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DETECTION, QUARANTINE, AND ERADICATION OF FRUIT FLIES INVADING FLORIDA

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Abstract. Detection and eradication techniques employed in Florida's first fruit fly eradication program required destruction of all medfly host fruits and vegetables on all infested properties, including destruction of such material in the surrounding 1 mile area. Since this first successful attempt to eradicate a major economic species of fruit fly from Florida, fruit fly detection and eradication techniques have advanced to include a permanent fruit fly detection program utilizing synthetic lures. The synthetic used for medfly is trimedlure. Other synthetic attractants are used for *Dacus* species. Quarantine regulations have evolved from requiring mandatory destruction of host fruit and maintaining a host-free period to certification of regulated articles through treatment and inspection. As techniques were improved it became clear that early detection meant greater savings of dollars and efforts spent on eradication. Early detection enhances the chances of eradicating any pest. This is the aim of Florida's Fruit Fly Detection Program.

The 1929 Mediterranean Fruit Fly Eradication Campaign

The value of Florida's Fruit Fly Detection Program can be well justified when the history of some of the past fruit fly eradication programs are considered. The first infestation of an economically important fruit fly in Florida occurred on April 6, 1929, when a state nursery inspector became alarmed at the presence of "maggots" in grapefruit which he acquired in the vicinity of Orlando, Florida. Examination of these larvae by entomologists led them to conclude that a fruit fly of the family Tephritidae was involved, possibly *Anastrepha fraterculus* (Wiedemann), which at that time was believed to occur in the West Indies and was commonly referred to as the West Indian fruit fly.

Shortly after this a visitor reported an excessive drop of grapefruit had taken place at the H. L. Hamlin 40-acre citrus grove located at Marks and Mills Streets, Orlando. A visit to the citrus grove confirmed the presence of many fruit fly larvae. Upon further observation, adults were seen on the foliage. Some were captured and mailed to Washington and Gainesville, and identified on April 10, 1929, as the Mediterranean fruit fly, (*Ceratitidis capitata* (Wiedemann)) (1).

The Chief of the Plant Quarantine and Control Administration and the Plant Commissioner of the State Plant Board approached the problem with one objective—eradication, although this had never been accomplished in any country in which the Mediterranean fruit fly had become established. A plan of approach was agreed upon, and, as might be expected, modifications were made from time to time. Essentially the program embraced the following features:

1. Scouting to determine the extent of its spread in Florida and elsewhere.
2. Division of the State into: (a) Infested Zones, to include any property within 1 mile of an infested grove or area in which infested host fruits or vegetables were located; and (b) Protective Zones, to include an area within 9 miles of the outside boundary of an infested zone.
3. Destruction of all host fruits and vegetables in infested properties as rapidly as found, including the destruction of such material in the surrounding mile (infested) zones.
4. Application of poisoned bait spray throughout both infested and protective zones. The first formula employed consisted of: lead arsenate, crude brown sugar, molasses, and water. (Almost 300,000 pounds of lead arsenate were used.) Later the lead arsenate was replaced by copper carbonate. Complaints were received concerning spray injury, which resulted in the appointment of a committee of successful citrus growers to investigate the claims. To summarize, the committee reported in part as follows: "that the beneficial results of the 'bait spray' far outweigh the damage that has occurred". (Eighth Biennial Report of the Plant Commissioner, pp. 55-56, February 1931).
5. Establishment of a summer host-free period by removing and destroying all summer ripening host fruits and the prohibition of the growing of summer ripening vegetables in both infested and protective zones.

6. Removal of all citrus and other host fruits or vegetables (*throughout* the year) in the infested zones prior to their reaching a stage of ripeness making them susceptible to fruit fly attack, including the prohibition of planting such vegetables in the infested zones.
7. Requirements of orchard and packing house controls, control of transportation in interstate and intrastate commerce, control of motor vehicle and other road movement and other features of sanitation and protection were enforced under state authority within the infested and protective zones.

