Review of Fruit Fly Surveillance Programs in the United States

February 2006

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This review summarizes the current status and performance of all fruit fly surveillance programs in Puerto Rico, U.S. Virgin Islands, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, New Mexico, Arizona, California and Hawaii.

Citing This Report

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Cover Images (From top to bottom)

1. Mediterranean fruit fly (*Ceratitus capitata*)
2. Mexican fruit fly (*Anastrepha ludens*)
3. Oriental fruit fly (*Bactrocera dorsalis*)
4. Melon fruit fly (*Bactrocera cucurbitae*)
5. Jackson trap with trimedlure solid plug
6. Jackson trap with cotton wick for liquid lure
7. McPhail trap (most likely with torula yeast)
8. Multilure® trap (most likely with Biolure® [3C])

Credits

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Contents

1 Executive Summary

This review is a summary of the current status and performance of all fruit fly surveillance programs in the continental United States, Hawaii, Puerto Rico and the U.S. Virgin Islands (Figure A-1 on page A-2, Figure A-2 on page A-3, and Figure A-3 on page A-4). It was based on discussions with program managers, and contains recommendations for each state or territory (Table B-6 on page B-7). An international group of fruit fly experts conducted the work during the period May 17—27, 2005 in Orlando (Florida), Austin (Texas) and Sacramento (California).

Continuous international and interstate trade with established fruit and vegetable markets and market diversification has resulted in growth of the agricultural sector in the United States. Early detection of introduced fruit fly pests facilitates eradication efforts through emergency action, thus reducing damage, costs, and the risk of trade embargoes to fruit production. In the United States, fruit fly surveillance programs have developed independently in each state. This situation has generated differences in technology or its application among United States programs.

Fruit fly surveillance programs in the United States need the following:

- Modernization to reflect new technologies
- Harmonization at the national level
- Periodic review by an independent international panel for quality assurance

Recommendations in this review were based on new trapping developments reported in *Trapping Guidelines for Area-wide Fruit Fly Programmes* (IAEA 2003). IAEA (2003) was endorsed by several national and regional plant protection organizations and will probably serve as the basis for future standardization of global trapping technologies.

The Standards Committee of the International Plant Protection Convention (IPPC) is considering the use of *Trapping Guidelines for Area-Wide Fruit Fly Programmes* (IAEA 2003) as a reference document in fruit fly International Standards for Phytosanitary Measures (ISPMs).

2 Introduction

Surveillance programs for the detection of fruit flies have been in operation in the continental United States for more than 50 years. The goal has been to protect current and future fruit and vegetable production and trade. In particular Florida, Texas and California have historically been susceptible to fruit fly infestations. The introduction of exotic fruit flies of quarantine and economic importance threatens the fruit and vegetable industry in these states. In 2002, the value of fruit fly host commodities in Florida, Texas and California was $1.8 billion, $60 million and $5.2 billion, respectively.

In order to detect or eradicate introduced populations of exotic fruit flies in the United States, various detection systems have been used. National and cooperative state/federal fruit fly trapping protocols are currently used as references to guide surveillance activities. The historical independent development of these trapping protocols over time illustrates how fruit fly surveillance technology has evolved from the initial use of kerosene traps in the early 1900s to the current technology. These developments justify the need for a constant review and harmonization of surveillance protocols to ensure the maintenance of efficient national systems by incorporating state of the art technologies. Advances in trapping technology have lead to increased efficiency in the detection of exotic fruit flies.

In 2005, the cost of surveillance in Florida, Texas and California was $11 million, $1.8 million and $20 million, respectively.

Due to the current trends in globalization, states that have historically been at risk of fruit fly introductions, are now subject to greater risk due to the rising approach rate of infested fruit fly hosts transported as a result of increased trade, tourism and population migration. To ensure that the surveillance programs are updated and, if appropriated, to mitigate the increased pest risk posed by the effects of globalization, an international team of technical experts was formed to conduct a national review of the U. S. fruit fly programs.

The goals of this review included the following:

1. Review and report on the current program status and practices.
2. Compare fruit fly surveillance programs in the United States with programs described in *Trapping Guidelines for Area-wide Fruit Fly Programmes* (IAEA 2003).
3. Offer recommendations for improvements of the current fruit fly surveillance programs within the United States.

3 Recommendations

1. **Harmonize technical criteria of international, national and state surveillance protocols which include trapping procedures, trap densities, quality assurance and emergency response protocols.** Technical criteria should take into account the strategic objectives and conditions (i.e. program size, risk involved, resources, types of surveillance, within a PRP area, etc.) of the state surveillance programs. IAEA (2003) provided a good basis for harmonizing some of the aforementioned criteria.
2. **Harmonize fruit fly trapping terminology among surveillance programs in the United States.** Terminology should follow IPPC Glossary ISPM 5 (2005) and NAPPO (2004). Harmonization of terminology would greatly enhance communication among surveillance programs in the United States and at the international level. Commonly used terms that need to be harmonized include the following:
   - ➤ Containment
   - ➤ Detection
   - ➤ Exclusion
   - ➤ Exotic species
   - ➤ Entry
   - ➤ Find
   - ➤ Introduction
   - ➤ Infested area
   - ➤ Outbreak
   - ➤ Prevention
   - ➤ Surveillance
3. **Upgrade surveillance programs in the United States to meet current national and international protocols.** Escalating trade, migrant populations, and tourism increase the pest risk posed by the introduction of exotic fruit fly populations. To compensate for increasing pest risk, surveillance programs in the United States must be maintained and upgraded to match *Trapping Guidelines for Area-wide Fruit Fly Programmes* (IAEA 2003).
4. **Conduct a cost-benefit analysis on the current and recommended surveillance programs.** Economic returns of surveillance programs serve as a strong justification for continuous funding and upgrading of fruit fly detection programs. A revision of trapping systems does not necessarily

mean an increase in operational costs of the fruit fly program, but in some cases cost reductions may actually be achieved. A cost-benefit analysis is required to assess the returns on investing in the current fruit fly programs and to determine whether improvements and upgrades for more sensitive trapping networks will require additional funding.

5. **Implement an alternate trapping system for certain eastern coastal states based upon species specific area susceptibility for the introduction of fruit fly populations.** Climate and host availability in South Carolina and Georgia (along the Atlantic coast) and in Alabama, Mississippi and Louisiana (along the Gulf of Mexico) makes these areas conducive to introduction and establishment of exotic fruit flies. The fruit fly species with the greatest likelihood for establishment are the Mediterranean fruit fly (*Ceratitis capitata*) and the Mexican fruit fly (*Anastrepha ludens*). These species are well adapted to temperate climates and are able to survive mild winters with occasional days of freezing temperatures. In the event of establishment in any of the above mentioned states, the coast line could be a pathway for further spread. Thus, consideration should be given to upgrading, and if lacking, to integrate trapping systems against these species into the current surveillance programs.

   The following economic species have a wide host range, but are unlikely to become established:

   - Oriental fruit fly (*Bactrocera dorsalis*)
   - Melon fly (*B. cucurbitae*)
   - Peach fruit fly (*B. zonata*)
   - Guava fruit fly (*B. correcta*)
   - Caribbean fruit fly (*Anastrepha suspensa*)
   - South American fruit fly (*A. fraterculus*)

   The following economic species have a limited host range, but are unlikely to become established:

   - West Indian fruit fly (*A. obliqua*)
   - Guava fruit fly (*A. striata*)
   - Sapote fruit fly (*A. serpentina*)

   The natural distribution range of these species occurs in tropical and subtropical environments. Freezing temperatures during winter and scarce availability of hosts, especially for the more host specific species, would be major limiting factors for establishment of these species. Nevertheless, given the biotic

potential of some of these species, in particular *B. dorsalis* and *B. cucurbitae*, traps baited with ME and CUE should be placed at low densities (i.e. 1 trap per square mile) in high risk areas.

6. **Conduct a pest risk analysis to identify pathways and the susceptible areas in the United States for the establishment of *Bactrocera* spp.** For a detailed assessment of the potential risk of establishment of species other than *C. capitata* and *A. ludens* in states considered to be of low risk, a pest risk analysis should be conducted. Findings should be used as the basis for further fine-tuning of the trapping systems and trap densities required.

7. **Designate the Multilure® trap (MLT) as the standard for synthetic food lures (Biolure® and two-component lures) and protein baits (torula yeast, Nu-lure, etc.).** Using MLT will slightly improve trap catches, when compared to the McPhail trap. Its design allows for more efficient servicing and rebaiting techniques resulting in reduced labor costs (IAEA 2003).

8. **Establish a detection network for exotic fruit flies nonresponsive to parapheromones or synthetic food lures using MLT/torula yeast at a density of 1 trap/mi^2.** This trapping system would cover the nonresponding ME and CUE *Bactrocera* and *Dacus* spp. and the *Anastrepha* spp. that have a weak response to the dry synthetic lues (Biolure and 2C) such as the South American fruit fly (*A. fraterculus*) and the Guava fruit fly (*A. striata*).

9. **Improve the communication and exchange of information among all fruit fly surveillance programs so procedures are harmonized and updated on a continuing basis.** This harmonization process should include the standardization of GPS and GIS systems to eventually incorporate all the information on a single source of trapping records.

10. **Develop DNA analysis for *Ceratitis* spp., *Bactrocera* spp. and *Anastrepha* spp.** This tool would allow identification of the likely geographical origin of these fruit fly species which would allow a more effective implementation of surveillance programs and quarantine measures at points of entry by detecting high risk pathways. Identification of the origin of detections would also give direction to strategic planning for the implementation of off-shore pest mitigation measures.

11. **Develop new technologies to discern wild and sterile fruit flies.** Current dependence upon dyes as an analytical tool to discriminate wild from sterile fruit flies captured in the field can lead to misidentification and subsequent costly response actions

if problems occur in the dying process. Inclusion of a redundant back-up system (genetic markers, DNA identification capabilities, etc.) would relieve the risk of any misidentifications.

12. **Establish an effective mechanism to validate and transfer technology from USDA/ARS to state-level surveillance programs.**

13. **Conduct regular fruit fly surveillance reviews.** Fruit fly surveillance reviews of a national scope should be conducted every three years. More detailed yearly analyses of the major fruit fly surveillance programs in United States will be required in order to fine tune some of the generic recommendations that are presented in this document.

14. **Conduct methods development evaluations to explore the possible use of Multilure® traps baited with torula yeast in low-toxic antifreeze.** Such traps could be serviced every 14 days.

4 Puerto Rico and the U.S. Virgin Islands

Fruit Fly Surveillance Program

Background

The Commonwealth of Puerto Rico consists of the main island of Puerto Rico and the smaller islands of Culebra, La Mona and Vieques. Puerto Rico is located 994 miles southeast of Florida. Puerto Rico has a surface area of 3,507 mi^2. Maximum distance from east to west is 111.85 miles; maximum distance from north to south is 40.4 miles. Elevation ranges from sea level to 4,400 feet above sea level. Puerto Rico maintains a mean temperature year-round of 80° F.

Tropical plants are in abundance. Fortunately, the Mediterranean fruit fly is absent. Major agricultural commodities include fruit, vegetables and coffee—all are potential hosts of the Mediterranean fruit fly if it became established on the islands.

In 2002, Puerto Rico's market value of crops was $250.4 million, as follows: 16.8% in coffee, 12.2% in vegetables and 7.2% in fruits and coconuts (USDA/NASS 2004a). Mango is one of the major commercial fruit fly host commodities exported to both international and domestic markets from Puerto Rico.

The U.S. Virgin Islands (USVI) includes three islands located east of Puerto Rico in the Caribbean Sea:

- Saint Thomas—32 mi^2
- Saint John—20 mi^2 and
- Saint Croix—81.85 mi^2

The islands have abundant vegetation with an average temperature year round of 80° F. Tourism and the services sector (hotels and restaurants), which require a continuous supply of fruit and vegetables, are a major income source for the islands. Value of the combined fruit and vegetable production of the USVI in 2002 was close to $500,000 (USDA/NASS 2005).

On St. Croix Island, agricultural production is limited and most fruit fly hosts are found in dooryards.

Current Status

The Commonwealth of Puerto Rico and the USVI are potential gateways for the introduction of fruit flies into the continental United States. This is due to their close association to other Caribbean islands and their potential to support fruit fly populations year-round. Many tourists travel from foreign Caribbean islands to Puerto Rico and USVI, and continue to the continental United States. Tourism establishes Puerto Rico and USVI as potential gateways for movement of fruit flies between other Caribbean islands and the continental United States. In addition to a fruit fly surveillance program, USDA/APHIS maintains a domestic pre-departure program in both Puerto Rico and USVI to mitigate the risk of fruit flies.

Puerto Rico's trapping program began in 1979. Currently, the fruit fly surveillance program on these islands is divided into two work units. The trapping array includes 1,897 traps divided among 48 trapping routes. Trapping techniques vary with each working unit.

Surveillance System

Monitoring Of Endemic Species

Endemic fruit flies of economic importance in Puerto Rico are limited to the Caribbean fruit fly (*Anastrepha suspense*) and the West Indian fruit fly (*A. obliqua*).[1] Surveyors use McPhail and Multilure® traps baited with torula yeast (260 and 226 units respectively) to monitor important fruit flies in Puerto Rico. Mango (*Mangifera indica*) and tropical almond (*Terminalia catappa*) are the most common hosts.

A USDA pre-clearance program is used to monitor mango exports from Puerto Rico to the continental United States. Pre-clearance includes the following techniques:

- Installation of traps in orchards to monitor *A. suspensa* and *A. obliqua*
- Cutting of fruit during inspection
- Post-harvest treatment with hot water

A USDA pre-departure program screens passenger baggage moving from Puerto Rico and the USVI to the continental United States. Most interceptions of *A. suspensa* and *A. obliqua* occur in mangoes and guavas.

1 Unimportant endemic species include *A. antillensis* (Norbom), *A. interrupta* (Stone) and *A. maculata* (Norbom).

Detection Of Exotic Species

Exotic fruit flies of quarantine significance in Puerto Rico and the USVI include the following species:

- Mediterranean fruit fly (*Ceratitis capitata)*
- Oriental fruit fly (*Bactrocera dorsalis)*
- Melon fruit fly *(Bactrocera cucurbitae)*
- Mexican fruit fly *(Anastrepha ludens)*
- South American fruit fly *(Anastrepha fraterculus*)

The surveillance program in Puerto Rico and the USVI follows *Trapping Guidelines for Area-wide Fruit Fly Programmes* (IAEA 2003). Seventy per cent of the trap locations have been geo-referenced using GPS units. This information has been entered into a geographical information system.

Frequency of servicing traps and lures varies (Table 4-1). McPhail traps baited with torula yeast are serviced and re-baited every seven days. Multilure® traps baited with Biolure® are serviced every 21 days. Jackson traps baited with trimedlure, methyl eugenol, and cuelure are serviced at 14 day intervals. Traps are relocated four times each year following fruiting of main hosts.

TABLE 4-1:Trapping Systems and Number of Traps Used in Puerto Rico and the U.S. Virgin Islands for Surveillance of Fruit Flies.

Trap	**Multilure®**		**McPhail**	**Jackson**			
Attractant	**Torula yeast**	**Biolure®**	**Torula yeast**	**Trimedlure**	**Cuelure**	**Methyl eugenol**	
Species	*A. ludens* *A. fraterculus*	*C. capitata* *A. ludens*	*A. fraterculus* *A. ludens*	*C. capitata*	*B. cucurbitae*	*B. dorsalis*	**Total**
Unit 1[1]	28 (21)[2]	Varies	192 (7)	354 (14)	131 (14)	345 (14)	28 (21)
Unit 2[3]	198 (21)	Varies	68 (7)	239 (14)	175 (14)	167 (14)	198 (21)
Total	226	N/A[4]	260	593	306	512	226

1 Unit 1 includes 21 trap lines

2 Number in parentheses = Inspection interval

3 Unit 2 includes 27 trap lines

4 N/A = Does not apply

Quality Assurance

Quality assurance was incorporated into the surveillance program and has substantially improved the operation of trapping networks. Supervisors periodically place dyed sterile flies in traps to monitor the accuracy of their technicians.

