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Final Report

Animal And Plant Health Inspection Service United States And Mexico Lower Rio Grande Valley Mexican Fruit Fly Eradication Program Review

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Expert Review Panel Members:

Susan D. McCombs, Chairperson
Terry E. McGovern
Jesus Reyes-Flores
Martin de los Santos Ramos

Coordinator:
Edward F. Gersabeck

Expert Review Panel Members:

Susan D. McCombs
United States Department of Agriculture
Animal and Plant Health Inspection Service
P.O. Box 50002
Honolulu, HI 96850 USA

Terry E. McGovern
Moscamed Program
United States Department of Agriculture
Animal and Plant Health Inspection Service
International Services
4a. Avenida 12-62 Zona 10
Guatemala City 01010, GUATEMALA

Jesus Reyes-Flores
Insect Pest Control Section
Joint FAO/IAEA Division of Nuclear
Techniques in Food and Agriculture
P.O. Box 100, A-1400 Vienna, AUSTRIA

Martín de los Santos Ramos
Dirección General de Sanidad Vegetal
Guillermo Pérez Valenzuela No. 127
Col. Del Carmen Coyoacán
C.P. 04100, México D.F.

Coordinator:

Edward F. Gersabeck
Mexican Fruit Fly Program
Animal and Plant Health Inspection Service
International Services
4700 River Road
Riverdale, Maryland, 20737 USA

Cover images of Mexican fruitfly courtesy of USDA ARS Photo Unit

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Executive Summary

A review of the current status and performance of Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ) and International Services (IS) Mexican fruit fly (*Anastrepha ludens* Loew) eradication activities in Texas and seven municipalities in northern Tamaulipas, Mexico is provided in this report. It is based on site visits and discussions with operational staff and program managers in Texas and Mexico. The review contains recommendations for each component of the operational program, strategic planning, and support activities. An international expert panel conducted site visits to Edinburg and Harlingen, TX and Reynosa, Tamaulipas, Mexico in August 2009.

The threat from exotic fruit fly (Diptera: Tephritidae) entry and establishment in the United States remains high due to a number of factors. APHIS responds to exotic fruit fly risks with an integrated system incorporating off-shore risk mitigation, surveillance, control, prevention, and regulatory activities. To eradicate the Mexican fruit fly, APHIS and their cooperators operate surveillance, regulatory, insecticide applications, and sterile insect technique (SIT) programs in high risk areas of the Lower Rio Grande Valley (LRGV) of Texas and northern Mexico.

The LRGV Mexican Fruit Fly Eradication Program operated by APHIS and its cooperators requires the following:

- Fully integrated program operations with a well-defined management structure to coordinate activities among APHIS agencies and cooperators.
- An eradication strategy that includes tactical operations applied in a systematic manner to achieve eradication from east to west across three counties of Texas and seven municipalities of Tamaulipas.
- A long-term strategy for declaration and maintenance of Mexican fruit fly free areas.

The goal of this review is to enhance program efficacy and operational efficiencies through implementation of technical and tactical changes. The panel reviewed the strategy, tactical operations, and status of the LRGV Mexfly eradication program in formulating their recommendations. A total of 90 recommendations were put forth by the expert panel.

1 Introduction

Fruit flies in the family Tephritidae are among the most destructive, feared, and well-publicized pests of fruits and vegetables around the world. The threat from spread of established fruit fly populations or the establishment of introduced exotic fruit fly species remains high in the United States due to a number of factors:

- Potential for natural spread from infested areas of Mexico, Central America, and the Caribbean Basin
- High approach rate of fruit fly host material at ports of entry
- Prevailing climatic conditions that are favorable to establishment of reproducing populations
- Availability of host fruits and vegetables

APHIS responds to exotic fruit fly risks with an integrated system incorporating off-shore risk mitigation, surveillance, control, prevention, and regulatory activities. Surveillance operations in Texas and northeastern Mexico indicate a seasonal incidence of the Mexican fruit fly, *Anastrepha ludens* Loew (Figure C-3 on **page-75**. This economic pest has the potential to spread beyond Hidalgo and Cameron Counties in Texas and to become established in states in the southern citrus growing region (e.g., California, Arizona, Louisiana, and Florida). In addition, some northeastern states in Mexico that are generally infested with Mexican fruit fly pose a risk for natural spread across the border into Texas, California, Arizona, and New Mexico (USDA 2008). Therefore, eradication of the Mexican fruit fly from the Lower Rio Grande Valley of Texas and northeastern Mexico was identified as a strategic goal in the APHIS Fruit Fly Strategic Plan 2006-2010 (USDA 2006).

The Mexican fruit fly is an important agricultural pest in Mexico and Central America. Hosts include varieties of apple, apricot, avocado, grapefruit, mango, nectarine, peach, pear, plum, sapote, sweet orange, sour orange, and tangerine, among other fruit (USDA 2008). Economic losses result from mitigation measures required for movement of commercial hosts from generally-infested areas and from direct damage caused by the larvae feeding on the fruit pulp. The female inserts her ovipositor beneath the skin of the fruit and deposit eggs. These eggs hatch in 3 to 4 days and the larvae develop inside the fruit. The larvae feed within the fruit pulp, rendering it unmarketable. The mature third instar exits the fruit and pupates in the soil. Adults emerge from the puparium in 10 to 14 days. Larval development may halt during periods of adverse environmental conditions, e.g., extreme heat or cold, and the larvae remain inside the fruit. The adult sexual maturation period is approximately 14 days. During this period adults typically seek carbohydrate, protein, and water sources in the environment.

The Texas Protocol was initiated in 1986 to allow the shipment of commercial citrus from Texas to other citrus-producing states (USDA 2007b). Mexican fruit fly surveillance and population suppression were the primary program activities. Under the Texas Protocol, commercial citrus could be shipped without post-harvest treatment when the number of detections remained below specified levels for each production zone (Map D-1). The sterile insect technique (SIT) was a critical population suppression tool. The density of sterile flies was relatively low due to the available number of sterile pupae.

A multi-phase LRGV Mexican Fruit Fly Eradication Program was initiated in FY2007 (USDA APHIS 2008). The goals of this program were eradication of the Mexican fruit fly from the LRGV of Texas and northeastern Tamaulipas; followed by establishment of a barrier in Mexico to prevent reintroduction. Surveillance, bait sprays, and SIT are the primary tactics in the eradication program. Phases were to be conducted sequentially with progress based on the availability of resources. Phase I was completed in FY2007 and included an increase in funding and establishment of the Harlingen TX and Reynosa, Mexico emergence and release facilities (ERF); release of 20 million sterile flies per week in Mexico; and expansion of surveillance activities to 10 traps per mi^2 in Willacy County. Phase II was completed in FY2008 and included declaration of Willacy County as Mexican fruit fly free; obtaining authority to apply bait sprays in northern Tamaulipas; operation of the Harlingen ERF; and an increase in sterile fly density to 320,000 per mi^2 (500 per acre). The latter was possible because the mass-rearing capacity was increased from 20 million sterile pupae per week to 200 million per week. Phase III activities are underway, but full implementation is not possible due to insufficient resources.

In August 2009, an Expert Review Panel observed Lower Rio Grande Valley Mexfly Eradication Program operations at the following locations:

- Mexican Fruit Fly Rearing Facility in Edinburg, Texas
- Mexican Fruit Fly Emergence and Release Facility in Edinburg, Texas
- Mexican Fruit Fly Emergence and Release Facility in Harlingen, Texas

- Texas Fruit Fly Surveillance Program in McAllen, Harlingen, and Edinburg, Texas
- Mexican Fruit Fly Emergence and Release Facility in Reynosa, Tamaulipas, México
- Fruit Fly Surveillance Program in Reynosa, Tamaulipas, Mexico

The Expert Review Panel assignments were to:

- Review the strategy, tactical operations, and status of the LRGV Mexfly Eradication Program in two counties (Hidalgo and Cameron) in Texas and seven municipalities (Miguel Aleman, Camargo, Diaz Ordaz, Reynosa, Rio Bravo, Valle Hermoso, and Matamoros) in northeastern Tamaulipas.
- Recommend technical and tactical changes to enhance program efficacy and cost efficiencies.

2 Eradication Strategy

The overall goal of the Mexican Fruit Fly Program is the eradication of *Anastrepha ludens* from the Lower Rio Grande Valley in Texas and the northern municipalities of Tamaulipas, Mexico. Eradication will be followed by the establishment and long-term maintenance of a functional barrier to keep these areas free of Mexican fruit fly.

Current program operations include the implementation of a variety of field activities, applied at various levels of intensity, to both suppress and eradicate Mexican fruit fly populations as they are identified. These activities include surveillance using a number of trap and lure combinations (Table 1; Maps 2 & 3), ground bait sprays (Table 2; Maps 4 - 11), regulatory controls, and the release of sterile Mexican fruit fly (Tables 3, 4, 5; Maps 12 - 14). Program staff demonstrated a high degree of competence in the design and implementation of the various field activities as well as a good understanding of the population dynamics of the target pest. Program staff demonstrated sound use of the limited resources available and good decision making in terms of how best to deploy these resources.

Current Program Activities

APHIS is a partner with the Texas Department of Agriculture (TDA) and the local citrus industry in Texas in conducting suppression and eradication activities. One overarching concern is the ability to maintain citrus exports from the area during the eradication period. The cooperators are understandably reluctant to jeopardize the operational integrity of the Texas Protocol for the export of citrus to other United States markets, primarily California.

There is a seasonal cycle to the work conducted in Texas and Mexico to ensure that the Mexfly populations are suppressed to the maximum extent possible. The field survey and mitigation begins during the summer when hot, dry weather conditions suppress the fly populations to their lowest detection levels of the year (Figure C-3). TDA provides a cadre of 15 full time trappers to run approximately 2000 traps deployed over 770 mi^2 (Table B-1). Traps are serviced on a seven day schedule and placed at a density of 5 traps per mi^2. The primary trap used for *Anastrepha* detection is the plastic Multilure trap (MLT) (Better World Manufacturing, Fresno, CA) baited with torula yeast in a 5% Splash antifreeze solution. In addition to the survey work, ongoing releases of sterile Mexican fruit fly (males and females) are conducted over commercial groves and high risk areas (Maps 12–14). The sterile flies are released on a weekly basis in densities varying from 250,000 to 320,000 flies per mi^2 (400 to 500 flies per acre) (Table B-2).

The intensity at which these various activities are deployed varies with the operational goals in each specific area. The areas are primarily defined by the county borders and include Willacy, Cameron, and Hidalgo Counties in Texas (Map 1). Willacy, the most northern county does not have a common border with Mexico. Willacy County was declared free of Mexican fruit fly after the 2007/2008 season. Declaration was based on one year of surveillance at 10 traps per mi^2 with no outbreaks detected (NAPPO 2004; Table B-1). Two outbreaks were detected there in the 2008/2009 season and each was eradicated in accordance with the mitigation protocols included in the Texas Action Plan for Mexfly (USDA 2007b) for emergency response to outbreaks in fly free areas.

Cameron County is currently targeted for declaration of eradication. Surveillance was increased to 10 traps per mi^2 in 2008 (Table B-1). Two mated wild females were detected during the 2008-2009 season (Map 7). This 'restarted' the clock for the required 12 months of freedom from outbreaks. Full eradication protocols will apply to all detection and outbreaks until eradication is declared. This includes SIT at a release density of 320,000 sterile flies per mi^2 (500 flies per acre), extended bait sprays with malathion or spinosad, and fruit stripping. Commercial fruit harvested in the outbreak area may be subject to post harvest treatments according to the Texas Protocol wherein Cameron County is identified as Production Zone 5.

Hidalgo County has the majority of the citrus production in the LRGV. This county also has the highest number of Mexican fruit fly detections over the last several years (Table B-2). APHIS operations in Hidalgo County are primarily suppressive in nature. Trapping is conducted at 5 traps per square mi^2 and SIT releases vary from ca. 250,000 to 320,000 flies per mi^2 (400 to 500 flies per acre). Bait sprays are applied, and fruit stripping conducted, in response to all Mexican fruit fly detections in Hidalgo County. The two primary operational concerns here are protecting Cameron County from new introductions and suppression to a sufficient degree to prevent production zones identified by the Texas Protocol from reaching regulated status. Hidalgo County is subdivided by the Texas Protocol into Production Zones 1, 2, 3 and 4 (Map 1). A production zone comes under regulated status during the citrus shipping season (September through May) when one or more wild Mexican fruit flies are detected in 5% of the total one mi^2 blocks or when 1.5% of the total blocks in a production zone has two or more wild Mexican fruit fly captures.

APHIS IS in northern Tamaulipas is conducting a suppression program. Trapping is conducted on a weekly servicing schedule at a density of 5 traps per mi^2 (Table B-1). The primary trap used for *Anastrepha* detection is the Multilure trap using a water/antifreeze mix and baited with the 3-component Biolure (Suterra LLC, Bend, OR). The 3-component lure is used as an extra measure of security against the possible introduction of the Mediterranean fruit fly, *Ceratitis capitata* Wiedemann. Jackson traps baited with Trimedlure, Cuelure and Methyl Eugenol are utilized to detect Mediterranean fruit fly and various *Bactrocera* species. SIT releases are made over the seven population centers aligned along the southern side of the border stretching from Matamoros on the eastern coast to the small municipality of Miguel Aleman in northwest Tamaulipas (Maps 13, 14; Figure C-4). Releases are made on a weekly basis at densities ranging from ca. 50,000 to 112,000 per mi^2 (80 to 175 per acre) (Table B-5). In 2008, Mexico granted APHIS permission to apply ground sprays of malathion both preventively and in reaction to new detections (Map 11). Some fruit stripping is also conducted as circumstances warrant.

Enhanced Cross-Border Coordination

The Texas and Mexico areas of the LRGV Mexican fruit fly program function as independent units. There is insufficient cross-border coordination to ensure that successful eradication will be achieved in the most efficient manner. The international border should be disregarded so that the entire eradication area is considered as a single unit. A comprehensive, multi-stage plan should be implemented to ensure continuous progress of the eradication effort. Progress may be limited by the funding level, however an eradication strategy that allocates resources based on the stage of the eradication program should result in incremental successes. Control actions south of the international border should complement eradication actions in Texas. Enhanced coordination and harmonization of key operational tools (e.g., trap and lure types, trap servicing frequency, and SIT release densities) should increase program efficacy.

A major consideration for enhancing the eradication strategy is inclusion of SAGARPA as a full cooperator in this international effort. The highest risk pathway threatening the success of the LRGV eradication effort is the movement of Mexican fruit fly-infested host material from southern Mexico. Infested fruits are transported from generally-infested areas in the south to be sold in the Mexico-U.S. border areas. The implementation of effective road stations could significantly reduce the approach rate of this infested material. This is critical to both the short-and long-term success of the project as well as for maintenance of current Mexican fruit fly free areas in Nuevo Leon (Map 15). Road stations should be established within Tamaulipas as the eradication program advances from eastern municipalities to the west. Checkpoints at major transportation routes would provide protection of Mexican fruit fly free areas in Mexico as they are recognized.

SAGARPA is currently conducting surveillance in the most northwestern end of Tamaulipas. Detections will be treated with malathion bait sprays to prevent movement of Mexican fruit fly into the recently declared free area in northern Nuevo Leon. This effort complements that being conducted by APHIS IS in northeastern Tamaulipas. Through coordinated surveillance and mitigation efforts, the entire LRGV will be included in the eradication effort.

Short-Term Multi-Stage Eradication Strategy

The short-term eradication strategy should be to achieve eradication as quickly as available resources allow, applying all needed operational tactics for as long as is required. Geographic progress would be limited based on financial resources. Declaration of eradication would depend upon meeting a number of specific criteria in a target area (NAPPO 2004). Eradication should not be based on declaration of the entire LRGV. It should not be programmed to fit a predetermined time table unless there is a large infusion of financial support. However, the more rigorously and uniformly required mitigation measures are applied, the faster the Program should progress towards satisfying the requirements of the multi-stage strategy (Table B-6).

The key strategy in the LRGV eradication program is linkage of corresponding areas north and south of the border to ensure that operational activities are conducted in a coordinated manner (Table 6; Maps 16 - 19). Specific operational areas will be defined by three main tactical operations (Table B-7):

1. Maintenance of current Mexican fruit fly free areas
2. eraDication
3. Suppression

The program in Texas should continue implementing eradication tactics already underway, moving from the natural barrier on the east, the Gulf of Mexico, to the west (Map 16). Willacy County was declared Mexican fruit fly free in 2007 and the eradication effort shifted to Cameron County. The Mexican municipalities of Matamoros and Valle Hermoso, immediately to the south of Cameron County (Map 16), require concurrent implementation of harmonized eradication tactics. That is, APHIS IS should increase its trapping array to 10 traps per mi^2 with a two week servicing interval. The density of sterile fly releases should increase to 250,000 to 320,000 flies per mi^2 in high risk, urban areas of Matamoros and Valle Hermoso. The reaction to any detection in Cameron County, Matamoros, or Valle Hermoso should include the mitigation measures delineated in the multi-stage strategy (Table B-7). Eradication activities in Cameron County protect the fly free areas in Willacy County.

Similar cross-border pairings should occur as the eradication program progresses from east to west (MAP 16). Specific tactical operations (Table B-7) should be assigned to each area to ensure continued progress of the overall eradication strategy. During the eradication period in Cameron County, Matamoros, and Valle Hermoso, suppression with SIT should be applied to Hidalgo County, Rio Bravo, and Reynosa. Suppression without SIT should be applied in the northwestern Mexican municipalities of Diaz Ordaz, Camargo and Miguel Aleman. The Texas Action Plan for maintaining a Mexican fruit fly free area should be applied to the corresponding bordering areas of Starr County. A similar arrangement should apply to the border area stretching northwest from Miguel Aleman to Nuevo Laredo on the Mexican side as well as the free area from Roma to Laredo on the Texas side (MAP 16).

Upon declaration of eradication in Cameron County, Matamoros, and Valle Hermoso, eradication tactics should be implemented in the eastern half of Hidalgo County (Production Zones 3 and 4) and Rio Bravo (Map 17). Following eradication in these areas, western Hidalgo County (Production Zones 1 and 2) and Reynosa would be the focus of eradication tactics. It is anticipated that declaration of eradication would occur for all of Hidalgo County simultaneously. During Stage 3, eradication tactics should also be applied to the remaining program areas, as necessary (MAP 18). Maintenance tactics would be applied to Mexican fruit fly free areas.

Eradication efforts should be implemented progressively for each area as financial resources and outbreaks allow. An area should undergo active suppression, with or without SIT, until the front of the western-moving eradication effort reaches it, prompting the change to full eradication mode. Declaration of eradication would be dependent upon meeting the criteria outlined in NAPPO RSPM No. 17 (NAPPO 2004), which calls for one year of trapping at a specific density (10 traps/mi^2 for Mexican fruit fly) with no evidence of an established population. The Mexican NOM-023-FITO-1995 requirements should also be considered for Mexico (SAGARPA 1999), e.g., surveillance parameters. Once a specific area is declared eradicated, the conditions and restrictions of the Texas Protocol should no longer apply to movement of fruit from that area.

Long-Term Maintenance of Mexican Fruit Fly Free Areas

The long term strategy should be to maintain the LRGV as a Mexican fruit fly free area. The operational tools deployed for early detection and eradication of new introductions should include surveillance, bait sprays, and preventive SIT (Table B-7). International border controls and other regulatory measures should increase to prevent reintroduction of this species. The importance of SAGARPA road station checkpoints south of the fly free areas cannot be overstated. The movement of infested host material from south of the LRGV program area will continue to represent a high risk pathway for Mexican fruit fly outbreaks. Significantly reducing the flow of infested material from central Tamaulipas and points south will be critical to long-term maintenance of the LRGV fly free area.

Maintenance of fly free areas should include focusing of SIT release operations over human population centers in Texas and Mexico (Table B-7; Map 19). This preventive release program (PRP) at a density of 200,000 sterile Mexican fruit flies per mi^2 should be most effective in high risk areas where infested host material is most likely to be introduced. This will represent a shift from targeting commercial citrus groves. Surveillance would continue across the entire LRGV. Traps should be deployed at a density of 5 traps per mi^2, serviced every two weeks. Emergency response capabilities will have to be maintained and fully implemented in response to any new detections or outbreaks as they occur. The continued production of sterile Mexican fruit fly in the fly free area will require a high level of biosecurity at the Edinburg production facility.

Recommendations for Eradication Strategy

ES1. Implement population suppression actions in a coordinated, fully integrated manner in Texas and Tamaulipas.

ES2. Implement the same trap densities, trap type, trap servicing frequency, frequency of bait sprays, and sterile release densities across the program.

ES3. Establish an eradication strategy based on four operational stages (Table B-6), including:

Stage 1. (Map 16)

- ❖ Implement an eradication strategy with SIT and bait sprays in the eastern most counties/municipalities this includes Cameron County and Matamoros and Valle Hermoso Municipalities.
- ❖ Implement a suppression strategy with SIT and bait sprays in Hidalgo County and Reynosa and Rio Bravo Municipalities. Intensive bait sprays should be applied to the Rio Bravo citrus groves on the same schedule as the certification treatments in Texas as a preventive measure. These groves have been identified as hot spots and a possible source of reinfestation of the municipality.
- ❖ Implement an intensive suppression strategy with bait sprays in Miguel Aleman, Camargo, and Diaz Ordaz Municipalities and corresponding areas of Hidalgo and Starr Counties.

SAGARPA implements surveillance and bait sprays in Tamaulipas between Miguel Aleman and Nuevo Laredo.

Stage 2. (Map B-17)

- ❖ Maintenance of Mexfly free area in Willacy, Cameron, and Starr Counties; area from Roma to Laredo; and Valle Hermoso and Matamoros Municipalities.
- ❖ Implement an eradication strategy with SIT and bait sprays in eastern Hidalgo County (zones 3 and 4) and Rio Bravo Municipality.
- ❖ Continue suppression with SIT and bait sprays in western Hidalgo County (zones 1 and 2) and Reynosa Municipality.
- ❖ Continue an intensive suppression strategy with bait sprays in Miguel Aleman, Camargo, and Diaz Ordaz Municipalities and corresponding areas of Hidalgo and Starr Counties.
- ❖ SAGARPA continues surveillance and bait sprays in Tamaulipas between Miguel Aleman and Nuevo Laredo.

Stage 3. (Map 18)

- Maintain Mexfly free area in Willacy, Cameron, Starr, and eastern Hidalgo Counties; area from Roma to Laredo; and Valle Hermoso, Matamoros, and Rio Bravo Municipalities.
- Implement an eradication strategy with SIT and bait sprays in western Hidalgo County (zones 1 and 2) and Reynosa Municipality.
- Implement eradication strategy with SIT and bait sprays in Miguel Aleman, Camargo, and Diaz Ordaz Municipalities.
- SAGARPA implements eradication strategy with bait sprays in Tamaulipas between Miguel Aleman and Nuevo Laredo.

Stage 4. (Map 19)

- Maintain LRGV as Mexfly free area.
- Implement a preventive release of sterile Mexfly in high risk areas.

ES4. The eradication strategy should employ maintenance, eradication and suppression tactical operations (Table B- 7), including:

Maintenance of Mexican fruit fly free area

- Surveillance at 5 traps per mi^2, serviced at a two week interval.
- A preventive release program is recommended for high risk areas at 100,000 sterile males per mi^2 or 200,000 male/ female per mi^2.
- Use the Texas Mexfly Action Plan considering the following points:
  - The trigger for an outbreak without SIT is 5 wild flies within a 3 mi radius in one life cycle, one mated female, or immature stages.
  - The trigger for an outbreak with SIT is 5 wild flies within a 3 mi radius in one life cycle or an immature stage.
  - Bait sprays at a 500 meter radius around a wild Mexfly detection for one life cycle after the last fly is detected.
  - Declaring the outbreak eradicated would occur after two life cycles of negative trap catches.

Eradication

- This includes 10 traps per mi^2 serviced on a two week interval and SIT within a range of 250,000 to 320,000 sterile (males and females) per mi^2 (400 to 500 sterile flies per acre).
- Include at least one Multilure trap torula yeast trap per mi^2 in accordance with the Mexican fruit fly free protocol for declaring a free area (SAGARPA 1999).
- The response to a wild Mexican fruit fly detection will be bait sprays at 500 meter radius around a wild detection for a minimum of three life cycles or ten bi-weekly applications; fruit sampling; and the trap servicing interval of seven days within a 4.5 mi^2 radius of the detection for a three life cycles.
- The response to an outbreak (5 flies within a 3 mi^2 or immatures) would include bait sprays and fruit stripping in non-commercial areas within a 500 meter radius of all detections and regulatory treatments for movement of commercial hosts out of the one mi core of the outbreak.
- Declaration of eradication would be based on the NAPPO RSPM No. 17. One year of trapping at the specified trap density with no evidence of an established population, e.g., no outbreaks. Documentation of all detections and mitigation measures should be maintained.

Suppression with SIT and bait sprays

- The density of sterile flies will be at a range of 115,000 to 320,000 per $mi^{2.}$ (175 to 500 per acre).
- Surveillance at 5 traps per mi^2, serviced at a two week interval.
- Trap servicing in the production zones will be at a seven day interval during the harvest season.
- Bait sprays at a 500 meter radius around a wild Mexican fruit fly detection for a minimum of three life cycles or ten applications at a two week interval.
- Fruit sampling for one life cycle within a 250 meter radius of the detection.

Suppression with bait sprays

- Surveillance with intensive trapping will be at 10 traps per mi^2, serviced at a two week interval.
- Bait sprays at 500 meter radius around a wild Mexican fruit fly detection for a minimum of three life cycles or ten applications at a two-week interval.
- Fruit sampling for one life cycle within 250 meters of a detection.
- No SIT will be used in this area.

ES5. Establish SAGARPA as a cooperator in the eradication effort. SAGARPA involvement should be incorporated into the U.S. – Mexico harmonization plan.

ES6. Conduct a cost benefit analysis to determine the most economical long-term source of sterile pupae for preventive SIT to maintain Mexican fruit fly free areas in the LRGV. The analysis should consider the longevity of the Edinburg production facility, structural changes required to increase the level of biosecurity, repairs and preventive maintenance, and the cost of sterile pupae from other available sources.

3 Program Management

APHIS formed the Fruit Fly Program Executive Board (FFPEB) in 2006 as a policy setting and coordination group within APHIS to provide overall leadership for the exotic fruit fly safeguarding system. The FFPEB approved the APHIS Fruit Fly Strategic Plan 2006-2010 (USDA 2006) as the basis for fruit fly control activities and decision-making processes. Eradication of the Mexican fruit fly from the Lower Rio Grande Valley (LRGV) of Texas and northern Mexico was identified as a strategic goal of this plan.

Primary program management and administrative support for the LRGV Mexican Fruit Fly Eradication Program is based in McAllen, Texas and Reynosa, Tamaulipas, Mexico. APHIS is the lead agency at both locations; Plant Protection and Quarantine (PPQ) in Texas and International Services (IS) in Mexico. APHIS state, regional, and headquarter staff work with cooperators to review program progress, set annual goals, and develop budgets.

Operations Management

APHIS is the lead agency for the LRGV Mexican Fruit Fly Eradication Program. However, Texas and Mexico activities are managed separately through their respective chain-of-command, PPQ and IS. Two managers at APHIS headquarters in Riverdale, Maryland have responsibility for long-term planning and management of the LRGV program. Ed Gersabeck, IS Mexican Fruit Fly Program Technical Director, is the National Coordinator for the Mexfly Program. In this role, he is the first APHIS manager common to PPQ and IS lines of oversight for both Texas and Mexico LRGV program operations. His primary responsibilities include program planning, budget management, and coordination of resource utilization. These duties are conducted through periodic site visits and long distance communications. He is not on-site and is not involved with daily supervision of field activities. The other APHIS program manager assigned to Riverdale is Wayne Burnett, the APHIS Fruit Fly Coordinator. Mr. Burnett is responsible for all aspects of APHIS fruit fly control programs, both domestic and off-shore. In this capacity, his primary concerns are program planning, direction, coordination, and budget management. He reports directly to the FFPEB.