The eradication area embraced approximately 10,000,000 acres of land which included a total of 120,000 acres of citrus and about 160,000 acres devoted to non-citrus. 1,002 infested properties were involved, distributed over 20 counties (Alachua, Brevard, Citrus, Duval, Flagler, Hernando, Hillsborough, Lake, Levy, Marion, Osceola, Pasco, Pinellas, Orange, Polk, Putnam, St. Johns, Seminole, Sumter, Volusia) extending from the Atlantic Ocean to the Gulf of Mexico. These properties contained 72 of the bearing citrus trees which in 1929 produced 73% of the crop.

McPhail traps played an important part in the eradication program, serving in a triple capacity: (a) in infested properties they served as an index to the adult population; (b) in what were believed to be non-infested areas they assisted in detection of adult flies not discoverable by any other means; and (c) they made it possible to determine the effectiveness of control measures, and in a few instances the first record in a given area resulted from catching adults in the traps. At one period as many as 12,645 traps were scattered throughout the affected areas. The lure used in the McPhail trap was kerosene, which was found to be attractive to the male fruit flies.

The eradication of the Mediterranean fruit fly in Florida after the build-up of a tremendous population in 1,002 infested properties ranks as one of the outstanding entomological miracles of the age. The Mediterranean fruit fly was finally declared eradicated in late 1930, at a cost of \$7,573,136.91.

The 1956 Mediterranean Fruit Fly eradication Campaign

The second invasion of an economic species of fruit fly became evident on April 13, 1956, as larvae in grapefruit in Miami Shores, Florida. A single larva sent to the Gainesville entomological department was identified as the Mediterranean fruit fly. On April 18, 1956, the Plant Commissioner directed the Acting Chief Entomologist to go to the infested area in Miami to collect adults with McPhail traps. Eleven adults of the Mediterranean fruit fly were collected in the McPhail traps and the Agricultural Research Service in Washington, D.C. was notified.

On April 20, 1956, 12 more adults were caught, and Dr. D. O. Wolfenbarger of the Sub-Tropical Experiment Station was informed that the infestation was definitely Mediterranean fruit fly. The information was released to the public on April 23 (3).

The methods used in fighting the Mediterranean fruit fly in the 1956 campaign were entirely different from those techniques employed in the first campaign, when host trees and plants were stripped of fruit and produce in order to eliminate breeding spots. This latest campaign involved the most recent technologies, although many of

the newest chemicals, such as oil of Angelica seed, were still in the testing stage and were put to use before final laboratory examinations were completed. The old system of fruit stripping and a host-free period was discarded at the outset. Substituted was a new theory of regulation through fumigation and certification, with practically no loss to farmers and growers of produce and fruit.

In general, when a fly infestation was found, a quarantine zone of 1 mile was established, and all host fruit or produce moving out of this quarantine zone had to be fumigated or processed immediately. Weekly spraying for a minimum of 40 days was prescribed for a radius of 1/2 mile around the infestation. Barring further fly finds, the entire area was released from quarantine restrictions 90 days after recovery of the last fly, or 120 days after the last larval find.

Baited traps were increased greatly within the spray area to serve as guides in determining cut-off dates for controls. Traps also were increased along the outside margin of the spray area to ascertain if flies had escaped to develop a new infestation.

State and federal program officials lost little time in getting the eradication operation airborne. Aircraft were called into the struggle to do the spraying which previously had been confined to the ground. By the use of aircraft, the mass application of insecticides was possible over heavily populated areas, often within minutes after an infestation was discovered. Planes could transfer from one area to another with little loss of time due to the necessary movement of equipment. At the peak of the 1956 "medfly" program there were 27 planes in operation daily ranging in size from B-17's of World War II to single-engine Piper Cubs.

A newly perfected bait spray, which was applied to vegetation by airplanes and ground sprayers, was one of the principal weapons used in the fight against the adult fly. The mixture used in aerial spraying consisted of 25% wettable malathion and an approved protein hydrolyzate suspended in water. Staley Sauce Bait No. 2 was used in the early formulas, with a later switch to Sauce Bait No. 7. The bait spray was applied at intervals of approximately once a week, with the length of time between sprayings depending upon the frequency and intensity of rain and upon other climatic conditions (2). Ground and hand equipment were used in the treatment of soil with dieldrin, an insecticide which obtained a high percentage of kill on larvae entering the soil and a reasonable kill of adult flies emerging from the pupal stage.