Training

Trapping personnel receive basic training from the USDA/APHIS/PPQ entomologist stationed at the port.

Emergency Preparedness

A cooperative rapid response plan, in response to detection of an exotic fruit fly, has not been developed for Puerto Rico and the USVI. Florida will contribute some resources to Puerto Rico and the USVI in the event of detection. Nevertheless, coordination of these efforts would be time consuming, and resources available in Florida may be insufficient for a widespread outbreak. Moreover, a USDA-led eradication effort would require authorization of the Commonwealth.

Identification

The identification of specimens captured in detection traps is back-logged. This back-log will impede rapid response to detection of an exotic fruit fly.

Recommendations

1. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies.** Fruit flies of primary concern are the Mediterranean, Mexican, South American, Oriental and melon fruit flies. An emergency response program needs to be built into the surveillance program to be able to respond to an introduction of exotic fruit flies. Introduction and establishment of Mediterranean fruit fly in Puerto Rico and/or the USVI would be of great concern for the continental United States.
2. **Survey for new hosts of endemic fruit flies.** *Spondias* spp. (hog plum, red mombin, etc.) are considered to be the main host of West Indian fruit fly (*A. obliqua*) in Mexico and Central America and are widely spread in Puerto Rico. However, the host status of *Spondias* spp. for *A. obliqua* in Puerto Rico is unknown. This could be determined through implementation of a systematic fruit sampling in the field in areas where *Spondias* spps. are more abundant and where this fruit is associated with mango, the main commercial host of *A. obliqua*. Fruit sampling procedures described in guidelines of large-scale operational programs such as the Moscamed Program in Guatemala and Mexico should be followed. Assessment of the host status could be important for effective control of this species in the islands and for quarantine purposes.
3. **To ensure rapid identification of fruit fly specimens, devote resources to training and assign additional personnel to identification facilities.**

5 South Carolina

Fruit Fly Surveillance Program

Background

The program aims to avoid establishment of the Mediterranean fruit fly. Adult Mediterranean fruit flies have not been detected in South Carolina. Recognized established fruit fly species (*A. suspensa*, *T. curvicauda* and *A. ludens*) are unknown in South Carolina. This may be due to the following conditions:

- Low volume of fruit fly host material entering through Charleston, the state's major port of entry
- Low availability of hosts in port environs
- Seasonal climatic unfavorable to reproduction of economic fruit flies

No cooperative agreements exist between the South Carolina Department of Agriculture and USDA for fruit fly surveillance and emergency response. The Plant Health Safeguarding Specialist responsible for Agriculture Quarantine Inspection and Domestic Program duties at the Port of Charleston traditionally has been assigned collateral duties to survey port environs for Mediterranean fruit fly. This program lacks surveillance for the introduction of other exotic fruit fly pests.

Current Status

South Carolina, in particular the Charleston area, has many visitors each year. The risk of introductions of fruit flies in infested commodities is latent. South Carolina has a minor horticultural industry. Important crops include peaches, bell and chili peppers, tomatoes and melons (**Figure A-4 on page A-5**). In South Carolina's temperate climate, these crops would be threatened by exotic fruit flies.

Species of greatest concern include the Mediterranean fruit fly and the Mexican fruit fly. The following species present a lesser risk for establishment:

- Caribbean fruit fly (*A. suspensa*)
- West Indian fruit fly (*A. obliqua*)

- South American fruit fly (*A. fraterculus*)
- Oriental fruit fly (*B. dorsalis*)
- Melon fly (*B. cucurbitae*)

However, the coastline could provide a favorable climate for the establishment of these species. Establishment of exotic fruit flies in South Carolina would pose a serious threat to neighboring states—in particular Georgia and Florida—since the coastline could serve as a pathway to spread fruit fly populations. Currently the trapping program targets the Mediterranean fruit fly, using Jackson traps baited with trimedlure. Traps are placed around points of entry. Periodic inspections are conducted in the state where ethnic markets exist.

Surveillance System

The South Carolina fruit fly surveillance program is seasonal. USDA/APHIS/PPQ personnel conduct an annual surveillance from April 1 to September 15. Trapping is limited to dooryard hosts within a 3-mile radius of the maritime ports in Charleston County. Jackson traps (45-60 each season) baited with trimedlure are installed at a density of 2-4 traps/mi^2 and serviced every 14 days (Table 5-1). All traps are rebaited and relocated at six week intervals. Trap locations are recorded using GPS equipment to capture placement coordinates.

TABLE 5-1:Trapping Systems and Number of Traps Used in South Carolina For Surveillance of Fruit Flies.

Trap	**Jackson**
Attractant	**Trimedlure**
Species	***C. capitata***
Charleston County	40—60 (14)[1]

1 Number in parentheses = Inspection interval

Quality Assurance

The South Carolina program lacks a quality assurance component.

Training

The South Carolina program lacks a formal training course. Trapping personnel receive basic identification training from the USDA/APHIS/PPQ entomology identifier in Charleston.

Emergency Preparedness

The South Carolina program utilizes the guidelines detailed in *Florida Fruit Fly Detection Manual* (Anonymous 2004) and *Action Plan For Mediterranean Fruit Fly* (Anonymous 1999); however a specific emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi^2.** In rural and residential areas, replacement with Biolure® would enhance sensitivity for *C. capitata* and allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (Table B-1 on page B-2) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the Melon Fly (*B. cucurbitae*), at a density of 1 trap/mi^2.**
3. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi^2 based on assessed risk.**
4. **Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.**
5. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in both exotic fruit fly identification and fruit fly surveillance activities.**
6. **Implement a quality assurance program for all fruit fly surveillance activities.**
7. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies which includes delimitation protocols.**

6 Georgia

Fruit Fly Surveillance Program

Background

Georgia's program aims to avoid establishment of exotic fruit flies. The historical record indicates that economically important fruit flies have not been detected in Georgia. This may be due to the following factors:

- Low volume of fruit fly host material entering through the state's international airport and seaports
- Few hosts available in port environs
- Seasonal climatic conditions unfavorable to establishment

Cooperative agreements between the Georgia Department of Agriculture and USDA have not been written for fruit fly surveillance activities and emergency response. USDA/APHIS/PPQ/Plant Health Safeguarding Specialists (PHSSs) are responsible for agriculture quarantine inspection and Domestic Program duties in the international ports of Atlanta, Brunswick and Savannah. PHSSs traditionally have been assigned collateral duties to survey port environs and the peach belt for exotic fruit flies.

Analysis of historical fruit fly interceptions recorded in Georgia ports indicates the low risk of exotic fruit fly detections surrounding port environs. However, in February 2003, live Tephritids were discovered at the Atlanta Farmers Market in imported Manzano pepper (*Capsicum* spp.). In response, technicians added Multilure® traps to the surveillance program in 2004. Traps placed near the market failed to capture exotic fly flies. Consequently, resources for exotic fruit fly surveillance have remained unchanged.

Host production in Georgia includes peaches, bell peppers, tomatoes, and cantaloupe.

Current Status

Georgia's climate is suitable for introduction and establishment of some exotic fruit fly species during part of the year (Sequeira *et al.* 2001). Mediterranean fruit fly and Mexican fruit fly are most likely to become established. The species are polyphagous and able to survive mild winters with infrequent temperatures below 0° C. Trapping

systems for early detection of these species should be upgraded and or implemented in urban areas and at points of entry along the coast-line.

The following tropical/subtropical species are unlikely to become established:

- Caribbean fruit fly (*A. suspensa*)
- West Indian fruit fly (*A. obliqua*)
- South American fruit fly (*A. fraterculus*)
- Oriental fruit fly (*B. dorsalis*)
- Melon fly (*B. cucurbitae*)

However, the coast-line could provide adequate climatic and host conditions for these species to establish. Establishment of any of these species in Georgia would pose a serious threat to neighboring states, in particular the state of Florida, as the coast-line would be a pathway for spread of fruit fly populations.

Surveillance System

USDA/APHIS/PPQ personnel conduct the program from April to October. The program targets the following species:

- Mediterranean fruit fly (*Ceratitis capitata*)
- Mexican fruit fly (*A. ludens*)
- Oriental fruit fly (*B. dorsalis*)

Technicians place traps within a three-mile radius in two maritime port areas and in host orchards in the peach production areas within the state. Trap locations are recorded using GPS equipment to capture placement coordinates. All traps are serviced every 2-3 weeks and are re-baited every three weeks. Traps are not rotated within the port areas during the season; limited rotation is conducted in host areas. Program personnel place 80 traps within the port and various host production areas in 10 counties as detailed (Table 6-1). Not all 10

production counties are trapped every season for fruit flies with periodic trapping occurring once every three to five years in central and southern Georgia.

TABLE 6-1:Trapping Systems and Number of Traps Used in Georgia For Surveillance of Fruit Flies.

Trap	**Multilure®**	**Jackson**		
Attractant	**Biolure®**	**Trimedlure**	**Methyl Eugenol**	
Species	***A. ludens*** ***C. capitata***	***C. capitata***	***B. dorsalis***	Total
Savannah	5 (14-21)[1]	5 (14-21)	5 (14-21)	15
Brunswick	7 (14-21)	7 (14-21)	6 (14-21)	20
Other host areas	15 (14-21)	15 (14-21)	15 (14-21)	45
Total	**27**	**27**	**26**	**80**

1 Number in parentheses = Inspection interval

Quality Assurance

The Georgia program lacks a quality assurance component.

Training

The Georgia program lacks a formal training course.

Emergency preparedness

The Georgia program utilizes the guidelines detailed in *Florida Fruit Fly Detection Manual* (Anonymous 2004); however, a specific emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi^2.** In rural and residential areas, replacement of TML with Biolure® would enhance sensitivity for *C. capitata* and allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (Table B-1 on page B-2) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the melon fly (*B. cucurbitae*), at a density of 1- 2 traps/mi^2 based on assessed risk.**

3. Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of ***Anastrepha*** complex including Mexican fruit fly (***A. ludens***) and Caribbean fruit fly (***A. suspensa***), at a density of 1- 2 traps/mi^2 based on assessed risk.
4. Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.
5. Fruit fly surveillance staff should be regularly trained, including refresher courses, in both exotic fruit fly identification and fruit fly surveillance activities.
6. Implement a quality assurance program for all fruit fly surveillance activities.
7. Develop a cooperative rapid response plan for detections of wild exotic fruit flies which includes delimitation protocols.

7 Florida

Fruit Fly Surveillance Program

Background

Florida is at great risk for the establishment of exotic fruit flies due to the following conditions:

- Historical record of frequent outbreaks
- High approach rate of fruit fly host material at the major points of entry (by passenger movement and cargo)
- Climate favorable for reproduction of fruit flies
- Public opposition to chemical control measures
- Availability of hosts

The market value of exotic fruit fly host commodities totaled about $1.8 billion in Florida in 2002 (USDA/NASS 2004b).

Since 1997, the Florida program is in full compliance with the guidelines contained in *National Exotic Fruit Fly Trapping Protocol* (USDA/APHIS/PPQ 1991). Resources were increased ten fold in response to a $27 million eradication campaign which was centered in the Tampa area. The infestation generated satellite outbreaks in Florida and threatened fruit and vegetable production.

Technicians use a variety of traps in combination with several attractants to target the species of concern. Trap servicing duties are divided between USDA and Florida Department of Agriculture and Consumer Services officials.

Surveillance and control activities include rapid response to detections, the maintenance of a sterile Mediterranean fruit fly in high risk areas, and other fruit fly control and regulatory actions. This approach is the product of close collaboration and consultation between USDA and Florida's Department of Agriculture and Consumer Services to maintain Florida's fly free status.

Target pests include various species of three economically important genera: *Ceratitis* spp. (primarily Mediterranean fruit fly), *Bactrocera* spp., (Oriental fruit fly, melon fly, guava fruit fly, etc.) and *Anastrepha spp. (*Mexican fruit fly, West Indian fruit fly, etc.*). Anastrepha suspensa* (Caribbean fruit fly) and *Anastrepha suspensa* (Papaya fruit

fly) are established in Florida. An export certification program exists for *Anastrepha suspensa*, which includes trapping protocols that meet bilateral trade requirements.

Current Status

Florida's climate ranges from sub-tropical at the tip of the peninsula, to temperate in the northern peninsula which extends into the panhandle region. The state is divided into risk categories by counties taking into consideration the different climatic zones, socioeconomic data and historical fruit fly introduction information:

- Counties in the southern peninsular risk area are surveyed for exotic fruit flies year-round
- Counties in the northern peninsular and western panhandle risk areas are surveyed for exotic fruit flies on a seasonal basis, including counties north of the commercial citrus producing areas of Florida

In addition, technicians monitor the release of sterile Mediterranean fruit flies in a preventative release program covering 600 square miles in Dade, Manatee, Sarasota, and Hillsborough counties (Table B-1 on page B-2, Table B-2 on page B-3, and Table B-3 on page B-4).

Surveillance System

The objective is to monitor economically important fruit fly pests in the state. Florida is divided into high and moderate risk areas for trapping purposes. The following counties are at high risk:

- Dade
- Broward
- Palm Beach
- Hillsborough
- Orange
- Pinellas
- Manatee
- Sarasota

A Mediterranean fruit fly preventative release program is conducted in Dade, Manatee, Sarasota, and Hillsborough counties.

The following counties are at moderate risk:

- Other counties conducting year-round trapping
- Seasonal trapping areas March—November (counties north of Gainesville and west across the Panhandle)

An array of trap types is placed in both high and moderate risk areas to survey the species of major concern (Table B-1 on page B-2, Table B-2 on page B-3, and Table B-3 on page B-4). Technicians service traps every three weeks. Trap types and attractants vary among species. Improved female bias synthetic attractants have been recently developed for some of the main fruit fly species of economic importance. However, for some species no synthetic attractants have yet been developed.

Delimitation Activities

The detection of any target fruit fly species triggers a specified emergency action which initiates placement of additional trapping devices to delimit the extent of the fruit fly presence. The actions differ between the various species of the target pest. A core area is determined and a delimitation trapping grid is placed around the area of the find. The size of the trapping area is detailed in the Emergency Action Plans (Anonymous 1997, 1999, 2000a, 2000b, 2000c, 2004a). Traps are serviced the next day after placement. All traps are then checked daily for seven days. After seven days of negative survey the traps are serviced weekly. If no additional flies are found, surveillance activity reverts to routine detection trapping. In case of additional fly captures a pre-defined eradication action will follow.

Quality Assurance

The Florida program includes the following features:

- Both USDA and the State of Florida dedicate staff resources to fruit fly quality assurance
- All trap specialists receive a procedural review quarterly
- Quality control dyed flies are placed in traps of every specialist each quarter
- All fruit fly work units are reviewed by the state and federal coordinators annually

Training

New employees receive orientation training for overall trapping procedures and fruit fly identification. All fruit fly personnel are required to complete a refresher fruit fly ID training course annually. The State Taxonomic Specialist for Tephritidae and the entomologist in charge of the fruit fly Identification Laboratory in Palmetto conduct all ID training.

Emergency Response

The Florida program utilizes the guidelines detailed in *Florida Fruit Fly Detection Manual* (Anonymous 2004).

Recommendations

1. **Change the risk category for urban/suburban areas of Florida from risk category 2 to risk category 1 and consequently downgrade points of entry from risk category 1 to risk category 2.**

   The following factors were considered in this recommendation:

   - Fruit hosts that are carried to points of entry by international trade, tourism and population migration are either confiscated and properly disposed of or smuggled away from the port of entry into populated areas
   - Commercial shipments of fruit hosts are pre-cleared at origin and/or statistically sampled at points of entry and safeguarded in case of interceptions of immature stages of fruit fly pests
   - The majority of fruit fly detections in Florida occur at private homes in residential areas
   - Within the past 15 years no fruit fly adult detections have occurred in points of entry

2. **For Mediterranean fruit fly detection, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 2 to 5 traps per square mile (depending on risk criteria as described in 4.3) as proposed in** **Table B-1 on page B-2**, **Table B-2 on page B-3**, and **Table B-3 on page B-4****.** Early detection is essential to prevent outbreaks of fruit flies. In the case of Mediterranean fruit fly, scientific evidence indicates that the female biased Biolure® detects populations at lower levels from 4 to 6 weeks earlier than the male specific trimedlure (IAEA 1999, Miranda *et al.* 2001, Montoya *et al.* 2002). Furthermore, data from large-scale operational programs in various countries supports that trimedlure-baited Jackson traps should be replaced by Biolure® baited Multilure® traps. Replacement of trimedlure traps by Biolure® traps would not only enhance the sensitivity of the trapping system for Mediterranean fruit fly, but would also allow for detection of other quarantine species such as natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (IAEA 2006 *in press*).