APHIS PPQ has program directors in McAllen and Austin, Texas that report directly to Stuart Kuehn, the State Plant Health Director (SPHD). The SPHD reports to the PPQ Western Regional Office in Fort Collins, Colorado. Robert Vlasik, Port Director in McAllen, is responsible for managing field activities in Texas. George Nash, Senior Program Manager for the SPHD in Austin, is responsible for program coordination. Mr. Nash makes routine site visits to McAllen and participates in planning and coordination of the field operations. He communicates issues, needs, and progress of the program to the SPHD and Regional Office.

APHIS IS has a program manager, Foreign Service Officer (FSO) Lizandro Gonzalez, in Reynosa. Mr. Gonzalez is the Director for APHIS IS Area 1 in Mexico (Map 20). He is responsible for all APHIS work conducted along the entire length of the U.S./Mexico border. This includes not only the LRGV Mexfly Eradication Program, but also Mexican fruit fly eradication in Tijuana, aquatic weeds, and cotton pests in the areas of northern Mexico immediately south of California and Arizona. Mr. Gonzalez reports to a supervisory FSO stationed in the APHIS IS office in Mexico City. This supervisor reports to Nicholas Gutierrez, the current Senior FSO in Mexico.

Separate management structures have resulted in inconsistencies in program operations. For example, while PPQ officials are working to eradicate Cameron County, the Mexican municipalities to the immediate south are still being treated as suppression areas (Map 16). Efficiencies for the overall eradication effort can be achieved by more closely aligning the field work on both sides of the border to allow for a more orderly implementation of specific field tactics and more rapid progress of each area from infested to free status.

The Review Panel recommends that a management team be established for the entire program, with one individual designated as the lead coordinator with decision making authority for both PPQ and IS. The duty station of this manager should be in the LRGV during the period of the eradication program. Monthly management meetings should be held to allow review of program progress and joint decision making by PPQ and IS. The lead coordinator should be responsible for communication among team members, finalizing the decision process, formulating budget requests, and be a direct liaison with the APHIS Fruit Fly Director. This management team should also meet at least quarterly with the other entities involved, including SAGARPA, the Comite Estatal de Sanidad Vegetal of Tamaulipas, TDA, and the Texas

Valley Citrus Committee, among others. This should facilitate communication of program progress and issues as well as coordinated decision making.

Resource Management

The systems utilized for resource management of the LRGV Mexfly Eradication Program follow the same agency-defined structure as the overall operational management. PPQ rules and systems are followed on the Texas side of the border and IS rules and regulations are utilized on the Mexican side. Budget development, financial planning, facility management, and personnel utilization are conducted according to each respective Agency's requirements and are, for the most, part similar. However, there are differences on each side, e.g., PPQ and IS cooperation with other entities that provide support to the Program. The current APHIS budget for the Mexfly Eradication Program is slightly more that $5 million a year. (Table B- 8).

The FY2009 PPQ budget was approximately $4.4 million net to field (Table B- 8). These financial resources were split between the field work and SIT production. The McAllen Work Unit, which includes the Harlingen Office and ERF, is supervised by Bob Vlasik and received just over $2 million to conduct the federal trapping and bait spray; and the Harlingen SIT packing, eclosion and release operations for approximately 190 million sterile pupae per week. John Worley, Director of the Mexican Fruit Fly Production Facility, received $2.4 million to produce approximately 200 million sterile Mexican fruit fly pupae per week for release on both sides of the border.

The PPQ McAllen financial resources are supplemented by several other sources to cover the operational costs (Table B- 8). PPQ Aircraft and Equipment Operations (AEO) provides a significant amount of subsidized release work, including the majority of costs for aircraft and pilot time for aerial releases from that location. AEO is located at Moorefield in Edinburg with the Mexican Fruit Fly Production Facility and Emergence and Release Facility. The McAllen PPQ budget pays the private contractor who conducts the majority of the releases from Harlingen. The TDA provides trappers to service MLT traps at a density of 5 traps per mi^2 over the entire program area. PPQ covers the total cost to service an additional 5 traps per mi^2 for a total of 10 traps per mi^2 required to declare eradication in Cameron County. The TDA cost for this work is estimated to be about $100,000 a year. Ground spray costs are shared by PPQ and the local commercial citrus producers. PPQ pays for the spinosad bait sprays in dooryards or non-commercial areas and the industry pays for malathion bait sprays in commercial citrus groves. Treatment in commercial citrus is approximately 95% of all ground spray costs, estimated to be about $80,000 a year. The citrus industry provides $179,000 per year to the

Mexican Fruit Fly Production Facility to supplement PPQ funding of sterile fly rearing. Recent decisions regarding ground spray tactics will place increased focus on dooryard spraying and will likely increase the PPQ cost share of this mitigation work.

On the Mexican side of the border, the APHIS IS budget for suppression activities in the seven Tamaulipas municipalities is approximately $670,000 per year (Table B- 8). These funds cover all activities conducted by the IS staff, including surveillance, bait sprays, sterile fly emergence, and aerial release activities. Approximately 25 million sterile pupae per week are processed and released from Reynosa. The releases are conducted by a private contractor who is paid from this budget. SAGARPA provides no additional resources directly to IS for this work. SAGARPA does conduct some surveillance in the extreme northwest corner of Tamaulipas and provides regulatory support as needed. SAGARPA recently granted permission for APHIS staff to apply malathion bait sprays in Tamaulipas in cooperation with the Comite Estatal de Sanidad Vegetal of Tamaulipas. The ability of APHIS to conduct these applications resulted in timely reaction to Mexican fruit fly detections.

One additional resource available to the LRGV program is sterile Mexican fruit fly produced at the San Miguel Petapa (SMP) Mexfly Production Facility in Guatemala. In FY 2009 PPQ provided $550,000 to produce and ship 16 million Mexfly pupae per week to the United States (Table B- 8). From January to May 2009 these pupae were provided to California to combat a Mexfly outbreak there. Once the outbreak was eradicated, the sterile pupae were immediately diverted to Texas for use on the eradication program. SMP will receive $967,000 in FY2010 to support the production and shipping of 30 million sterile Mexican fruit fly pupae per week to the LRGV. The Review Panel recommends that an amount equivalent to this increased production be provided to Reynosa in order to increase SIT release densities required for eradication blocks in Matamoros and Valle Hermoso. Additional funds may be required for an increase in ERF staff and aerial release flight hours in Reynosa, if the number of sterile flies released is increased.

An additional burden that must be borne by APHIS in the LRGV is the cost of mitigation measures triggered by the detection any *Anastrepha* of quarantine significance (e.g., *Anastrepha striata, Anastrepha serpentina,* and *Anastrepha obliqua*). These measures may include delimitation trapping, bait sprays, and increased regulatory controls. These activities may cost hundreds of thousands of dollars and any costs up to $700,000 are expected to be absorbed by the current Mexican fruit fly operational budget.

Budget Management and Planning

As stated above, the LRGV Mexican fruit fly eradication program is operating on an annual APHIS budget of approximately $5 million per year (Table B- 8). PPQ Texas receives $2 million for field work and SIT releases and an additional $2.4 million for sterile fly production. Additional support for the program comes via the Tri-Party Reimbursable Coop Agreement between APHIS, TDA and the Texas Valley Citrus Committee (TVCC). In addition to $4.4 million provided by APHIS, the TDA contribution of $100,000 per year supports survey work and the TVCC contribution of $179,000 per year supports sterile fly production. TVCC and individual growers also finance bait sprays in commercial groves (Table B- 8).

The IS Reynosa Work Unit receives approximately $670,000. These funds are for both field activities and SIT emergence and release operations. SAGARPA makes no direct payment to support the program work in Mexico, but does provide a building that houses the Reynosa ERF and program offices. IS renovated the building with APHIS funds.

The IS and PPQ budgets for the LRGV Mexican Fruit Fly Eradication Program are covered in the overarching APHIS Fruit Fly Exclusion and Detection (FFED) line item. All APHIS agencies participate in an annual operational and budget planning session in Riverdale, Maryland. Each program area presents operational updates and new financial requests for upcoming budget years. The group is tasked with setting priorities, both operational and financial, for presentation by the APHIS Fruit Fly Director to the APHIS FFPEB. The FFPEB takes the recommendations, modifies them as necessary, and sends them forward for final budget consideration and approval by the upper management levels of the USDA, Office of Management and Budget, and ultimately the U.S. Congress. While there have been some small additions to the FFED line item recently, the overall APHIS fruit fly budget has remained essentially flat for the last several years. This funding trend is expected to continue for the foreseeable future.

Final funding decisions are approved through the FFPEB, APHIS PPQ and IS Deputy Administrators, Regional Offices, and eventually the field level managers in Texas and Mexico. After operating budgets are set, there is no transfer of dollars between PPQ and IS. However, there is an opportunity to share resources such as trapping supplies and, most importantly, sterile pupae. Reynosa is currently provided with 25 million sterile pupae per week from Edinburg. This number can be modified depending upon decisions which are made locally. However, additional logistical and financial support may be required to allow for the full implementation of activities for each side of the border. For example, Reynosa operations may obtain additional sterile pupae from SMP Guatemala in FY2010. Additional funds are required for the extra staff and flight hours to release these flies. These funds should not come from the Texas PPQ operating budget, but from other APHIS funding sources.

The Review Panel has identified cross-border coordination as a key area for improvement. While the overall welfare of the program is considered by APHIS managers, there is no one person in charge to coordinate the work, finalize the needed financial decisions, and direct resource utilization for the entire program. In a period of fiscal constraints, it is very difficult for a local manager to reallocate resources for other aspects of the LRGV program. Establishing a LRGV Management Board headed by an overall Coordinator with decision making authority should facilitate efficient utilization of the operating budgets to meet program goals.

Program Planning

The LRGV Mexican Fruit Fly Eradication Program is currently managed as two separate operations which are being conducted in adjacent geographical areas. Two APHIS agencies are partners in the eradication effort. However, APHIS PPQ and IS function under different rules, regulations, and chains of command. While there are sufficient opportunities to work cooperatively, operations in Texas and Mexico do not function in the most efficient manner. Insufficient coordination of program activities is the greatest obstacle to improving program management and performance. Although PPQ and IS are effectively working within the scope of their authority and resources, opportunities for synergist interactions are being overlooked because operations are implemented differently in Texas and Mexico. Progress at one location should be matched with similar progress at the other, if the eradication program is to be successful in the long-term. The Review Panel strongly recommends that the LRGV Mexican Fruit Fly Eradication Program be fully integrated and coordinated across the Texas and Mexico border. All activities should be conducted according to the agreed upon tactical plan.

Program planning would improve in Texas and Mexico by integrated data management, e.g. surveillance data, host availability, and fruit movement. Maps of the LRGV eradication program should illustrate both Texas and Mexico. The Review Panel did not observe even one map at any office visited showing the entire program area. Data management and map making are done strictly on the basis of operational oversight – PPQ has maps of Texas traps, detections, bait spray sites, and SIT release blocks. IS in Reynosa has similar data management and mapping capabilities. Neither site had maps indicating the area-wide scope of the program. This issue was discussed at length and it was determined that some IT compatibility problems have prevented data sharing. This issue should be addressed immediately and whatever changes made to ensure that the IT communication networks existing within PPQ and IS are linked without problems. The Review Panel therefore recommends that all LRGV program data should be managed as one unit. All reports and maps should reflect the surveillance and treatment summaries for both Texas and Mexico. In order to facilitate the sharing of this data to outside entities and cooperators the Panel also recommends the establishment and maintenance of a QuickPlace website for the area-wide program. Access to the site (e.g., IDs and passwords) should be provided to all participants and stakeholders.

The eradication program in Texas is larger in scope than that in Mexico. Therefore, Texas requires more resources. PPQ in Texas is very effective in managing these resources and coordinating the associated activities. PPQ holds monthly meetings with program cooperators, including APHIS IS, CPHST, ARS, TDA and the TVCC. Issues of concern are discussed, e.g., the impact of Mexican fruit fly detections on fruit exports; budget status; technical questions; and operational strategies.

In order to enhance program-wide efficiencies, the Review Panel recommends establishing a management team for the entire LRGV program in Texas and Mexico. The management team should have one lead coordinator with decision-making authority and direct contact with the APHIS Fruit Fly Director. The team should include local program managers from PPQ and IS, operational program directors, and technical advisors. Decisions for the entire program should be made jointly by the PPQ and IS counterparts, with input from all cooperators. The lead coordinator should convene a monthly management team meeting to evaluate program status and make decisions on program direction. The lead coordinator should be responsible for communication among team members, finalizing the decision making process, formulating final budget requests, and liaison with APHIS Fruit Fly Director.

In the past program staff from the Reynosa IS work unit met on a regular basis with SAGARPA and the Mexican citrus growers association in central Tamaulipas. These meetings provided an opportunity to discuss issues of common interest in eradication of Mexican fruit fly. These meetings were discontinued when the former IS FSO in Reynosa retired. The FSO for IS Area 1, should strongly consider participation in such meetings as soon as possible. Representatives from the Texas PPQ program should also participate in regular meetings with SAGARPA.

International cooperation and coordination should be encouraged through quarterly, or more frequent, meetings of the LRGV Management Team with SAGARPA and the Comite Estatal de Sanidad Vegetal of Tamaulipas. Participants would discuss the status of each program and common issues of concern. Enhanced overall coordination would also be achieved by convening a program-wide annual meeting that includes all stakeholders in both Mexico and the U.S. Participants would review program progress and establish tactical goals for the following year.

The LRGV Mexican Fruit Fly Eradication Program could benefit from periodic review by external technical and operations experts. Technical and scientific experts available in the LRGV assist local supervisors in program operations. However, external experts may provide useful recommendations. Many of the CPHST and ARS scientists located in the LRGV routinely work on program issues. In fact, many are deeply entrenched in technical aspects of program design, evaluation, and execution. This may result in unintentional bias in program operations. In addition, persons working closely on the program may be reluctant to criticize their cooperators. In order to eliminate potential conflict of interest, the Review Panel recommends that a Science Advisory Panel (SAP) composed of national and international experts be established. The SAP should meet on a regular basis to review the progress of the eradication program and technical issues impacting that progress. This SAP should provide an independent assessment of the program and make recommendations regarding operations for consideration by the Management Team and the Coordinator.

Another opportunity for enhanced program planning identified by the Review Panel is participation of SAGARPA in program management. Over recent years SAGARPA has expended a great deal of time, funds, and effort to create low prevalence areas in citrus production zones of central and southern Tamaulipas. While some success has been achieved, these areas still harbor significant and well-established Mexican fruit fly populations. The goal of these SAGARPA programs is compatible with that of the LRGV program, movement of commercial citrus without costly post-harvest treatments.

Expanded participation of SAGARPA in the LRGV eradication effort should strengthen efforts to establish Mexican fruit fly free areas throughout Tamaulipas. A key tactical activity would be the establishment of effective roadside check points that prevent or at least significantly reduce the movement of infested host material. The insect population levels are much lower along the northern border than in central Tamaulipas, therefore SAGARPA should implement road station check points when a new free area is close to establishment.

Road stations should be relocated as the eradication program progresses in order to protect additional free areas as they are recognized. Free areas established along the northern border of Tamaulipas would protect the free area in northern Nuevo Leon (Map

15). The logical progression of eradication activities would be from the natural low prevalence areas in northern Tamaulipas to areas of higher Mexican fruit fly populations to the south.

SAGARPA has managerial and administrative capabilities that could greatly assist the LRGV eradication effort. There are many trained managers and scientists in SAGARPA with a great deal of experience in managing field activities. Procurement arrangements could result in large benefits to the LRGV program, if used properly. For example, SAGARPA purchase of pesticides for bait spray applications in the northern municipalities would result in a great savings to the LRGV program. The Review Panel recommends that APHIS should approach SAGARPA and request their full cooperation in this eradication effort that benefits both Mexico and the United States. A request should be made to SAGARPA to make contributions, such as bait sprays, for use in Mexico. In addition, SAGARPA should develop and implement a public information campaign in Tamaulipas to deter movement of infested fruit into northern Tamaulipas, conduct regulatory inspections at markets and road side stands, and establish effective road stations check points to protect free areas.

Program management and execution requires personnel with experience in operational programs. Critical knowledge and skills are gained through 'hands-on' work experience and observation. Therefore, succession planning for key program personnel is essential. The program should identify positions which may be vacated within one to two years (e.g., due to retirement). One or more program personnel should be trained to undertake those duties. This should facilitate a smooth transition and ensure continued progress of eradication activities. Succession planning was observed in the hiring of an Assistant Director of the Mexican Fruit Fly Production Facility.

Recommendations for Program Management

PM1. Fully integrate the LRGV Mexican Fruit Fly Eradication Program and coordinate activities across the Texas and Mexico border.

PM2. Conduct all activities according to the agreed upon tactical plan.

PM3. Establish a management team and designate one lead coordinator. Include program managers from PPQ and IS, operational program directors, and technical advisors in the management team.

PM4. Establish a joint decision making process for the entire LRGV eradication program.

PM5. The lead coordinator should convene a monthly management team meeting to evaluate program status and make decisions on program direction.

PM6. The lead coordinator should be responsible for communication among team members, finalizing the decision making process, formulating final budget requests, and liaison with APHIS Fruit Fly Director.

PM7. Establish a Science Advisory Panel (SAP) composed of national and international experts that meet quarterly to review the progress of the eradication program and technical issues impacting that progress. This SAP should provide an independent assessment of the program and make recommendations regarding operations for consideration by the Management Team and Coordinator.

PM8. Approach SAGARPA to request their cooperation in the eradication effort which is of mutual benefit. SAGARPA may contribute resources such as spinosad, malathion, and hydrolyzed protein for bait sprays in Mexico, public information campaign, inspections at markets, and establishment of checkpoints to protect free areas.

PM9. The management team should meet quarterly, or more frequently, with SAGARPA and the Comite Estatal de Sanidad Vegetal of Tamaulipas to discuss the status of common issues.

PM10. Hold an annual meeting to include all stakeholders to review program progress and establish tactical goals for the next year.

PM11. Manage data as one unit. All reports and maps should reflect the surveillance and treatment summaries for Texas and Mexico.

PM12. Facilitate information sharing by establishing a QuickPlace website. Provide access to the site for all participants and stakeholders.

PM13. Implement a succession plan for key operational program positions. This should facilitate a smooth transition and ensure continued progress of eradication activities.

4 Surveillance

Surveillance is a basic tool for detection and monitoring of insect pests. Surveillance is critical to effective application of control measures against pest fruit flies. When surveillance is absent or applied inappropriately, it can be the single factor for failure of population suppression measures. In areas such as the LRGV where the prevalence of Mexican fruit fly is naturally low, surveillance is of utmost importance. Increasing the overall performance of surveillance activities should result in more effective eradication efforts by allowing for early detection of, and response to, Mexican fruit fly in the target area.

Traps and attractants are used in surveillance to estimate the incidence of the target pest in a defined area. The APHIS National Fruit Fly Trapping Committee reviews scientific data from trap and lure evaluations and provides guidance on appropriate detection technology and its application (USDA 2007a). The effectiveness of Mexican fruit fly surveillance is dependent upon proper and consistent deployment of traps and lures. Mexican fruit fly traps use a food-based attractant such as torula yeast or the 'Biolure' three-component (trimethylamine, putrescine, and ammonium acetate) or two-component (putrescine and ammonium acetate) formulations. In addition, borax or propylene glycol in water is used as a preservative. Traps and lures may differ in effectiveness, catching different numbers of Mexican fruit fly at the same location. This makes it difficult to compare the number and distribution of detections to determine the failure or success of control strategies and tactics. Therefore, the trap type, attractant, and preservative, as well as the density and servicing interval, should be consistent across the operational program to facilitate data management and analysis.

Fruit sampling complements trapping for surveillance of the Mexican fruit fly. Fruit sampling is particularly useful when trap efficiency is low, in areas under SIT, or in outbreak areas to determine the presence of a reproducing population. This may be of particular benefit in areas with very low Mexican fruit fly populations, such as the current situation in the LRGV during the hot summer months or prior to the citrus maturation. Fruit sampling should target alternate hosts, e.g., sour orange, that may be the source of immatures.

Surveillance for the LRGV Mexican Fruit Fly Eradication Program is conducted by APHIS and the TDA. Costs for this surveillance program are shared in Texas and APHIS fully funds the operation in Mexico (Table B-s 1 and B-8).

Trapping

Two trapping strategies were observed in the LRGV Mexican Fruit Fly Eradication Program (Table B- 1). In Texas the trapping program deploys Multilure traps baited with torula yeast pellets in a 5% Splash solution (Appendix B). Splash is a commercially available propylene glycol-based marine grade coolant. It is used as a preservative to facilitate identification of insects caught in the traps. The trap density is 10 traps/mi^2 in Cameron County and 5 traps/mi^2 in the remaining program areas. Traps are serviced at a one week interval. This trapping protocol supports the systems approach developed for the movement of commercial hosts from the LRGV.

In Mexico the trapping program deploys MLT baited with the Biolure three-component lure and 5% Splash (Table B- 1; Appendix B). The use of the three-component lure for detection of Mexican fruit fly remains the subject of debate by the scientific community (Diaz-Fleischer *et al*. 2009; Thomas *et al*. 2008). Field evaluations have indicated a repellent effect of trimethylamine to Mexican fruit fly and this component is removed from the two-component formulation. Evaluation by CPHST in Texas indicated that the detection pattern and number of Mexican fruit fly for the three-component and two-component lures were not significantly different. Biolure is currently deployed in individual plastic bags, however a solid 'cone' formulation of the three component lure is under consideration by the APHIS National Trapping Committee. In this formulation the trimethylamine may not have a repellent effect.

Trapping activities observed in Texas and Mexico appeared to be performed correctly. However, trap servicing records indicated a low servicing rate in Texas. This appeared due to absences of the TDA trappers from illness, holidays, or temporary re-assignment to other projects. The schedule and staffing was not adjusted to allow continuous trap servicing. Quality control of the surveillance program was under TDA. It was not apparent what quality control protocols were in place or how frequently these activities were conducted. Incomplete servicing and quality control records could result in issues with acceptance of Mexican fruit fly free areas.

Data management systems are maintained in the Harlingen office (Appendix B). The staff is well-trained for database and mapping activities. Detection data from Texas and Mexico units was not managed in the same database. Information Technology issues (e.g., dial-up internet connection in Reynosa) impede the transfer of data from the Reynosa APHIS office to the Harlingen office where the database is maintained. Maps and reports were generated separately for the each unit.

Identification

Identification of fruit flies captured in traps is an important part of the surveillance program. All fruit fly specimens collected are submitted to work unit officers trained in fruit fly identification. During this process, fruit flies are separated by species, sterile vs. wild, and the mating status of wild females is determined (Figures. C-5 and C-6). Sterile Mexican fruit flies are marked with an external fluorescent dye, however in some instances the dye is lost or difficult to see. Captured Mexican fruit flies without observable dye are dissected to determine the status of gonad development. Undeveloped gonads in a specimen with mature body coloration indicate that it has been irradiated. When the identification of a wild Mexican fruit fly is confirmed, the action taken by APHIS personnel is dependent upon the sex, mating status, and number within a 3 mi^2 radius of the detection trap.

Accurate identification of wild and sterile flies is central to program management and application of appropriate tactics. Failures in this activity can lead to implementation of unnecessary actions and can be costly in terms of funds and time expended, e.g., misidentification of sterile flies can result in delimitation actions.

The number of sterile Mexican fruit fly in each trap is recorded, but not the sex of those flies. Documenting the number and sex of captured Mexican fruit fly will provide valuable information for assessing control tactics, e.g., longevity and dispersal of sterile males; over-flooding ratio for wild mated females. This single piece of data may be necessary for acceptance of Mexican fruit fly free areas and is likely to reduce unnecessary mitigation measures.

There are three identification laboratories in the LRGV: McAllen, TX; Harlingen, TX; and Reynosa, Tamaulipas (Appendix B). The laboratories were located in separate rooms with doors that could be closed for work in low/no light conditions. Each laboratory has the capability of transmitting via the internet information captured by a digital camera and microscope. This allows for immediate confirmation of identifications and sharing of information within the program and with APHIS identifiers at other locations. Some upgrading of equipment and laboratory tables would provide a more ergonomic and efficient work environment for staff.

The number (Table B- 1) and skill level of staff appeared adequate for the current level of activity. However, an increase in the density of sterile flies released, an increase in the density of traps, or recording of additional data (e.g., sex of sterile flies) may require an increase in the number of identification staff.

Geographic Information Systems

The use of Geographic Information Systems (GIS) is routine in the LRGV Mexican Fruit Fly Eradication Program. All trap locations are identified by global position system (GPS) coordinates. Texas trap data from identification laboratories is entered into an Access (Microsoft) database with oversight at the Harlingen APHIS office (Appendix B). Data is collected and transferred to the computer in a timely fashion and detections are depicted on maps (Maps 2 - 11). Mexico trap data is managed and mapped separately because of problems transmitting data via the internet.

The use of more sophisticated GIS applications including tools for querying attributes, querying locations, and editing of geographical and tabular data would facilitate program management decisions. GIS that incorporates additional vector layers may provide tools for better understanding the ecology of Mexican fruit fly populations and the efficacy of control measures. Features of interest may include, among others, commercial production zones, abandoned citrus groves, location of wild hosts, presence of water sources, and location of ethnic markets and roadside fruit stands. In practice an area layer of groves, wild hosts or dooryards might be cross-referenced with trap capture data to better understand the distribution and behavior of Mexican fruit fly individuals and populations.

Recommendations for Surveillance

S1. Deploy the same trap and lure combination in Texas and Mexico. Use the most effective traps based on scientifically-sound data generated by CPHST and ARS-Weslaco.

S2. Standardize the trap density and servicing interval in accordance with the tactical plan employed in each area (Table B- 7). In maintenance areas, 5 traps per mi^2, serviced at a two week interval. In eradication areas, 10 traps per mi^2 serviced at a two week interval and include at least one MLT baited with torula yeast in Mexico. Suppression areas with bait sprays and SIT, 5 traps per mi^2 serviced at a two week interval. Suppression with bait sprays, 10 traps per mi^2 serviced at a two week interval.

S3. Establish an alternate schedule or relief staffing for trappers so that traps are serviced on a regular schedule. TDA should make a commitment so that the trappers are dedicated to the program and not diverted to other TDA activities. Trap servicing records indicate that traps on a one week servicing schedule may be skipped for up to three weeks when the TDA trapper is absent due to holidays, illness, or assignment to another project.

S4. Replace vehicles with more than 100,000 miles. Improve operating costs by using more fuel-efficient trucks for trapping program. Increase safety of trappers by the use of more reliable trucks.

S5. Standardize equipment and protocols in the identification labs.

S6. Upgrade equipment in the identification laboratories, e.g., fluorescent lights, ergonomic microscope tables.

S7. Standardize information for databases, e.g., number and sex of sterile and wild flies.

S8. Manage data for Texas and Mexico surveillance activities at the Harlingen office.

S9. Facilitate data transfer from Mexico to Harlingen. Upgrade the internet connection at the APHIS Reynosa office and/or manually transfer data at least two times per week.