As an indication of the size and scope of the program in Florida, a total of 800,423 acres was treated with insecticides one or more times. In view of the fact that some areas were covered as many as a dozen times, insecticides were applied to an aggregate total of 6,804,383 acres.

A federal quarantine regulated the movement from Florida to other states all articles that might harbor the insect. State regulations controlled movement of these articles to non-infested areas of the state. At the height of the Mediterranean fruit fly campaign, roadblock inspection stations were operated on highways leading out of heavily infested areas to prevent the spread of the pest through the movement of host fruit and soil. In spite of the roadblocks, the spread of the medfly followed the main highways leading from the infested areas, and all

roadblocks were discontinued on October 23, 1956. Program officials approved a total of 264 fumigation chambers in which approximately 5,040,000 boxes of citrus were fumigated with ethylene dibromide. The cost of fumigation was approximately 5 cents per box in truck load lots. This treatment proved faster and less expensive than either of the 2 treatments, vapor heat and cold storage, used in the 1929 campaign. Fruit fly trapping, as a result of the 1956 Mediterranean Fruit Fly Campaign, became a permanent federal-state cooperative survey program in Florida.

In 1956 adult Mediterranean fruit flies were found as far north as Seminole County and as far south as Key West. The final application of spray was at Sneads Island in Manatee County on February 25, 1958, and the quarantine was lifted the following day. That, to all intents and purposes, marked the end of an \$11,000,000 fight to chase the Mediterranean fruit fly out of Florida for a second time in 2 decades.

In the 1929 campaign, the method of detection was not considered a complete success because the attractant used in the traps was declared weak. The McPhail trap, known as the "wet trap", could not be operated as efficiently and quickly as the plastic Steiner traps used in the later campaigns. During the first part of the 1956 campaign, oil of Angelica seed, an expensive lure, costing on an average of \$100.00 a pound, was the attractant. Later, when supplies of this oil were completely exhausted, research developed a synthetic lure called ENT 21478. This later was improved upon and called ENT 21486. This lure proved comparable to angelica oil and was considered more uniform and stable. At the height of the program, 54,000 traps were in use, extending from Pensacola to Jacksonville to Key West. Records show that 11,932 medflies were trapped and identified as positive during the campaign.

The 1962 Mediterranean Fruit Fly Campaign

Since the 1956 Mediterranean fruit fly eradication campaign the Florida Department of Agriculture, Division of Plant Industry and the United States Department of Agriculture have maintained a strong fruit fly detection program in an effort to detect early infestations of economically important fruit flies. This program first proved its merit on June 8, 1962, when an adult Mediterranean fruit fly was trapped in Dade County.

On June 18, 1962, a Federal quarantine was placed on Dade County; this was later extended to include Broward and Palm Beach counties. It required that all host fruit, vegetables and nursery stock be either fumigated or certified before being moved. The Federal quarantine regulated the movement from Florida to any other state, any articles that might harbor the insect. State regulations controlled movement of these articles to non-infested areas of the State.

In general, when a fly infestation was found, a quarantine zone of 1 mile was established. This area was known as Zone I. All host fruit or produce moved out had to be fumigated. Zone II was that area lying between the Zone I boundary and the federal quarantine boundary. Fruit and produce in Zone II could be moved without fumigation after being certified. Eleven fumigation chambers were approved for fumigating fruit and produce (8).

The method used for eradication of the Mediterranean fruit fly in the third campaign was basically the same as in the 1956 campaign. Several improvements were made with the method of pesticide application. All planes were equipped with a positive cut-off valve on each nozzle. A radio was used from the airport to direct the entire operation. Spotters in the field measured the swath width and used kytoons to guide the pilot. The size of the spray area in the third campaign averaged 2,400 acres for a single fly find. The spray (malathion) was applied at 7-day intervals for a minimum of 56 fly-free days, and the area was re-sprayed if washed off by rain within 2 hours after application. Ground spray was applied around a small area at the infestation immediately following rain and in between aerial applications (5).