3. **Reduce the number of MLT/Biolure® – JT/TML traps from 5:1 to a density of ca. 3:1/mi² in Preventative Release Program (PRP) areas (Table B-1 on page B-2).** Multilure® traps baited with Biolure® are more sensitive than JT baited with TML for detection survey. The need for 5 MLT traps as a detection system in PRP areas should be revised. A density of 3 traps per square mile is sufficient. PRP areas are protected by a continuous high-density blanket release of sterile male flies. Fertile females will have a reduced chance of reproduction given the high density of sterile males in the PRP areas. This has been demonstrated by the history of fly detections and outbreaks since implementation of the PRP in Florida. Resources saved from reducing trap density in these areas could then be used to increase trapping densities in other high-risk areas which are not under PRP releases. Resource savings could also be used to reduce the trap service intervals from 21 to 14 days in areas where lack of resources result in inspections below the recommended rate. Another possibility would be to use the resources for including trapping systems which target *Anastrepha* spp. of economic significance.

4. **Change the current bait used for the detection of Mexican fruit fly from Biolure® (three component lure – 3 C) to the 2 component synthetic food lure at a density of 3 - 5 traps per mi² based on assessed risk.** Florida is subjected to introductions of a number of *Anastrepha* spp. considered to be of quarantine significance:

   - Mexican fruit fly (*A. ludens*)
   - West Indian fruit fly (*A. obliqua*)
   - Sapote fruit fly (*A. serpentina*)
   - Guava fruit fly (*A. striata*)
   - South American fruit fly (*A. fraterculus*)

   Currently, there is no specific trapping system in place for the detection of these species in Florida. A McPhail/torula yeast trapping network is in place; however, it is aimed at monitoring the Caribbean fruit fly (*A. suspensa*), which is established in Florida. The first three species are known to respond to the Mediterranean fruit fly female biased lure (Biolure®). However, compared with the conventional torula yeast or hydrolyzed proteins, the response is weak. Moreover, it has been demonstrated that *A. ludens*, A *serpentina*, and *A. obliqua* respond significantly better to the recommended two component synthetic food lure (ammonium acetate and putrescine) (Heath, *et al.* 2004, IAEA 2006 *in press*). These lures have been extensively tested and recommended in *Trapping Guidelines for Area-wide Fruit Fly Programmes* (IAEA 2003). In the case of *A.*

striata and *A. fraterculus*, no response to the Biolure® or to the two component lure has been observed, thus the conventional food lures are still the best available option (IAEA 2006 *in press*).

5. **Study the possibility of using statistical sampling procedures to process sterile males captured in JT/TML deployed in a PRP area.** If a female biased detection trapping system is implemented, TML baited JT would be used for monitoring of sterile male flies. This would save substantial amount of staff resources which could be assigned to other activities of the surveillance program.
6. **The trap inspection rate should be reduced from 21 days to 14 days in areas considered to be high risk based on historical detections and following recommendations of USDA and international trapping protocols (IAEA 2003).** From a biological point of view, a 21 day interval is not acceptable since it could allow an introduced fruit fly population to reproduce. If resources are a constraint, in areas of lower risk inspection rates extended to 21 days could be considered.
7. **Include in the current reporting protocol for the sterile insect release drop zone, calculations regarding the recapture rates of sterile insects.** This information would be useful to estimate the number of sterile insects to identify at the laboratory.
8. **Extend rebaiting of MLT/Biolure® traps for more than six weeks. Currently the rebaiting frequency of the Biolure® is once every 42 days (6 weeks).** This frequency could probably be extended for additional weeks but field validation would be required. Extending the rebaiting interval would bring substantial savings to the program.

8 Alabama

Fruit Fly Surveillance Program

Background

The fruit fly surveillance program aims to avoid establishment of the Mediterranean fruit fly. The historical records for Alabama's program indicate the absence of detections of this pest. Endemic species of economically important fruit flies are not known to occur in Alabama. This may be due to the following factors:

- Low volume of commercial fruit fly host material entering through Mobile, the state's major point of entry
- Low availability of hosts in port environs
- Seasonal climatic conditions unfavorable to establishing reproducing populations of economic fruit flies

Current Status

The production of commercial fruit fly host commodities in Alabama is limited. However, an important factor to consider is the geographical location of Alabama between the East/West corridor of Florida and Texas, both recognized for the presence of economic fruit flies and for their susceptibility to fruit fly introductions.

At present, no cooperative agreements between the Alabama Department of Agriculture and USDA have been written for fruit fly surveillance activities and emergency response. The USDA/APHIS/PPQ/Plant Health Safeguarding Specialist responsible for Agriculture Quarantine Inspection and Domestic Program duties in the Port of Mobile traditionally has been assigned collateral duties to survey port environs for exotic fruit flies.

Surveillance System

Alabama has a seasonal program conducted annually by USDA/APHIS/PPQ personnel from April to October. The program targets Mediterranean fruit fly. Jackson traps baited with trimedlure are placed within the maritime port environs of Mobile and Baldwin Counties (Table 8-1). These traps are serviced every two weeks and rebaited at six week intervals. Trap locations are recorded using GPS

equipment to capture placement coordinates. Trap rotation is limited within the port and host trapping areas. The Alabama program does not utilize state personnel through a cooperative agreement. However, an agreement with the Florida Fruit Fly Cooperative Program to trap the northwestern Florida counties of Escambia and Santa Rosa by USDA/APHIS personnel stationed in Alabama is being developed.

TABLE 8-1:Trapping Systems and Number of Traps Used in Alabama for Surveillance of Fruit Flies.

Trap	**Jackson**
Attractant	**Trimedlure**
Species	***C. capitata***
Mobile	22 (14)[1]
Baldwin	20 (14)
Total	**42**

1 Number in parentheses = Inspection interval

Introduction and establishment of some of the most important exotic fruit flies in the coastal areas of Alabama such as the Mediterranean fruit fly and the Mexican fruit fly is feasible given the favorable climate and availability of hosts (Figure A-6 on page A-7, Figure A-7 on page A-7, and Figure A-8 on page A-8).

Quality Assurance

The Alabama program lacks a quality assurance component.

Training

The Alabama program lacks a formal training course. Surveillance personnel are scheduled to attend the annual training course conducted by Florida DPI.

Emergency Preparedness

The Alabama program utilizes the guidelines detailed in *Florida Fruit Fly Detection Manual* (Anonymous 2004). A specific emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi^2.** For detection in rural and residential areas replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for *C. capitata* but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (Table B-1 on page B-2)(IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the melon fly (*B. cucurbitae*), at a density of 1-2 traps/mi^2 based on assessed risk** (Table B-1 on page B-2).
3. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi^2 based on assessed risk.**
4. **Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.**
5. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in both exotic fruit fly identification and fruit fly surveillance activities.**
6. **Implement a quality assurance program for all fruit fly surveillance activities.**
7. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies. This should include delimitation protocols.**

9 Mississippi

Fruit Fly Surveillance Program

Background

Mississippi's surveillance program aims to avoid establishment of exotic fruit flies. The historical records for Mississippi's program indicate the absence of adult detections of economically important fruit flies. This may be due to the following factors:

- Low volume of commercial fruit fly host material entering through Gulfport, the state's major point of entry
- Low availability of hosts in port environs
- Seasonal climatic conditions unfavorable to establishing reproducing populations of economic fruit flies

There is no production of commercial fruit fly host commodities in Mississippi.

Current Status

No cooperative agreements between the Mississippi Department of Agriculture and USDA have been written for fruit fly surveillance and emergency response. The USDA/APHIS/PPQ/Plant Health Safeguarding Specialists responsible for Agriculture Quarantine Inspection and Domestic Program duties in Gulfport traditionally has been assigned collateral duties to survey port environs for exotic fruit flies.

Surveillance System

Mississippi has a seasonal program conducted annually by USDA/APHIS/PPQ personnel from May to September. The program targets Mediterranean fruit fly, Mexican fruit fly and Oriental fruit fly. Two hundred ten traps are placed within a 3-mile radius of the maritime ports in three coastal counties: Hancock, Jackson and Harrison (Table 9-1). Traps are placed in the port areas approximately 100 yards apart and serviced and rebaited every two to three weeks. Trap

locations are recorded using GPS equipment to capture placement coordinates. Traps are not rotated within the port area during the season.

TABLE 9-1:Trapping Systems and Number of Traps Used in Mississippi For Surveillance of Fruit Flies.

Trap	**McPhail**	**Jackson**		
Attractant	**Torula yeast**	**Trimedlure**	**Methyl eugenol**	
Species	***A. ludens***	***C. capitata***	***B. dorsalis***	**Total**
Hancock County	2 (14-21)[1]	2 (14-21)	2 (14-21)	6
Jackson County	2 (14-21)	50 (14-21)	50 (14-21)	102
Harrison County	2 (14-21)	50 (14-21)	50 (14-21)	102
Total	**6**	**102**	**102**	**210**

1 Number in parentheses = Inspection interval

Quality Assurance

The Mississippi program lacks a quality assurance component. The Program Supervisor has scheduled three field reviews with trapping personnel in 2006. The reviews involve inspection of trap lines and trapping records.

Training

The Mississippi program lacks a formal training course. Surveillance personnel receive basic fruit fly instruction through USDA/APHIS/ Plant Protection and Quarantine Officer training and by reviewing reference materials.

Emergency preparedness

The Florida program utilizes the guidelines detailed in *Florida Fruit Fly Detection Manual* (Anonymous 2004) and *National Exotic Fruit Fly Trapping Protocol* (USDA/APHIS/PPQ 1991); however a specific emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi².** For detection in rural and residential areas replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for *C. capitata* but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly *Dacus ciliatus* (Table B-1 on page B-2) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the Melon Fly (*B. cucurbitae*), at a density of 1-2 traps/mi² based on assessed risk.**
3. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi² based on assessed risk.**
4. **Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.**
5. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in both exotic fruit fly identification and fruit fly surveillance activities.**
6. **Implement a quality assurance program for all fruit fly surveillance activities.**
7. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies which includes delimitation protocols.**

10 Louisiana

Fruit Fly Surveillance Program

Background

Louisiana's surveillance program aims to avoid establishment of exotic fruit flies. The historical records for Louisiana's program indicate the absence of adult detections of economically important fruit flies. This may be due to the following factors:

- Low volume of fruit fly host material entering through New Orleans, the state's major port of entry
- Low availability of hosts in port environs
- Minor production of commercial citrus fruit and other vegetables in southern Louisiana
- Seasonal climatic conditions unfavorable to establishing reproducing populations of economic fruit flies

Current Status

No cooperative agreements between the Louisiana Department of Agriculture and USDA have been written for fruit fly surveillance activities and emergency response. USDA/APHIS/PPQ hires seasonal personnel to support Plant Health Safeguarding Specialists responsible for Agriculture Quarantine Inspection and Domestic Program duties in Louisiana. Seasonal personnel are assigned collateral duties for fruit fly surveillance.

Trapping is limited to dooryard hosts surrounding port environs, commercial citrus, and other hosts near selected markets scattered throughout parishes in the southern third of the state. Target fruit flies include the following species:

- Mexican fruit fly (*Anastrepha ludens*)
- Mediterranean fruit fly (*Ceratitis capitata*)
- Oriental and melon fruit fly (*Bactrocera* spp.)

Surveys for the introduction of exotic fruit fly pests have been performed in some northern parishes.

Analysis of historical fruit fly interceptions recorded in Louisiana's ports indicates the low risk of exotic fruit fly finds surrounding port environs. However, in January, 2002, live Tephritids were discovered at a retail chain store in imported Clementine fruits (*Citrus* spp). In response, surveillance of dooryard hosts was enhanced near the market with negative results. Resources for exotic fruit fly surveillance have remained unchanged and have not expanded as a result of the interception.

Surveillance System

Fruit fly surveillance is primarily conducted in the southern half of Louisiana, targeting exotic fruit flies of the genera *Anastrepha*, *Bactrocera* and *Ceratitis*. In southern Louisiana, 1,308 acres of commercial citrus are grown. Adult exotic fruit flies have never been detected in Louisiana. Jackson/trimedlure traps are deployed year-round to survey for *Ceratitis* spp. Jackson/methyl eugenol traps and Jackson/cuelure traps are deployed year-round to survey for certain *Bactrocera* spp. Plastic McPhail/torula yeast traps are deployed seasonally from April through November to survey for *Anastrepha* spp. (Table 10-1).

TABLE 10-1:Trapping Systems and Number of Traps Used in Louisiana For Surveillance of Fruit Flies.

Trap	**McPhail**	**Jackson**			
Attractant	**Torula yeast**	**Trimedlure**	**Cuelure**	**Methyl eugenol**	
Species	***A. ludens***	***C. capitata***	***B. cucurbitae***	***B. dorsalis***	**Total**
Southern Louisiana	131 (14)[1]	556 (14)	119 (14)	168 (14)	974

1 Number in parentheses = Inspection interval

Quality Assurance

The Louisiana quality assurance program consists of placing dyed *Anastrepha* spp. in Jackson traps to evaluate the abilities of the trappers to detect Tephritid flies in their traps.

Training

The Louisiana program lacks a formal training course. Surveillance personnel receive basic identification training from experienced USDA/APHIS/PPQ employees within the state.

Emergency Preparedness

The Louisiana program utilizes *National Exotic Fruit Fly Trapping Protocol* (USDA/APHIS/PPQ 1991), *Action Plan For Mediterranean Fruit Fly* (Anonymous 1999) and *Florida Fruit Fly Detection Manual* (Anonymous. 2004b). However, a specific fruit fly emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi².** For detection in rural and residential areas, replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for *C. capitata* but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (Table B-1 on page B-2) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the melon fly (*B. cucurbitae*), at a density of 1-2 traps/mi² based on assessed risk.**
3. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi2 based on assessed risk.**
4. **Continue trapping year-round for *A. ludens*.** Historical trapping data in neighboring Texas shows that detections of A. ludens increases in the winter months and decreases in the summer months.
5. **Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.**
6. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in exotic fruit fly identification, fruit fly rapid response and fruit fly surveillance activities.**
7. **Incorporate trap rotation into the fruit fly surveillance program.** Trap rotation allows for more effective population sampling as a greater number of sites within the trapping area are sampled. The basic criteria for trap rotation should follow the fruiting phenology of the main host commodities.
8. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies.**

11 Texas

Fruit Fly Surveillance Program

Background

With a surface area of 267,275 mi², Texas is the second largest state in the United States. Its elevation varies from sea level to 8,759 feet above sea level. Texas has a semitropical climate in the Lower Rio Grande Valley (LRGV) and is semiarid in the southwest and the panhandle regions. The LRGV, located adjacent to Mexico in the south, is a flat desert river delta receiving an average rainfall less than 24 inches annually. Hot summer temperatures exceeding 100° F and winter temperatures averaging 70° F are common. Texas is the largest gateway to the United States from Mexico, processing thousands of passengers through six border points of entry along the Rio Grande Valley.

Texas is one of the highest risk states for the introduction and establishment of exotic fruit flies. Since commercial citrus production in the LRGV began in the early 1900s, Mexican fruit fly (*Anastrepha ludens*) has been detected frequently. Although the Texas citrus industry does not suffer significant losses from the presence of Mexican fruit fly, costly treatments were imposed by a USDA regulatory quarantine designed to restrict interstate movement of fruit, and reduce the threat of this pest posed to other citrus producing states. The state's multifaceted program to combat Mexican fruit fly and other exotic fruit fly pests is composed of surveillance, control, and sterile fly release operations.