S10. Conduct quality control of the surveillance program. APHIS should be responsible for establishing quality control standards and conducting quality control audits of all detection staff.

S11. Use GIS applications to facilitate program management decisions. Incorporate additional data layers to improve the understanding of program effectiveness and Mexican fruit fly ecology.

5 Chemical Control

Bait sprays are the only chemical control tool being used for suppression of fruit fly populations in the LRGV Mexican Fruit Fly Eradication Program (Table B- 2). They are typically a mixture of an insecticide (e.g., spinosad or malathion) and a food-based attractant (e.g., hydrolyzed yeast). Ground technologies are used for bait spray applications. In the LRGV, ground sprays in commercial groves are made with the 'Mockingbird' sprayer on a modified all-terrain vehicle (Table B- 2, Appendix B). In non-commercial sites trombone-type backpack spray units are used to apply bait sprays. In Texas, the citrus growers conduct malathion bait sprays in commercial groves as a preventive measure or in response to a detection. APHIS responds to detections with spinosad in dooryards or other non-commercial sites in Texas and malathion at all detection sites in the seven Mexico municipalities.

The life cycle concept is central to bait spray applications and other program management activities. The LRGV Mexican fruit fly program uses a set time period of 30 days as one life cycle. A more accurate and biologically-significant definition would be based on a degree-day model. A degree-day model should include development data derived from wild Mexican fruit fly at a series of relevant temperatures that includes the upper and lower range of temperatures in the LRGV. The pre-oviposition period of wild females is critical to establishing a valid degree-day model for predicting life cycle duration and must be included in the calculations.

Bait Spray Activities

Commercial citrus groves in regulated zones of Texas may receive regular bait spray treatments as an alternative to post-harvest fumigation of fruit as provided in 7 CFR 301.32-10-b Part 305. These treatments must take place at 6 to 10 day intervals, starting a sufficient time (e.g., one life cycle) before harvest. Under the terms of the Texas Protocol, the contractor is monitored by APHIS.

The detection of a wild Mexican fruit fly in dooryards and urban areas results in APHIS application of bait sprays in a 500 meter radius around the detection. Spinosad applications in Texas occur at 7 to 10 day intervals for three life cycles. Malathion bait sprays in Mexico occur at 10 to 14 day intervals for three life cycles. Applications of malathion bait sprays in commercial or production orchards in Texas are conducted by a private contractor hired by industry and occur at 10 to 14 day intervals for three life cycles. APHIS staff has the required training to conduct and oversee bait sprays. However, additional staff may increase the efficiency of the operation.

Bait sprays were applied at the site of all Mexican fruit fly detections in Texas for the past four years and in Mexico for the past two years (Table B- 2; Maps 4 - 7). Although no statistical analyses have been conducted, application of bait sprays appears to have benefited the program. This observation is based on the decline in the number of wild flies trapped during the next year at sites that were sprayed during the previous year. For example, of 33 detection sites treated in 2008, only 4 sites had wild Mexican fruit fly captures in 2009 (Maps 6 & 7). This indicates that bait sprays may be useful as a preventive measure in areas with historical records of detections.

The high cost of spinosad restricts the broader use of bait sprays by APHIS. It was noted that the cost of this material, GF-120NF (Dow AgroSciences, Indianapolis, IN), is $111 per gallon in the United States. This is significantly more than the $5 per liter (ca. $20 per gallon) paid by the MOSCAMED program in Mexico and Guatemala. This cost difference may be due to bulk purchasing to accommodate the broader use of the GF-120NF by MOSCAMED in Mexico and Guatemala. The LRGV program requires approximately 6, 50-gallon drums per year. It was noted that the spinosad purchased by the MOSCAMED program is not labeled for use in the United States. Therefore APHIS programs in the U.S. cannot participate in the bulk purchase.

Other Chemical Control Tactics

Bait stations have been considered over the past 10 years as an alternative to bait sprays for suppression of Mexican fruit fly populations. Although the bait station concept is simple in theory, the application has proven more difficult. The concept is to deploy a weather-resistant, biodegradable unit in the field that can attract and kill wild Mexican fruit flies for a minimum of eight weeks. In contrast to bait sprays which are subject to degradation by rain and direct sunlight, the insecticide in bait stations is stabilized in a matrix. Initial distribution of bait stations would require a significant effort by field staff, however this may be off-set by a reduction in staff hours and insecticides required for bait spray applications every 10 to 14 days for three life cycles. Availability of a bait station with effectiveness for a period longer than eight weeks may result in an even greater savings to the program.

A candidate bait station is being evaluated in open field studies by APHIS in Guatemala. Validation of this technology for use against the Mexican fruit fly in Texas is necessary before a decision is made to implement bait stations in the eradication program. The cost per unit of the current configuration is approximately $3.00. The final cost is dependent upon the number of units per mi^2 required for population suppression and the longevity of the bait station in the field.

Recommendations for Chemical Control

CC1. Intensify the use of bait sprays in high risk areas.

CC2. Identify hot spots and apply bait sprays at least one life cycle before historical first detection is made each year.

CC3. Continue bait spray treatments for two years at the site of detections in eradication areas.

CC4. Apply preventive ground bait sprays on sour orange trees and dooryards.

CC5. Request assistance from SAGARPA to obtain spinosad, malathion, and hydrolyzed protein for bait spray applications in Mexico.

CC6. Evaluate the implementation of bait stations as an alternative to bait spray treatments. Bait sprays must be applied approximately every 10 days. Bait stations that actively attract and kill Mexican fruit fly in the LRGV over a period of six to eight weeks would reduce the personnel, vehicle, and chemical costs associated with bait spray applications.

CC7. Analyze the effectiveness of bait spray applications on subsequent wild fly detections. There is a general agreement that the bait sprays at detection sites has a positive impact on population suppression. This has not been documented through statistical analysis.

CC8. Use a validated degree-day model for calculation of life cycles. This model should be based on developmental data from wild Mexican fruit fly reared at a range of temperatures. The 30 day assumption is not biologically-significant.

6 Sterile Insect Technique

The sterile insect technique is central to area-wide suppression of Mexican fruit fly populations. SIT involves the mass production (Appendix B), irradiation (Appendix B), and release (Appendix B) of sterile Mexican fruit fly in the target area. The sterile males disperse and mate with wild females. Because wild females mated with sterile males do not produce offspring, the wild population declines with continuous sterile releases. The efficacy of SIT is dependent upon the ability of the sterile males to disperse in the environment and compete with wild males for mates. Therefore, evaluations are required to monitor the quality and performance of flies during the production, emergence, and release phases of SIT (FAO/IAEA/USDA 2003). Surveillance traps are used to monitor the dispersal of sterile flies and estimate the over-flooding ratio (number of sterile males to wild flies).

Success of SIT requires continuous releases of large numbers of sterile flies into the target area. The density of sterile flies released, measured as the number of sterile flies per mi^2, is dependent upon the goal of the operational program. Eradication requires the highest over-flooding ratio, whereas population suppression and maintenance of fly-free areas require a lower density of sterile males. The density required is also dependent upon the topography, host phenology, and human activities in the target area. Eradication programs are multi-tactical in nature, integrating bait sprays to reduce the incidence of wild flies and SIT to reduce the population to zero. SIT then becomes a tool for maintenance of a fly-free area by preventing the establishment of any wild flies that subsequently enter the area. These tactics have been demonstrated in periodic Mexican fruit fly eradication programs in California, in eradication campaigns in Mexico, and as part of a systems approach in the LRGV of Texas.

The general strategy for establishing and maintaining Mexican fruit fly free areas in the LRGV of Texas and northern Tamaulipas is based on systematic application of SIT. Used in conjunction with bait sprays targeted at detections, a sterile fly release rate of 320,000 per mi^2 (500 per acre) has been successful in eradicating Mexican fruit fly from Willacy and Cameron Counties in Texas (Table B- 5). Although this rate was initially based on the availability of sterile flies, this successful field demonstration indicates that this release rate should be sufficient for eradication from the remaining program areas. Lower densities may be required in maintenance and suppression (Table B- 7).

Sterile Mexican Fruit Fly Production

The Mexican fruit fly production facility in Edinburg has a capacity of 200 million sterile pupae per week (Table B- 3). The quality of the sterile flies is within recommended parameters (FAO/IAEA/USDA 2003; Figure 8 – 10). This facility provides sterile pupae to emergence and release facilities in Edinburg, Harlingen, and Reynosa. An additional 16 million sterile pupae per week are being produced at the APHIS San Miguel Petapa (SMP) production facility in Guatemala. Production in Guatemala will increase to 30 million pupae per week in FY2010. Both facilities rear a standard strain of Mexican fruit fly that produces both males and females for release. The strain currently in production in Edinburg was established from wild flies collected in Mexico and has been in production for two years. The SMP strain was established from wild flies collected in Guatemala and has been in production for two years.

The FY2008 and FY2009 operating budgets for the Edinburg production facility were $2,408.928 (Table B- 8). The San Miguel Petapa operating budget for FY2009 was $550,000 which allowed for production and shipping of 16 million sterile pupae per week to the LRGV program for five months. The SMP projected budget for FY2010 is $950,000, which allows for production and shipping of 30 million sterile pupae per week to the LRGV program for the full year.

The Edinburg production facility was designed and constructed in 1986 to rear and release approximately 20 million sterile Mexican fruit fly per week. The goal of the LRGV program at that time was suppression, not eradication. This facility was incrementally expanded by adding modules to the original structure in order to provide sterile pupae for emergency programs in California. In January 2007, the LRGV program goal was changed from suppression to eradication. The Edinburg production facility was modified for enhanced biosecurity and to increase the production capacity 200 million sterile pupae per week (Table B- 3). Adjacent emergence capacity was increased to approximately 110 million per week without increasing floor space by converting from the PARC system to the Worley emergence tower system (Table B- 4; Appendix B).

Expansion of the Edinburg facility was accomplished by attaching modules to the exterior of the original concrete block structure and cutting doorways to connect the two. This resulted in work flow patterns that make it difficult to separate dirty and clean rearing activities. This work flow pattern results in movement of staff and equipment through dirty areas to reach clean areas. This makes control of microbial organisms in the building an issue, larval diet is a particular concern. The high temperatures and humidity in the facility facilitate the growth of microbes in the HVAC system. When operating at maximum capacity, available floor space is extremely limited and the space between rearing racks makes it necessary to use fans to dissipate metabolic heat and maintain some degree of uniformity in temperatures. The quality of dietary ingredients is not routinely assessed and remains a concern.

The Edinburg production facility has been in continuous operation for 23 years and the structural deterioration is evident. The HVAC system was upgraded in 2005 with new, high efficiency chiller and air handlers. The interior of the building, including doors, door hardware, flooring, ceilings, air registers, and other hardware are currently in need of repair or replacement. The task of performing renovations is complicated by the fact that the facility is in continuous operation and most repair work is either detrimental to insect production or violates the biological security of the facility. It is anticipated that the Edinburg production facility will cease production for repairs and maintenance over a period of three or four months after the 2009-2010 citrus harvest season ends. The projected production capacity from SMP Guatemala is not sufficient to meet the SIT requirements for the eradication program during this period.

The production facility director, assistant director, and administrative staff are very knowledgeable. They oversee daily operations and long-term planning. The insect production workers function as teams with overlapping duties that cover all aspects of the rearing process. Quality control evaluations (FAO/IAEA/USDA 2003) are conducted by staff specifically trained for this activity. Although the number (Table B- 3) and skill level of the core staff is good, the workforce consists largely of temporary employees and new hires that can be prone to mistakes that affect production. Additional supervisors and staffing by permanent employees would be helpful in reducing employee errors and improving the stability of production.

Sterile Mexican Fruit Fly Emergence

Sterile pupae are held under controlled conditions for adult emergence prior to release. There are three emergence and release facilities (ERF) servicing the LRGV Mexican fruit fly program: Edinburg, Harlingen, and Reynosa. Edinburg has a maximum capacity of 134.2 million; Harlingen 63.3 million, and Reynosa 100 million sterile pupae per week (Table B- 4). All ERFs utilize the tower emergence system (Appendix B). This system allows for optimal use of floor space and loading of release boxes.

The Edinburg ERF was renovated at the end of the 2008-2009 citrus shipping season. The screen panels on all emergence towers were replaced and the foam blocks were replaced with a more water-proof material. The vacuum system was upgraded to a more efficient configuration. It is anticipated that the ERF and equipment will be in excellent condition for the 2009-2010 citrus shipping season. The limited floor space in the Edinburg ERF makes it necessary to stack 80 trays per tower in order to process 100 million flies per week. Air flow in the towers, and therefore, fly quality could be improved if the number of trays per tower were limited to no more than 70.

The Harlingen ERF began operation in 2008 in a customized space adjacent to the Harlingen International Airport. Harlingen processes 63 million sterile pupae per week. The Reynosa ERF began operation in 2007 in a renovated warehouse space provided by SAGARPA. Reynosa processes 25 million sterile pupae per week.

Quality control tests were conducted at each ERF (FAO/IAEA/USDA 2003). The mean values were within the recommended parameters (Figures C-11– C-16). Variations in temperature and relative humidity in the ERF can impact emergence and sterile fly quality. Fly quality is also negatively impacted by holding of adults in towers beyond seven days when weather conditions prevent aerial release. The quality of diet ingredients, microbial contamination, and failure of HVAC systems are the most frequent cause of problems at the Edinburg ERF.

The director of each ERF oversees daily operations and contributes to long-term planning. The insect production workers function as teams with overlapping duties that cover all aspects of the emergence process. Quality control evaluations (FAO/IAEA/USDA 2003) are conducted by staff specifically trained for this activity. Although the number (Table B- 4) and skill level of the core staff is adequate to executing required duties, there is turn-over in the workforce. New, untrained employees can be the source of problems if not properly supervised. An increase in the number of sterile pupae processed at each ERF would require additional staff.

Sterile Mexican Fruit Fly Release

Sterile Mexican fruit fly adults are distributed in the LRGV via aerial release (Table B- 5, FAO/IAEA 2007). Edinburg and Reynosa use an auger-type single release box which is loaded with 2.5 million sterile adults per flight and Harlingen uses a double box which is loaded with 4 million sterile adults per flight. APHIS-owned Cessna 206 and Beech 58 are used for Edinburg flights that originate from the old, but well-maintained Moorefield runway (Appendix B). Contracted aircraft in Harlingen (Cessna 207) and Reynosa (Cessna 206) use commercial airport runways (Appendix B). Aircraft are equipped with GPS systems to track aerial releases.

The releases are currently made over the commercial citrus groves and high-risk areas in Texas and Mexico (Maps 12 - 14). GPS is used to track the flight lines. The releases are at six flight lanes per mi^2. The flight time is a major expense in SIT programs. Therefore, improved technology or strategies that reduce the number of flight hours without reducing the quality or dispersal of sterile flies could greatly benefit the operational program. It may be possible to get adequate distribution and reduce the number of flight lanes to three, alternating weekly, as is typical in Mexico programs. APHIS is developing a new, higher capacity release box that essentially doubles the number of sterile Mexican fruit fly that can be distributed per flight.

Recommendations for Sterile Insect Technique

SIT1. Implement sterile fly densities based on the stage of the program strategy (Table B- 7). In maintenance areas, 200,000 sterile flies per mi^2. In eradication areas, 250,000 to 320,000 sterile flies per mi^2. In suppression areas with SIT and bait sprays, 115,000 to 320,000 per mi^2.

SIT2. Prepare and implement a plan for short- and long-term maintenance of the production and emergence facilities. Bring in technical experts from the U.S. (e.g., APHIS A&EO) to consult on maintenance needs in Reynosa and Edinburg.

SIT3. Develop a plan to replace sterile pupae from Edinburg when the production facility closes for repairs and maintenance in 2010.

SIT4. Introduce new genetic material into the production colony on a regular basis. Periodic replacement or refreshing of the mass-reared strain should provide a robust strain with characteristics that improve the quality of sterile flies in the field.

SIT5. Assess the quality of larval and adult diet ingredients.

SIT6. Implement microbial monitoring and sanitation protocols at ERFs and the production facility.

SIT7. Evaluate the flight patterns and release rate of sterile flies to see if the number of flight lines per mi can be reduced to three per week, alternated, without a significant impact on program effectiveness. Doubling the release rate and flying alternate lines every other week should allow for a reduction in flight time while providing an adequate density of sterile flies in target areas.

SIT8. Implement the use of double release boxes to increase the efficiency of the aerial release by reducing the ferry time. This would require use of appropriate aircraft.

SIT9. Optimize the amount of dye used to color to mark the sterile pupae. The amount of dye observed in the Harlingen ERF appeared to be excessive. The dye was present on surfaces of the ERF.

SIT10. Continue to mark sterile pupae released in Texas a different color from those released in Mexico. Sterile pupae produced in Guatemala should be a third color.

SIT11. Initiate sterile fly releases as early in the morning as possible when the temperature is more favorable for survival.

SIT12. Optimize temperature in the emergence and knockdown rooms of ERFs. The flies should be well-chilled when loaded into the release box to prevent milling and damage.

SIT13. Insulate the ceiling of the Harlingen ERF to conserve energy and maintain the proper temperature in the tower incubation rooms.

SIT14. Implement the use of protein in the diet for adults in the emergence towers. Standardize the adult diet formulation for all ERFs.

SIT15. Perform mating competitiveness tests as part of the routine quality control. Tests should be conducted in areas with established wild populations, e.g., Mexico or Guatemala.

SIT16. Develop a staffing plan for the ERFs and production facility to increase the number of supervisors and permanent employees. This should help in reducing the number of errors in the handling processes and increasing the stability of production. A staffing plan should be used for succession planning.

7 Regulatory Measures

The APHIS Smuggling Interdiction and Trade Compliance (SITC) staff works with PPQ and the Department of Homeland Security Customs and Border Patrol (CBP) to identify high risk pathways for entry of Mexican fruit fly into Texas. SITC and CBP regulate movement of commercial shipments and cargo into the United States. If an illegal shipment of host material into Texas is detected, SITC works with CBP to identify the pathway and stop further movement. SITC makes inspections of vendors and associated markets receiving shipments of regulated host material. SITC has access to a database that contains background information on the shipper and receiver of regulated articles. Financial linkages to other businesses and past history of illegal shipments are tracked in the database. Trucks carrying these regulated materials can be monitored as to origin, integrity of seals, and other movement requirements. Private vehicles are an increasing threat because of the low probability (ca. 10%) that they will be inspected upon entry into the U.S.

SITC cooperates with PPQ in responding to detections of exotic fruit flies, e.g., *Anastrepha serpentina*. The goal is to understand how the exotic species entered Texas and block that pathway. In this effort, SITC and PPQ inspect markets and produce stands within a three mile radius of the detection. Questionable produce is destroyed. Internet businesses pose a risk for movement of regulated host materials. eBay and Craig's List have been identified as sources of regulated products from Florida sent into Texas. Updated maps of ethnic markets, road side vendors, and nurseries would be useful in pathway analysis. The addition of more SITC personnel would allow for more frequent inspection of markets and roadside stands for regulated hosts from Mexico.

The per unit volume of illegal shipments approaching Texas has increased in recent years. The typical volume currently is approximately 2,000 to 3,000 pounds per vehicle. SITC is notified by CBP when shipments are intercepted. Shipments of regulated products are destroyed according to APHIS protocols, typically by disposal in a landfill. These activities could be improved by addition of more check points and additional APHIS personnel. This will grow in importance when a barrier is in place to prevent re-introduction of

Mexican fruit fly into eradicated areas. The U.S. and Mexico border in the LRGV is quite extensive, with several border crossings. SITC should continue to monitor traffic flow patterns and identify possible smuggling routes into Texas.

APHIS IS staff in Reynosa conducts some inspections at markets and roadside stands. IS has no legal authority to regulate infested fruit and must purchase fruits for sampling. APHIS IS informs SAGARPA when infested fruits are found, but SAGARPA does not assist with inspections. SAGARPA does fruit sampling at check points near low prevalence areas and at large warehousing centers. SAGARPA should be encouraged to operate check points to deter the movement of infested host material from southern Tamaulipas into the northern municipalities. This is especially important to maintaining a Mexican fruit fly free area after eradication is complete.

A coordinated effort by the United States and Mexico is necessary to establish and maintain a barrier to introduction of Mexican fruit fly to the LRGV post-eradication. Control of regulated host material movement is critical. Such movement controls should also protect the newly designated free area in northern Nuevo Leon (Map 15). Inspection stations on major roadways south of the eradication areas should play an important role in halting the movement of infested fruits. APHIS and SAGARPA should develop a coordinated plan to establish check points as the LRGV eradication program progresses. It is understood that declaration of a free area in Tamaulipas would allow SAGARPA to take action to protect that area from re-infestation. The plan should clarify the status of fly free municipalities and the regulatory actions are possible to protect them.

Movement of host material into eradicated areas from regulated zones will be required. When Cameron County is declared eradicated, then fruit from regulated zones in Hidalgo County will not be moved to the single packinghouse in Cameron County. If Hidalgo production zones are not under regulated status, then fruit movement should be unrestricted. The Cameron County packinghouse does not have the capacity to conduct methyl bromide fumigation. The long-term maintenance plan should consider how fruit from a quarantine area in Cameron County would be moved to a fruit fly free area in Hidalgo County for fumigation.

Recommendations for Regulatory Measures

RM1. Identify highest risk areas based on the approach rate of vehicles entering the U.S. through the points of entry. SITC should continue to monitor traffic flow patterns and identify possible smuggling routes into Texas

RM2. Request information from CBP and SITC regarding the point of origin in Mexico of host material entering the U.S.

RM3. Request that CBP and SITC confirm that seals on trucks moving host material are affixed properly.

RM4. Strengthen the inspection of vehicles at ports of entry according to seasonal patterns of host availability from regions of México, e.g., movement of mango from April to June and oranges from November to January.

RM5. Continually update maps of ethnic markets, road side vendors, and nurseries for pathway analysis.

RM6. Increase the number of SITC personnel to allow for more frequent inspection of markets and roadside stands for regulated hosts from Mexico.

RM7. Request that the Texas Department of Agriculture obtain authority over abandoned citrus groves and destroy them.

RM8. Use GIS as a tool for spatial and temporal analysis to identify hotspots.

RM9. Develop a long-term maintenance plan that considers how fruit from a quarantine area in Cameron County could be moved to a fruit fly free area in Hidalgo County for fumigation.

RM10. Develop a coordinated plan with SAGARPA to implement regulatory control of host material approaching the Mexican fruit fly free areas in the LRGV. Checkpoints should be placed so as to deter movement of infested host material from southern Tamaulipas into the LRGV.

8 Scientific and Technical Support

Scientific and technical advances are critical to increasing the efficacy of eradication programs. This is especially true of programs that employ SIT as the central control tactic. SIT is a multi-step, biological process that requires constant monitoring and troubleshooting. Mexican fruit fly production and emergence facilities require constant monitoring of environmental control systems and preventive maintenance. Field operations should be targeted based on the ecology of the Mexican fruit fly and performance of the sterile flies. All aspects of the program employ specialized equipment that is designed, manufactured, and maintained by equipment specialists in consultation with operational staff and scientists.

Technical advances have typically been the result of cooperative projects among operational staff and scientists. The development of the Worley emergence tower is an excellent example of the synergy and benefits of such interactions. Emergence towers were the result of a specific program need, a more efficient, space-saving method to hold sterile Mexican fruit fly for emergence and adult maturation (Appendix B). The result was an elegant system of stackable screened trays holding ca. 1 million pupae per tower. Towers replaced the much bulkier PARC boxes in Edinburg, allowing the emergence of 100 million pupae in the same space that had held 20 million in PARC boxes. This tower technology was validated for use with the Mediterranean fruit fly and is being used in APHIS programs in California and Florida as well as internationally. The Worley tower was modified by CPHST scientists and operational staff to meet specific requirements of the MOSCAMED program.

Facilities Management

APHIS Facilities Management (FMS) is responsible for maintenance of the production and release facilities as well as all systems within, including plumbing, electrical, HVAC, doors, and door hardware. Funding required to conduct maintenance activities varies from year to year and the amount of these expenditures by FMS was unavailable to the Review Panel (Table B- 8). Preventative maintenance of these facilities, including Reynosa, should be improved in order to sustain processing activity levels and adult quality. The number and technical qualifications of FMS staff is insufficient to meet maintenance needs of the Mexican Fruit Fly Production and Emergence Facility in Edinburg. Additional, qualified staff is needed to perform routine maintenance on building systems in a timely manner. At the present time, repairs are made on an emergency basis, often requiring overtime by the limited FMS staff.

The Mexican Fruit Fly Production Facility will suspend operation in FY2010 for repair and sanitation of the structure. FMS should facilitate this process so that production can resume as soon as possible.

The Reynosa ERF does not have a dedicated maintenance staff. Periodic consultation with FMS staff would help to identify maintenance needs, the scope of repair projects, and fair market value of required contracts. Funds for repairs and maintenance are obligated against the program operating budget unless additional funds are provided from the FFED line item.

Aircraft and Equipment Operations

Aircraft & Equipment Operations (A&EO) is responsible for design, fabrication, and repair of specialized rearing and release equipment used in daily operations. The personnel are highly qualified for this work and have demonstrated expertise in new designs. A&EO performs fabrication projects for many APHIS operational programs. The number of staff is insufficient to address all project requests (e.g., completion of the double release boxes).

Aerial release of sterile Mexican fruit fly from Moorefield is the responsibility A&EO. The aircraft are owned and maintained by A&EO. The duty station of the pilots and their salary and benefits are funded through this location (Table B- 8).

Scientific Support

Scientific support for the LRGV Mexican Fruit Fly Eradication Program is primarily from the USDA Agricultural Research Service in Weslaco, Texas and the APHIS Center for Plant Health Science and Technology (CPHST) Mission Lab. Scientists from both organizations are a tremendous asset to the eradication program. They participate in monthly program meetings and provide input on the planning process. Continued support by ARS and CPHST is critical to the success of the eradication effort. The CPHST Mission Lab is located in a fully-renovated building adjacent to the Mexican fruit fly production facility at Moorefield. The personnel and resources are available to assist in development and validation of new rearing and population management technologies. This includes, among others, enhanced field operations by optimizing SIT release rates, increased production efficiency through facility sanitation, validating trap and lure types, and molecular technologies. The ARS scientists provide basic research that furthers the understanding of Mexican fruit fly ecology, behavior, detection, quarantine treatments, and control technologies. Research is documented in peer-reviewed publications in scientific journals and provides the technical basis for program planning.

The continued involvement of ARS and CPHST scientists is critical to the success of the eradication program. Program staff and scientists expressed concern that scientists currently assigned to Mexican fruit fly projects may be diverted to other projects. This would have a negative impact on the eradication program at a time when scientific and technical support is most needed to reach a successful conclusion.

The number and skills of the scientists is adequate to address program needs. However, the approval and funding of projects for both entities requires clarification. Most support activities are 'unfunded' and provided on an informal basis.

Recommendations for Scientific and Technical Support

STS1. Communicate a prioritized list of scientific and technical needs to appropriate program managers in ARS and CPHST.

STS2. Conduct release-recapture studies in Mexico, near the border to determine the natural movement and survival of Mexican fruit fly. Sterile flies would be released in the Mexican side by ground and marked with a different color dye from sterile flies released in the program.

STS3. Conduct ecological studies in the LRGV to better understand the origin of annual infestations and over-summering mechanism of adults, larvae, and pupae.

STS4. Conduct trapping and larval survey in sour orange and other alternate wild hosts to determine possible reservoirs in Texas and Mexico.

STS5. Identify the optimal lure type for use in LRGV surveillance programs.

STS6. Validate the Biolure 3-component or 2-component cone formulation in Texas and Mexico for surveillance of Mexican fruit fly.