It was during the 1962 Mediterranean fruit fly campaign that the newly developed Mediterranean fruit fly lure, trimedlure, was used in the plastic Steiner trap. The density of traps in Dade and Broward Counties was increased to approximately 40 traps per square mile. At the time the first fruit fly was found in Dade County, 941 traps were in operation. Two weeks later 3,000 traps were being tended. The 11-month battle was ended with the announcement on May 7, 1963, that Broward and Palm Beach Counties had been released from quarantine. The quarantine on Dade County had been lifted on October 23, 1962. A working force of approximately 100 people was required to eradicate the pest at an expenditure of \$1,000,000.

The 1963 Mediterranean Fruit Fly Campaign

The fourth entrance of the Mediterranean fruit fly into Florida occurred on June 17, 1963. It was discovered again near the Miami International Airport. This marked the third time in 7 years that a fruit fly infestation had been detected in Dade County. An all-out attack was launched immediately against the pest. At the time of discovery, 2,400 traps were being tended in Dade County. This no doubt resulted in the early detection of the infestation which greatly reduced the cost of eradication and saved the state and federal governments considerable funds. The survey and control techniques used for detection and eradication of the Mediterranean fruit fly in the fourth campaign were basically the same as the 1962 campaign. The fourth campaign ended with the lifting of the quarantine in Dade County on November 26, 1963. Eradication was achieved at a cost of \$100,000.

1964 Mediterranean Fruit Fly Survey

On May 20, 1964, 1 adult male fruit fly was caught in a trap near Pier 3 in Miami. At a quickly called conference held that day at the Division of Plant Industry office in Gainesville, it was decided to delay aerial spray pending the discovery of more flies. Authorities believed the single fly was an escapee from a merchant vessel from Hawaii which had tied up at the dock on May 18. However, fruit fly officials took no chances. Traps were increased immediately from 20 to 100 per square mile within 4 square miles of the fly find, and from 20 to 60 per square mile within a 21-square mile area adjacent to the 4-mile area. No other fruit flies were trapped (5).

1964 Oriental Fruit Fly Survey

On November 15, 1964, 1 Oriental fruit fly (*Dacus dorsalis* Hendel) was trapped in St. Petersburg, touching off an all-out survey. A total of 4,850 Steiner traps was added to the 605 traps already in the field in Pinellas County. An additional 1,000 traps were put in the field in Hillsborough County, and 200 were added in Manatee County. These Steiner traps were baited with methyl eugenol and tended until January 18, 1965, when it became apparent that there was no active infestation. The 1 fly trapped was considered to be a hitchhiker which escaped from a ship or plane (6).

1965 Caribbean Fruit Fly Survey

In April 23, 1965, larvae collected from Surinam cherries (*Eugenia uniflora*) in Miami Springs were identified as *Anastrepha suspensa* (Loew), commonly known as the Caribbean fruit fly. Instructions were issued to increase trapping and observe the infestation closely. More than 14,000 flies had been trapped for identification by June 30, 1965, and tens of thousands had been seen in the infested area. The Caribbean fruit fly is not considered to be a serious pest of citrus and other commercial crops moving in interstate commerce. Non-commercial crops such as calamondin (*Citrus X Fortunella*). Surinam cherry (*Eugenia uniflora*), guava (*Psidium guajava*), loquat (*Eriobotrya japonica*), and other tropical and subtropical fruit are severely damaged or destroyed. A conference was held in Miami July 15, 1965 with state and federal plant pest eradication officials and representatives of the University of Florida agricultural research stations. After a careful review of the situation, the conference participants agreed that there was no need for an eradication program at that time because the caribfly had not attacked commercial crops. This decision to delay eradication was considered by many to be a mistake, for the Caribbean fruit fly has seriously damaged most varieties of dooryard fruit in South Florida. It has infested late maturing varieties of commercial citrus and has caused a quarantine against fresh Florida citrus bound for Arizona, California, Texas, Hawaii, and Japan (9).

The 1967 Mediterranean Fruit Fly Survey

A single Mediterranean fruit fly was trapped at Miami Beach, October 10, 1967. Intensified trapping during the months of October and November did not turn up another specimen.

The 1969 Oriental Fruit Fly Survey

On December 3, 1969, a male Oriental fruit fly was trapped at Golden Beach in northeast Dade County, marking the second appearance of this fly in Florida. No additional specimens of the fly were detected despite the addition of 1,557 traps.