The Mexican fruit fly program in Texas is a cooperative program. USDA and the Texas Department of Agriculture (TDA) share responsibilities for conducting a suppression/management objective with emphasis on suppression rather than eradication. The focus is on biologically sound measures to facilitate the certification of commercial shipments of citrus from the affected areas. Out of the 254 counties in the state, only three in the southern border with Mexico are part of the Mexican fruit fly cooperative program. Within these counties, a total area of 780 mi^2 is actually being surveyed.

Texas faces major challenges to limit the reinfestation rate and control of economically important fruit flies, in particular in the southern half of the state. These challenges include:

- Increased trade with Mexico
- Commercial production of fruits and vegetables within the state
- Seasonal climatic conditions
- High volumes of international visitors through the border points of entry
- Existing populations of *A. ludens* in areas of Mexico adjacent to the Texas

Host fruits with Tephritid larvae historically have been intercepted from passengers and cargo, indicating the continual threat of the introduction of exotic fruit flies. The 2002 market value of Mediterranean fruit fly host material produced in Texas was $60.47 million.

To further reduce the risk to other states and to find alternatives to fumigation of fruit with ethylene dibromide, an SIT pilot project for suppressing feral Mediterranean fruit fly population in the LRGV was conducted during 1981-1984. Based upon the encouraging results of the pilot project, the a full scale LRGV-wide aerial releases of sterile Mexican fruit fly was initiated and has been in operation since 1984, resulting in the movement of untreated citrus from the regulated areas to citrus producing states and the decrease of the use of malathion bait sprays. The USDA, TDA and the Texas citrus industry share the cost of Mexican fruit fly production and aerial release.

A protocol based on trapping numbers of feral Mexican fruit fly, which has been modified numerous times since its inception in 1981, regulates the shipment of citrus out of Texas. Regular detections of wild Mexican fruit fly each season normally reach the regulatory action trigger which initiates treatment requirements to allow certification of consignments of host commodities moving out of the regulated area.

The following factors hamper the Mexican fruit fly suppression efforts in the LRGV:

- Increased conversion of commercial host production areas, especially citrus, to residential areas in the LRGV thereby increasing the availability of unmanaged host material
- Increase of infested fruit approaching the LRGV from southern Mexico
- Limited funding of the overall program

A technical panel convened in 1999 and 2000 to propose to convert the current suppression program into an area wide "elimination" program, including all residential areas, with the goal of establishing a fly-free area. Program adjustments were made to adopt this recommendation.

Current Status

The majority of the fruit fly surveillance activity is conducted in an area that comprises three counties of the LRGV. These areas are subdivided into five production zones. Within this region, the commercial production of citrus includes 28,000 acres. Seventy percent is in grapefruit and the remaining 30% is in orange production.

Some detection traps are also deployed near the Mexican land border Port of Laredo and the international seaports of Houston and Corpus Christi.

To conduct these activities, the USDA employs 18 permanent personnel for fruit fly surveillance activities and operates on a total budget of approximately $2.4 million for all fruit fly activities in the LRGV. The majority of these USDA allocated monies is spent on sterile Mexican fruit fly production and release.

The TDA program employs 13 permanent personnel and operates on approximate annual budget of $350,000. TDA employees conduct 95% of the trapping activities including the placement and servicing of the 4,760 traps used on the program. The USDA personnel perform the identification, quality assurance, training, treatments and certification activities.

Surveillance System

Monitoring Program

Three counties are considered infested by Mexican fruit fly. In these areas, monitoring traps are deployed at a density of 5 traps/mi^2. All traps are serviced weekly and remain in the field year-round. All trap sites have been located using a global positioning system (GPS). These monitoring traps are utilized under a systems approach concept, which along with sterile insect release and chemical control, facilitate the trade of citrus from the three infested counties. This trade is both interstate and international.

Detection Program

The majority of the fruit fly surveillance is conducted in the LRGV. This also includes detection survey activities. The LRGV area contains several points of entry into the United States from Mexico. McPhail traps baited with torula yeast, as a food attractant, are deployed as monitoring traps for Mexican fruit fly and provide for general detection of all exotic fruit flies. Jackson traps baited with trimedlure are deployed for the specific detection of *Ceratitis* spp. Jackson traps with methyl eugenol, as well as Jackson traps with cuelure, are deployed for the specific detection of species of *Bactrocera* spp. (Table 11-1). Detection traps are also deployed near points of entry into Texas outside of the LRGV including Laredo, Houston, and Corpus Christi. Detection traps in Corpus Christi are deployed surrounding a cold treatment facility and at ethnic markets. The cost of having this fruit fly surveillance program in operation is of $1.52 million per year.

TABLE 11-1:Trapping Systems and Number of Traps Used in Texas For Surveillance of Fruit Flies.

Trap	**McPhail[1]**	**Jackson[2]**			
Attractant	**Torula yeast**	**Trimedlure**	**Cuelure**	**Methyl eugenol**	
Species	***A. ludens***	***C. capitata***	***B. cucurbitae***	***B. dorsalis***	**Total**
Hidalgo, Willacy and Cameron Counties[3]	1,894 (7)[4]	1,965 (7)	398 (7)	400 (7)	4657
Laredo	90 (7)				90
Houston	6	15	2		23
Total	**1990**	**1980**	**400**	**400**	**4770**

1 McPhail traps are re-baited weekly

2 Jackson traps are re-baited at 6-week intervals

3 Includes production and residential areas

4 Number in parentheses = Inspection interval

Quality Assurance

The Texas system includes a multi-facet quality assurance program to validate its integrity. Surveillance includes regular quarterly checks of traps serviced, supervisors accompanying trappers during servicing and the placement of dyed flies in traps unknown to trappers to test the surveillance and identification systems.

Training

Members of the identification staff train fruit fly trappers to identify and submit all Tephritid flies and specimens with similar wing characteristics. Refresher training is given annually.

Emergency Preparedness

Any detections of wild Mexican fruit fly in the LRGV are handled according to the appropriate provisions of the *Texas Rio Grande Valley, Mexican fruit fly (Anastrepha ludens) Protocol 2003-(4)/2004 (5)* which provides for a delimitation surveillance and, if appropriate, control measures. Delimitation surveillance of any wild Mexican fruit fly detection is accomplished within a few days. If a specimen of any other *Anastrepha* spp. is detected then *Action Plan For Caribbean Fruit Fly* (Anonymous 2000a) will be utilized. The state of Texas lacks an emergency response action plan for *Bactrocera* spp. If a *Ceratitis* spp. is detected then *Action Plan For Mediterranean Fruit Fly* (Anon. 1999) will be utilized.

Recommendations

1. **Replace McPhail traps baited with torula yeast by MLT baited with the 2 Component Lure (AA + PT) in all areas subjected to trapping for monitoring and detection including PRP areas.** For detection survey trap density should be kept at 3-5/mi^2 based on assessed risk. Two component baited MLT traps would increase the sensitivity of trapping systems and would substantially reduce captures of non target species (Thomas 2003). Apart from Mexican fruit fly (*A. ludens*), this trapping system would also detect the Caribbean fruit fly (*A. suspensa*) and other *Anastrepha* species such as the Sapote fruit fly (*A. serpentina*) and the West Indian fruit fly (*A. obliqua*). (Thomas *et al.* 2001, Heath *et al.* 2004, IAEA 2006 *in press*).
2. **Reduce trap densities in PRP area from 5 McPhail/torula yeast/mi^2 to 3 MLT/2 C/mi^2.** PRP areas are protected by a continuous release of sterile male flies. Any introduction of a fertile adult female fly would be in an area with sterile flies. Thus chances for a fertile mating would be very low as demonstrated by the history of fly detections and outbreaks since implementation of the PRP in Texas. In addition, MLT traps baited with 2 C are more sensitive and selective than McPhail traps baited with torula yeast. Resources saved from reducing trap density in these areas could then be used to increase trapping densities in other higher risk areas such as ethnic markets and back yard hosts in urban areas (Table B-4 on page B-5).
3. **Adjust trap densities for JT/ME and JT/CUE to those suggested in Table B-4 on page B-5.** Modify the emphasis of trap densities from higher densities at points of entry to higher densities at ethnic markets and populated areas including those areas around the points of entry (**See "Recommendations" on page -26**).

4. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi².** For detection in rural and residential areas see Table B-4 on page B-5). Replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for Mediterranean fruit fly but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon Fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fruit fly (*Dacus ciliatus*) (IAEA 2006 *in press*).
5. **Study the possibility of using statistical sampling procedures to process sterile flies captured in McPhail traps deployed in a PRP area.** Consider the possibility of processing only a fraction of total captured sterile flies utilizing a statistical sampling. In particular, during the period where it is known that no wild flies will be available. This would save substantial amount of staff resources which could be assigned to other activities of the surveillance program.
6. **Survey for new hosts of endemic flies. Fruit of primary dooryard hosts should be systematically sampled following procedures described in guidelines of large-scale operational programs such as the Moscamed Program in Guatemala and Mexico.** This would allow assessment of host sequence and dispersion patterns of *A. ludens* and other less important *Anastrepha* spp. in the LRGV, which are basic elements for designing an effective control strategy.
7. **Trap rotation should be incorporated into the surveillance program.** Rotating traps allows for more effective fruit fly population detection as a greater number of sites within the trapping area are sampled. The basic criteria for trap rotation should be fruiting phenology of main fruit hosts.
8. **Conduct research to determine the host status of grapefruit and oranges with respect to *Anastrepha serpentina*.** In the last few years detections of West Indian fruit fly (*A. obliqua*) and Sapote fruit fly (*A. serpentina*) have increased. This could be a result of the increased trapping in marginal areas outside the commercial citrus orchards and/or an increase in untreated fruit entering through international border points. Given the host specificity of these two species and taking into consideration the lack of primary cultivated hosts (i.e. mango, mombin [*Spondias* sp.], and sapote fruit) of these species in Texas, the likelihood of establishment is low. Coma Real (*Bumelia lactevirens*), a plant taxonomically related to the Sapotacea family, is known to be a wild host of *A. serpentina*. This host grows throughout subhumid and arid environments. The presence of this host in Texas should be assessed, and if present, fruit sampling should be conducted to determine host status for *A. serpentina*.

9. **Harmonize a geographic information system including fruit fly trap locations in the entire LRGV.** Effective control of the Mexican fruit fly (*A. ludens*) in Texas and in the Mexican states of Nuevo Leon and Tamaulipas requires a regional approach. Trapping criteria in the region should be harmonized with Mexico. A common regional GIS information management system for trapping networks should be developed and implemented in these areas.
10. **Evaluate the need to initiate a detection program for the Walnut Husk Fly.** The Walnut Husk Fly (*Rhagoletis completa*) is present in other parts of the United States and is considered to be an economic pest of husk nuts. States that have a strong pecan industry such as Texas should be aware of the possibility of introduction of this pest and should consider implementing a surveillance program based on traps baited with ammonium acetate for detection of both males and females.

12 New Mexico

Fruit Fly Surveillance Program

Background

With a surface area of 121,597 mi² New Mexico is the second largest state in the United States. Elevation ranges from 2,800 feet in the southeast to 13,100 feet in the north. Its climatic conditions range from an annual mean temperature of 64° F in the extreme southeast to 40° F or lower in high mountains and valleys of the north. Average annual precipitation ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan Valleys to more than 20 inches at higher elevations. Average relative humidity is lower in the valleys but higher in the mountains. Relative humidity ranges from an average of near 65% at sunrise to near 30% in mid afternoon; however, afternoons in warmer months are often less than 20%.

This range of climatic conditions allows the production of different species of fruits and vegetables. In 2003 the market value of fruit fly host materials produced in New Mexico include $5 million for apples, $41.08 million for peppers and $70.4 million for pecans. Other host commodities produced included apricots, grapes, peaches, pears, melons and tomatoes (USDA/NASS 2003b).

The surveillance program aims to avoid establishment of exotic fruit flies in its territory, as well as to exclude the possibility of being a transit corridor for infestations to its bordering states. The major species of interest are Mexican fruit fly and Mediterranean fruit fly.

Historical records for New Mexico's program indicate the absence of detections of these and other economically important fruit flies. This may be influenced by the following factors:

- Low volume of fruit fly host material entering through the state´s Mexico—United States border checkpoints
- Low availability of hosts in border environs
- Relatively low production of commercial fruits and other vegetables in New Mexico's desert
- Seasonal climatic conditions unfavorable to establishing reproducing populations of economic fruit flies

However, a characteristic worth considering is its geographical location with Mexico adjacent to the south, and the East/West corridor of Texas and California, both recognized for the presence of economic fruit flies and for their susceptibility to fruit fly introductions.

No cooperative agreements between the New Mexico Department of Agriculture and USDA have been written for fruit fly surveillance activities and emergency response. USDA/APHIS/PPQ hires seasonal personnel to support Plant Health Safeguarding Specialists responsible for Agriculture Quarantine Inspection and Domestic Program duties throughout the state.

Available hosts for trapping are limited to the Chihuahuan Desert ecozone surrounding border points, commercial fruit and vegetable production areas, and near selected truck routes from Mexico. Surveys for the introduction of exotic fruit fly pests have been conducted in limited areas in June and July. Analysis of historical fruit fly interceptions indicates a low approach rate of fruit flies toward points of entry into New Mexico.

Current Status

New Mexico's fruit fly surveillance program is a seasonal program primarily targeting Mediterranean fruit fly. USDA/APHIS employs temporary staff to perform trapping activities in June and July along the state's highways. New Mexico's commercial chili pepper production is an economically important crop covering approximately 15,000 acres with an estimated market value at $38 million.

Renewed interest for expanding the surveillance program has focused on an awareness of the importance of early detection of exotic fruit flies, and on prevention of their establishment in the commercial fruit and vegetable production counties. A large chili pepper crop is produced in the southern region of the state (Hidalgo, Luna, Doña Ana, Otero, Eddy, Lea, Chaves and Sierra counties) and apples are produced in the northern region (San Juan, Sandoval and Rio Arriba counties).

The phenological relationship between climatic conditions and host availability is not conducive for the establishment of *Anastrepha* spp. in New Mexico. However, due to the types of crops being produced as hosts for Mediterranean fruit fly and the Walnut husk fly (*Rhagoletis completa*) an infestation would be of concern due to the pecan production in the southern counties of Sierra, Eddy, Chaves, Otero and Doña Ana.

Surveillance System

The surveillance program deploys Jackson traps baited with trimedlure, and Multilure® traps baited with Biolure®, along transit corridors in the southern portion of the state. Jackson traps are dispersed at a rate of 1 trap/3 linear miles. Multilure® traps are located at points of entry into New Mexico and at inland control points along major highways (Table 12-1).

TABLE 12-1:Trapping Systems and Number of Traps Used in New Mexico For Surveillance of Fruit Flies.

Trap	Multilure®	Jackson	
Attractant	Biolure®	Trimedlure	
Species	*A. ludens* *C. capitata*	*C. capitata*	Total
Southern New Mexico[1]	11[2]	75 (14)[3,4]	86

1 Traps are installed along transit corridors in the southern portion of the state

2 Multilure®traps are located at points of entry into New Mexico and at inland control points along major highways

3 Number in parentheses = Inspection interval

4 Jackson traps are dispersed at a rate of 1 trap per every 3 linear miles

Quality Assurance

The New Mexico program lacks a quality assurance program.

Personnel Training

The New Mexico program lacks a formal fruit fly identification training program. Surveillance personal receive identification training from a PPQ entomologist identifier.

Rapid Response and Emergency Preparedness

The New Mexico program utilizes *National Exotic Fruit Fly Trapping Protocol* (USDA/APHIS/PPQ 1991) and *Action Plan For Mediterranean Fruit Fly* (Anon. 1999). However, a specific fruit fly emergency action plan for the state has not been developed.

Recommendations

1. **For Mediterranean fruit fly detection in urban and points of entry, replace the current array of JT/TML with MLT/ Biolure®: JT/TML using 5 traps/mi^2 and a ratio of 4:1.** For detection in rural and residential areas (Table B-1 on page B-2). Replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for *C. capitata* but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon Fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit Fly (*Dacus ciliatus*) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and the Melon Fly (*B. cucurbitae*), at a density of 1-2 traps/mi^2 based on assessed risk.**
3. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi^2 based on assessed risk.**
4. **Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.**
5. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in exotic fruit fly identification, fruit fly rapid response and fruit fly surveillance activities.**
6. **Implement a quality assurance program for all fruit fly surveillance activities.**
7. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies.**
8. **Validate the possibility of extending the rebaiting frequency of TML and Biolure® traps to once every 4 to 6 weeks or more.** Extending the rebaiting interval would bring savings to the program.
9. **Establish a detection program for the walnut husk fly (*Rhagoletis completa*) using ammonium acetate as a lure.** The walnut husk fly is present in other parts of the United States and is considered a pest of husk nuts. States that have a strong pecan industry should be aware of the possibility of the introduction of this pest and should consider implementing a surveillance program for this pest.