STS7. Interpret trap catch to estimate population size. Release-recapture studies of marked, sterile flies at defined distances from the traps should provide a basis for determining the sensitivity of the trap and lure.

STS8. Analyze bait spray applications and their impact on detections in subsequent years.

STS9. Validate the use of bait stations to replace or supplement bait sprays against Mexican fruit fly in eradiation and suppression areas.

STS10. Develop a degree-day model as the basis for determining the life cycle of wild Mexican fruit fly.

STS11. Develop quality control and purchasing specifications for larval and adult diet ingredients. Specifications will help to facilitate the purchasing process and reduce the waste from ingredients that do not perform well.

STS12. Identify alternate bulking agents for larval diet. A list of validated bulking agents will allow for rapid replacement of a material that has dramatically increased in cost or is unavailable.

STS13. Identify alternate types of agar for adult diets in towers. A list of validated agar will allow for rapid replacement of a material that has dramatically increased in cost or is unavailable.

STS14. Evaluate and implement new mass-rearing strains every three to five years. Fruit fly strains that have been under mass-rearing conditions are typically selected for traits that allow for performance under those conditions. This may result in reduced performance in the field.

STS15. Validate and implement a genetic sex sorting strain that eliminates females from the sterile releases. The removal of females from the released sterile flies could reduce the operating costs significantly. Reductions would be in: the amount of larval diet required; number of pupae handled and irradiated; irradiation staff-hours; shipping costs; emergence operations; and aerial release flight hours. The efficiency of SIT will likely increase because the sterile females will not compete with wild females as mates for the sterile males.

STS16. Develop, validate, and implement a technique to determine if a wild female has mated with a wild or sterile male, e.g., molecular diagnostics or fluorescent sperm marker. The ability to positively distinguish the sperm from a sterile male from that of a wild male in a mated wild female would eliminate unnecessary action programs in fly free areas. Conversely, detection of a wild female that has mated with a wild male can result in an appropriate action program.

STS17. Develop, validate, and implement a technique to determine the age of wild flies in traps.

STS18. Maintain a DNA database of wild Mexican fruit fly captured in all program areas. Wild flies should be preserved in alcohol and deposited at the CPHST Mission Lab for molecular analysis. This is important because it may form the basis for understanding the movement of Mexican fruit fly within or into the LRGV. The appearance of wild flies with a distinct morphological character (ovipositor length) may indicate entry of flies of a new strain or biotype. This should be documented.

STS19. Use molecular diagnostic technology to understand population structure in Texas and throughout the range of the Mexican fruit fly

STS20. Develop aromatherapy treatments to enhance the mating competitiveness of sterile males.

STS21. Establish and validate protocols for routine quality control evaluation of mating competitiveness of sterile males relative to wild males.

STS22. Conduct cost benefit analyses to document the value of implementing new technology (e.g., genetic sexing strain, bait stations) and tactical operations (e.g., altering flight lines).

STS23. Make the completion and evaluation of double release boxes a priority. The cost of aerial release of sterile flies is a major obstacle to increasing the release density. The availability of a release box that holds additional flies would reduce this cost by reducing the ferry time.

STS24. APHIS technical experts (e.g., FMS and A&EO) provide guidance to the Reynosa ERF regarding maintenance and repair of mechanical systems. This should include quarterly visits to the Reynosa ERF and consultation on contractor bids for repairs.

STS25. APHIS FMS respond promptly to requests for repairs and maintenance of the physical plant at the Mexican Fruit Fly Production Facility. The production facility has been operating at full capacity for an extended period of time. The physical plant has considerable damage due to high temperature and humidity requirements and normal wear in areas accommodating ‘dirty’ processes.

STS26. APHIS FMS develop a short- and long-term plan for maintenance of the Edinburg ERF and production facility.

9 Recommendation Tables

LRGV Mexfly Eradication Program

TABLE 9-1: Eradication Strategy

ES1. Implement population suppression actions in a coordinated, fully integrated manner in Texas and Tamaulipas.
ES2. Implement the same trap densities, trap type, trap servicing frequency, frequency of bait sprays, and sterile release densities across the program.
ES3. Establish an eradication strategy based on four operational stages (Table 6, Maps 16 - 19).
ES4. Implement maintenance, eradication, and suppression tactical operations (Table B-7).
ES5. Establish SAGARPA as a cooperator in the eradication program.
ES6. Conduct a cost benefit analysis to determine the most economical long-term source of sterile pupae for preventive SIT to maintain Mexican fruit fly free areas in the LRGV.

TABLE 9-2: Program Management

PM1. Fully integrate the LRGV Mexican Fruit Fly Eradication Program and coordinate activities across the Texas and Mexico border (Table 6).
PM2. Conduct all program activities according to the tactical operations plan for each stage of the eradication strategy (Table B-7).
PM3. Establish a management team and designate one lead coordinator.
PM4. Establish a joint decision making process for the entire program.
PM5. The lead coordinator should convene a monthly management team meeting to evaluate program status and make decisions on program direction.
PM6. The lead coordinator should be responsible for communication among team members, finalizing the decision making process, formulating final budget requests, and liaison with APHIS Fruit Fly Director.
PM7. Establish a Science Advisory Panel (SAP) composed of national and international experts that meet quarterly to review the progress of the eradication program and technical issues impacting that progress.
PM8. Approach SAGARPA to request their cooperation in the eradication effort which is of mutual benefit.
PM9. The management team should meet quarterly, or more frequently, with SAGARPA and the state Comite de Sanidad Vegetal representatives from Mexfly programs in central Tamaulipas to discuss the status of common issues.
PM10. Hold an annual meeting that includes all stakeholders to review program progress and establish tactical goals for the next year.
PM11. Manage data as one unit. All reports and maps should reflect the surveillance and treatment summaries for Texas and Mexico.
PM12. Facilitate information sharing by establishing a QuickPlace website. Provide access to the site for all participants and stakeholders.
PM13. Implement a succession plan for key operational program positions.

TABLE 9-3: Surveillance

S1. Deploy the same trap and lure combination in Texas and Mexico. Use the most effective traps based on scientifically-sound data generated by CPHST and ARS-Weslaco.
S2. Standardize the trap density and servicing interval in accordance with the tactical plan employed in each area.
S3. Establish an alternate schedule or relief staffing for trappers so that traps are serviced on a regular schedule. TDA should make a commitment so that the trappers are dedicated to the program and not diverted to other TDA activities.
S4. Replace vehicles with more than 100,000 miles.
S5. Standardize equipment and protocols in the identification labs
S6. Upgrade equipment in the identification laboratories, e.g., fluorescent lights, ergonomic microscope tables).
S7. Standardize information for databases, e.g., number and sex of sterile and wild flies.
S8. Manage data for Texas and Mexico at the Harlingen office.
S9. Facilitate data transfer from Mexico to Harlingen. Upgrade the internet connection at the APHIS Reynosa office and/or manually transfer data at least two times per week.
S10. Conduct quality control of the surveillance program. APHIS should be responsible for establishing quality control standards and conducting quality control audits of all detection staff.
S11. Use GIS applications to facilitate program management decisions.

TABLE 9-4: Chemical Control

CC1. Intensify use of bait sprays in high risk areas.
CC2. Identify hot spots and apply bait sprays at least one life cycle before historical first detection is made each year.
CC3. Continue bait spray treatments for two years at the site of a detection in eradication areas.
CC4. Apply preventive ground bait sprays on sour orange trees and dooryards.
CC5. Request assistance from SAGARPA to obtain spinosad, malathion and hydrolyzed protein for bait spray applications in Mexico.
CC6. Evaluate the implementation of bait stations as an alternative to bait spray treatments.
CC7. Analyze the effect of bait spray applications on subsequent wild fly detections.
CC8. Use a validated degree-day model for calculation of life cycles.

TABLE 9-5: Sterile Insect Technique

SIT1. Implement sterile fly densities based on the stage of the program strategy (Table B-7).
SIT2. Prepare a plan for short- and long-term maintenance of the production and emergence facilities.
SIT3. Develop a plan to replace sterile pupae from Edinburg when the production facility closes for repairs and maintenance in 2010.
SIT4. Introduce new genetic material into the production colony on a regular basis.
SIT5. Assess the quality of larval and adult diet ingredients.
SIT6. Implement microbial monitoring and sanitation protocols at ERFs and the production facility.
SIT7. Evaluate the flight patterns and release rate of sterile flies to see if the number of flight lines per mi can be reduced to 3 without a significant impact on program effectiveness.
SIT8. Implement the use of double release boxes to increase the efficiency of the aerial release by reducing the ferry time.
SIT9. Optimize the amount of dye used to color to mark the sterile pupae.
SIT10. Continue to mark sterile pupae released in Texas a different color from those released in Mexico. Sterile pupae produced in Guatemala should be a third color.
SIT11. Initiate sterile fly releases as early in the morning as possible when the temperature is more favorable for their survival.
SIT12. Optimize temperature in the emergence and knockdown rooms of ERFs. The flies should be well-chilled when loaded into the release box to prevent milling and damage.
SIT13. Insulate the ceiling of the Harlingen ERF to conserve energy and maintain the proper temperature in the tower incubation rooms.
SIT14. Implement the use of protein in the diet for adults in the emergence towers. Standardize the adult diet formulation for all ERFs.
SIT15. Perform mating competitiveness tests as part of the routine quality control. Tests should be conducted in areas with established wild populations, e.g., Mexico or Guatemala.
SIT16. Develop a staffing plan for the ERFs and production facility.

TABLE 9-6: Regulatory Measures

RM1. Identify highest risk areas based on the approach rate of vehicles entering the U.S. through the points of entry.
RM2. Request information from CBP and SITC regarding the Mexican point of origin of host material entering the U.S.
RM3. Request that CBP and SITC confirm that seals on trucks moving host material are affixed properly.
RM4. Strengthen the inspection of vehicles in the port of entry according to seasonal patterns of host availability in México.
RM5. Continually update maps of ethnic markets, road side vendors, and nurseries for pathway analysis.
RM6. Increase the number of SITC personnel to allow for more frequent inspection of markets and roadside stands for regulated hosts from Mexico.
RM7. Request that the Texas Department of Agriculture obtain authority over abandoned groves and destroy them.
RM8. Use GIS as a tool to for spatial and temporal analysis to identify hotspots.
RM9. Develop a long-term maintenance plan that considers how fruit from a quarantine area in Hidalgo County could be moved to a fruit fly free area in Cameron County for fumigation.
RM10. Develop a coordinated plan with SAGARPA to implement regulatory control of host material approaching the Mexican fruit fly free areas in the LRGV.

TABLE 9-7: Scientific and Technical Support

STS1. Communicate a prioritized list of scientific and technical needs to appropriate program managers in ARS and CPHST.
STS2. Conduct release-recapture studies in Mexico, near the border to determine the natural movement and survival of Mexican fruit fly.
STS3. Conduct ecological studies in the LRGV to better understand the origin of annual infestations and over-summering mechanism of adults, larvae, and pupae.
STS4. Conduct trapping and larval survey in sour orange and other alternate wild hosts to determine possible Mexican fruit fly reservoirs in Texas and Mexico.
STS5. Identify the optimal Mexican fruit fly lure type for use in LRGV surveillance programs.
STS6. Validate the Biolure 3 component and 2 component cone formulation in Texas and Mexico.
STS7. Interpret trap catch to estimate population size. Release-recapture studies of marked, sterile flies at defined distances from the traps should provide a basis for determining the sensitivity of the trap and lure.
STS8. Analyze bait spray applications and their impact on detections in subsequent years.
STS9. Validate the use of bait stations to replace or supplement bait sprays against Mexican fruit fly in eradiation and suppression areas.
STS10. Develop a degree-day model as the basis for determining the life cycle of wild Mexican fruit fly.
STS11. Develop quality control and purchasing specifications for larval and adult diet ingredients.
STS12. Identify alternate bulking agents for larval diet.
STS13. Identify alternate types of agar for adult diet in towers.
STS14. Evaluate and implement new mass-rearing strains every three to five years.
STS15. Validate and implement a genetic sex sorting strain that eliminates females from the sterile releases.
STS16. Develop, validate, and implement a technique to determine if a wild female has mated with a wild or sterile male.
STS17. Develop, validate, and implement a technique to determine the age of wild Mexican fruit fly in traps.
STS18. Maintain a DNA database of wild Mexican fruit fly captured in all program areas.
STS19. Use molecular diagnostic technology to understand the population structure in Texas and throughout the range of the Mexican fruit fly.
STS20. Develop aromatherapy treatments to enhance the mating competitiveness of sterile Mexican fruit fly males.
STS21. Establish and validate protocols for routine quality control evaluation of mating competitiveness of sterile males relative to wild males.
STS22. Conduct cost benefit analyses to document the value of implementing new technology and tactical operations.
STS23. Make the completion and evaluation of double release boxes a priority.
STS24. APHIS technical experts provide guidance to the Reynosa ERF regarding maintenance and repair of mechanical systems.
STS25. APHIS FMS respond promptly to requests for repairs and maintenance of the physical plant at the Mexican Fruit Fly Production Facility.
STS26. APHIS FMS develop a short- and long-term plan for maintenance of the Edinburg ERF and production facility.

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Appendix A

Definitions, Abbreviations and Acronyms

AEO. APHIS Aircraft and Equipment Operations

APHIS. Animal and Plant Health Inspection Service

ARS. Agricultural Research Service

CBP. Customs and Border Patrol (Department of Homeland Security)

CPHST. Center for Plant Health Science and Technology

EPA. Environmental Protection Agency

ERF. Emergence and Release Facility

FFED. Fruit Fly Exclusion and Detection

FFPEB. Fruit Fly Program Executive Board

FMS. APHIS Facilities Management Services

FSO. Foreign Service Officer

GPS. Global Position System

HVAC. Heating, ventilation, and air conditioning system

IS. International Services

km. Kilometer

Mexfly. Mexican fruit fly, *Anastrepha ludens* Loew

mi (mi2). Mile (square mile)

MLT. Multilure trap (Better World Manufacturing)

MOSCAMED. Joint United States, Mexico, and Guatemala control program to maintain a barrier in Chiapas, Mexico to prevent the northern spread of the Mediterranean fruit fly

PARC. Plastic Adult Rearing Container

PPQ. Plant Protection and Quarantine

Preventive Release Program (PRP). The prophylactic use of SIT, in an area where the risk of entry of a non-indigenous fruit fly into a free area is high, to thwart any entries of the target fruit fly from becoming an established population.

RH. Relative humidity

SAGARPA /SENASICA. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (México) / Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria

SITC. Smuggling Interdiction and Trade Compliance (USDA APHIS PPQ)

SMP. APHIS San Miguel Petapa Guatemala Mexfly Production Facility

Sterile Insect Technique (SIT). Method of pest control using area-wide inundative release of sterile insects to reduce reproduction in a field population of the same species (IPPC 2009)

TDA. Texas Department of Agriculture

USDA. United States Department of Agriculture

B Apppendix B

Tables

TABLE B-1. LRGV Mexican Fruit Fly Eradication Program surveillance activities from FY2006 to 2009

APHIS-TEXAS	FY2006	FY2007	FY2008	FY2009
***Anastrepha* & general**				
Total # Multilure + 2C	0	173	0	0
# sq miles		57		
# per sq mi		5		
Servicing interval (day)		7		
Lure replacement interval (day)		42		
Total # Multilure + yeast	2100	2100	1420[a]\1464	1420 [a]\1464
# sq miles	885	885	885	885
# per sq mi	5	5 \ 10	10 [b]\ 5	10 [b] 5
Servicing interval (day)	7	7	7	7
Lure replacement interval (day)	7	7	7	7
Type of preservative	Splash/PPG	Splash/PPG	Splash/PPG	Splash/PPG
Total # Jackson traps + TML	1920	1920	1920	1920
# sq miles	885	885	885	885
# per sq mi	5	5	5	5
Servicing interval (day)	7	7	7	7
Lure replacement interval (day)	42	42	42	42
Total # Jackson traps + ME	160	160	160	160
# sq miles	73	73	73	73
# per sq mi	.45	.45	.45	.45
Servicing interval (days)	7	7	7	7
Lure replacement interval (day)	42	42	42	42
Total # Jackson traps + CUE	160	160	160	160
# sq miles	73	73	73	73
# per sq mi	.45	.45	.45	.45
Servicing interval (days)	7	7	7	7
Lure replacement interval (day)	42	42	42	42
GPS tracking (yes/no)	yes	yes	yes	Yes
# GIS specialists	2	2	2	2

TABLE B-1. LRGV Mexican Fruit Fly Eradication Program surveillance activities from FY2006 to 2009 (continued)

APHIS-TEXAS	FY2006	FY2007	FY2008	FY2009
# trappers	12	13	18	18
# vehicles	17	18	23	23
# identifiers	6	6	6	6
# per sq mi	N/A	N/A	N/A	5
Servicing interval (day)	N/A	N/A	N/A	7
Lure replacement interval (day)	N/A	N/A	N/A	90
APHIS-MEXICO	**FY2006**	**FY2007**	**FY2008**	**FY2009**
***Anastrepha* & general**				
Total # Multilure + 2C	N/A	N/A	N/A	897
# sq miles	N/A	N/A	N/A	5260
# per sq mi	N/A	N/A	N/A	5
Servicing interval (day)	N/A	N/A	N/A	7
Lure replacement interval (day)	N/A	N/A	N/A	90

[a, b] Number of traps at 10 traps per mi^2 required for declaration of eradication.

TABLE B-2. LRGV Mexican Fruit Fly Eradication Program Bait Spray Activities from FY2006 to 2009.

	FY2006	FY2007	FY2008	FY2009
TEXAS				
# treatments in Willacy County	0	0	10	2
# treatments in Cameron County	8	1	46	6
# treatments in Hidalgo County	31	0	118	25
Total # Spinosad treatments				
% of detections treated	100	100	100	100
Treatment area (radius in m^2)	250	0	250	250
# treatments / site	259/39	0	452/113	193/25
Frequency of treatments (days)	7 / 10	0	7-10	7-10
Application rate (vol/acre)	1-3oz/tree	0	1-3oz/tree	1-3oz/tree
Cost / application ($)	$17 /Acre	0	$17 /Acre	$17 /Acre
Applicator (APHIS/other)	APHIS	0	APHIS	APHIS
Type of sprayer	Backpack / Polaris	0	Backpack / Polaris	Backpack / Polaris
Total # Malathion treatments				
% of detections treated	100	100	100	100
Treatment area (radius in m^2)	Grove/250	250	250	250
# treatments / site	50/8	5/1	424/106	102/22
Frequency of treatments (days)	10-14	10-14	10-14	10-14
Application rate (vol/acre)	12oz/Acre	12oz/Acre	12oz/Acre	12oz/Acre
Cost / application ($)	$3/Acre	$3/Acre	$3/Acre	$3/Acre
Applicator (APHIS/other)	Industry	Industry	Industry	Industry
Type of sprayer	Polaris	Polaris	Polaris	Polaris
MEXICO	**FY2006**	**FY2007**	**FY2008**	**FY2009**
Total # Spinosad treatments	N/A	N/A	N/A	0
Total # Malathion treatments	N/A	N/A	N/A	10
% of detections treated				100
Treatment area (radius in $m^{2)}$				750
# treatments / site				10
Frequency of treatments (days)				7
Application rate (vol/acre)				4 L/Acre
Applicator (APHIS/other)				APHIS IS
Type of sprayer				backpack

TABLE B-3. LRGV Mexican Fruit Fly Eradication Program SIT production activities from FY2006 to 2009.

	FY2006	FY2007	FY2008	FY2009
Source of sterile pupae in LRGV				
APHIS-TEXAS (# pupae/wk)	99.5 MIL	142.8 MIL	192 MIL	223 MIL
MOSCAFRUT (# pupae/wk)				
APHIS-PETAPA (# pupae/wk)		0	0	16 MIL
APHIS-TEXAS				
Total pupae production/week	99.5 MIL	142.8 MIL	192 MIL	223 MIL
# pupae returned to colony/wk	1.8 MIL	1.8 MIL	1.8 MIL	1.8 MIL
# of sterile pupae/week	97.7 MIL	141 MIL	190.2 MIL	221.2 MIL
# pupae/bag for irradiation	75,000	75,000	75,000	75,000
Minimum irradiation dose (GY)	70	70	70	70
Total # hours in hypoxia	2 hrs +	2 hrs +	2 hrs +	2 hrs +
# production staff	16-42	44	47-49	47-49
Filter rearing system (yes/no)	No	No	No	No
Strain replacement (yes/no)	No	No	No	Yes
Quality control (annual data)				
Pre-oviposition period (days)	10	10	10	10
Oviposition period (days)	25	25	25	25
Time from egg to pupae (days)	14	14	14	14
Time pupae to adult (days)	18-20	18-20	18-20	18-20
Fecundity (# eggs/female)	35	35	35	35
Mean % egg hatch	>90	>90	92.6	93.4
Pupae weight (mg)	17.9	17.9	16.5	17.1
Mean % emergence	88.9	82.5	84.3	83.5
Mean sex ratio (% male)	54.8	42.5	45.3	56.1
Mean % flyers	80.1	78.5	80.3	81.1
Stress test % mortality at 72 hr	30.7	42.4	19.7	49.8
Mating evaluation (yes/no)	No	No	No	No

TABLE B-4. LRGV Mexican Fruit Fly Eradication Program SIT emergence activities from FY2006 to 2009

	FY2006	FY2007	FY2008	FY2009
EDINBURG ERF				
Size: emergence area (sq ft)	2,608	2,608	2,608	2,608
Size: knockdown area (sq ft)	357	357	357	357
Maximum # towers	164	164	164	164
# trays / tower	80	80	80	80
# pupae / tray	12500	12500	12500	12500
Source of sterile pupae	Edinburg	Edinburg	Edinburg	Edinburg & Guatemala
# of sterile pupae/week	87.4 MIL	109.3 MIL	122.2 MIL	134.2 MIL
Minimum irradiation dose (GY)	70	70	70	70
Total # hours in hypoxia	2 hrs +	2 hrs +	2 hrs +	2 hrs +
Quality control (annual data)				
Pupae weight (mg)	17.9	17.9	16.5	17.1
Time pupae to adult (days)	18-20	18-20	18-20	18-20
Mean % emergence	88.9	82.5	84.3	83.5
Mean sex ratio (% male)	54.8	42.5	45.3	56.1
Mean % flyers	80.1	78.5	80.3	81.1
Stress test % mortality at 72 hr	30.7	42.4	19.7	49.8
Mating evaluation (yes/no)	No	No	No	No
Age of adults at release (days)	5-7	5-7	5-7	5-7
Knockdown parameters				
Temperature (°F)	38	38	38	38
Time (minutes)	15-20	15-20	15-20	15-20
# emergence staff	9	13	12	12
HARLINGEN ERF				
Maximum # towers	191	191	191	191
# trays / tower	70	70	70	70
# pupae / tray	12500	12500	12500	12500
Source of sterile pupae	Edinburg	Edinburg	Edinburg	Edinburg
# of sterile pupae/week	—	50.8 MIL	45.4 MIL	63.3 MIL
Minimum irradiation dose (GY)	70	70	70	70
Total # hours in hypoxia	2 hrs +	2 hrs +	2 hrs +	2 hrs +
Quality control (annual data)				
Pupae weight (mg)	17.9	17.9	16.5	17.1
Time pupae to adult (days)	18-20days	18-20days	18-20days	18-20days
Mean % emergence	88.9	82.5	84.3	83.5
Mean sex ratio (% male)	54.8	42.5	45.3	56.1

TABLE B-4. LRGV Mexican Fruit Fly Eradication Program SIT emergence activities from FY2006 to 2009 (continued)

	FY2006	FY2007	FY2008	FY2009
Mean % flyers	80.1	78.5	80.3	81.1
Stress test % mortality at 72 hr	30.7	42.4	19.7	49.8
Mating evaluation (yes/no)	No	No	No	No
Knockdown parameters				
Temperature (°F)	38	38	38	38
Time (minutes)	15-20	15-20	15-20	15-20
# emergence staff	0	5	7	7
Reynosa ERF				
Maximum # towers				136
# trays / tower				70
# pupae / tray				10,500
Source of sterile pupae				Edinburg
# of sterile pupae/week				25 MIL
Minimum irradiation dose (GY)				70
Total # hours in hypoxia				2.5
Quality control (annual data)				
Pupae weight (mg)				19
Time pupae to adult (days)				5
Mean % emergence				78
Mean sex ratio (% male)				64
Mean % flyers				75
Stress test % mortality at 72 hr				62
Mating evaluation (yes/no)				No
Age of adults at release (days)				6
Knockdown parameters				
Temperature (°F)				38
# emergence staff				3

TABLE B-5: LRGV Mexican Fruit Fly Eradication Program SIT release activities from FY2006 to 2009.

	FY2006	FY2007	FY2008	FY2009
Edinburg				
# aircraft available	3	3	3	3
Type of aircraft	◆ C206 ◆ Beech 58	◆ C206 ◆ Beech 58	◆ C206 ◆ Beech 58	◆ C206 ◆ Beech 58
Twin or single engine	Both	Both	Both	Both
# pilots available	4	4	4	4
Type of release machine	◆ Auger ◆ Single box	◆ Auger ◆ Single box	◆ Auger ◆ Single box	◆ Auger ◆ Single box
# flies / release box	2.5 MIL	2.5 MIL	2.5 MIL	2.5 MIL
GPS tracking (yes/no)	Yes	Yes	Yes	Yes
Harlingen				
# aircraft available	N/A	1	1	1
Type of aircraft	N/A	C207	C207	C207
Twin or single engine	N/A	Single	Single	Single
# pilots available	N/A	1	1.5	2
Period of contract	N/A	annual	annual	Annual
Type of release machine	N/A	◆ Auger ◆ Double box	◆ Auger ◆ Double box	◆ Auger ◆ Double box
# flies / release box	N/A	2 MIL X 2 boxes	2 MIL X 2 boxes	2 MIL X 2 boxes
GPS tracking (yes/no)	N/A	Yes	Yes	Yes
Willacy County				
Origin of flight	Moore AB	Moore AB	Moore AB	Moore AB
# of weeks / year under SIT	52	52	52	52
Total # sq mi under SIT	Grove	Grove	8	10
Mean # sterile flies / sq mi	N/A	N/A	312,500	250,000
Mean # sterile flies / acre	500	500	480	390
# releases / sq mi / week	1	1	1	1
Mean cost/flight ($ / hour)	187.00	220.00	296.00	436.00
Mean release cost/million flies	112.20	132.00	177.60	261.60
Mean # hours/flight	1.5	1.5	1.5	1.5
Ferry time (minutes)	35	35	35	35
Cameron County				
Origin of flight	Moore AB	Moore AB	N/A	N/A
# of weeks / year under SIT	52	32		
Total # sq mi under SIT	142	142		
Mean # sterile flies / sq mi	267,132	399,978		
Mean # sterile flies / acre	635	625		
# releases / sq mi / week	1	1		

TABLE B-5: LRGV Mexican Fruit Fly Eradication Program SIT release activities from FY2006 to 2009. (continued)

	FY2006	FY2007	FY2008	FY2009
Mean cost/flight ($ / hour)	187.00	220.00	N/A	N/A
Mean release cost/million flies	59.84	70.40		
Mean # hours/flight	0.8	0.8		
Range of ferry time (minutes)	30	30		
Hidalgo County				
Origin of flight	Moore AB	Moore AB	Moore AB	Moore AB
# of weeks / year under SIT	52	52	52	52
Total # sq mi under SIT	258	258	258	258
Mean # sterile flies / sq mi	223,800	239,267	408,281	372,139
Mean # sterile flies / acre	350	374	638	582
# releases / sq mi / week	1	1	1	1
Mean cost/flight ($ / hour)	187.00	220.00	296.00	436.00
Mean release cost/million flies	74.80	88.00	118.40	174.40
Mean # hours/flight	1	1	1	1
Ferry time (minutes)	10 - 20	10 - 20	10 - 20	10 – 20
APHIS-REYNOSA				
# aircraft available				1
Type of aircraft				Cessna 206
Twin or single engine				Single
# pilots available				1
Period of contract				6 yrs
Type of release machine				Mission
# flies / release box				2.5 MIL
GPS tracking (yes/no)				Yes
Reynosa Municipality				
# of weeks / year under SIT				52
Total # sq mi under SIT				180
Mean # sterile flies / sq mi				100,000
Mean # sterile flies / acre				156
# releases / sq mi / week				8
Mean # sterile flies/trap/day				19
Mean cost/flight ($ / hour)				350
Mean release cost/million flies				140
Mean # hours/flight				2

TABLE B-6. Multi-stage Mexican fruit fly eradication strategy delineating stages and tactical operations for each location in the LRGV of Texas and Mexico.