The 1972 Mexican Fruit Fly Survey

On February 23, 1972, 1 adult female *Anastrepha ludens* (Loew) was trapped along with 18 *Anastrepha suspensa*, in a McPhail trap placed in a grapefruit (*Citrus paradisi*) tree in Sarasota. As a result of this find, an intensive Mexican Fruit Fly Trapping Program was initiated. Traps were placed in preferred hosts at the rate of one trap per city

block, using torula yeast borax in water, brown sugar and water, or cottonseed protein pellets. A total of 4,178 McPhail traps installed in 6 Florida counties revealed no new finds of the Mexican fruit fly (5).

The 1981 Mediterranean Fruit Fly Campaign

In August 1981, a total of 5 medflies was found at 3 different locations in Tampa. These were the only medflies detected, and no larvae were found. Since the fruit fly eradication efforts of 1956 and the early 1960's, contingency plans had been drawn up for use any time fruit flies become established in Florida. With the appearance of the medfly in California, Florida's plans were updated, ground spray equipment kept in readiness, and personnel to be called in were tentively selected. Florida's goal, in any fruit fly eradication effort, is to have ground spray applied to the infested area within 24 hours of identification of the fruit fly and aerial spraying commenced as soon as feasible, hopefully, within 72 hours.

A state and a federal worker were selected to jointly supervise each phase of the operation (survey, control, regulatory, and public relations). This system has worked well in past programs and succeeded in this campaign as well, with only a few very minor problems arising. The California medfly problem, having been in the national news for over one year, paved the way for workers in the Tampa campaign. The public, news media, and local governmental officials supported the efforts with very little disagreement. The public majority seemed to understand the importance of Florida's agriculture industry and the need to protect it.

A total of 66 days lapsed from the time the first flies were found until the last spray application was applied. Aerial spraying was scheduled every 7 days for a total of 8 complete applications. During the entire control operation, no major problems were encountered. With no further fly finds, the final aerial bait spray was applied on October 8, 1981 to the downtown Tampa and Ybor city areas, completing the planned 8 applications.

The quarantine which restricted the movement of host fruits and vegetables from the regulated area was lifted on November 12, 1981. One million (\$500,000 federal and \$500,000 state funds) was expended on this eradication campaign (4).

The 1983 Mediterranean Fruit Fly Survey

One adult female Mediterranean fruit fly was discovered in a Jackson trap near Miami International Airport on May 31, 1983. Trap density was increased to 100 traps/square mile in an 81 square mile zone extending 4 1/2 miles out from the site where the fly was found. Intensified trapping continued throughout July 1983 with no additional flies being trapped.

The 1984 Mediterranean Fruit Fly Campaign

Four Mediterranean fruit flies (1 unmated female and 3 males) were found in Miami on June 19, 1984. At a staff meeting of key federal and state personnel, it was agreed to apply aerial bait spray as quickly as a crisis exemption could be secured from the EPA. Under normal conditions in Dade County, state and federal inspectors checked some

3,146 fruit fly traps every 3 weeks. After the medflies were found, the number of fruit fly traps tended in Dade County was increased to 4,412, capturing 12 male flies and 1 unmated female in 8 locations. One larva was found by a neighbor of the homeowner at the original find in an orange she had picked from the infested sour orange tree (*Citrus aurantium*). This important find helped pinpoint the epicenter of the infestation. On June 20, 1984, the Florida Department of Agriculture and Consumer Services and the USDA filed a quarantine defining the exact boundaries of the regulated area. No host fruit grown in the regulated area could be shipped out. Fruit passing through or being sold in the regulated area had to be covered. The quarantine area contained 460 regulated establishments, which were monitored 7 days per week. The regulated establishments included 58 nurseries, 152 fruit stands, 46 plant and fruit vendors at flea markets, a farmers' market with 67 vendors, and 157 mobile vendors and lawn maintenance crews.