13 Arizona

Fruit Fly Surveillance Program

Background

The state of Arizona covers an area of 113,909 mi^2. Its climate shows little variation throughout the year, from hot summer temperatures exceeding 100° F to winter temperatures averaging 70° F. Under these conditions, the state has a significant production of fruit fly hosts. Arizona's host crop value from orange, grapefruit, lemon, grape and chili pepper production reached $57 million for export shipments in 2002.

Arizona's fruit fly surveillance program aims to deploy the best techniques for discovering the presence of exotic fruit fly species before they become established. Arizona contains the largest point of entry for commercial shipments of produce from Mexico into the United States. Host fruits with Tephritid larvae have historically been intercepted from passengers and cargo at the state's international border points of entry posing a continual threat for the introduction of exotic fruit flies. Thousands of international visitors enter daily through three major Mexican border points of entry at Nogales, Douglas, and San Luis.

An additional indirect risk is introduced to the state from California through the state border stations at Ehrenberg and Yuma, and from Texas, and Florida through the state border station at San Simon. The incipient fruit fly outbreaks in California and Texas threaten Arizona's commercial crops of citrus, dates, melons, pecans, and pistachio by risking new introductions of exotic fruit flies within the state. During the period 2001 through May 2005, Arizona Department of Agriculture (ADA) detected 53 sterile Mediterranean fruit flies and four sterile Mexican fruit flies in high risk border areas near Yuma, thereby validating risk pathways for the introduction of transported adult flies.

The ADA finances year round fruit fly surveillance in a cooperative program with the USDA/APHIS. ADA trapping personnel perform most fruit fly trapping activities throughout the state with USDA/APHIS trapping near border environs. Late in 2004, ADA and USDA/APHIS allocated matching emergency funding for enhanced surveillance as a result of Mediterranean fruit fly outbreaks in Tijuana, Mexico, in

September 2004. The ADA enhanced their operations by integrating a quality assurance program with improved identification training and trapping techniques.

Current Status

Arizona is afforded an internationally recognized fruit fly free status, supported by a fruit fly detection network. The network targets the three major Tephritid genera of economic importance: *Anastrepha*, *Bactrocera* and *Ceratitis*. Wild adult specimens of these three genera have never been detected in Arizona.

Arizona's fruit fly surveillance program protects a lucrative citrus production area near Yuma which currently exports untreated citrus fruit due to its fruit fly free status. Traps are deployed within the year-round fruit fly detection program according to identified risk areas. Risk areas are categorized as high, medium and low. These categories take into account transit corridors, commercial production areas, points of entry into the state, population densities and the location of host commodity markets.

Surveillance Program

The Arizona surveillance program deploys traps throughout the state based upon the risk categories previously mentioned (Table 13-1). USDA provided $200,000 for this program, and Arizona matched the fund. The total cost of operation of this program is $400,000 (based on the 4th Quarter Infusion of Emergency Funding lasting through 2005).

TABLE 13-1:Trapping Systems and Number of Traps Used in Arizona for Surveillance of Fruit Flies.

Trap	Multilure®		Liquibator[1]	Jackson			
Attractant	2-Component	Biolure®	Torula yeast	Trimedlure	Cuelure	Methyl eugenol	
Species	*Anastrepha* spp.[2]	*C. capitata*[3]	*Ceratitis* spp. *Anastrepha* spp.[4]	*C. capitata*[3]	*B. cucurbitae*	*B. dorsalis*	Total
Throughout Arizona	901 (21)[5]	219 (14)	707 (21)	2074 (14)	23 (14)	531 (14)	4,465

1 Liquibator is a McPhail type trap

2 *Anastrepha* spp. rebaiting at 2-4 week interval

3 *C. capitata* rebaiting at 1 week interval

4 *Anastrepha suspensa* (torula yeast) rebaiting 1-2 week interval

5 Number in parentheses = Inspection interval

Quality Assurance

The Arizona fruit fly surveillance system includes a multi-facet quality assurance program to validate the integrity of the system. The system includes regular quarterly checks of traps serviced, supervisors accompanying trappers during servicing and the placement of dyed flies in traps unknown to trappers to test the surveillance and identification systems.

Personnel Training

Surveillance personnel receive identification training from the Arizona State Department of Agriculture entomologist identifier.

Rapid Response and Emergency Preparedness

The state of Arizona has a general emergency response action plan based upon the Incident Command System which would be utilized in the event of a wild fruit fly detection. The state of Arizona also has a general fruit fly action plan which when updated will be used as a reference. A joint USDA/ADA fruit fly emergency exercise was conducted in 2005 in the Yuma area. The results and recommendations of this exercise will be used to update the Arizona fruit fly action plan.

Recommendations

1. **For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi².** For detection in rural and residential areas (Table B-1 on page B-2). Replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for *C. capitata* but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or cucurbit fly (*Dacus ciliatus*) (IAEA 2006 *in press*).
2. **Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi² based on assessed risk.**
3. **Fruit fly surveillance staff should be regularly trained, including refresher courses, in exotic fruit fly identification, fruit fly rapid response and fruit fly surveillance activities.**
4. **Develop a cooperative rapid response plan for detections of wild exotic fruit flies.**

5. **Establish a detection program for the walnut husk fly (*Rhagoletis completa*) using ammonium acetate as a lure.** The walnut husk fly is present in other parts of the United States and is considered a pest of husk nuts. States that have a strong pecan industry should be aware of the possibility of the introduction of this pest and should consider implementing a surveillance program for this pest.
6. **Enhance collaboration on fruit fly detection with the border states in Mexico through the United States—Mexico Border States Governors Task Force.**

14 California

Fruit Fly Surveillance Program

Background

The state of California has a surface area of 158,868 mi², which makes it the third largest state of the United States. Elevation ranges from 282 feet below sea level at Death Valley to 14,494 feet above sea level on Mount Whitney. California enjoys a variety of climates but is essentially subtropical—Mediterranean. California produces the largest quantity and variety of agricultural products in the United States. California's market value for production of fruit and vegetables susceptible to Mediterranean fruit fly infestation alone was $5.15 billion in 2002.

Surveyors began trapping in California in 1956, targeting the Mediterranean fruit fly. Trapping has evolved into a multifaceted program designed to maintain California free of internationally recognized species of economic importance. The detection and control program includes four components:

- Fruit fly exclusion programs
- Fruit fly detection programs
- Sterile Insect Technique (SIT) preventative release program
- Emergency response programs

Target pests of concern include various species belonging to five economically important genera: *Anastrepha*, *Bactrocera*, *Ceratitis*, *Dacus*, and *Rhagoletis*.

USDA/APHIS/PPQ, California Department of Food and Agriculture (CDFA), and California County Agricultural Commission cooperatively conduct the California (exotic) Fruit Fly Surveillance Program. Historically there have been several introductions of exotic fruit fly in California. These introductions were influenced by the following factors:

- Mediterranean climate
- Geographical location adjacent to Mexico in the south
- High rate of Tephritid larvae intercepted at the state's international points of entry

- Frequent detections of adult *Bactrocera* spp. in air and sea port environs
- Extensive availability of host plants in agricultural and residential plantings
- International trade
- Culturally diverse population demographics

The high risk of new exotic fruit fly introductions into the state illustrates the importance of early detection, before breeding populations become established.

In 2004, 77 adult exotic fruit flies were captured in seven California counties that triggered 38 delimitation trapping programs (Table 14-1).

TABLE 14-1:Description of Adult Exotic Fruit Flies Captured in Traps in California in 2004.

Species	Number of flies captured
Anastrepha ludens, Mexican fruit fly	1
Anastrepha obliqua, West Indian fruit fly	1
Anastrepha suspensa, Caribbean fruit fly	1
Bactrocera dorsalis, adult oriental complex	63
Other *Bactrocera* spp.	9
Bactrocera cucurbitae, melon fly	1
Ceratitis capitata, Mediterranean fruit fly	1
Total	**77**

The detection program also supports California's economically important domestic and international markets by providing verifiable assurance that the states production areas are free from these economically important pests. The early detection program combined with exclusion, sterile Mediterranean fruit fly preventative release program, and emergency response support are designed to protect California's $30 billion agriculture industry.

The California preventative release program is the largest sterile release project in the United States, covering 2,489 square miles in four high risk counties within the Los Angeles Basin. Following a successful campaign to eradicate existing Mediterranean fruit fly

populations in the Los Angeles Basin in July 1996, the preventative release program has operated cooperatively between USDA/APHIS and CDFA.

The detection program is primarily funded by the State of California, with additional allocations provided by USDA/APHIS and from select county agricultural commissions. CDFA, with consultation from USDA/APHIS, oversees and implements the detection, preventative release program and emergency response programs contained in the USDA/National Survey Protocol. Annually $20 million is spent to combat fruit fly infestations in order to maintain the fruit fly free status.

Current Status

California surveillance conducts trapping activities for exotic fruit flies year-round in county areas considered at risk for introduction and establishment. A combination of available hosts, population densities, and suitable climatic conditions influence the assignment of risk for trap placement and densities. In many northern and eastern counties where conditions such as low winter temperature or desert environment will not support the establishment of exotic fruit flies; trapping is conducted on a seasonal basis or traps are not placed in the area (see Figure A-1 on page A-2 and Figure A-2 on page A-3).

Surveillance Program

The program objective is to determine the presence/absence of economically important fruit fly pests in the state of California. Three primary criteria are used to determine trap placement in the California system:

- Environmental suitability
- Population density
- Risk of introduction

A multiple array of 94,000 traps is placed in risk areas to survey for five major fruit fly species of economic concern for the state. Five trap types, used with nine types of attractant/lures at varied densities, are utilized depending on the species of concern. The densities used vary depending on the designation of the trapping area as urban, rural residential, rural or within the current preventative release program area.

The trapping area is divided into square mile grids and traps are rotated through a five section division of each square mile every six weeks. Trap servicing and rebaiting for the large numbers of trap types is carried out by protocol requirements in accordance with the described risk criteria. Trapping program information is recorded using paper records and is reported daily to program managers who compile monthly summaries for distribution to county, state and federal interests.

Delimitation Activities

The detection of any target fruit fly species triggers a specified emergency action which initiates additional trapping in order to delimit the extent of the fruit fly presence. The actions differ between the various species of the target pests. A core area is determined and a delimitation trapping grid is placed within 24 hours around the area of the fly find. The size of the trapping area and density is detailed in emergency action plans. Traps are serviced the next day after placement. All traps are then checked daily for seven days. After seven days of negative survey the traps are serviced weekly. If no additional flies are found within 2—4 life-styles of the last fly find, surveillance activity reverts to routine detection trapping. In the case of additional fly captures, a pre-defined eradication action will follow.

Monitoring Activities

The California system monitors the release of sterile medflies in the preventative release program conducted over a 2,489 mi^2 area in Los Angeles, Orange, Riverside, and San Bernadino counties. Traps are placed in the area under preventative release program for both detection and monitoring purposes. Within the preventative release program, 5 trimedlure Jackson traps, 5 methyl eugenol Jackson traps, 5 cuelure Jackson traps, and 5 torula yeast McPhail traps are deployed in each mi^2. The dyed sterile flies recovered are screened by trained personnel.

Quality Assurance

An additional component of the surveillance program is the measurement of the efficiency in which trapping personnel react to the potential threat of fruit fly introductions. In order to maintain a proper level of alertness the surveillance program has established a series of actions designed to help maintain a high level of effectiveness:

1. County and State trapping programs are routinely checked by district entomologists for adherence to insect trapping guide standards.

2. All trappers are tested annually on ability to recover sterile flies placed in traps. Specially dyed sterile specimens of Mediterranean fruit fly, Mexican fruit fly, Oriental fruit fly, and melon fly are used. Failure to recover planted flies twice in a 9-month period can lead to removal of the employee from the trapping program.
3. The quality assurance program is administered and coordinated on statewide level by a CDFA senior biologist.

Personnel Training

Training in fruit fly identification and trapping techniques is critical for surveillance personnel. This will ensure timely submission of all suspect fruit flies. The California FFS conducts an extensive training program for new personnel. All trappers are trained by CDFA or USDA entomologists to recognize Mediterranean fruit fly, Mexican fruit fly, Oriental fruit fly, melon fly, *Rhagoletis* spp., and fruit flies in general. Trapping techniques and procedures are taught to new employees by program supervisors and project leaders. New surveillance personnel are paired with experienced employees or are accompanied by supervisors until an acceptable level of competency is attained. For most new surveillance personnel one month of training oversight is conducted before the trapper is allowed to survey alone.

Emergency Preparedness

California surveillance is conducted in accordance with the CDFA Insect Trapping Guide (2005). Upon detection of any wild exotic fruit flies delimitation trapping protocols are initiated within 24 hours. The program has developed specific action plans which detail the delimitation and, if required, control measures to implement in response to detections of target species exotic fruit flies. The following documents have been developed for emergency response:

- *Action Plan For Mediterranean Fruit Fly* (Anon. 1999)
- *Action Plan For Methyl Eugenol Attracted Fruit Flies* (Anon. 2000c)
- *Action Plan For Cuelure Attracted Fruit Flies* (Anon. 2000b)
- *Action Plan For Mexican Fruit Fly* (Anon. 2004a)
- *Action Plan For Caribbean Fruit Fly* (Anon. 2000a)
- *Mediterranean Fruit Fly Delimitation Plan* (Anon. 1997)

Recommendations

1. **For the Mediterranean fruit fly detection survey in urban areas and points of entry, reduce the TML baited JT from 5 traps/mi^2 to 1 trap/mi^2 and incorporate Biolure® baited MLT at a density of 4 traps/mi^2.** For detection in rural and residential areas (Table B-5 on page B-6) equivalent to risk criteria II for Florida.
2. **In PRP areas, reduce the TML baited JT from 5 traps/mi^2 to 1 trap/mi^2 to monitor distribution and abundance of released sterile male flies and include Biolure® baited MLT at a density of 3 traps/mi^2 for detection survey.** Replacement of TML traps by Biolure® traps would not only enhance the sensitivity of the trapping system for Mediterranean fruit fly but would also allow for detection of other quarantine species such as the natal fruit fly (*C. rosa*), peach fruit fly (*B. zonata*), melon fly (*B. cucurbitae*) and Ethiopian fruit fly or Cucurbit fruit fly (*Dacus ciliatus*) (IAEA 2006 *in press*). In addition, costs of sterile fly identification (ca. 15 million sterile flies per year) would substantially be reduced.
3. **Consider the possibility of processing only a fraction of the total captured sterile males utilizing a statistical sampling.** This would save a substantial amount of staff resources which could be assigned to other activities of the surveillance program.
4. **For detection survey, reduce the torula yeast baited McPhail traps from a range of 3 - 5 traps/mi^2 to 1 torula yeast baited MLT/mi^2.** This trapping system would cover the non-responding ME and CUE *Bactrocera* spp. and Dacus spp. and the *Anastrepha* spp. that have a weak response to the dry synthetic lures (Biolure® and 2 C) such as the South American fruit fly (*A. fraterculus*) and the guava fruit fly (*A. striata*) (See #8 in "Recommendations" on page 5).
5. **Incorporate into the trapping network the 2 C (AA + PT) baited MLT at a density of 3 - 5 traps/mi^2.** This trapping system would enhance detection networks against Mexican fruit fly (*A. ludens*), a major concern for California, and would also enhance the detection of other economic species including the Caribbean fruit fly (*A. suspensa*), sapote fruit fly (*A. serpentina*) and the West Indian fruit fly (*A. obliqua*) (Thomas *et al.* 2001, Heath *et al.* 2004, IAEA 2006 *in press*). This change would make the trapping network more selective and would greatly reduce the numbers of non-target insects caught in traps, reducing operational costs (Thomas 2003).
6. **Rebait MLT/Biolure® traps every six weeks. Currently the rebaiting frequency of the Biolure® is once every 28 days (4 weeks).** This frequency could be extended to once every 42 days

(6 weeks) or more (Table B-5 on page B-6). Extending the rebaiting interval would bring substantial savings to the program.