Stage	Location: United States	Location: Mexico	Tactical Operation
Stage 1	Willacy		Maintenance (without SIT)
	Cameron	Matamoros and Valle Hermoso	Eradication
	Hidalgo	Rio Bravo and Reynosa	Suppression with SIT/Bait sprays
	Starr		Maintenance (without SIT)
		Diaz Ordaz, Camargo, and Miguel Aleman	Suppression with bait sprays
	Roma to Laredo		Maintenance (without SIT)
		Miguel Aleman to Nuevo Laredo	Monitoring and intensive bait sprays by SAGARPA
Stage 2	Willacy		Maintenance (without SIT)
	Cameron	Matamoros and Valle Hermoso	Maintenance with SIT
	Hidalgo, zones 3 and 4	Rio Bravo	Eradication
	Hidalgo, zones 1 and 2	Reynosa	Suppression by SIT/bait sprays
	Starr		Maintenance (without SIT)
		Diaz Ordaz, Camargo, and Miguel Aleman	Suppression by bait sprays
	Roma to Laredo		Maintenance (without SIT)
		Miguel Aleman to Nuevo Laredo	Monitoring and intensive bait sprays by SAGARPA
Stage 3	Willacy		Maintenance (without SIT)
	Cameron and Hidalgo, zones 3 and 4	Matamoros, Valle Hermoso, and Rio Bravo	Maintenance with SIT
	Hidalgo, zones 1 and 2	Reynosa	Eradication
	Starr		Maintenance (without SIT)
		Diaz Ordaz, Camargo, and Miguel Aleman	Eradication
	Roma to Laredo	Miguel Aleman to Nuevo Laredo	Maintenance (without SIT)
Stage 4	Willacy		Maintenance (without SIT)
	Cameron and Hidalgo	Matamoros, Valle Hermoso, Rio Bravo, and Reynosa	Maintenance with SIT
	Starr	Diaz Ordaz, Camargo, and Miguel Aleman	Maintenance (without SIT)
	Roma to Laredo	Miguel Aleman to Nuevo Laredo	Maintenance (without SIT)

TABLE B-7. Tactical operations for each stage of the multi-stage Mexican fruit fly eradication strategy in the LRGV of Texas and Mexico.

Tactical operation	Surveillance	SIT	Bait sprays & Fruit Stripping	Triggers
Maintenance	◆ 5 traps per mi^2 ◆ 2 week servicing	◆ 200,000 per mi^2 ◆ High risk areas	**BAIT SPRAY** a. 500 m radius of detection b. 1 life cycle **FRUIT STRIPPING** a. 500 m radius b. Non-commercial hosts c. 1 life cycle	**WITHOUT SIT** a. 5 wild flies, 1 mated female, or immature b. Within 3 mi radius c. 1 life cycle **WITH SIT** a. 5 wild flies or immature b. Within 3 mi radius c. 1 life cycle
Eradication	◆ 10 traps per mi^2 ◆ 2 week servicing ◆ 1 torula yeast trap per mi^2 in Mexico **OUTBREAK** a. 5 traps per mi^2 b. 1 week servicing c. Within 4.5 mi^2	250,000 to 320,000 per mi^2	**BAIT SPRAY** a. 500 m radius of detection b. 3 life cycles **FRUIT STRIPPING** a. 500 m radius b. Non-commercial hosts c. 1 life cycle	d. 5 wild flies or immature e. Within 3 mi^2 radius f. 1 life cycle
Suppression with SIT and bait sprays	◆ 5 traps per mi^2 ◆ 2 week servicing	115,000 to 320,000 per mi^2	**BAIT SPRAY** a. 500 m radius of detection b. 3 life cycle **FRUIT STRIPPING** a. 250 m radius b. Non-commercial hosts c. 1 life cycle	**WITH SIT** a. 5 wild flies or immature b. Within 3 mi^2 radius c. 1 life cycle
Suppression with bait sprays	◆ 5 traps per mi^2 ◆ 2 week servicing	NONE	**BAIT SPRAY** a. 500 m radius of detection b. One life cycle **FRUIT STRIPPING** a. 250 m radius b. Non-commercial hosts c. 1 life cycle	**WITHOUT SIT** a. 5 wild flies, 1 mated female, or immature b. Within 3 mi^2 radius c. 1 life cycle

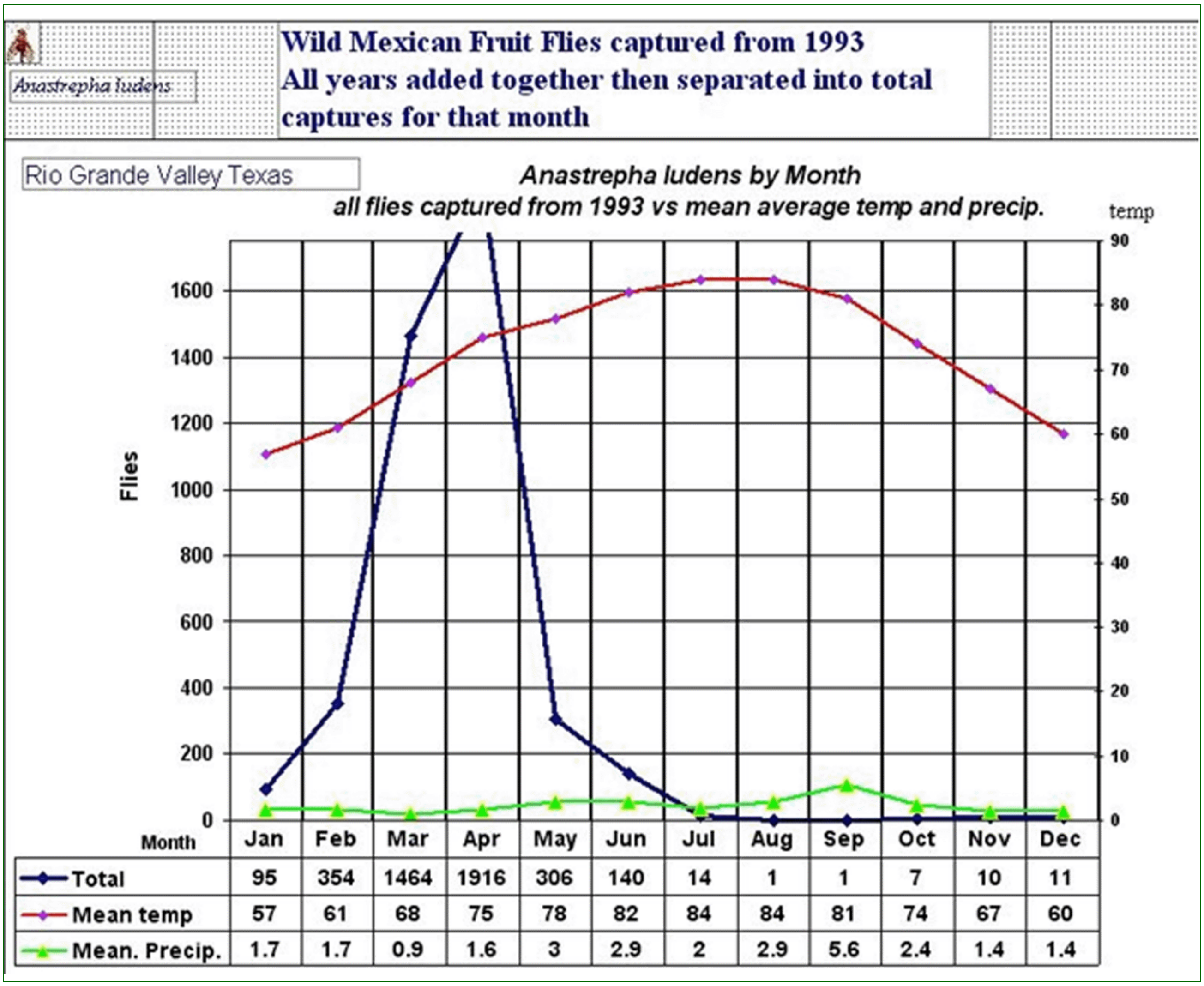
TABLE B-8. LRGV Mexican Fruit Fly Eradication Program budget summary FY2006 to 2009.

LOCATION	FY2006	FY2007	FY2008	FY2009
APHIS-TEXAS TOTAL	**2,505,908**	**3,050,140**	**3,960,182**	**4,140,501**
McAllen Work Unit				
Regulatory	356,194	476,134	339,977	452,748
Surveillance	130,675	239,171	270,836	330,494
Chemical control	71,828	34,565	149,245	104,851
Harlingen ERF	0	129,605	388,814	388,814
Release	129,704	263,598	374,212	392,116
McAllen Total	688,401	1,143,073	1,523,084	1,669,023
Edinburg Work Unit				
Production	1,561,618	1,590,095	2,069,713	2,091,356
Edinburg ERF	255,889	316,972	367,385	380,122
Edinburg Total	1,817,507	1,907,067	2,437,098	2,471,478
APHIS-Reynosa	0	650,000	650,000	672,000
APHIS-San Miguel Petapa Guatemala	0	0	0	550,000
APHIS – other				
FMS	N/A	N/A	N/A	N/A
A&EO	N/A	N/A	N/A	N/A
CPHST	N/A	N/A	N/A	N/A
Texas Department of Agriculture				
Surveillance	N/A	N/A	N/A	N/A
Production	100,000	100,000	100,000	100,000
Texas Valley Citrus Committee				
Production	179,000	179,000	179,000	179,000
Chemical control	N/A	N/A	N/A	80,000
ESTIMATED TOTAL	**2,784,908**	**3,979,140**	**4,889,182**	**5,721,501**

C Appendix C

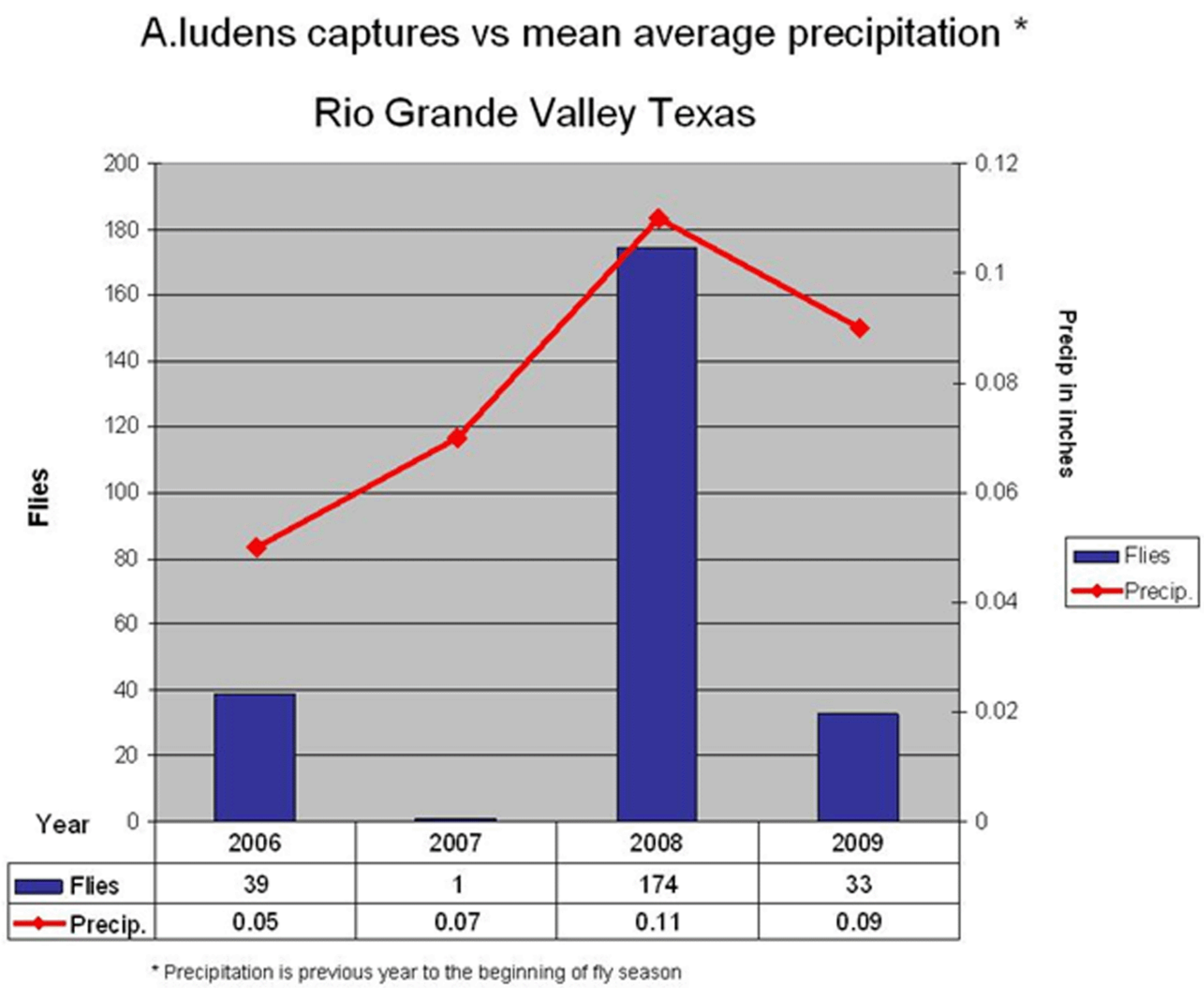
Figures

1. Mean monthly capture of wild Mexican fruit fly in Texas with mean temperature and precipitation from 1993 to present.

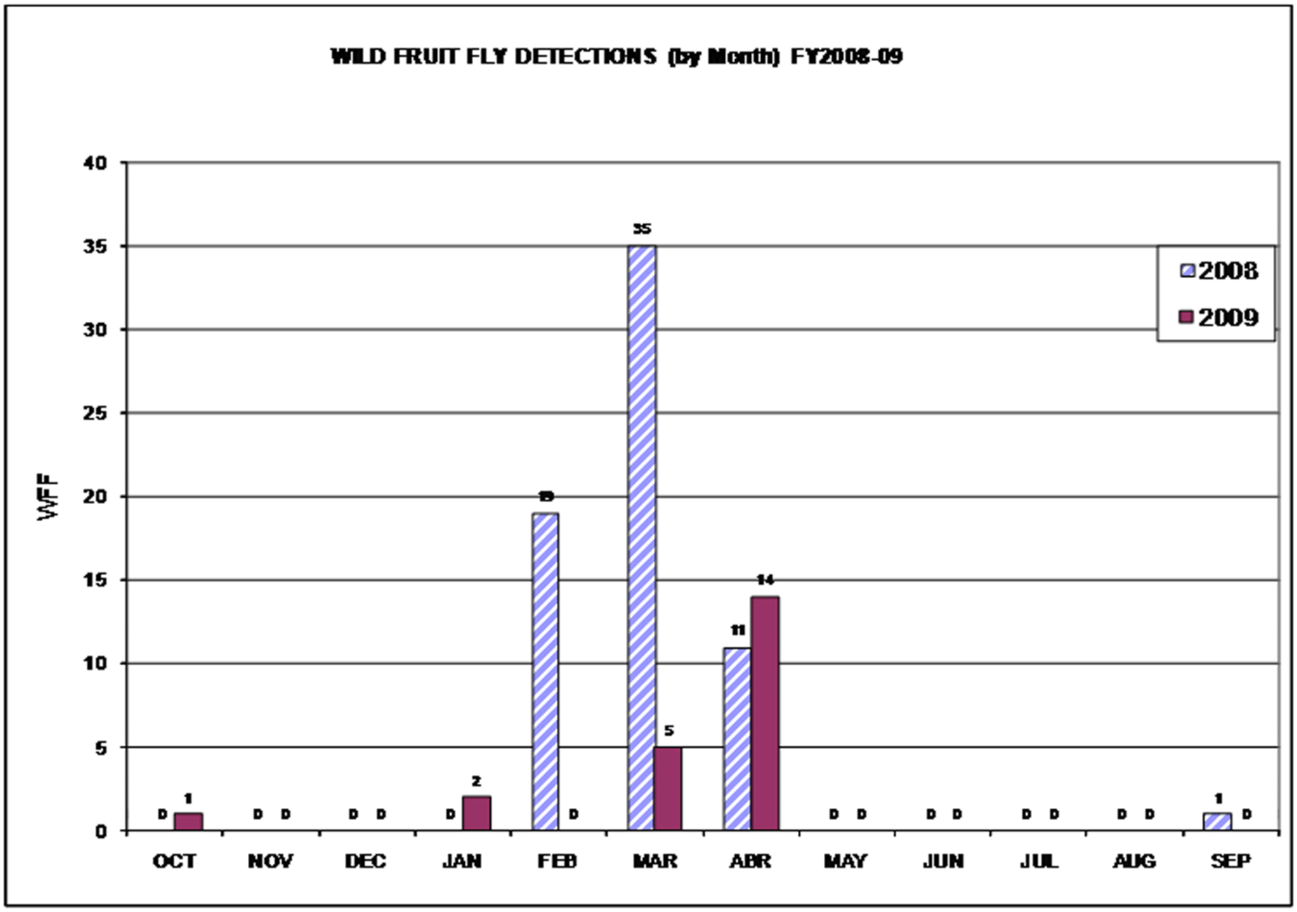


Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	95	354	1464	1916	306	140	14	1	1	7	10	11
Mean temp	57	61	68	75	78	82	84	84	81	74	67	60
Mean. Precip.	1.7	1.7	0.9	1.6	3	2.9	2	2.9	5.6	2.4	1.4	1.4

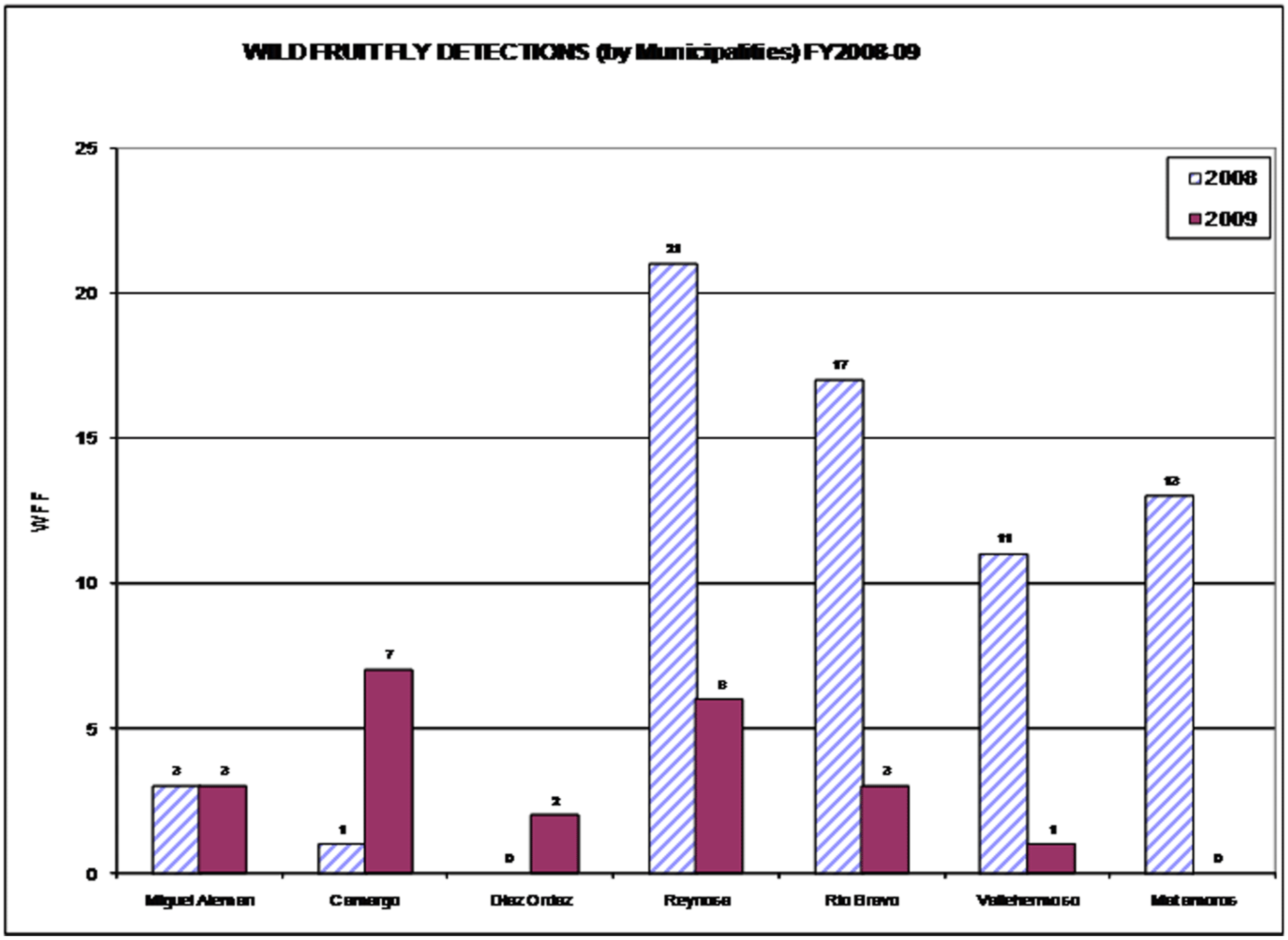
2. Number of wild Mexican fruit fly captured in Texas during the eradication program from 2006 to 2009, relative to the mean annual precipitation.



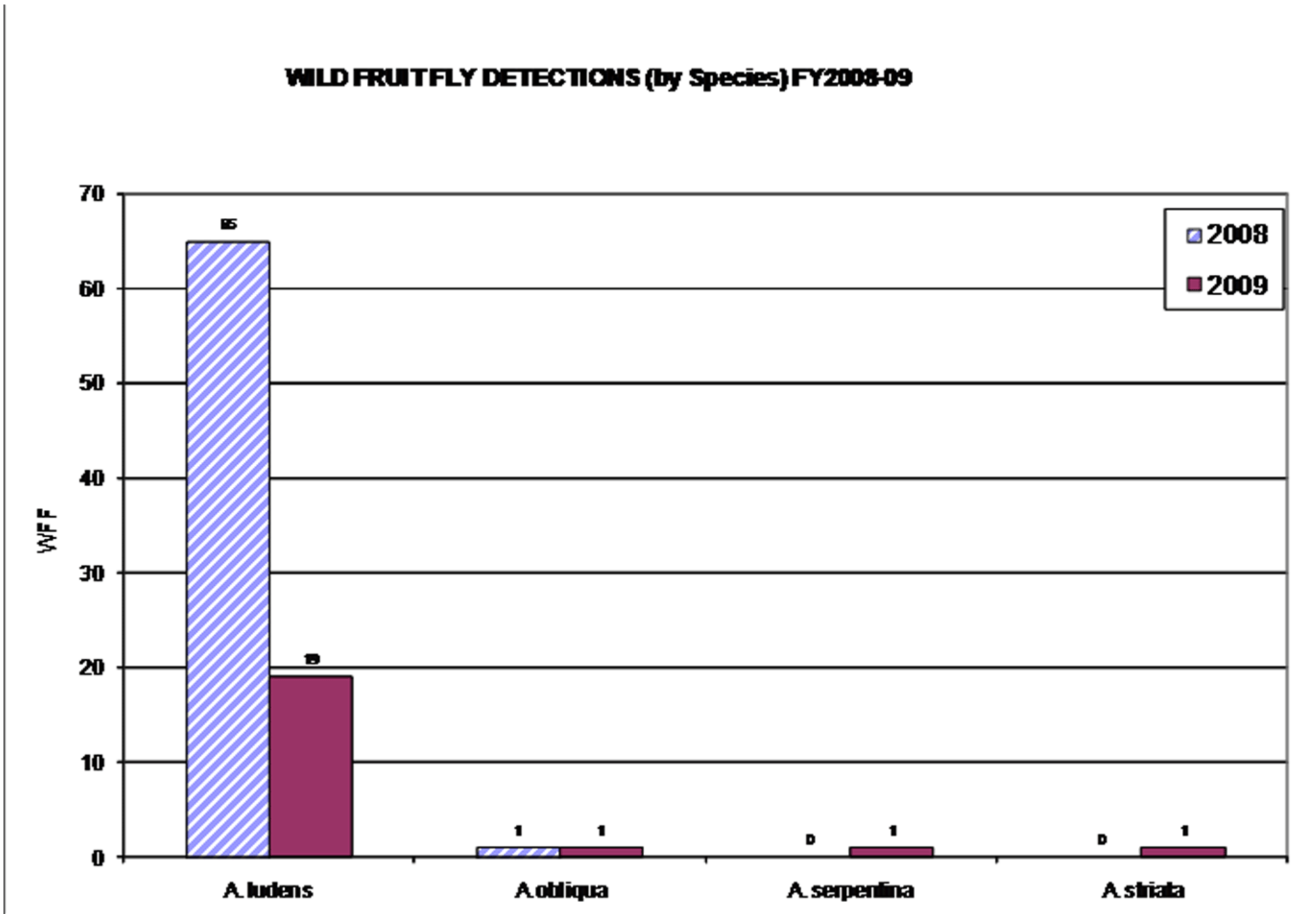
3. Number of monthly wild Mexican fruit fly captures in Mexico LRGV program area in FY2008 and 2009.



