as hosts in which the fly could complete its larval development. Additional tests were conducted in which healthy fruit of many kinds were placed in isolation cages with adult flies to determine which of these could serve as suitable hosts for the fly under laboratory conditions, thus providing a good indication of which fruits might be expected to serve as hosts under field conditions. In these tests special efforts were made to determine whether or not the Caribbean fruit fly would attack various species of citrus, and also mangoes and avocados.

A laboratory colony of the fruit fly was established by the Division of Plant Industry for test purposes.

An experimental area was designated in the heavily infested Miami Springs area where tests were conducted to determine the effectiveness of various lures and traps and to evaluate various sprays applied by airplane and by ground equipment at several concentrations. Malathion bait sprays, which proved effective during the successful eradication of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), in Florida in 1956, were tested by aerial application. Spray plane lines were marked by bright orange, helium-filled kitoons at each end of a run to provide accuracy of spray operation. These bait sprays, however, cause damage to paint on automobiles. Aerial applications of a high concentrate, low volume malathion spray without bait proved effective and showed much promise for use in future fruit fly eradication programs.

#### HOSTS

To date the Caribbean fruit fly has not proved to be a serious pest of commercial citrus, mangoes, or avocados under Florida conditions, but it is heavily infesting fruit of guava (*Psidium guajava*), Cattley or strawberry guava (*Psidium cattleianum*), calamondin (*Citrus mitis*), kumquat (*Fortunella* sp.), Surinam cherry (*Eugenia uniflora*), roseapple (*Syzygium jambos*), Barbados cherry (*Malpighia glabra*), peach (*Prunus persica*), and other soft fruits throughout much of southern and central Florida. The host list for *Anastrepha suspensa* in Florida now stands at 34 different kinds of fruit.

*Anastrepha suspensa* larvae (Fig. 3) typically infest mature to overripe fruits, but occa-



Fig. 3.—Larvae of *Anastrepha suspensa* (Loew) in a green peach.

sionally mangoes, as well as peaches and guavas, are attacked while whole and green on the tree. Larvae have been found also in green avocados.

#### LIFE HISTORY

Eggs are laid singly and hatch in two to three days. The larval feeding period occupies ten to fourteen days, and the pupal period about the same. Pupation takes place in the soil. These stages are prolonged in cool weather. Adults may live a few weeks to several months. The larvae bear a resemblance to the pulp of their host fruit, making detection somewhat difficult to the layman when the larvae are small. When exposed to light they exhibit a tendency to withdraw into the fruit. More than a hundred larvae have been collected from a single large fruit.

#### IDENTIFICATION

*Anastrepha suspensa* is a small, yellow-brown fly, slightly larger than a house fly. The long wings, patterned with yellow-to-brown bands, are characteristic of the genus *Anastrepha*. The female may be readily distinguished from the male by the presence of an elongated ovipositor sheath at the distal end of the abdomen (Fig. 1). A more complete description and a detailed history of the Caribbean fruit fly in Florida are given in Entomology Circular No. 38 (Weems 1965).

#### CURRENT DISTRIBUTION

Current distribution of the Caribbean fruit fly includes Cuba, Jamaica, Hispaniola, Puerto Rico, and southern Florida. The original description of the fly was made from Cuban specimens.

#### RECENT AND CURRENT RESEARCH

The recent dramatic successes of the sterilization technique in the eradication of the screwworm fly, *Cochliomyia hominivorax* (Coquerel), in Florida and in Texas have led to intensive studies on the application of this method for the eradication of several important species of fruit fly pests. Basically this method consists of exposing great numbers of laboratory reared pupae of the fruit fly to a carefully determined dosage of radiation sufficient to arrest the development of the reproductive cells, but otherwise permit these flies to continue to maturity and be able to mate with flies in normal, wild populations, resulting in no progeny. Tests were needed to determine the exact dosage of radiation needed to sterilize pupae of *Anastrepha suspensa* and to develop rearing techniques which could be used to produce great numbers of the fruit fly if an eradication campaign is ever attempted by this means.