7. **Strengthen the methods development component in California**. Given the importance of the horticulture industry in California and the threat that exotic fruit flies pose, the surveillance program should be supported by a methods development component to update and validate surveillance technologies.

15 Hawaii

Fruit Fly Surveillance Program

Background

The Hawaiin Islands and islets are located in the Pacific Ocean. With a surface area of 6,549 mi², Hawaii is one of the smallest states of the United States. Honolulu is the capital; other significant cities are Hilo, Kailna, Kaneshe and Waipaku.

The Hawaiin Islands of major importance include the following (arranged from largest to smallest):

- Hawaii
- Maui
- Oahu
- Kauai
- Molokai
- Lanai
- Niihau y Kahoolawe

Hawaii has a moderate tropical climate. Mean annual temperature is 75° F with little or no variation between summer and winter. The islands have a rich flora with about 2,500 endemic species, together with a large number of introduced plants.

Hawaiian fruit growers harvested 704.9 million pounds of fruit, with a market value of $129.7 million, for consumption and processing in 2003 (USDA/NASS 2003a). The market value in 2003 for most fruits was 3% higher than in 2002.

Hawaii produces avocados, bananas, guavas, papayas, pineapples, oranges, limes, grapes, grapefruit, lychee, mango, atemoya, passion fruit, persimmon, poha, rambutan, starfruit, strawberry, tangerine and tangelo. About 62,000 pounds of the other fruits were utilized for processing in 2003, up 55% from the previous year. Wine grapes and passion fruit are processed. Due to its production of fruit and coffee, and the high influx of tourism from all over the world, the islands are at high risk of introduction of exotic fruit flies.

Current Status

Hawaii currently lacks a specific survey for exotic fruit flies. Hawaii is infested with four species of economically important fruit flies:

- Oriental fruit fly (*Bactrocera dorsalis*)
- Melon fly (*Bactrocera cucurbitae*)
- Mediterranean fruit fly (*Ceratitis capitata*)
- Malaysian fruit fly (*Bactrocera latifrons*)

The first three species were detected through general surveillance by producers due to their negative economic impact on production. *Bactrocera latifrons* was first detected infesting exported host commodities and later confirmed present in Hawaii after the utilization of trace back information and the commencement of a specific survey.

Recommendations

1. **Establish a state-wide fruit fly surveillance program. Any fruit fly surveillance program should be designed to both detect new invasive species of fruit flies and monitor endemic species already established.**
2. **Identify risk areas within the state of Hawaii including points of entry, production areas for host commodities, populated areas and ethnic markets.**
3. **Determine the amount of traps needed using the trap densities established in IAEA (2003).**
4. **Utilize trap/lure combinations recommended in IAEA (2003) for detection and monitoring of target fruit flies.**

Glossary

area. Officially defined country, part of a country, or all or parts of several countries (FAO 1995)

commodity. Type of plant, plant product, or other article being moved for trade or other purpose (FAO 1990; revised ICPM 2001).

containment. Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO 1995).

control. Suppression, containment or eradication of a pest population (FAO 1995).

cooperative agreement[1]. Official agreement between USDA officials and State Plant Regulatory Officials to carry out plant protection activities.

delimiting survey. Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest (revised, FAO 1999); in this document same as delimiting trapping.

detection survey. Survey conducted in an area to determine if pests are present (revised FAO 1999); in this document same as detection trapping.

early detection[1]. Finding a pest population before it builds into significant reproducing populations.

emergency action. Prompt phytosanitary action undertaken in a new or unexpected phytosanitary situation [ICPM 2001]; in this document same as emergency response.

endemic fruit fly. Fruit fly of the family Tephritidae known to be established in a country or area.

eradication. Application of phytosanitary measures to eliminate a pest from an area (revised FAO 1995).

entry (of a consignment). Movement of a consignment through a point of entry into an area [FAO 1995].

entry (of a pest). Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 1995).

establishment. Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 1990; revised FAO 1995; IPPC 1997).

exclusion. Application of regulatory and phytosanitary measures to prevent the introduction or re-introduction of a pest into a pest free area.

exotic. Not native to a particular country, ecosystem or ecoarea (applied to organisms intentionally or accidentally introduced as a result of human activity); since this code is directed at the introduction of biological control agents from one country to another, the term "exotic" is used for organisms not native to a country (ISPM Pub. No. 3, 1996).

exotic fruit fly[1]. Fruit fly of the family Tephritidae not known to occur in a country or area.

1 Term is absent from International Plant Protection Convention Glossary ISPM no. 5 and may require review by an international panel.

female biased synthetic attractant[1]. An attractant designed to attract females of Mediterranean fruit fly and other fruit fly species.

flies per trap per day (FTD). Average number of flies captured per trap per day.

host sequence[1]. Chronological order of fruit hosts infested by a fruit fly pest in a delimited area.

infestation. Presence in a commodity of a living pest of the plant or plant product concerned; infestation includes infection (CEPM 1997; revised CEPM 1999).

infested area. Area that has been determined to have an established pest population (revised FAO 1987).

introduction. Entry of a pest resulting in its establishment (FAO 1990; revised FAO 1995; IPPC 1997).

monitoring survey. Ongoing survey to verify the characteristics of a pest population (FAO 1999).

outbreak. Isolated pest population recently detected and expected to survive for the immediate future (FAO 1994).

pest. Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (FAO 1990; revised FAO 1995; IPPC 1997).

pest free area. Area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 1999).

point of entry. Airport, seaport or land border point officially designated for the importation of consignments, and /or entrance of passengers (FAO 1995).

port of entry. Same as point of entry.

pre-clearance. Phytosanitary certification and/or clearance in the country of origin, performed by or under the regular supervision of the National Plant Protection Organization of the country of destination (FAO 1990; revised FAO 1995).

prevention[1]. Application of phytosanitary measures in and/or around a pest free area to avoid the introduction of a pest.

preventative release program[1]. Continued release of low density sterile insects over a delimited area to prevent introduction of fruit fly populations.

quality assurance program. For the purpose of this document a program designed to maintain high standards within the fruit fly surveillance programs.

quarantine pest. Pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 1990; revised FAO 1995; IPPC 1997).

re-bait[1]. Replacing the lure in a trapping device.

seasonal trapping[1]. For the purpose of this document a fruit fly surveillance network operated periodically.

service[1]. Maintaining trap components in good condition.

suppression. Application of phytosanitary measures in an infested area to reduce pest populations (FAO 1995; revised 1999).

survey. Official procedure conducted over a defined period of time to determine the characteristics of a pest population or to determine which species occur in an area (FAO 1999).

surveillance. Official process which collects and records data on pest occurrence or absence by survey, monitoring or other procedures (CEPM 1996).

trapping protocol. Documents used as a reference to guide trapping activities.

trap rotation[1]. Periodical change in the site where traps are placed following fruiting phenology of the main host commodities.

trapping system[1]. For the purpose of this document a combination of container, lure and retention mechanism used to trap insects.

trimedlure. Mediterranean fruit fly male specific para-pheromone.

Acronyms and Abbreviations

AB. Ammonium Bicarbonate.

ADA. Arizona Department of Agriculture.

APHIS. Animal and Plant Health Inspection Service.

2 C. Two component lure (ammonium acetate and putrescine).

3 C. Three component lure (ammonium acetate, putrescine and trimethylamine); also known as Biolure®.

CD. Current trap density.

CDFA. California Department of Food and Agriculture.

COSAVE. Comité de Sanidad Vegetal del Cono Sur.

CP. ChamP trap.

CUE. Cuelure.

DPI. Division of Plant Industry.

FAO. Food and Agriculture Organization of the United Nations.

FAO/IAEA. Joint Division of the Food and Agriculture Organization and the International Atomic Energy Agency of the United Nations.

FDACS. Florida Department of Agriculture and Consumer Services.

FFS. Fruit fly surveillance.

GPS. Geographic Positioning System.

HAS. Hawaii Agricultural Statistics.

IAEA. International Atomic Energy Agency.

ICPM. Interim Committee on Phytosanitary Measures.

IPPC. International Plant Protection Convention as deposited in 1951 with FAO in Rome and subsequently amended (FAO 1990; revised ICPM 2001).

ISPM. International Standard for Phytosanitary Measures (CEPM 1996; revised ICPM 2001).

JT. Jackson trap.

LRGV. Lower Rio Grande Valley.

Medfly. Mediterranean fruit fly (*Ceratitis capitata*, Wied.).

Mexfly. Mexican fruit fly (*Anastrepha ludens*, Loew).

MLT. Multilure® trap.

ME. Methyl eugenol.

NAPPO. North American Plant Protection Organization.

NPPO. National Plant Protection Organization (FAO 1990; ICPM 2001).

OIRSA. Organismo Internacional Regional de Sanidad Agropecuaria.

PPQ. Plant Protection and Quarantine, a division of **USDA/APHIS.**

PRP. Preventative release program.

RD. Recommended trap density.

RPPO. Regional Plant Protection Organization; intergovernmental organization with functions laid down by Article IX of the IPPC.

SIT[1]**.** Sterile Insect Technique.

1 Term is absent from International Plant Protection Convention Glossary ISPM no. 5 and may require review by an international panel.

SKT. Spiroketal.

TML. Trimedlure.

USDA. United States Department of Agriculture.

USVI. United States Virgin Islands

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A Appendix A

Maps

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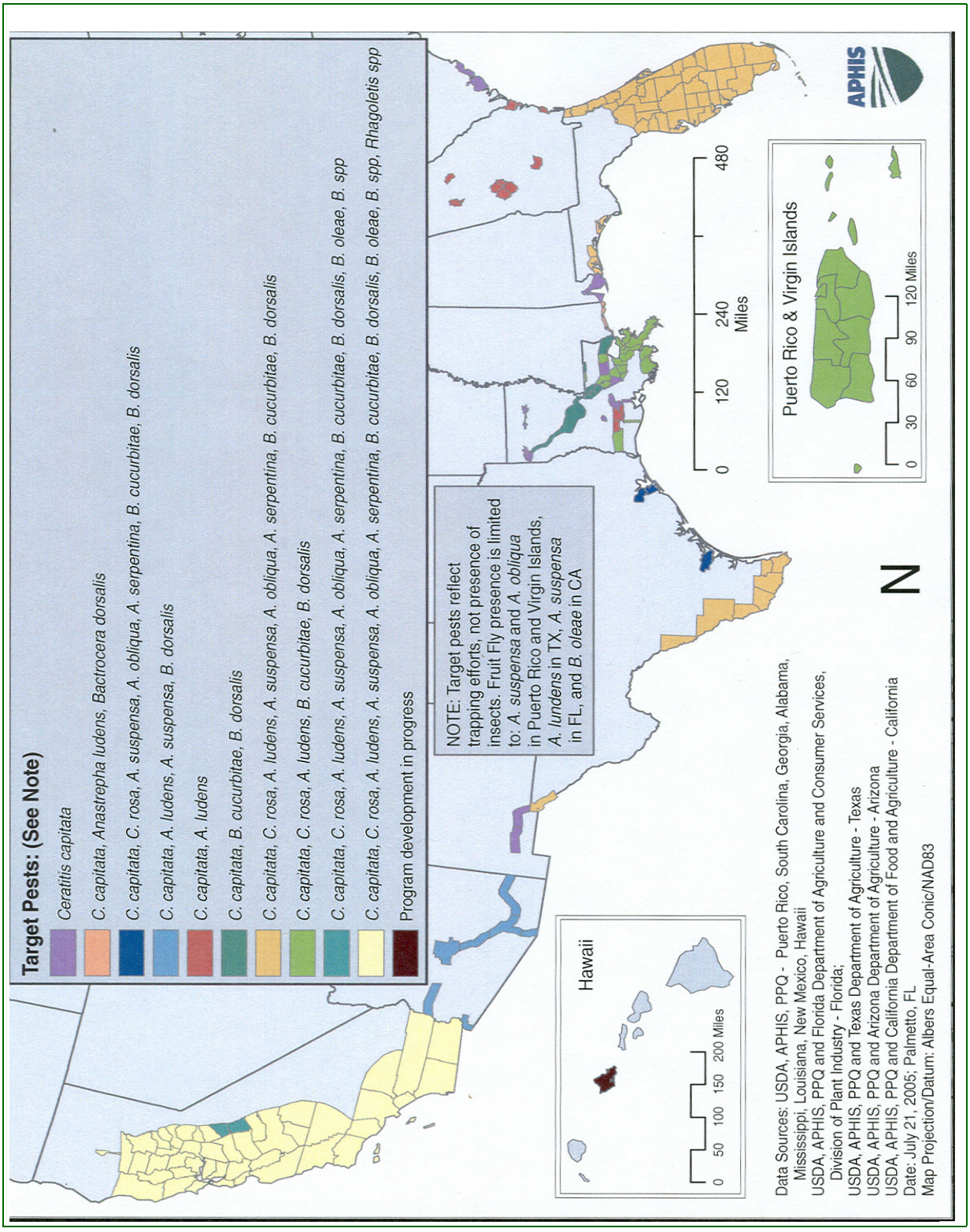

FIGURE A-1: Location And Target Pest Species Of Fruit Fly Programs In The United States In 2005.

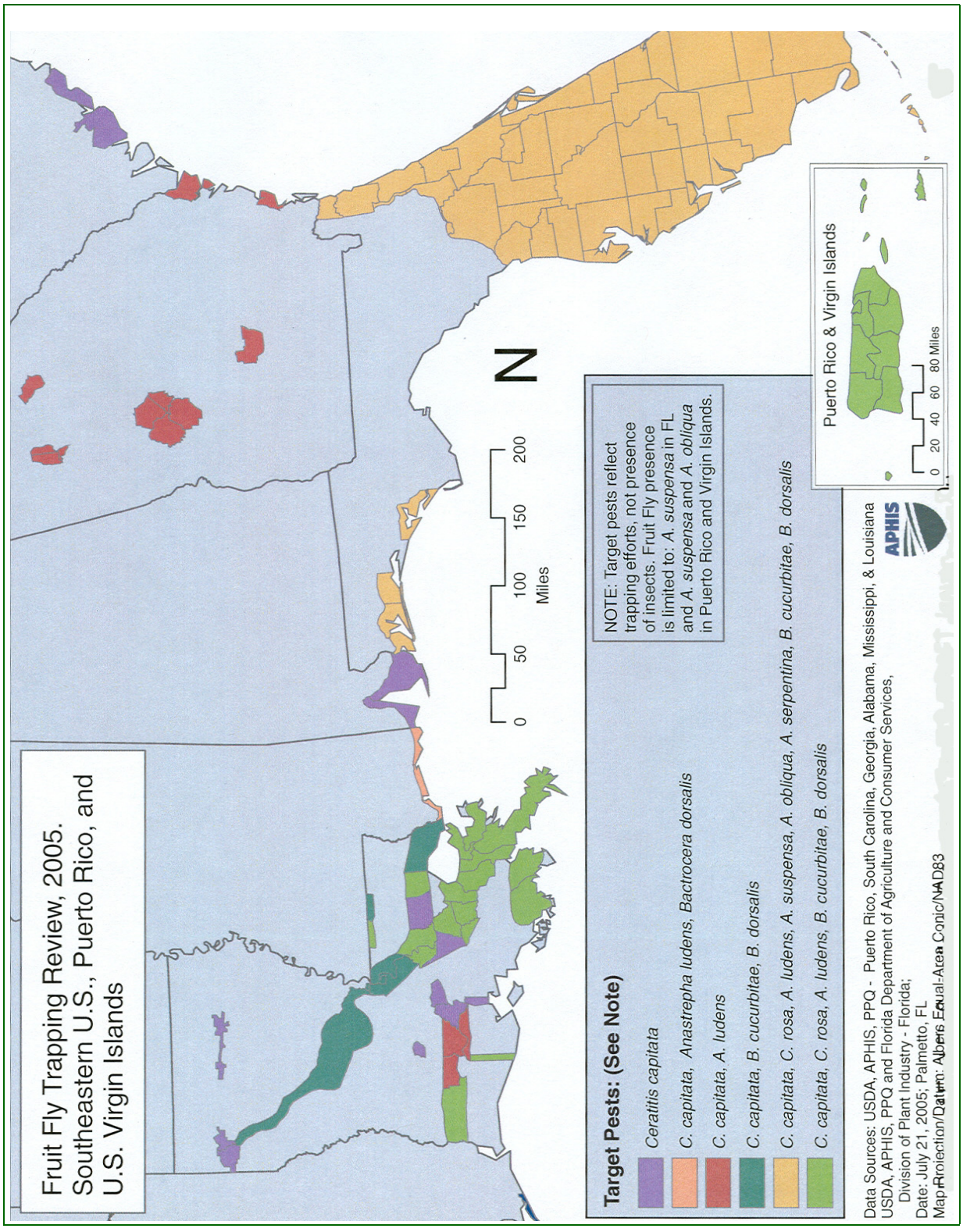

FIGURE A-2: Location And Target Pest Species Of Fruit Fly Programs In Southeastern United States, Puerto Rico and U.S. Virgin Islands.