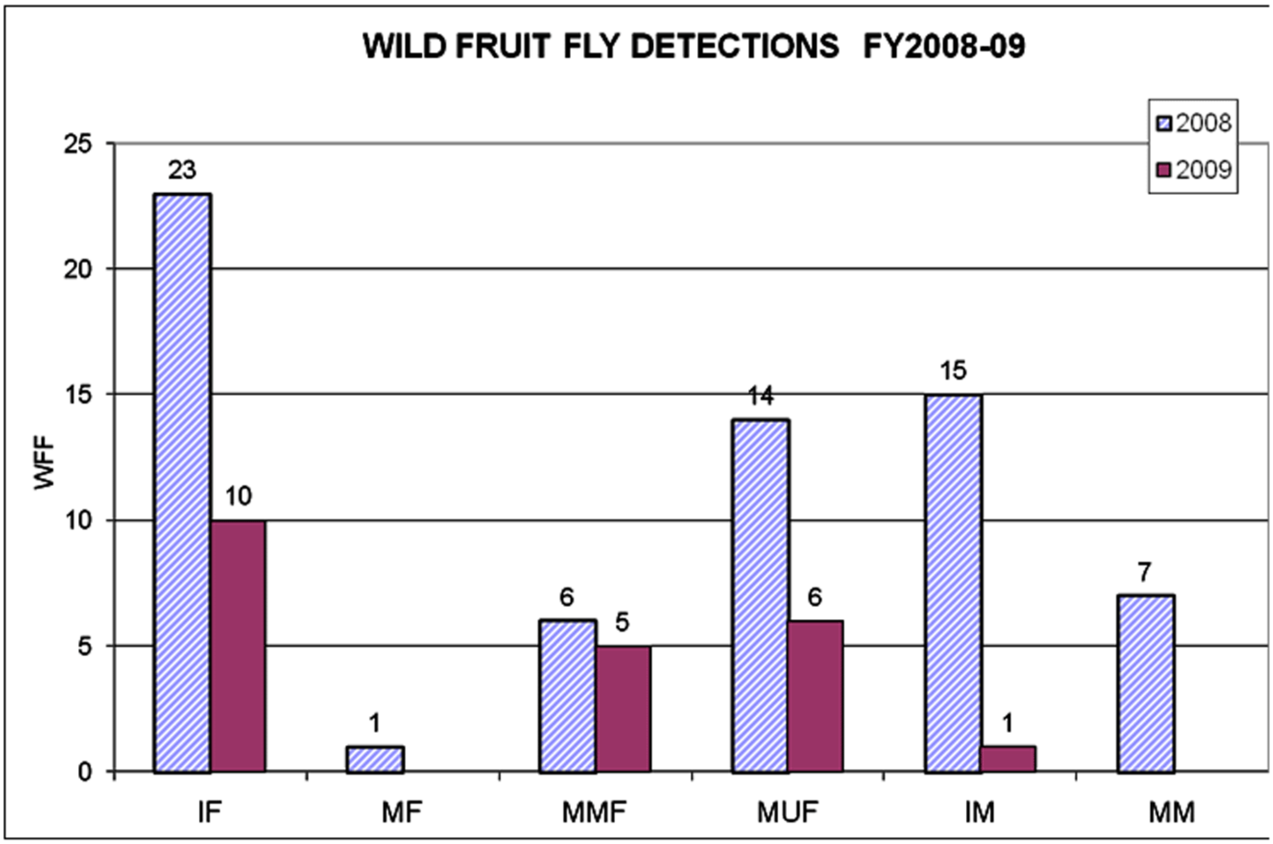
4. Number of wild Mexican fruit fly captured by Mexican municipality in FY2008 and 2009.



5. Number of wild *Anastrepha* captured in Mexico LRGV program area in FY2008 and 2009.

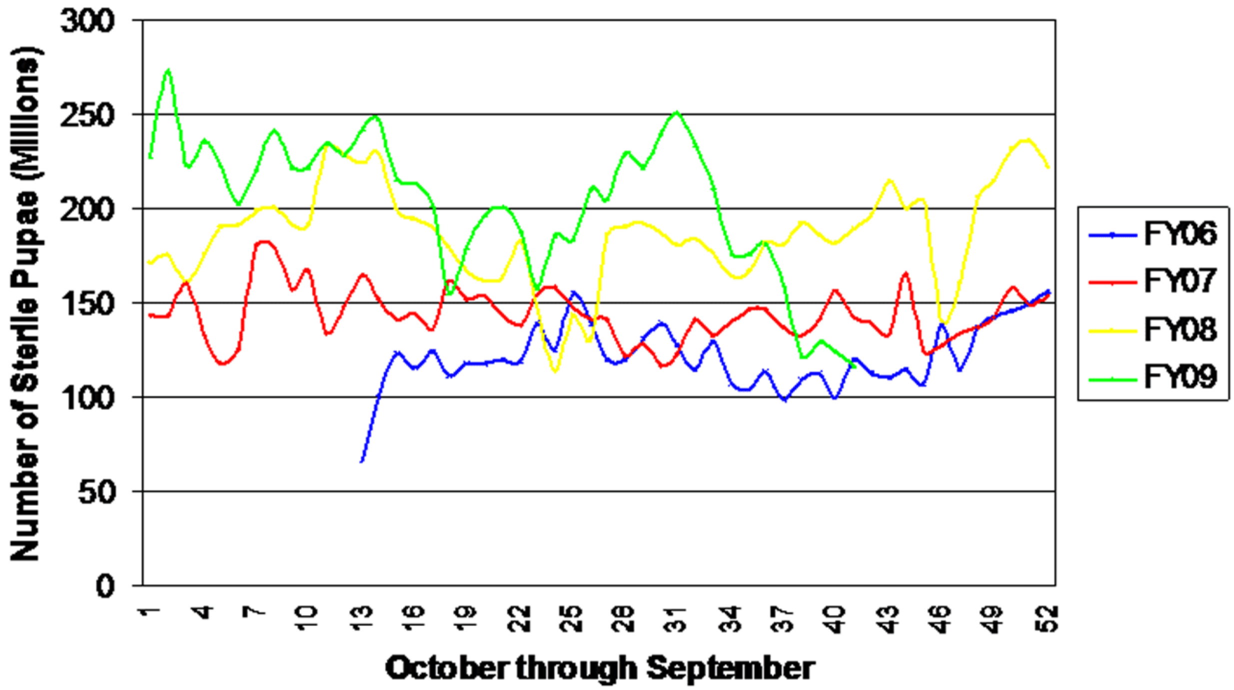


6. Classification of Wild Mexican Fruit Fly Captured in Mexico LRGV Program Area in FY2008 and 2009.

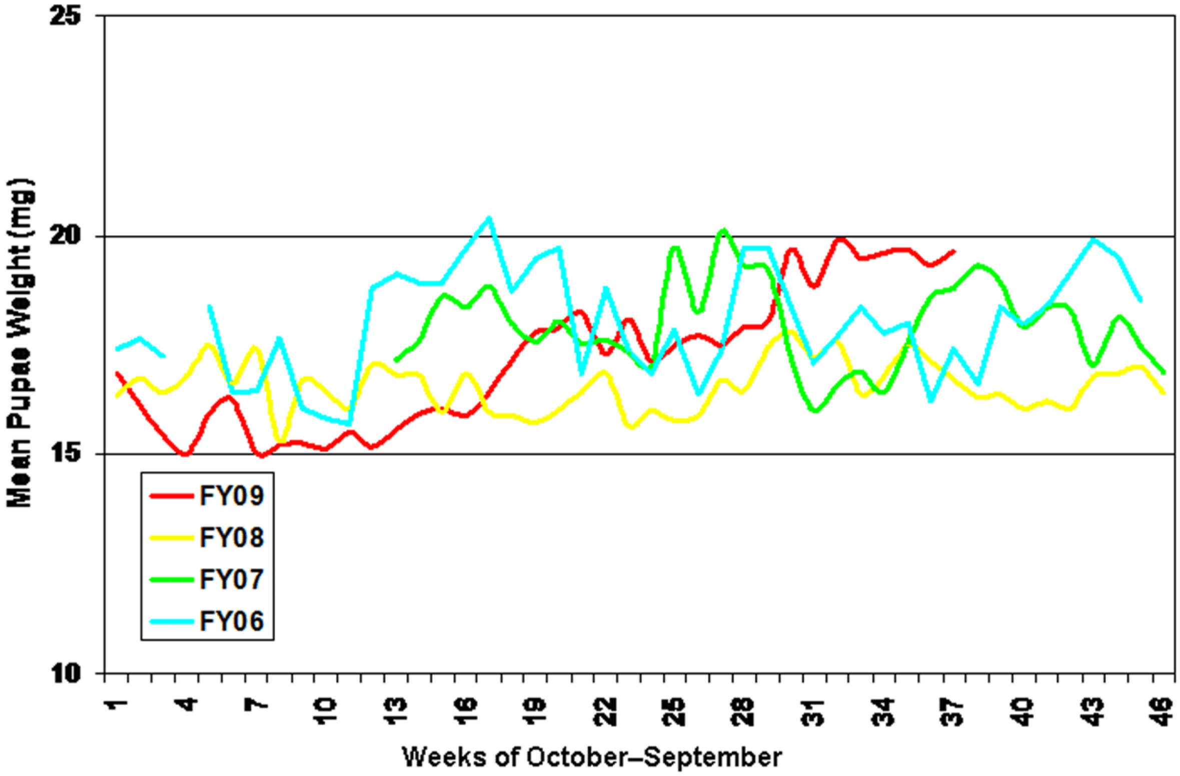


IF Immature Female
MF Mature Female
MMF Mature Mated Female
MUF Mature Unmated Female
IM Immature Male
MM Mature Male

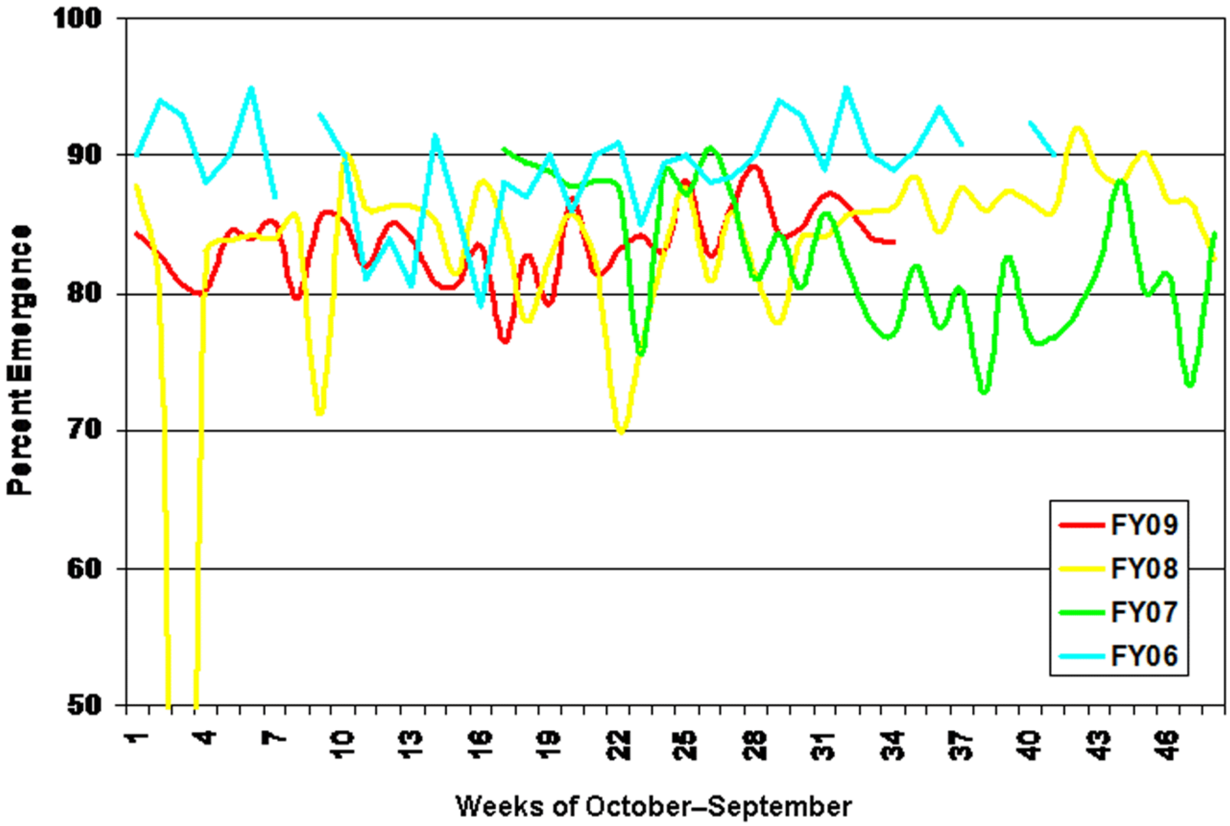
7. Mean Weekly Production of Sterile Mexican Fruit Fly Pupae Produced at the APHIS Edinburg Mexfly Production Facility from 2006 to 2009.



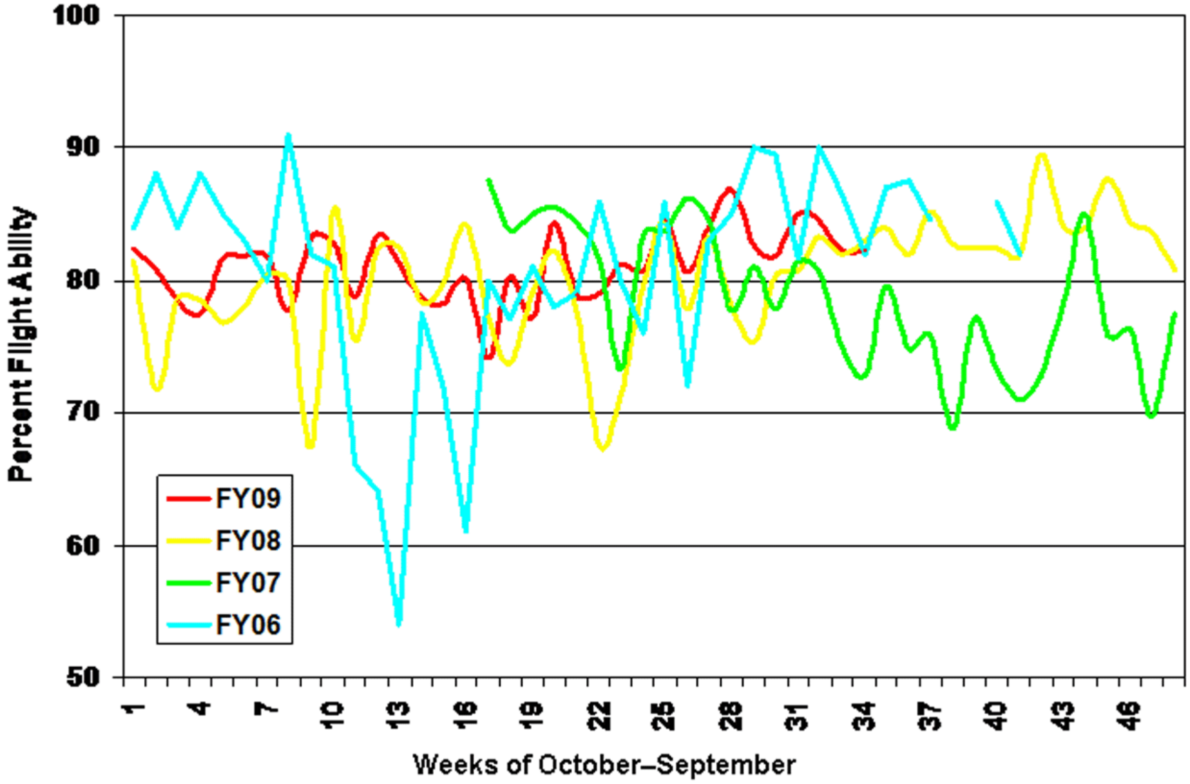
8. Mean Weekly Pupae Weight of Mexican Fruit Fly Produced at the APHIS Edinburg Mexfly Production Facility from 2006 to 2009.



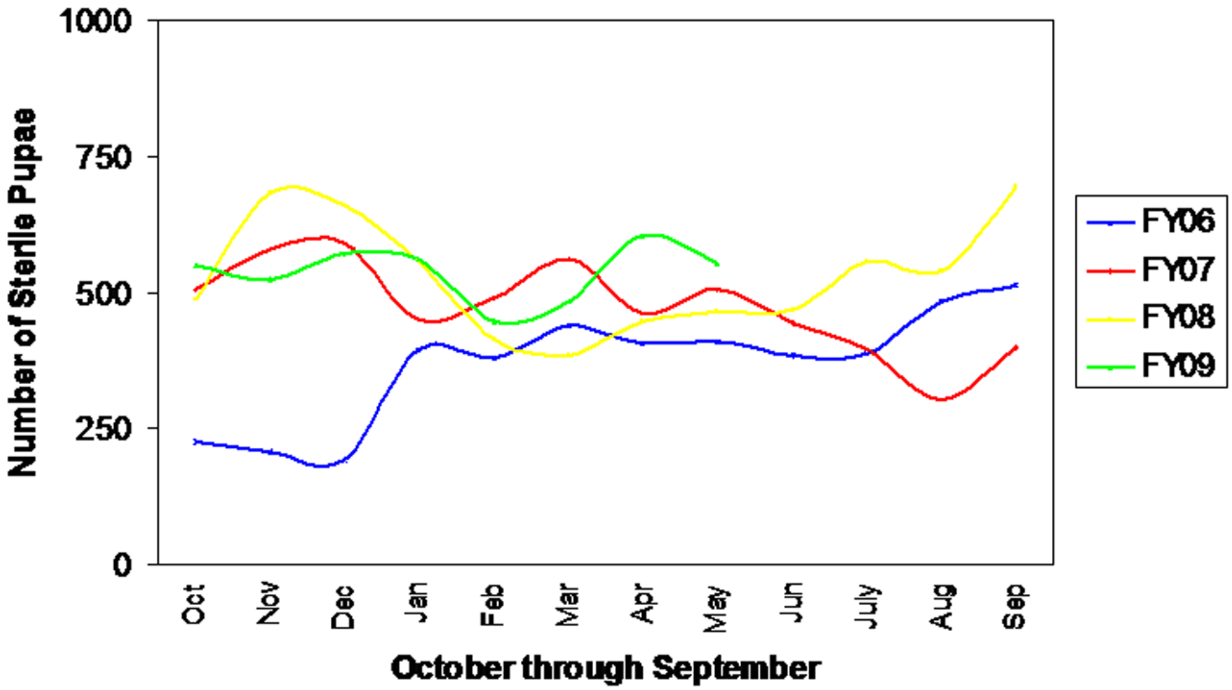
9. Mean Weekly Percentage Emergence of Mexican Fruit Fly Produced at the APHIS Edinburg Mexfly Production Facility from 2006 to 2009.



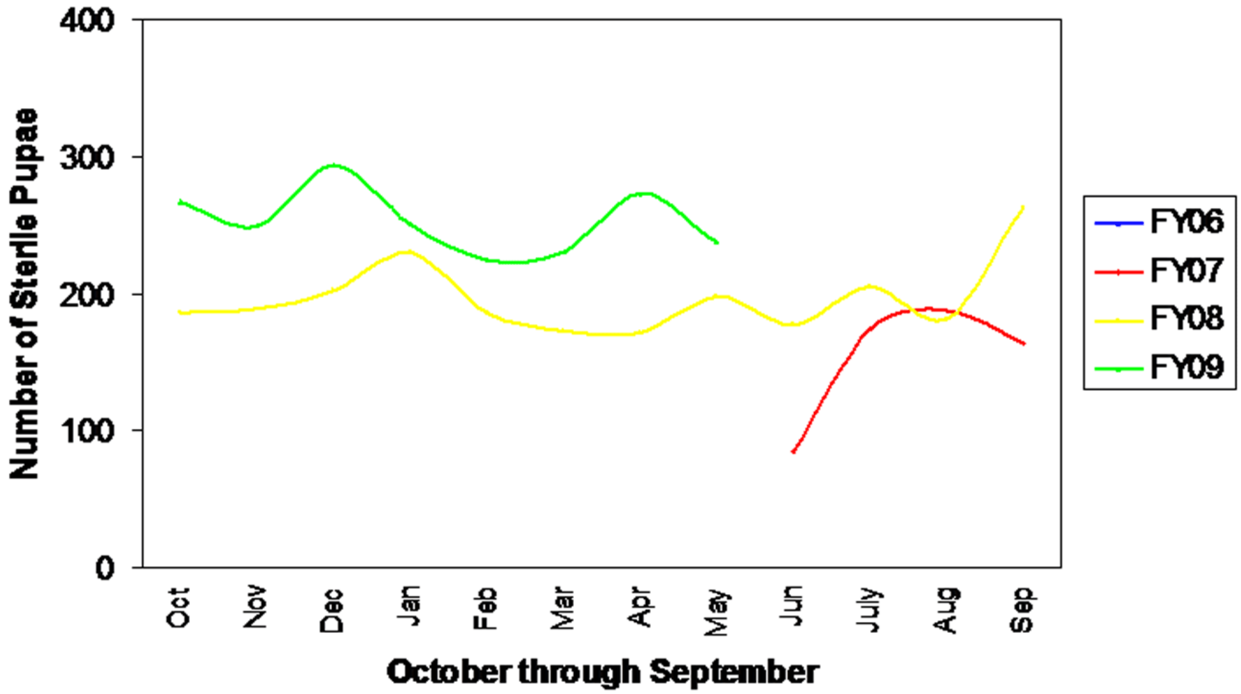
10. Mean Weekly Percentage Flight of Mexican Fruit Fly Produced at the APHIS Edinburg Mexfly Production Facility from 2006 to 2009.



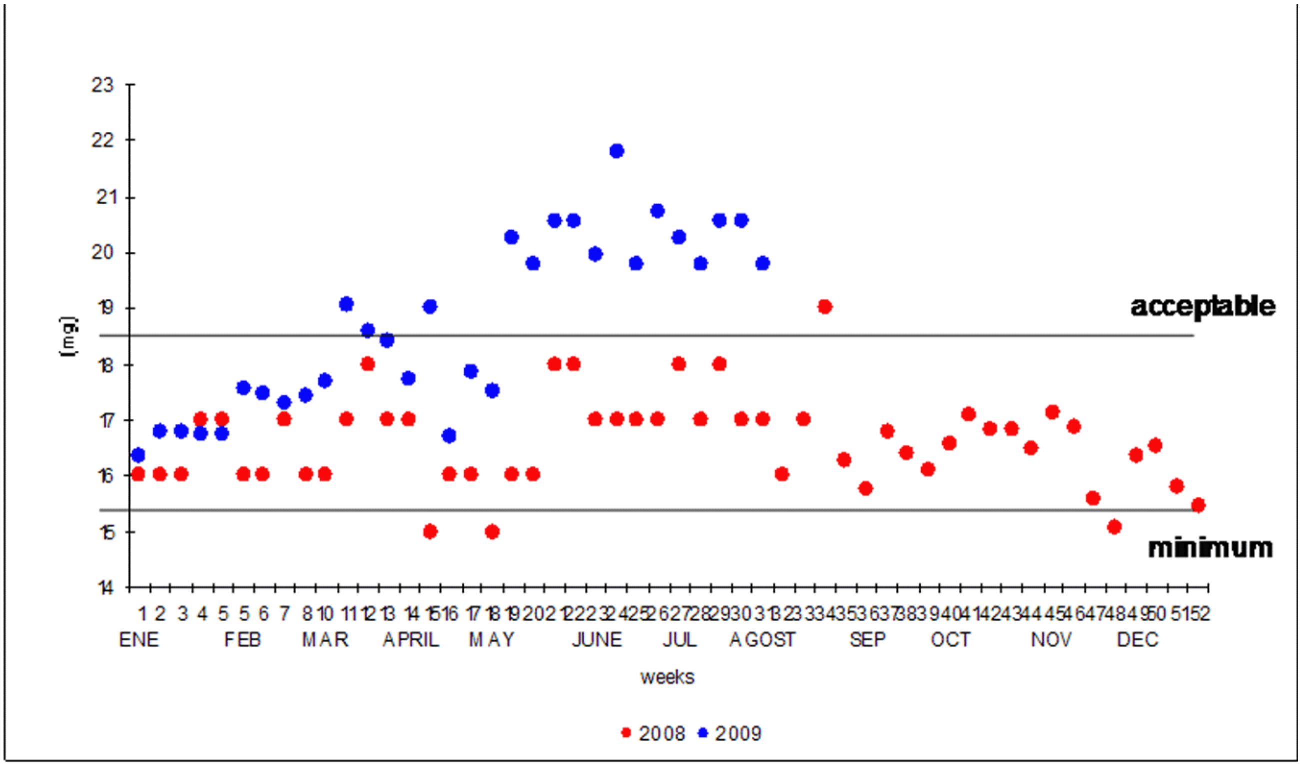
11. Mean Monthly Emergence of Sterile Mexican Fruit Fly Pupae Produced at the APHIS Edinburg Mexfly Production Facility from 2006 to 2009.



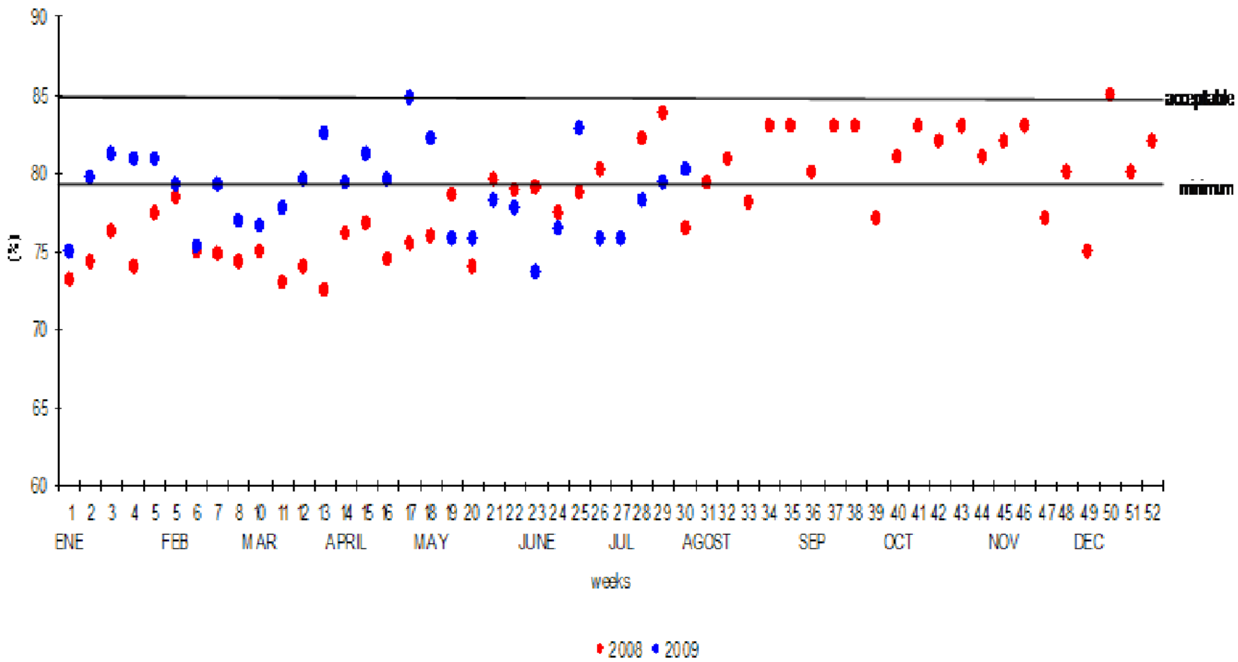
12. Mean Monthly Emergence of Sterile Mexican Fruit Fly Pupae Produced at the APHIS Harlingen Mexfly Production Facility from 2006 to 2009.