For rapid control of adult and larval populations, the chemical/mechanical method of control was used. This method included foliar bait spraying, fruit stripping, soil drenching, and aerial bait spraying. With foliar bait spraying, the leaves of all host plants within a 660-foot radius (approximately 4 blocks) of each find were sprayed with a mixture of Malathion and protein spray. Foliar bait spraying continued weekly for 4 weeks (1 generation) after the last find. Where flies and a larva were found at the site of the initial find, all host fruit were stripped from the infested property, and only mature host fruit were stripped from properties within a 600-foot radius. Where only flies were found, mature host fruit were stripped from only the infested properties. At properties within a 600-foot radius of the larval find, the soil beneath and 12 inches beyond the drip lines of host trees were drenched 3 times at 14-day intervals with Diazinon 4E to kill any remaining pupae.

One of the most effective methods to stop the medfly was the aerial application of Malathion and protein bait spray. Flies emerge from the pupal stage, usually in early morning hours, and seek and feed on protein for about 48 to 72 hours before mating. Aerial spraying was continued for 2 generations (8 weeks) after the last find. The aerial applications were conducted every 5 to 7 days, depending on rainfall. Aerial applications continued through August 28 in a 7.5 square-mile area.

Weekly applications of Malathion bait spray of 12 ounces per acre showed no adverse environmental accumulation or effects to air, soil, or water (6). A mixture of Malathion and Nu-Lure protein bait was mixed with water until the Malathion was at 20 percent concentration. The 1984 Miami infestation was similar to the 1980 medfly outbreak in California in that it was in a heavily populated area with dooryard hosts near major airports, seaports, and light industry. Eradication was achieved on November 2, 1984, at a cost of one million dollars.

The 1985 Mediterranean Fruit Fly Campaign

A single female Mediterranean fruit fly was found February 25, 1985, near the Opa Locka Airport in North Miami. Forty-three days later, two male medflies were trapped approximately 2 3/4 miles southwest of the previous find, triggering an eradication campaign. A quarantine was imposed on the 110 square-mile area surrounding

both finds to prohibit movement of host material from the regulated area. The sale and display of host material within the area were regulated to prevent the possible spread of the pest. Aerial treatments of Malathion and protein bait spray over the infested area were reduced from the usual 8 weekly sprays to 4 with the introduction of the sterile insect release method into the eradication program.

This eradication program marked the first time sterile medflies have been released in Florida. The release of large numbers of sterile medflies was intended to overwhelm any wild medflies which might have been present in the quarantine area, providing infertile mates for the wild flies. Medfly pupae were reared and shipped from the California Department of Food and Agriculture's rearing facility in Honolulu, Hawaii to Miami International. In Hawaii and at an emergence facility in Florida tests were conducted to monitor various performance factors of the sterile flies. These included pupal size (for competitiveness), percent emergence, flying ability, mating propensity, and ability to survive without food. Testing was also conducted to assure that one half of the flies were males. Each shipment of sterile pupae contained a dosimeter label which visually indicated if the pupae had been properly irradiated; in addition, sterility checks were made by dissection and microscopic examination. Fifty-two shipments of sterile pupae were received, with each shipment containing approximately 6.0 million pupae.

The first sterile flies were released May 7, 1985. Approximately 5.5 million sterile flies were released per day, 5 days per week. A total of 271.75 million sterile flies was released over the 75-day period which ended July 1985 by aircraft or from roving ground vehicles in the 3.5 square-mile core area of the quarantine zone. Following sterile fly release, intensified trapping was begun to determine the effectiveness of the release program. A total of 2,649 Jackson traps was tended in the 110 square-mile quarantine area for one life cycle (30 days). No wild medflies were discovered. Eradication was declared on August 27, 1985. The total eradication cost of 1.3 million dollars was shared equally between the state and federal governments.

The 1986 Mediterranean Fruit Fly Survey

On March 21, 1986, one unmated female Mediterranean fruit fly was detected in Indian Rocks Beach, located south of Clearwater in Pinellas County. Fruit fly detection efforts were immediately intensified in a 46 square-mile area surrounding the find in accordance with the Mediterranean Fruit Fly Emergency Program Action Plan. Intensified trapping efforts continued for 90 days, three life cycles of the medfly. Having detected no other Medflies, trapping returned to normal on June 13, 1986.