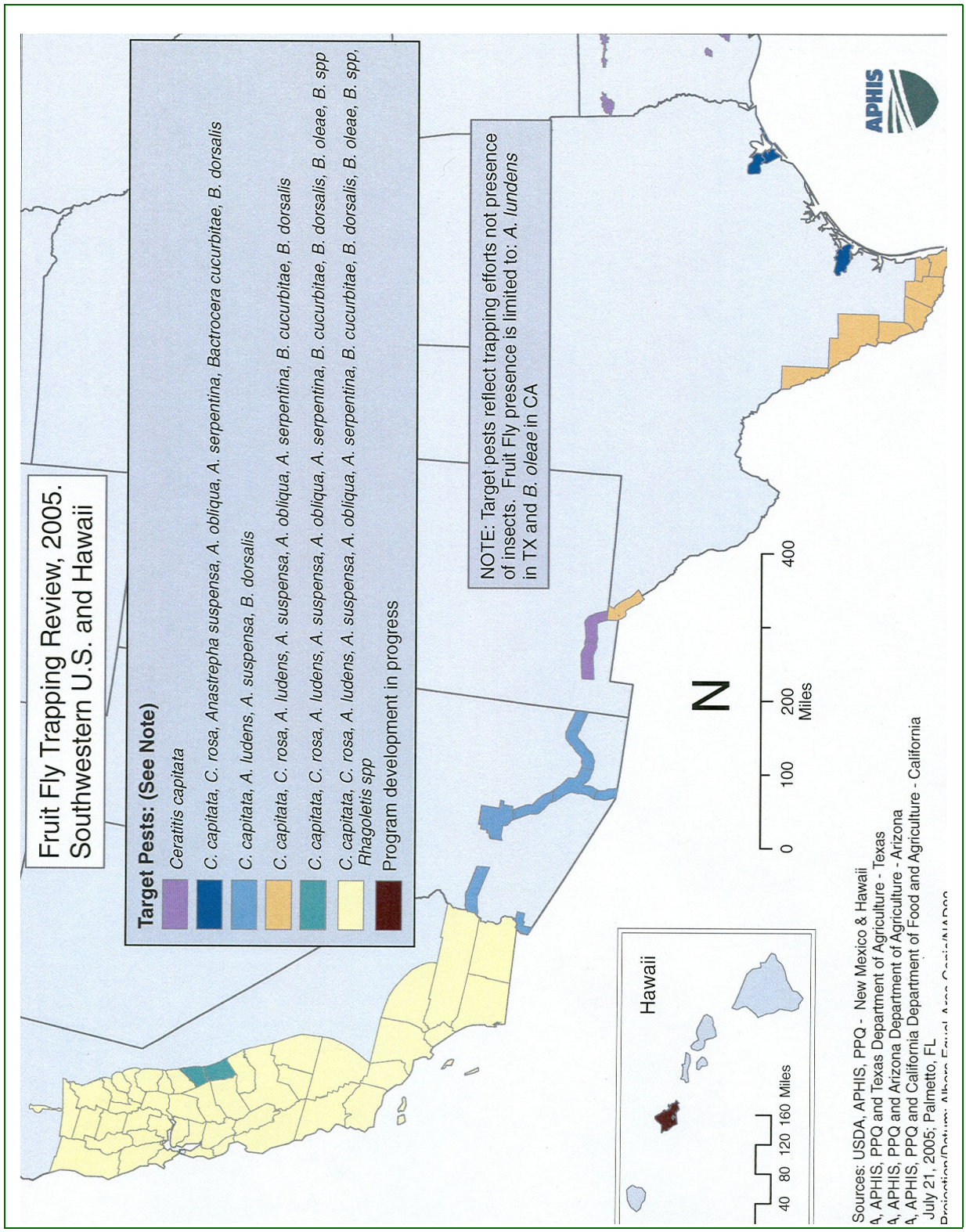

FIGURE A-3: Location And Target Pest Species Of Fruit Fly Programs In Southwestern United States and Hawaii in 2005.

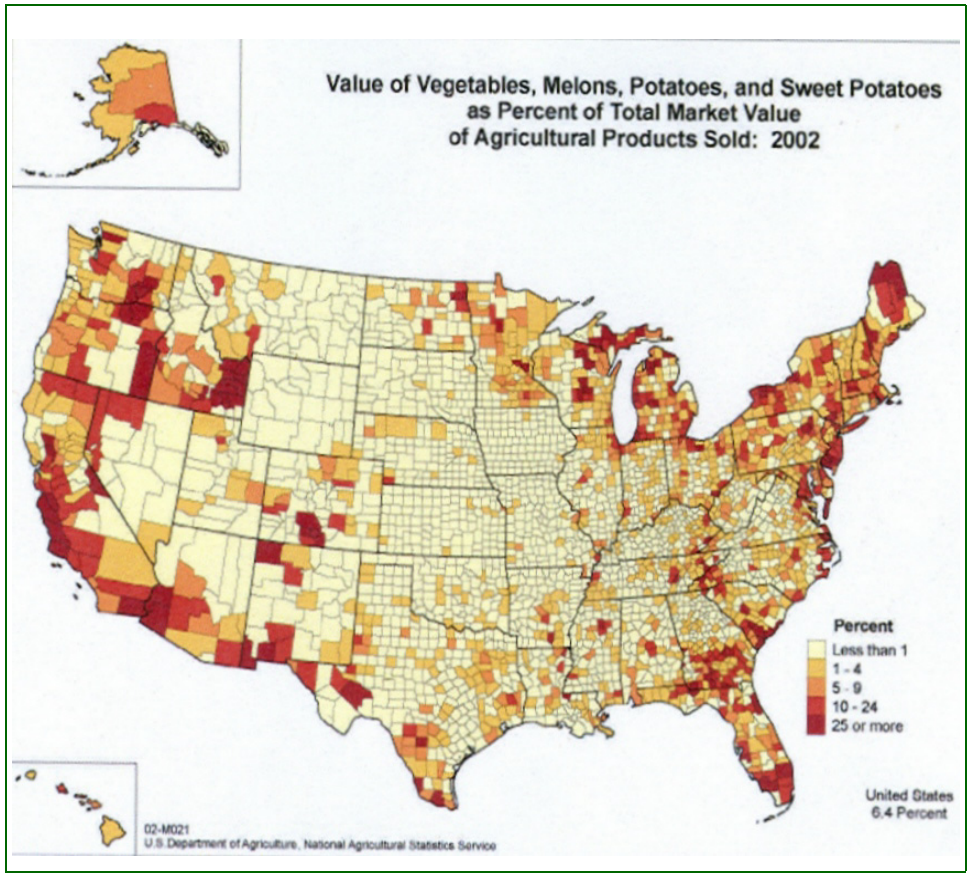

FIGURE A-4: Value of Vegetation, Melons, Potatoes and Sweet Potatoes as Percent of the Total Market Value of Agricultural Products Sold in 2002.

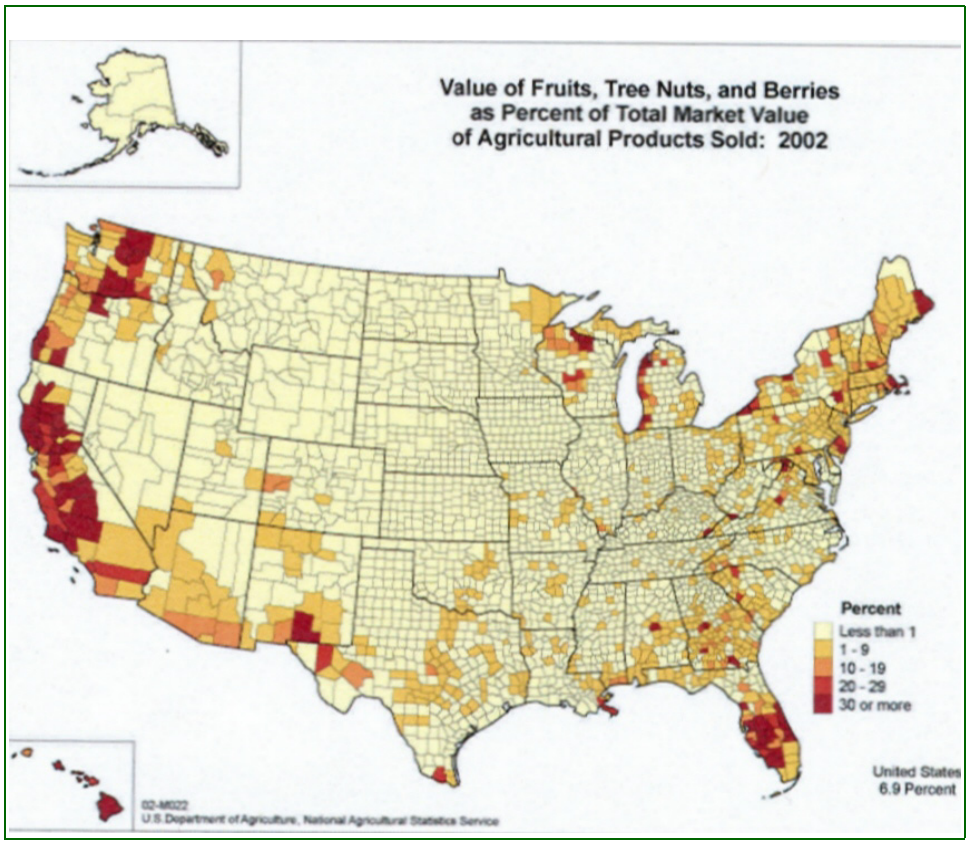

FIGURE A-5: Value of Fruits, Tree Nuts and Berries as Percent of the Total Market Value of Agricultural Products Sold in 2002.

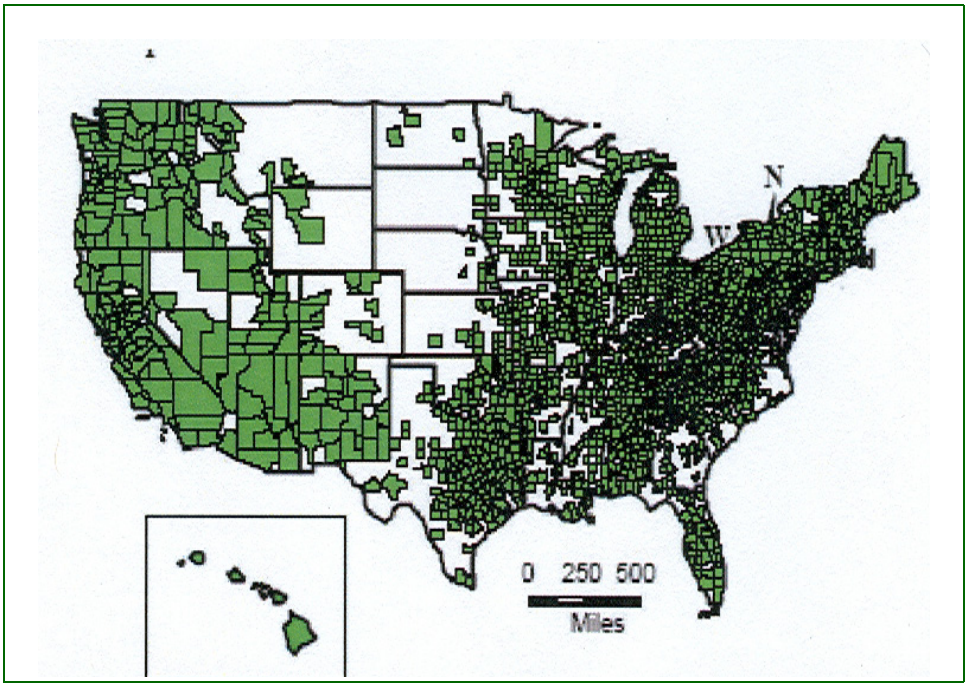

FIGURE A-6: Commercial Fruit Production Susceptible to *Anastrepha* spp. in the United States [Source: Sequeira, Millar, and Bartels 2001].

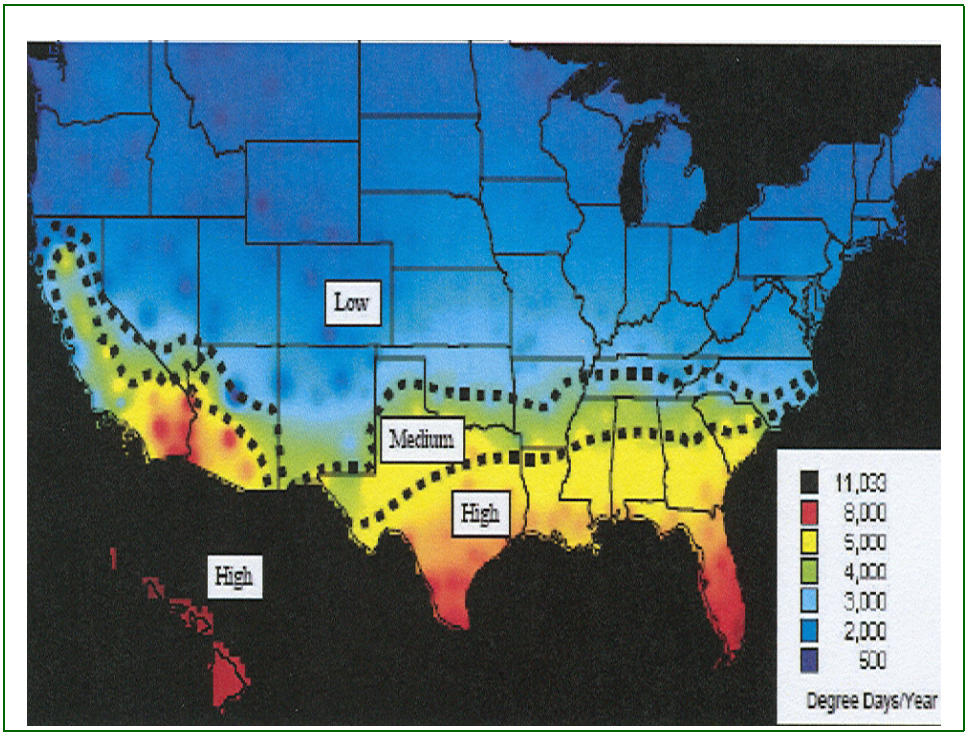

FIGURE A-7: Risk as Indicated by a Combination of Temperature Requirements, Generation Potential and Host Availability [Source: Sequeira, Millar, and Bartels 2001].