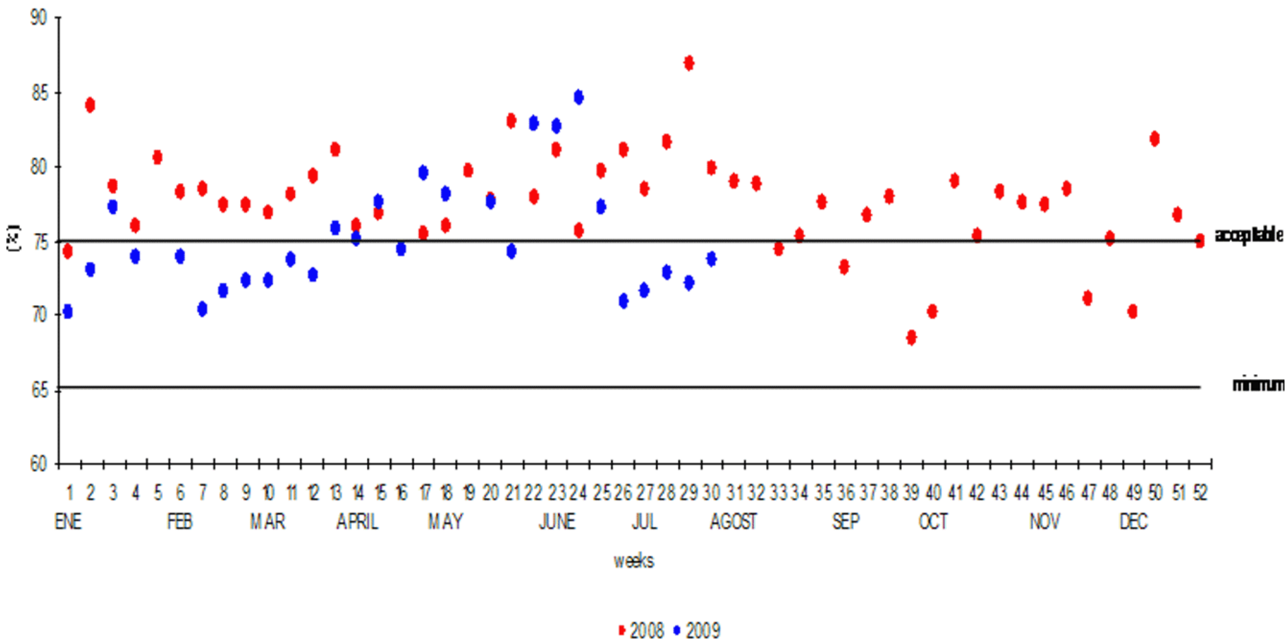
13. Mean Weekly Pupae Weight of Mexican Fruit Fly Emerged at the APHIS Reynosa Emergence and Release Facility from 2008 to 2009.



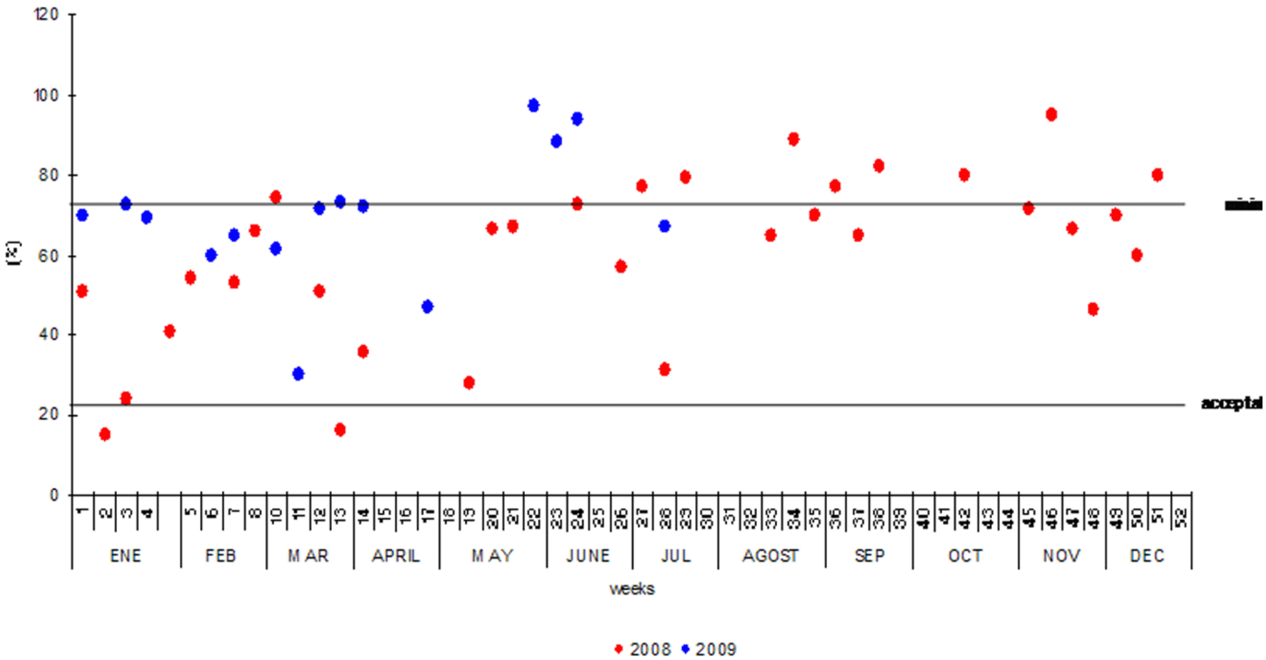
14. Mean Weekly Percentage Emergence of Mexican Fruit Fly Adults at the APHIS Reynosa Emergence and Release Facility from 2008 to 2009.



15. Mean Weekly Percentage Flightability Of Mexican Fruit Fly Adults at the APHIS Reynosa Emergence and Release Facility from 2008 to 2009.



16. Mean weekly Percentage Mortality of 96 Hours of Mexican Fruit Fly Adults at the APHIS Reynosa Emergence and Release Facility from 2008 to 2009.

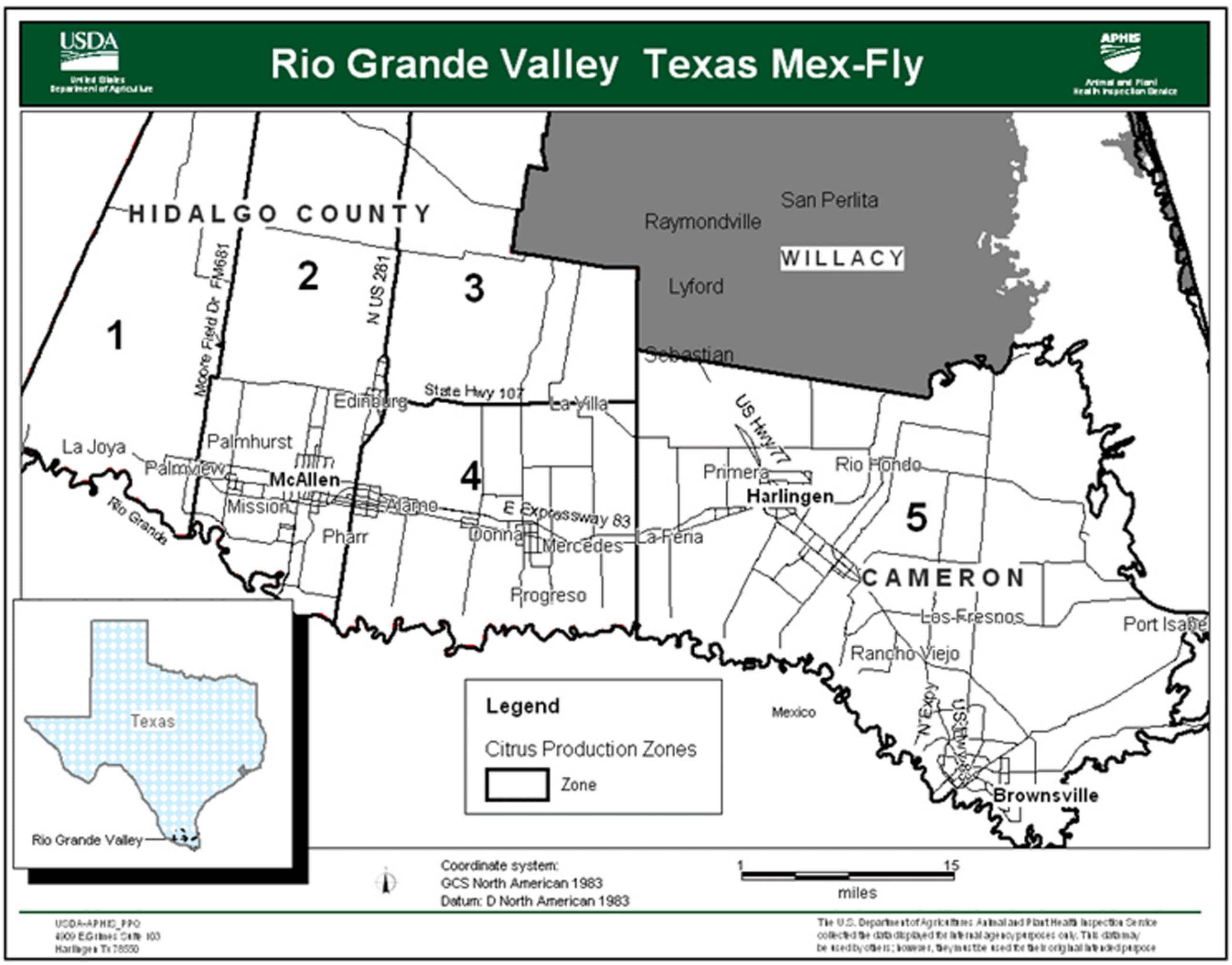


D

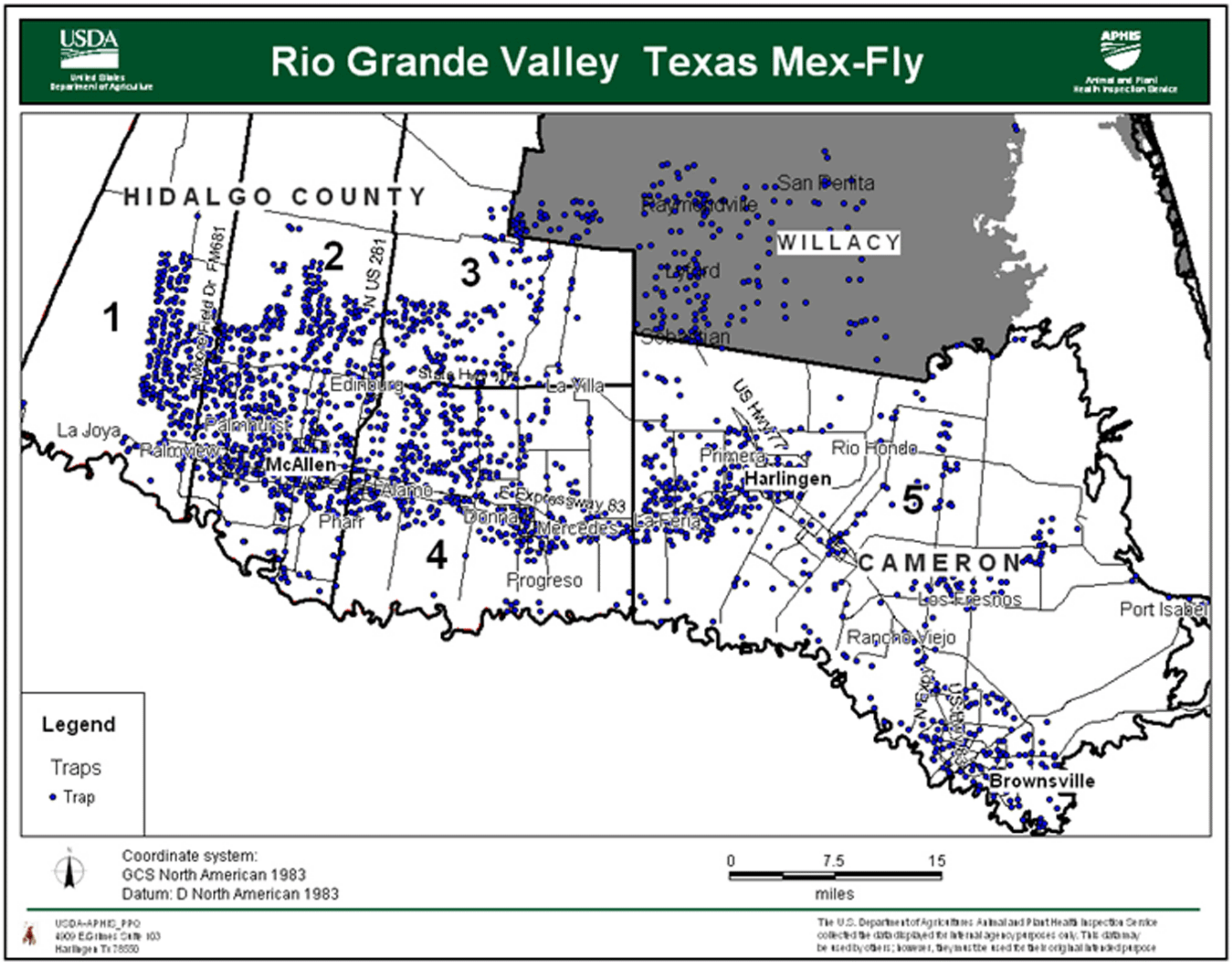
Appendix D

Maps

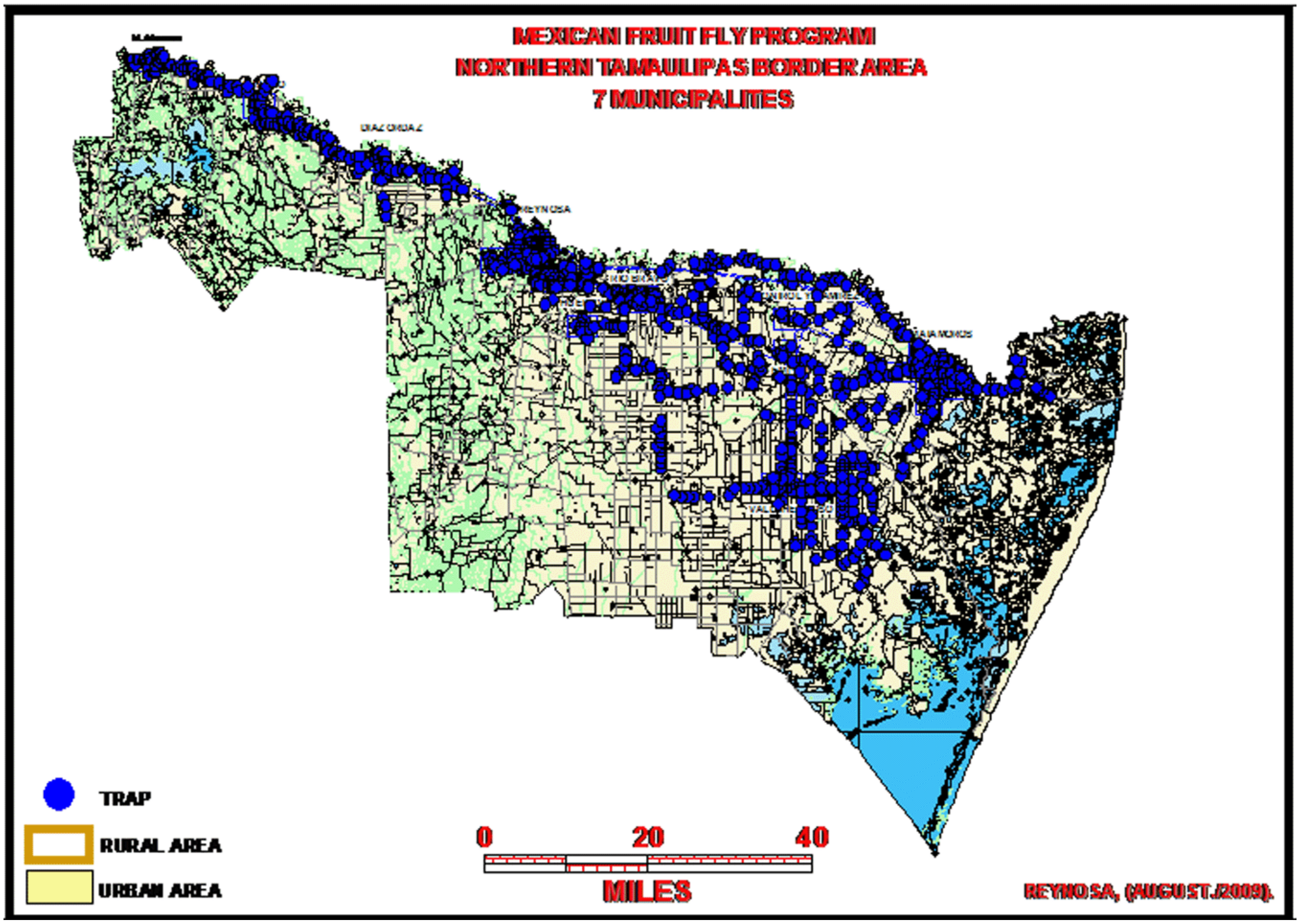
Map 1. Location of Citrus Production Zones (1 to 5) in Hidalgo and Cameron Counties of Texas as Delineated in the Texas Protocol



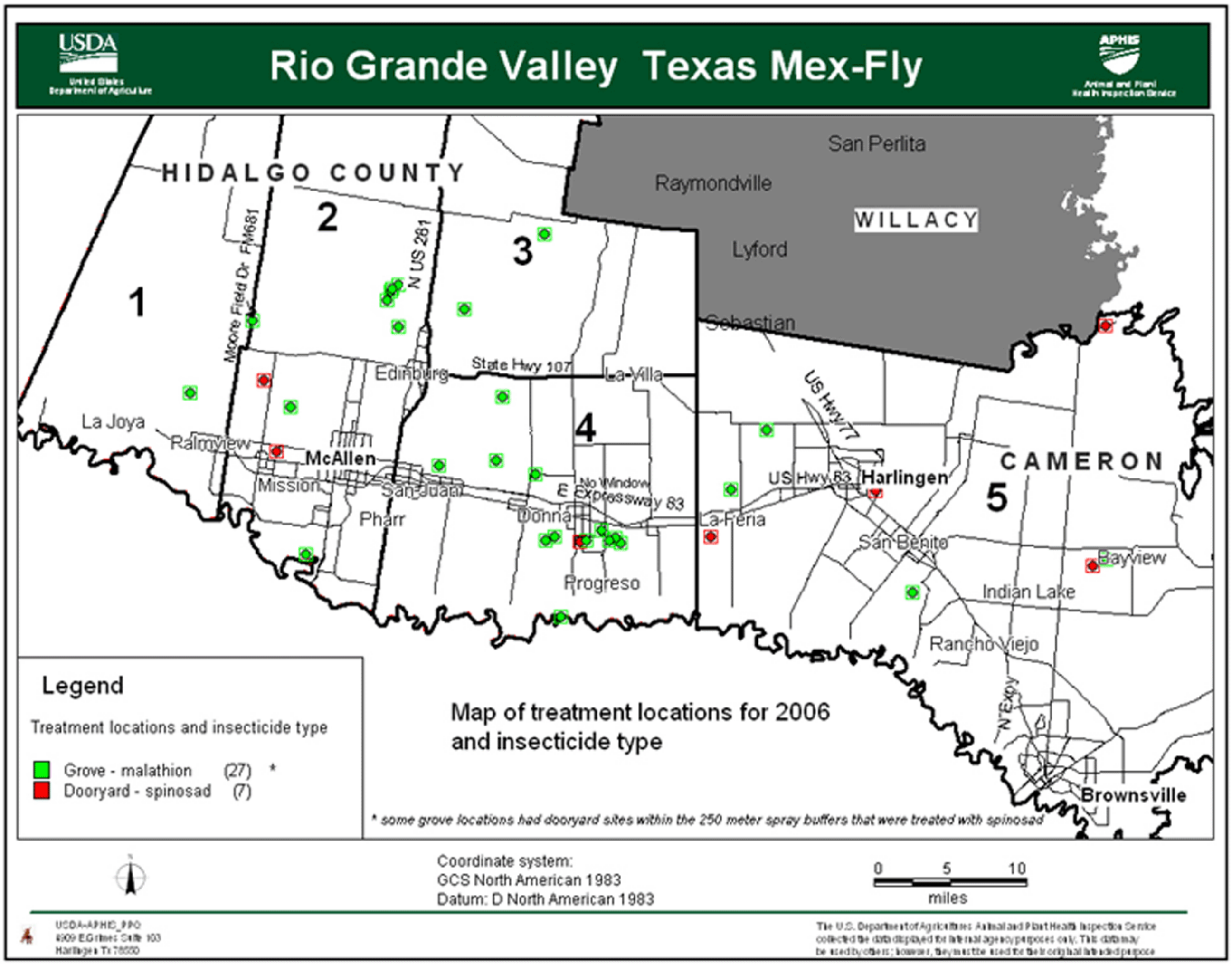
Map 2. Location of APHIS Mexican fruit fly surveillance traps (blue) in Texas in 2009.



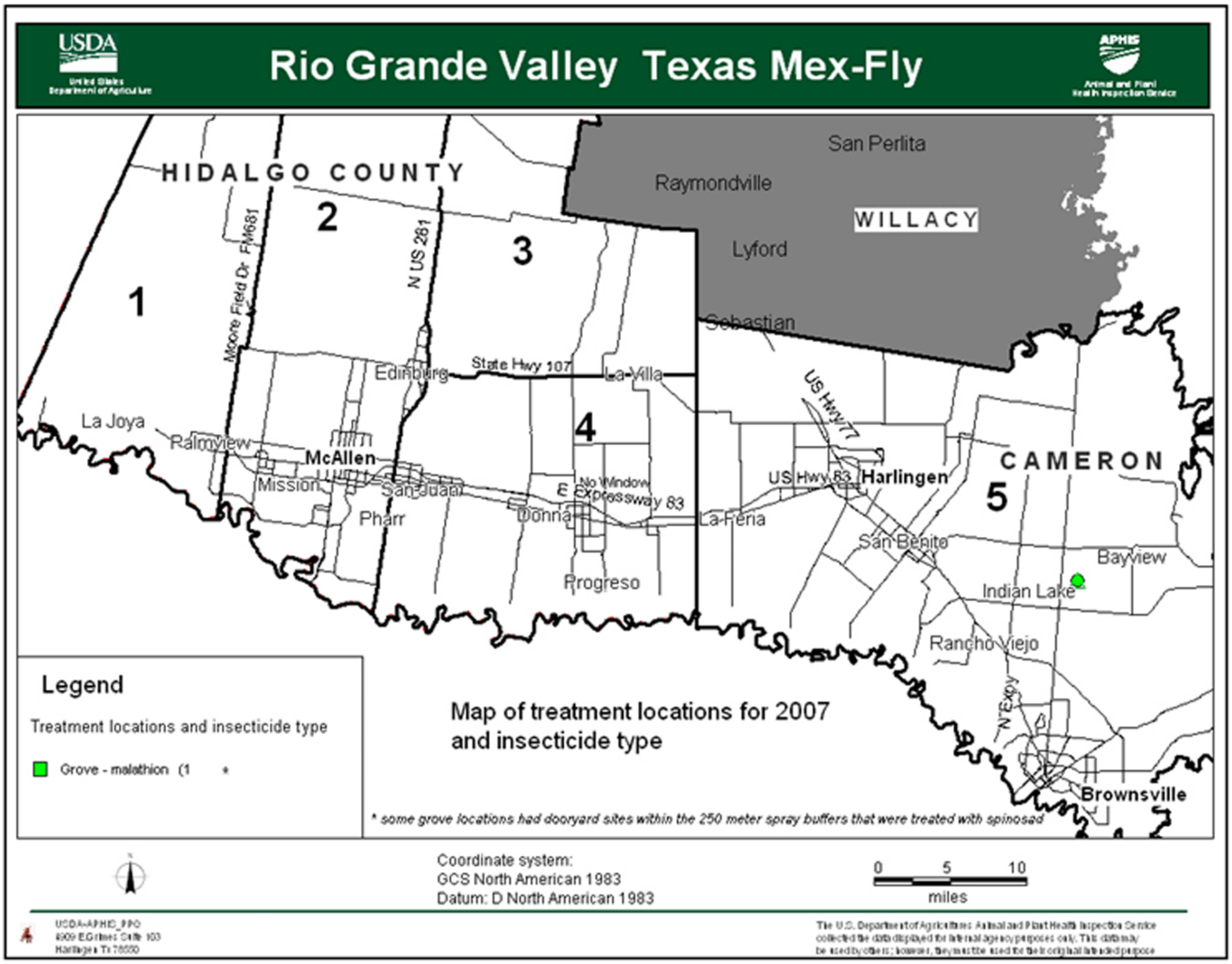
Map 3. Location of APHIS Mexican Fruit Fly Surveillance Traps (blue) in Tamaulipas, Mexico from 2006 to 2009.



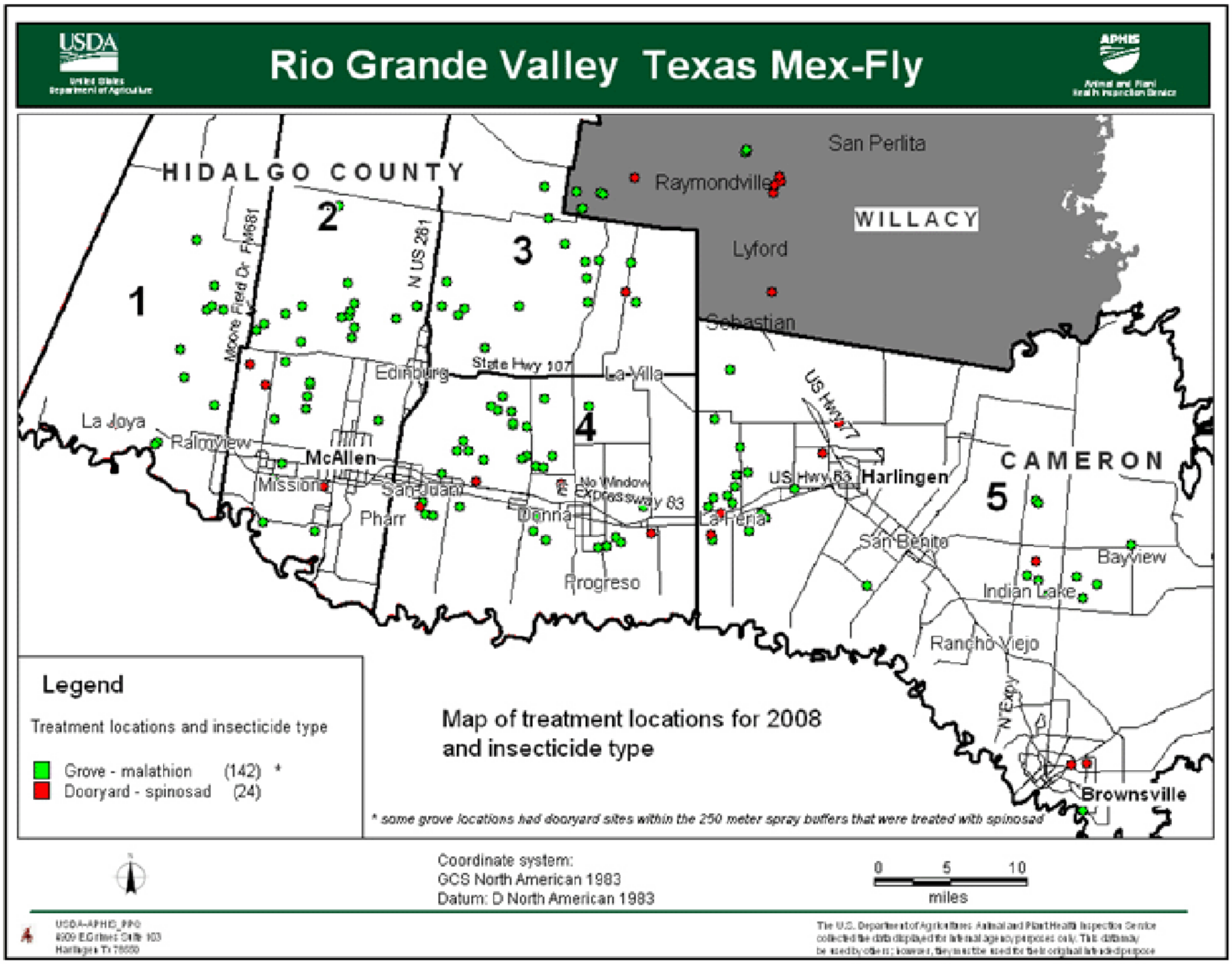
Map 4. Location of wild Mexican fruit fly captures and bait sprays treatments in commercial groves (green) and dooryards (red) n Texas in 2006.