Research and plant pest control units of the United States Department of Agriculture set up a laboratory at the Opa Locka Air Field near Miami to conduct irradiation and rearing tests. A rearing media composed of Fleishmann's Yeast hydrolysate (type M) proved to be more effective than the protein hydrolysate used in earlier test rearings. Flies were induced to oviposit into cups made of cheese cloth impregnated with wax to simulate fruit surface through which the fly can oviposit. Eggs were washed from the cups into a container and poured into calibrated tubes to obtain samples of uniform numbers. Approximately equal samples of the eggs were poured onto filter paper squares and placed on the rearing media in petri dishes where the larvae completed their development. Mature larvae were strained from the rearing media and allowed to pupate in containers of dry soil. These pupae were used in a series of tests to determine the proper irradiation dosage required to produce sterilization without otherwise injuring them. In an eradication campaign, huge numbers of these irradiated pupae would be released periodically by air-

plane, and possibly also by ground equipment, over infested areas. The number of sterile flies needed would depend upon the wild population and the size of the area to be covered, and would probably be done during the winter when the wild fly population is low. The number released would have to be many times that of the wild fly population. These fruit flies mate several times, unlike the screwworm fly which characteristically mates only once.

During the past several months, USDA entomologists at the Orlando station under Mr. Allen Selhime have screened over 50 chemical compounds in Dade County in the search for a highly effective lure. Work is being done at the University of Florida Subtropical Experiment Station at Homestead under the direction of Dr. R. M. Baranowski on control measures which can be applied on a local basis, if it is necessary for the people in Florida to "learn to live" with the Caribbean fruit fly. Tests are in progress in a five acre guava grove near Homestead made available by Mr. Harold Kendall of Goulds, who donated all of the fruit and the use of the grove to this project. A study of the bionomics, biology, and ecology of the fly is being set up in south Florida under the direction of Dr. Baranowski with the aid of a \$30,000 grant made through a cooperative agreement with the Entomological Research Division, Agricultural Research Service, USDA. The Division of Plant Industry of the Florida Department of Agriculture will continue to assist in these and other studies of the fly.

#### CONCLUDING REMARKS

At the present time the Caribbean fruit fly

has not been declared a serious economic pest detrimental to major commercial crops in Florida. However, there is no question but that this fly has proven to be a serious nuisance to the residents of the southeastern part of Florida. Dooryard plantings of tropical and subtropical fruits along the "Gold Coast" have suffered severely from the ravages of Caribbean fruit fly larvae. The key to any eradication program is a reliable survey to pinpoint the exact location of the fly, and that requires a highly effective lure. At the present time we do not have such a lure. An accurate survey would be required before any estimate of the infested acreage could be made. Any eradication attempt without a positive detection device would cost untold millions of dollars, because every acre of south and central Florida would have to be sprayed several times. Current research efforts by USDA scientists in Florida are centered on the search for a highly effective lure.

Once a positive lure is found, monetary justification would also be required before any program could be initiated. We would have to ask ourselves if the crops saved are worth the cost of the program. Even with a positive lure, it would be difficult to place an accurate monetary price tag on an eradication. Meanwhile, research by state and federal scientists continues to try to find the answers which would be needed if eventually a decision is made that the Caribbean fruit fly should be eradicated in Florida.

#### LITERATURE CITED

- Weems, H. V., Jr. July 1965. *Anastrepha suspensa* (Loew) (Diptera: Tephritidae). Ent. Circ. No. 38, Div. of Plant Industry, Fla. Dept. Agr., 4 p., 1 Fig.

## THE PEACH IN NORTH FLORIDA

H. W. YOUNG AND H. H. BRYAN<sup>1</sup>

The history of commercial peach production in the North Florida area began with a planting near Barney, Georgia, in 1950. The selection was developed at the USDA Peach Laboratory

at Ft. Valley, Georgia, and later named Maygold. The planting was quite successful and the fruit matured before other varieties in Georgia were ready for the market.

Research began in 1951 when variety tests were planted at Quincy, Jay, Live Oak, and Monticello, Florida. Results of these tests were reported by Sharpe<sup>(1, 2)</sup> in 1954 and 1961, and by Young<sup>(3)</sup> in 1962. Sharpe<sup>(1)</sup> also discussed

<sup>1</sup>Associate Horticulturist and Head, Big Bend Horticultural Laboratory, Monticello, and Assistant Horticulturist, North Florida Experiment Station, Quincy.