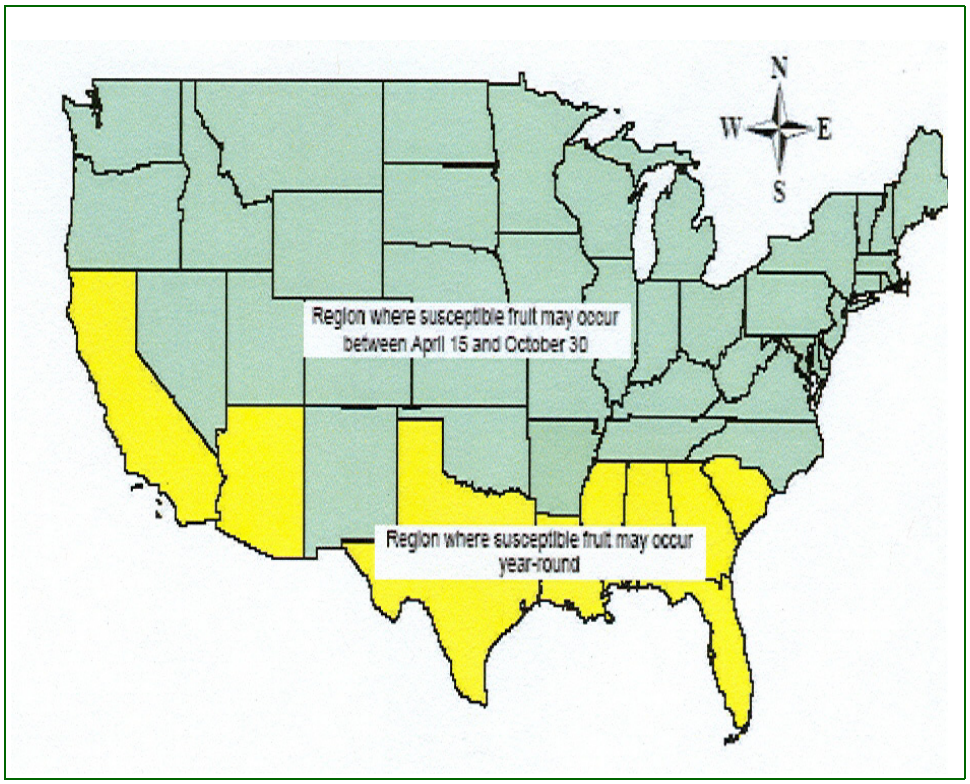

FIGURE A-8: United States Regions Susceptible to *Anastrepha* spp. [Source: Sequeira, Millar, and Bartels 2001].

B Appendix B

Tables

List of Tables

TABLE B-1: Trapping Densities (Traps/Square Mile) in Urban, Points of Entry, and Rural Residential Areas in South Carolina, Georgia, Alabama, Mississippi, Louisiana, New Mexico, Arizona, Hawaii and the Seasonal Trapping Areas of Florida.

Trapping System[1]	Number of Traps/Square Mile			
	Urban and Points of Entry		Rural Residential	
	Current	Recommended	Current	Recommended
MLT + 3C/ JT + TML	0/5	4/1	0/1-10	1-4[2]
JT + ME	0-5	1	0-3	1
JT + Cue	0-5	1	0-3	1
McPhail + Torula	0-5	0	0-1	0
MLT + 2C	0	2	0	1
MLT + Torula	0	1	0	1

1 Recommended inspection of all traps is every 21 days (except for MLT + Torula which should be inspected every 7-14 days depending upon local environmental conditions)

2 4:1 ratio (female traps MLT/3C: male trap Jackson trap/trimedlure); density of traps should be based upon assessed risk

TABLE B-2: Trapping Densities (Traps/Square Mile) in Urban (Criteria II), Points Of Entry (Criteria I), Rural Residential (Criteria III) and Medfly PRP Areas of High Risk Counties of Florida[1].

Trapping System[2]	Number of Traps/Square Mile					
	Urban and Points of Entry		Rural Residential		Mediterranean Fruit Fly PRP	
	Current	Recommended	Current	Recommended	Current	Recommended
MLT + 3C/ JT + TML	2-5/10-16	4/1	Risk Assessed /2	1-4[3]	5/1	4
JT + ME	3-5	5	1-3	2	3-5	5
JT + CUE	1-2	5	1	2	1-2	5
MLT + 2C	0	5	0	2	0	5
MLT + Torula	0	1	0	1	0	1

1 High risk counties of Florida include Dade, Broward, Palm Beach, Hillsborough, Orange, Pinellas, Manatee, and Sarasota

2 Recommended inspection of all traps is every 14 days; servicing intervals of MLT + torula traps and low toxic antifreeze should be evaluated (See #10 in "Recommendations" on **page -5**)

3 4:1 ratio (female traps MLT/3C: male trap Jackson trap/trimedlure); density of traps should be based upon assessed risk

TABLE B-3:Trapping Densities (Traps/Square Mile) in Urban (Criteria II), Points Of Entry (Criteria I), and Rural Residential (Criteria III) Areas Of Other Counties Of Florida Conducting Year-round Trapping.

Trapping System	Number of Traps/Square Mile			
	Urban and Points of Entry		Rural Residential	
	Current	Recommended	Current	Recommended
MLT + 3C[1]/JT + TML[1]	0/5-10	4/1	Risk Assessed/ 1	1-4[2]
JT + ME[1]	1-3	3	1	1
JT + CUE[1]	1	3	1	1
MLT + 2C[1]	0	3	0	1
MLT + Torula[3]	0	1	0	1

1 Recommended inspection of traps is every 21 days

2 4:1 ratio (female traps MLT/3C: male trap JT/TML); density of traps should be based upon assessed risk

3 Recommended inspection of traps is every 14 days; servicing intervals of MLT + torula traps and low toxic antifreeze should be evaluated (See #10 in "Recommendations" on **page -5**)

TABLE B-4:Trapping Densities (Traps/Square Mile) in Texas.

Trapping System	Number of Traps/Square Mile					
	Urban and Points of Entry		Rural Residential		Mexican Fruit Fly PRP	
	Current	Recommended	Current	Recommended	Current	Recommended
MLT + 3C[1]/JT + TML[1]	0/5	4/1	0/5	3[2]	0/5	3[2]
JT + ME[1]	1	2	1	1	1	2
JT + CUE[1]	1	2	1	1	1	2
MLT + 2C[3]	0	5	0	3	0	3
MLT + Torula[4]	0	1	0	1	0	1
McPhail + Torula	5	0	5	0	5	0

1 Recommended inspection of traps is every 21 days

2 4:1 ratio (female traps MLT/3C: male trap Jackson trap/trimedlure)

3 Recommended inspection of traps is every 21 days for detection survey [Note: In the monitoring survey in LRGV traps are serviced according to certification protocols]

4 Recommended inspection of traps is every 14 days

TABLE B-5: Trapping Densities (Traps/Square Mile) in California.

Trapping System	Number of Traps/Square Mile					
	Urban and Points of Entry		Rural Residential		Mediterranean Fruit Fly PRP	
	Current	Recommended [1]	Current	Recommended [2]	Current	Recommended [1]
MLT + 3C/JT + TML	0/5	4/1	0/1-4	3[3]	0/5	4[3]
JT + ME	2-5	5	1-2	1	5	5
JT + CUE	2-5	5	1-2	1	5	5
MLT + 2C	0	5	0	4	0	5
MLT + Torula	0	1	0	1	0	1
McPhail + Torula	3-5	0	1-3	0	5	0
ChamP + AC[4] +SK[5]	2	2	1-2	2	0	0

1 Recommended inspection of traps is every 14 days

2 Recommended inspection of traps is every 21 days except ChamP + AC + SK traps which should be inspected every 14 days

3 4:1 ratio (female traps MLT/3C: male trap JT/TML)

4 AC = Ammonium Carbonates

5 SK= Spiroketal (olive fruit fly lure)

TABLE B-6: General and Specific Recommendations Resulting From Review of National Fruit Fly Surveillance Programs in Continental United States. (continued)

Recommendation	AL	AZ	CA	FL	GA	HI	LA	MS	NM	PR	SC	TX
1. Harmonize technical criteria of international, national and state surveillance protocols which include trapping procedures, trap densities, quality assurance and emergency response protocols.	G[1]	G	G	G	G	G	G	G	G	G	G	G
2. Harmonize fruit fly trapping terminology across the surveillance programs in the United States.	G	G	G	G	G	G	G	G	G	G	G	G
3. Upgrade surveillance programs in the United States to meet current national and international protocols.	X[2]	X	X	X	X	X	X	X	X	X	X	X
4. Conduct a cost-benefit analysis on the current and recommended surveillance programs.	G	G	G	G	G	G	G	G	G	G	G	G
5. Implement an alternate trapping system for certain eastern coastal states based upon species specific area susceptibility for the introduction of fruit fly populations.	X				X		X	X			X	
6. Conduct a pest risk analysis to identify pathways and susceptible areas in the United States for the establishment of *Bactrocera* spp.	G	G	G	G	G	G	G	G	G	G	G	G
7. Designate the MLT as the standard for synthetic food lures (Biolure® and two-component lures) and protein baits (torula yeast, Nu-lure, etc.).	X	X	X	X	X	X	X	X	X	X	X	X
8. Establish a detection network for exotic fruit flies nonresponsive to parapheromones or synthetic food lures using MLT/torula yeast at a density of 1 trap/mi^2.	X	X	X	X	X	X	X	X	X	X	X	X
9. Improve the communication and exchange of information among all fruit fly surveillance programs so procedures are harmonized and updated on a continuing basis.	G	G	G	G	G	G	G	G	G	G	G	G
10. Develop a capacity for DNA analysis for *Ceratitis*, *Bactrocera* and *Anastrepha* species.	G	G	G	G	G	G	G	G	G	G	G	G
11. Develop new technologies to discern wild and sterile fruit flies.	G	G	G	G	G	G	G	G	G	G	G	G
12. Establish an effective mechanism to validate and transfer technology from USDA/ARS to the surveillance programs.	G	G	G	G	G	G	G	G	G	G	G	G

TABLE B-6: General and Specific Recommendations Resulting From Review of National Fruit Fly Surveillance Programs in Continental United States. (continued)

Recommendation	AL	AZ	CA	FL	GA	HI	LA	MS	NM	PR	SC	TX
13. Conduct regular fruit fly surveillance reviews.	X	X	X	X	X	X	X	X	X	X	X	X
14. Conduct methods development evaluations to explore the possible use of MLTs baited with torula yeast in low-toxic antifreeze.	G	G	G	G	G	G	G	G	G	G	G	G
15. Develop a cooperative rapid response plan for detections of wild exotic fruit flies.	X	X			X	X	X	X	X	X	X	X
16. Survey for new hosts of endemic fruit flies.										X		X
17. To ensure rapid identification of fruit fly specimens, devote resources to training and assign additional personnel to identification facilities.										X		
18. For Mediterranean fruit fly detection in urban areas and points of entry, replace the current array of 100% JT/TML with 4 MLT/Biolure®:1 JT/TML using 5 traps/mi^2.	X	X	X		X		X	X	X		X	X
19. Incorporate low density trapping of JT baited with ME and CUE for detection of Oriental fruit fly (*B. dorsalis*) and melon fly (*B. cucurbitae*), at a density of 1 trap/mi^2.	X				X		X	X	X		X	
20. Incorporate low density trapping of 2 C (AA + PT) baited MLT for detection of *Anastrepha* complex including Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*), at a density of 1- 2 traps/mi^2 based on assessed risk.	X	X			X		X	X	X		X	
21. Continue trapping year-round for *A. ludens*.							X					
22. Incorporate trap rotation into the fruit fly surveillance program.							X					X
23. Shift the emphasis from trapping at points of entry to trapping in and around ethnic markets and populated areas.	X				X		X	X	X		X	
24. Fruit fly surveillance staff should be regularly trained, including refresher courses, in both exotic fruit fly identification and fruit fly surveillance activities.	X	X			X		X	X	X		X	

TABLE B-6: General and Specific Recommendations Resulting From Review of National Fruit Fly Surveillance Programs in Continental United States. (continued)

Recommendation	AL	AZ	CA	FL	GA	HI	LA	MS	NM	PR	SC	TX
25. Implement a quality assurance program for all fruit fly surveillance activities.	X				X		X	X	X		X	
26. Change the risk category for urban/ suburban areas of Florida from risk category 2 to risk category 1 and consequently downgrade points of entry from risk category 1 to risk category 2.				X								
27. For Mediterranean fruit fly detection, replace the current array of 100% JT/ TML with 4 MLT/Biolure®:1 JT/TML using 2 to 5 traps per square mile (depending on risk criteria as described in "Surveillance System" on **page -24**) as proposed in **Table B-1 on page B-2**, **Table B-2 on page B-3**, and **Table B-3 on page B-4**.				X								
28. Reduce the number of MLT/Biolure®- JT/TML traps from 5:1 to a density of ca. 3:1/mi^2 in PRP areas (**Table B-1 on page B-2**).				X								
29. Change the current bait used for the detection of Mexican fruit fly from Biolure® (3 C) to the 2 component synthetic food lure at a density of 3—5 traps per mi^2 based on assessed risk.				X								
30. Study the possibility of using statistical sampling procedures to process sterile males captured in JT/ TML deployed in a PRP area.		X		X								
31. The trap inspection rate should be reduced from 21 days to 14 days in areas considered to be high risk based on historical detections and following recommendations of USDA and international trapping protocols (IAEA 2003).				X								
32. Conduct methods development evaluations to explore the possible use of MLTs baited with torula yeast in low-toxic antifreeze.				X								
33. Include in the current reporting protocol for the sterile insect release drop zone, calculations regarding the recapture rates of sterile insects.				X								
34. Extend rebaiting of MLT/Biolure® traps for more than six weeks.				X								

TABLE B-6: General and Specific Recommendations Resulting From Review of National Fruit Fly Surveillance Programs in Continental United States. (continued)

Recommendation	AL	AZ	CA	FL	GA	HI	LA	MS	NM	PR	SC	TX
35. Replace McPhail traps baited with torula yeast by MLT baited with the 2 Component Lure (AA + PT) in all areas subjected to trapping for monitoring and detection including PRP areas.												X
36. Reduce trap densities in PRP area from 5 McPhail/torula yeast /mi^2 to 3 MLT/2 C/mi^2.												X
37. Adjust trap densities for JT/ME and JT/CUE to those suggested in **Table B-4 on page B-5**.												X
38. Study the possibility of using statistical sampling procedures to process sterile flies captured in McPhail traps deployed in a PRP area.												X
39. Conduct research to determine the host status of grapefruit and oranges with respect to *Anastrepha serpentina.*												X
40. Harmonize a geographic information system (GIS) including fruit fly trap locations in the entire LRGV.												X
41. Evaluate the need to initiate a detection program for the Walnut Husk Fly.												X
42. Establish a detection program for the Walnut Husk Fly (*Rhagoletis completa*) using ammonium acetate as a lure.		X							X			
43. Validate the possibility of extending the rebaiting frequency of TML and Biolure® traps to once every 4 to 6 weeks or more.									X			
44. Enhance collaboration on fruit fly detection with the border states in Mexico through the United States-Mexico Border States Governors Task Force.		X										
45. In PRP areas, reduce the TML baited JT from 5 traps/mi^2 to 1 trap/mi^2 to monitor distribution and abundance of released sterile male flies and include Biolure® baited MLT at a density of 3 traps/mi^2 for detection survey.			X									
46. Consider the possibility of processing only a fraction of the total captured sterile males utilizing a statistical sampling.			X									

TABLE B-6: General and Specific Recommendations Resulting From Review of National Fruit Fly Surveillance Programs in Continental United States. (continued)

Recommendation	AL	AZ	CA	FL	GA	HI	LA	MS	NM	PR	SC	TX
47. For detection survey, reduce the torula yeast baited McPhail traps from a range of 3 - 5 traps/mi^2 to 1 torula yeast baited MLT/mi^2.			X									
48. Incorporate into the trapping network the 2 C (AA + PT) baited MLT at a density of 3 - 5 traps/mi^2.			X									
49. Strengthen the methods development component in California.			X									
50. Rebait MLT/Biolure® traps every six weeks.			X									
51. Establish a state-wide fruit fly surveillance program.						X						
52. Identify risk areas within the state of Hawaii including points of entry, production areas for host commodities, populated areas and ethnic markets.						X						
53. Determine the amount of traps needed using the trap densities established in IAEA (2003).						X						
54. Utilize trap/lure combinations recommended in IAEA (2003) for detection and monitoring of target fruit flies.						X						

1 G=General recommendations which need to be implemented at the National level

2 X=Recommendations that can be implemented at the State level