The 1987 Mediterranean Fruit Fly Campaign

On March 2, 1987, 5 male Mediterranean fruit flies were trapped in Hialeah. Since 1981 medfly detection trap densities in Dade County have been maintained at a minimum of 8 traps per square mile. Immediately following this discovery fruit fly detection activities were intensified in an 81 square-mile area surrounding the location of the find. On March 5, 1987, a single fly larva was identified from calamondin fruit collected near the March 2nd find, triggering eradication measures. Eradication meas-

ures began with 4 weekly ground and aerial spray treatments consisting of Malathion and NuLure protein bait. Aerial applications continued uninterrupted through March 29, 1987 in a 9 square-mile area. In addition to the aerial treatments, all medfly host trees located on properties within a 660 foot radius of the larva find were stripped of fruit and the soil under and 12 inches past the drip lines of host trees was drenched with Diazinon 4E to kill any remaining pupae.

On March 12, 1987, project officials announced emergency regulations governing the handling and movement of all medfly host fruit and vegetables in the 81 square-mile eradication zone. All medfly host materials originating outside the regulated area and offered for sale within the regulated area had to be either refrigerated at 55 degrees or less, kept in sealed containers without holes, or placed in screened enclosures. All medfly host material in transit through the regulated area was required to be safeguarded to prevent medfly oviposition. The aerial treatment phase of the program was followed by a sterile Mediterranean fruit fly release program. The sterile release phase began on April 3, 1987 and continued through June 16, 1987. For all practical purposes, this sterile medfly release program was a mirror image of the 1985 Medfly Eradication Program. Prior to the sterile release phase of the project, all Jackson traps in the 49 square-mile release zone were removed. Steiner traps were then placed in the release zone at a density of 5 traps per square mile. These are clear, plastic cylindrical traps baited with trimedlure. Each trap contained a single Vapona strip to kill captured flies. Steiner traps have the advantage of being a dry trap that allows easy access to specimens. In order to distinguish trapped sterile medflies from wild flies, all sterile flies were marked with neon red fluorescent dye.

During the week following the last sterile fly release, all the Steiner traps used to monitor the distribution of sterile flies within the 49 square-mile release zone were removed. A total of 1320 Jackson traps was reinstalled in the 81 square-mile eradication zone and tended for 30 days. Florida's eighth successful Mediterranean fruit fly eradication campaign officially ended July 17, 1987; the total cost of 1.1 million dollars was shared equally between the state and federal governments.

On March 22, 1988, one male Mediterranean fruit fly was caught in Miami in a trimedlure trap hung in a guava tree. The fly was a newly emerged male approximately 3 to 4 days old. On March 23, 1988, control crews were dispatched to the site of the find and completed ground applications of Diazinon 4E to the positive property and all adjoining properties to eliminate any newly emerging adults. The following day all medfly host plants located within a radius of 660 feet of the find received one application of a protein bait spray consisting of Malathion mixed with Nu-Lure protein hydrolysate. In addition, all medfly host fruit from the positive property were collected and examined for the presence of medfly larva. Although much of the fruit was found to be infested with Caribbean fruit fly larvae no medfly larvae were found. By March 26, 1988, 1,318 trimedlure traps had been placed in the 81 square-mile area surrounding the location of the find. Intensified trapping continued for 3 life cycles of the Mediterranean fruit fly with no additional medflies trapped. The cost for this intensified survey, \$100,000.00, was shared equally by state and federal governments.

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CONTROL OF TEMPERATURE AND RELATIVE HUMIDITY IN VAN CONTAINERS OF POTTED ARECA PALMS IN EXPORT SHIPMENTS TO EUROPE

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Additional index words. Ethylene, carbon dioxide, moisture, bottom-air delivery.

Abstract. In 3 test shipments of Areca palms, air and soil temperatures, relative humidity, and ethylene and carbon dioxide concentrations were monitored from Florida to Europe.

Shipments were made in 13.7 m refrigerated van containers equipped with bottom-air delivery, humidity reduction system and an air exchange system. Air and soil temperatures were reduced to within 2°C of the thermostat set point within 2 days of loading, and were maintained at or near set point throughout the transit period. Ethylene concentrations during transit were less than 0.01 ppm, and carbon dioxide levels were less than 1.2%. In 2 shipments without humidity reduction, the relative humidity ranged from 85 to 100% (mostly 95 to 100%); and with humidity reduction at 75 to 95%. In general, the condition of the plants was drier without any free moisture with the lower relative humidity.