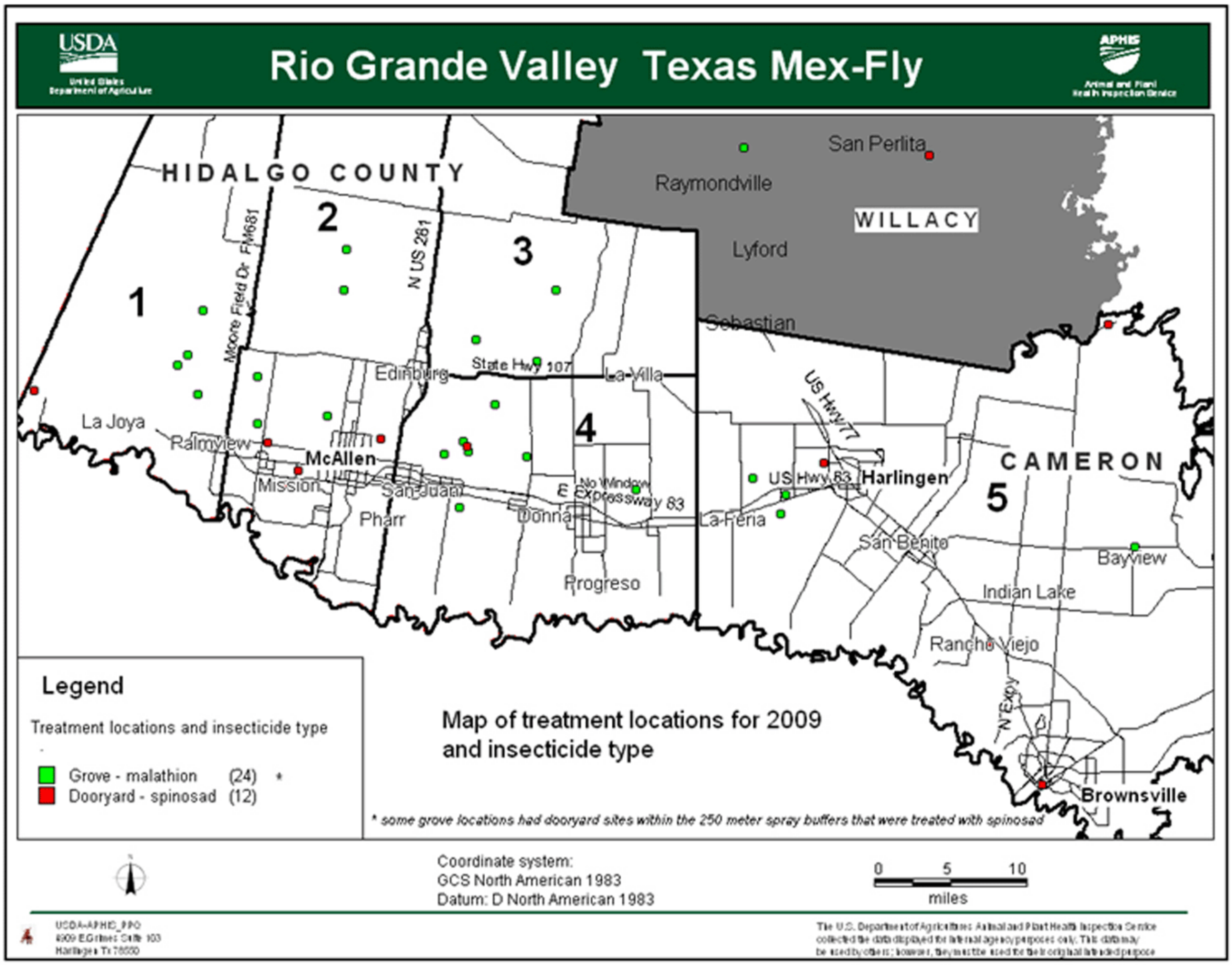
Map 5. Location of wild Mexican fruit fly captures and bait sprays treatments in commercial groves (green) and dooryards (red) n Texas in 2007.



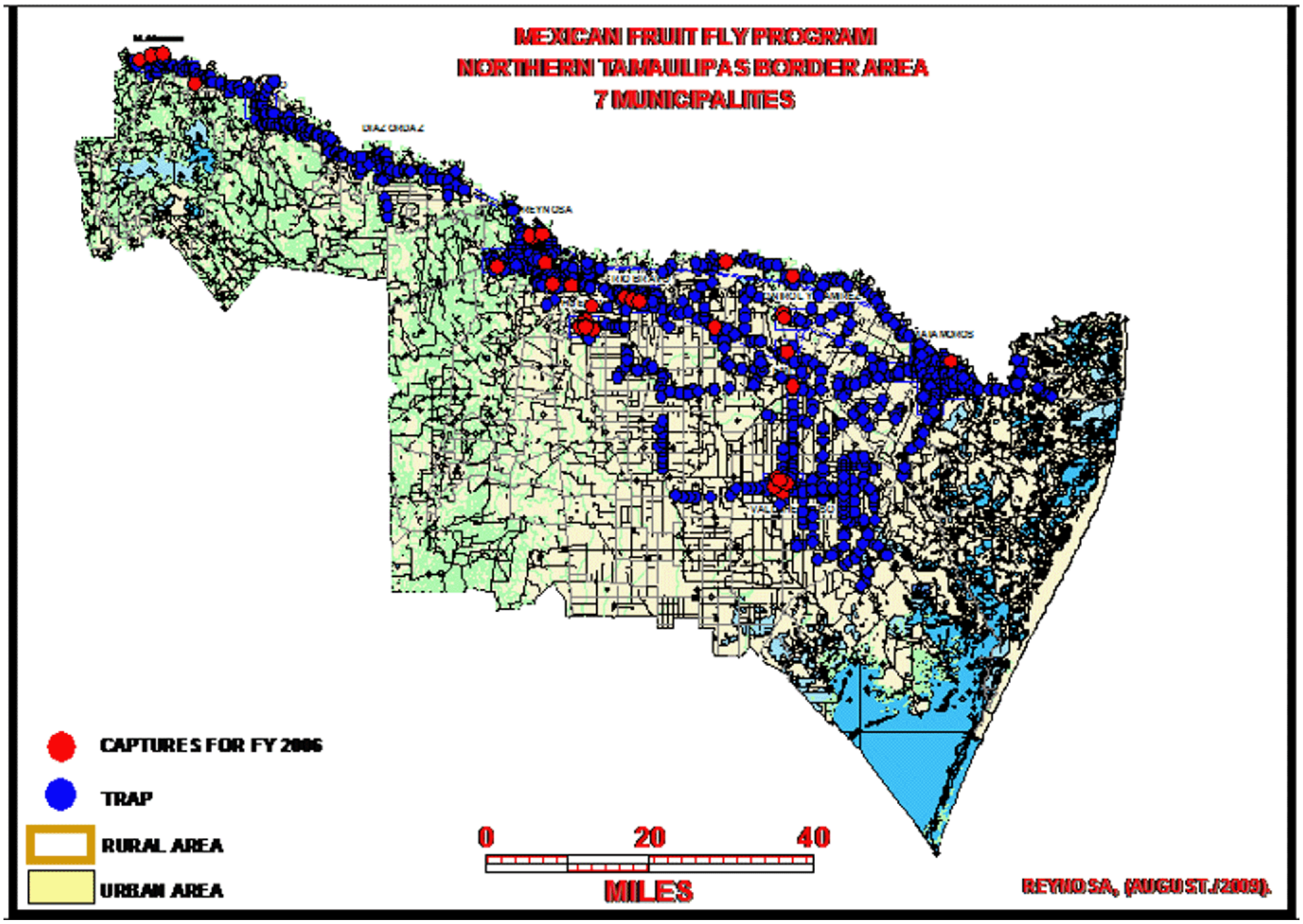
Map 6. Location of wild Mexican fruit fly captures and bait sprays treatments in commercial groves (green) and dooryards (red) n Texas in 2008.



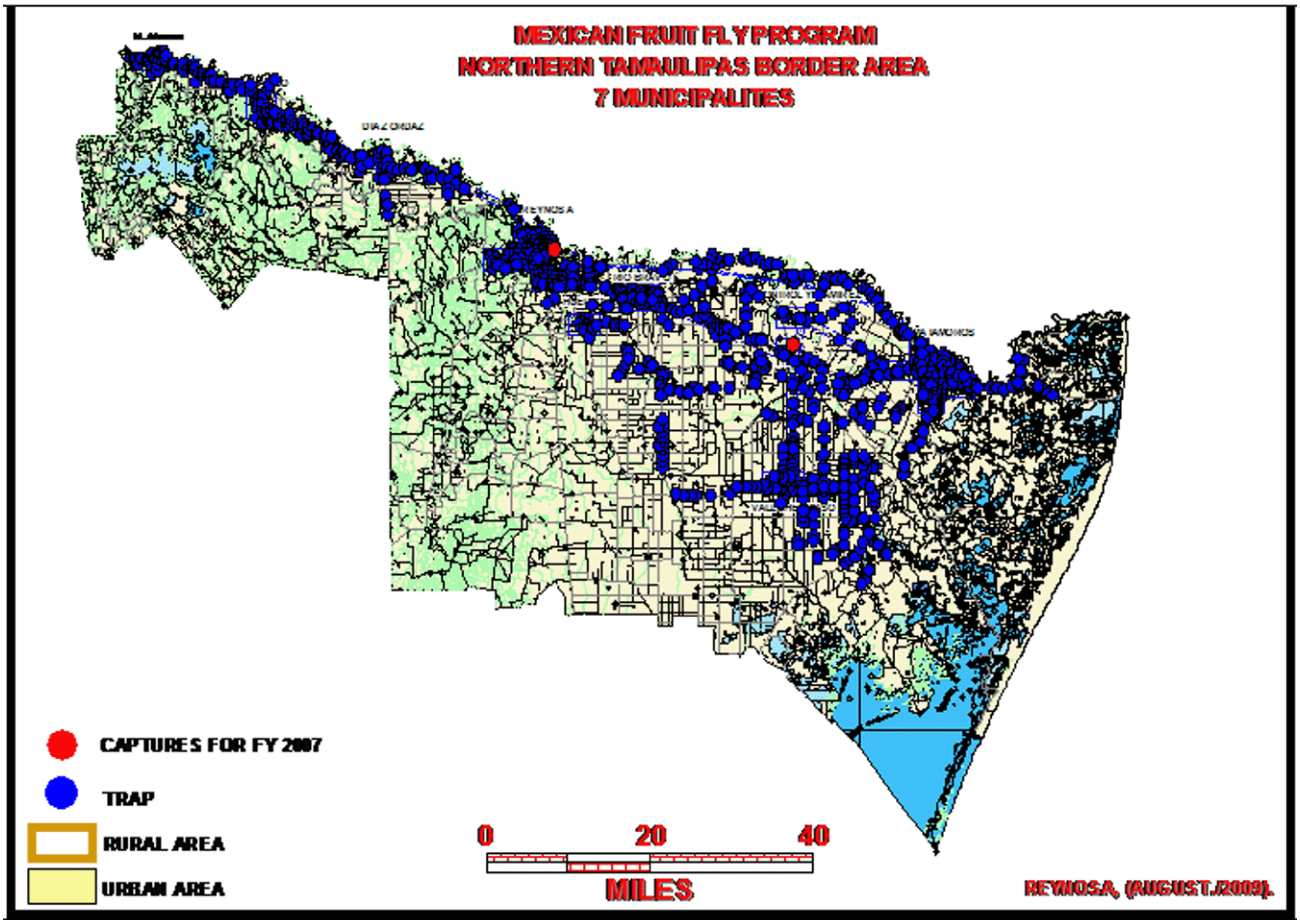
Map 7. Location of wild Mexican fruit fly captures and bait sprays treatments in commercial groves (green) and dooryards (red) n Texas in 2009.



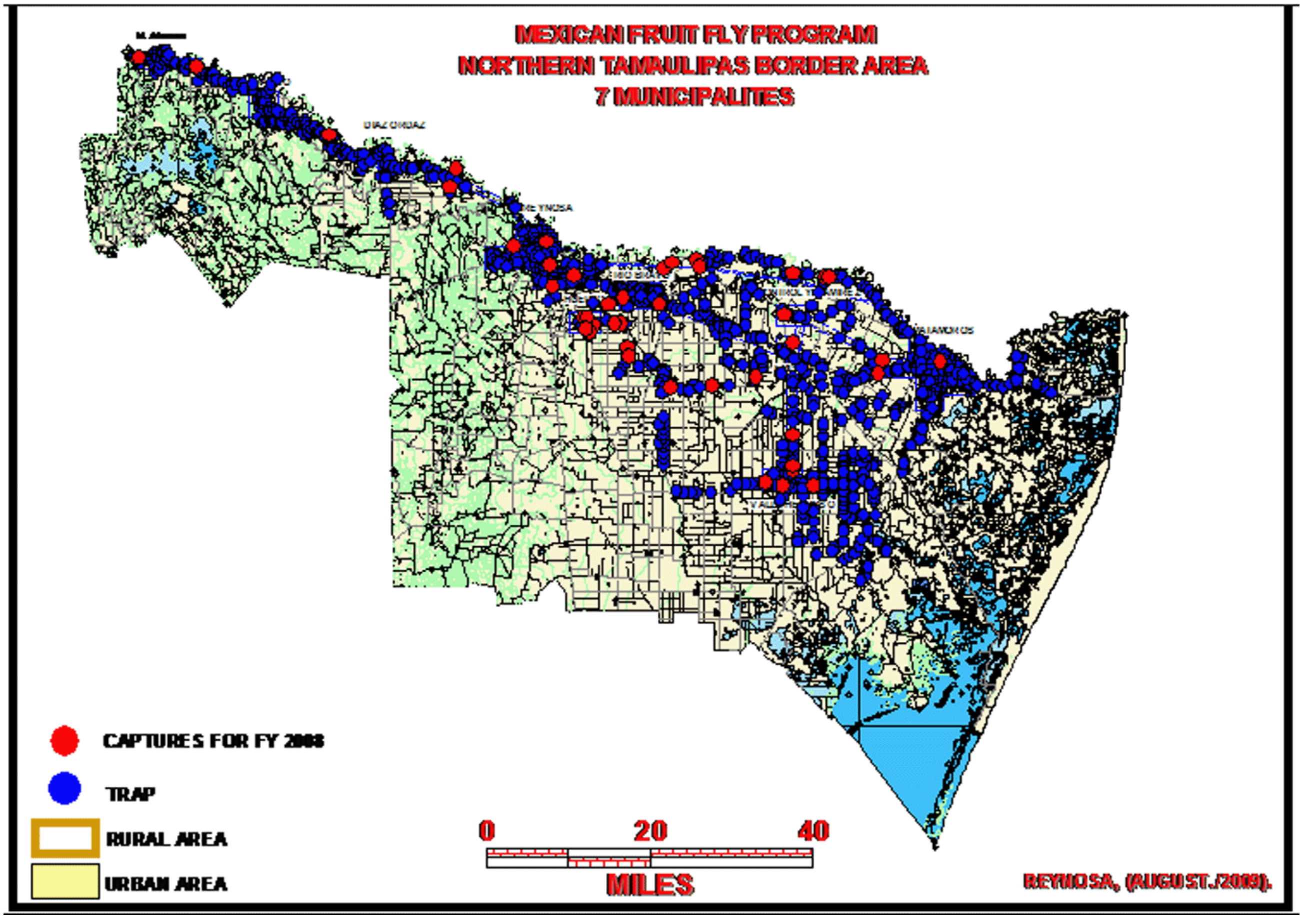
Map 8. Location of APHIS surveillance traps (blue) and wild Mexican fruit fly captures (red) in Tamaulipas, Mexico in 2006.



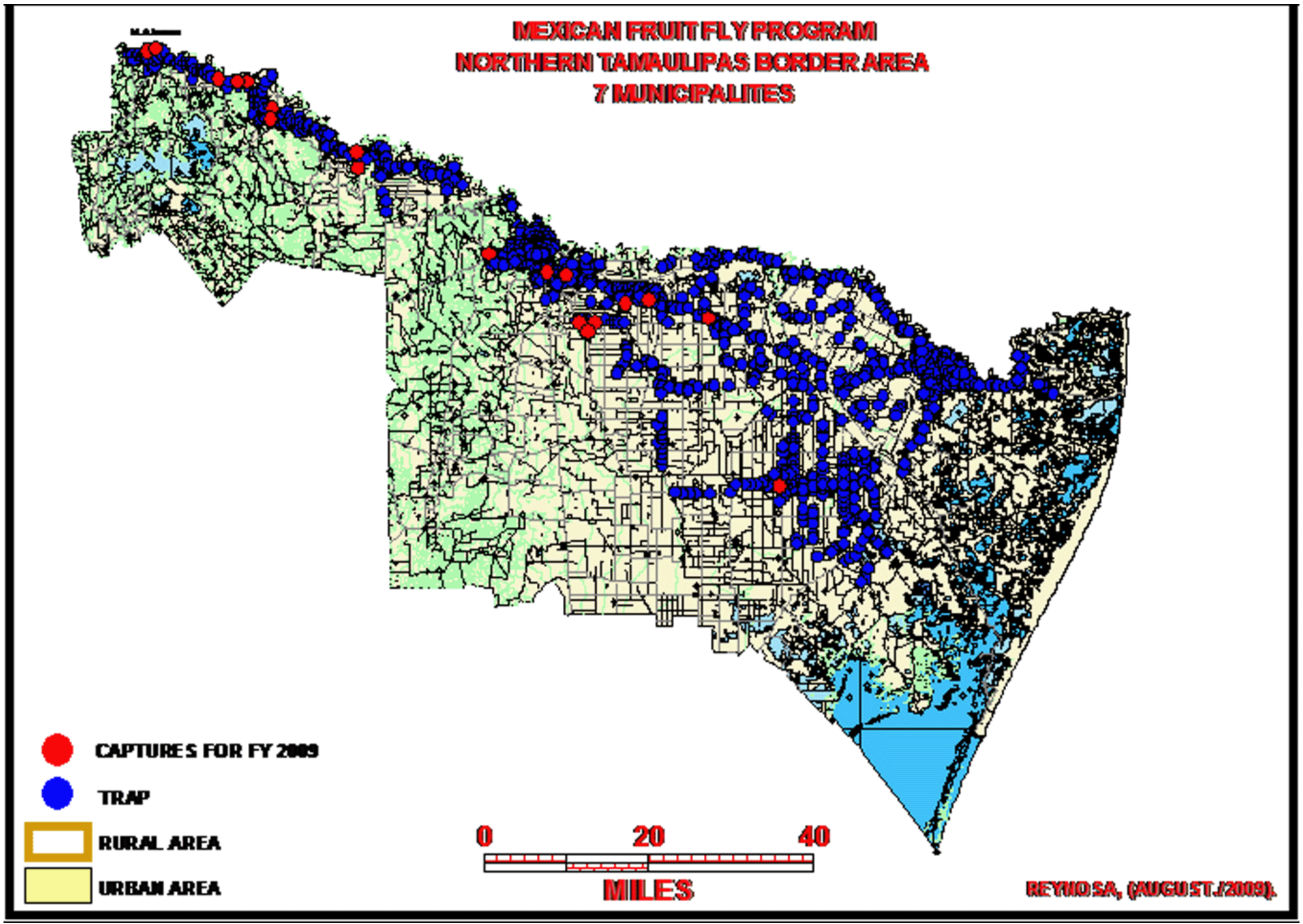
Map 9. Location of APHIS surveillance traps (blue) and wild Mexican fruit fly captures (red) in Tamaulipas, Mexico in 2007.



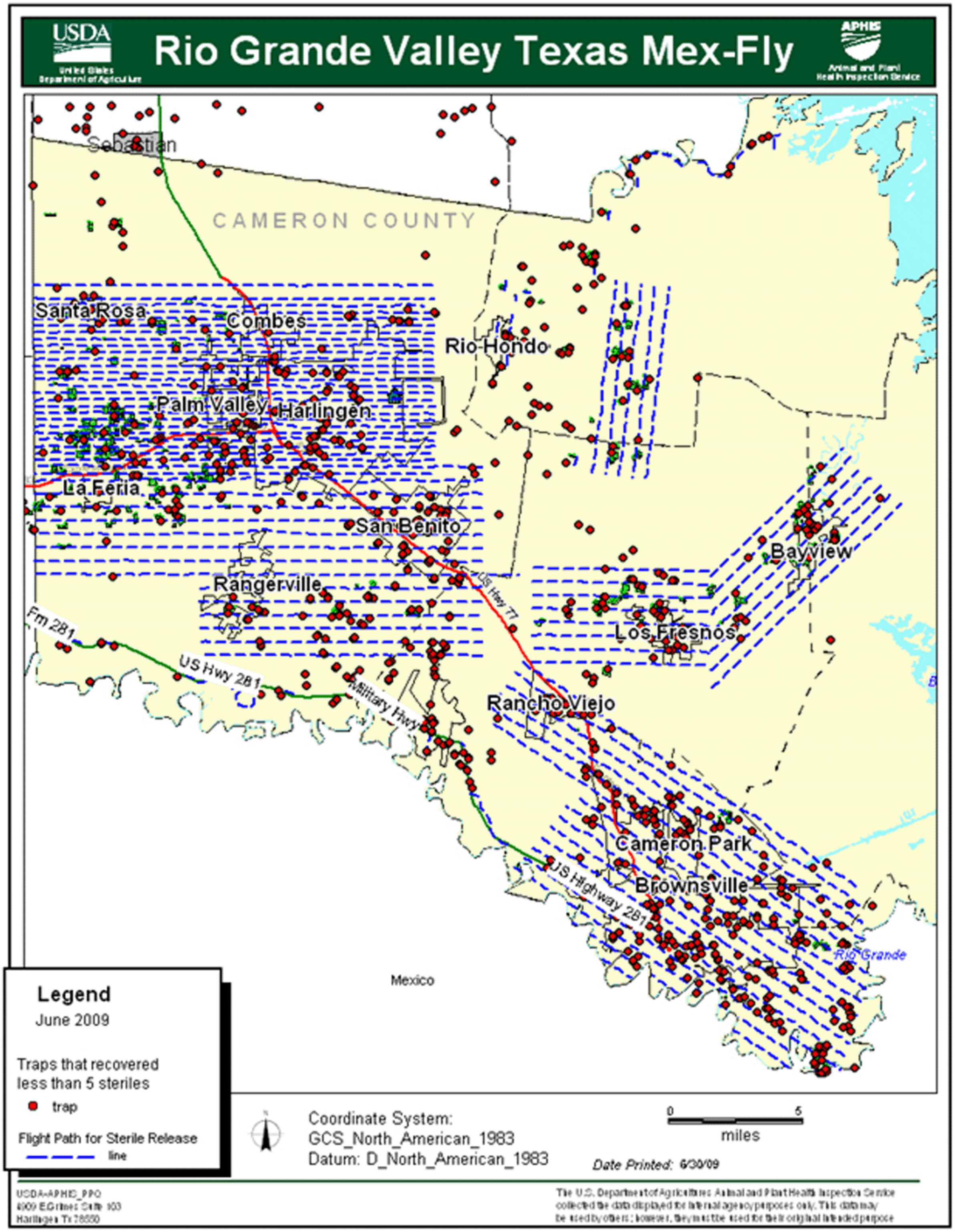
Map 10. Location of APHIS surveillance traps (blue) and wild Mexican fruit fly captures (red) in Tamaulipas, Mexico in 2008.



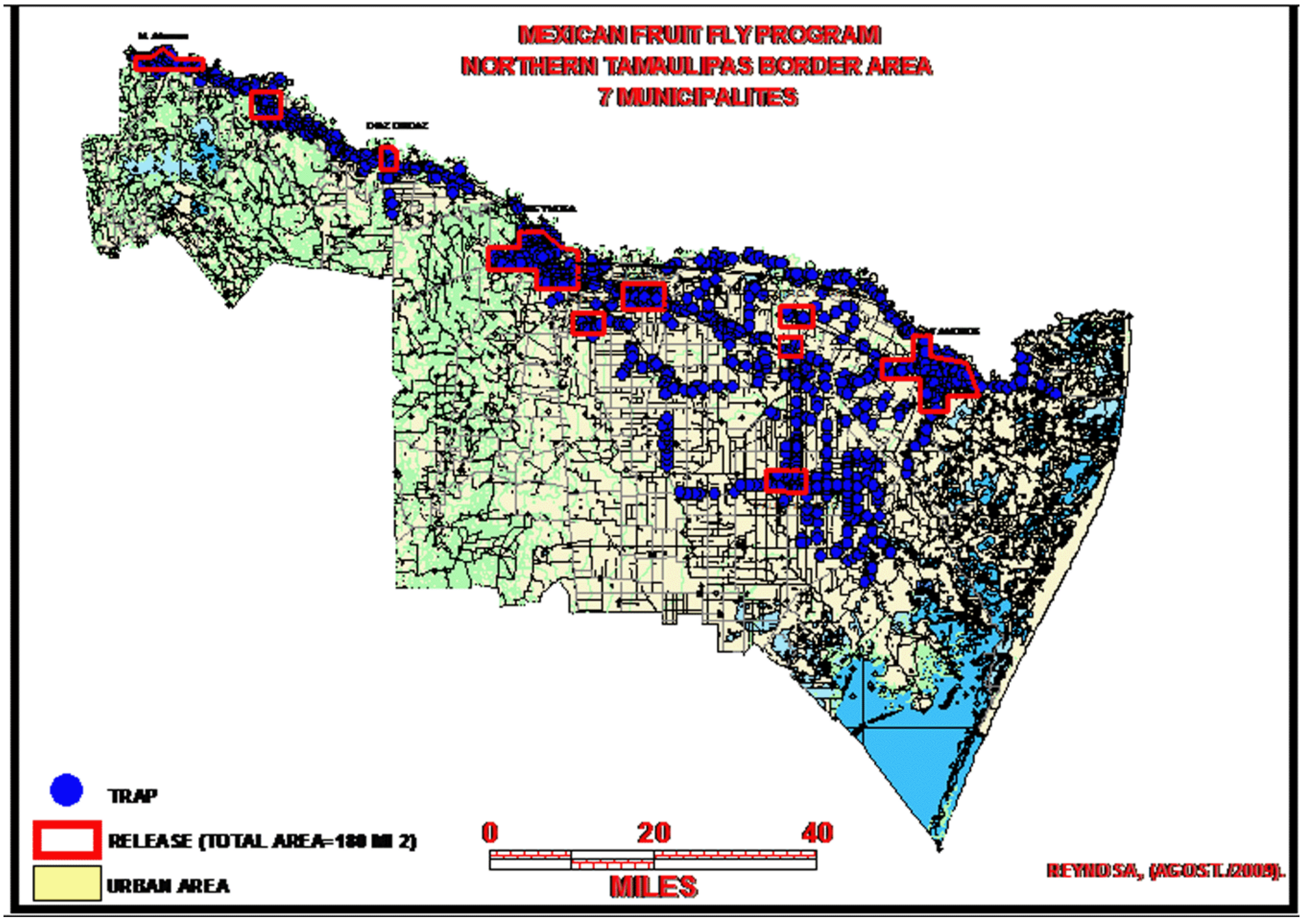
Map 11. Location of APHIS surveillance traps (blue) and wild Mexican fruit fly captures (red) in Tamaulipas, Mexico in 2009.



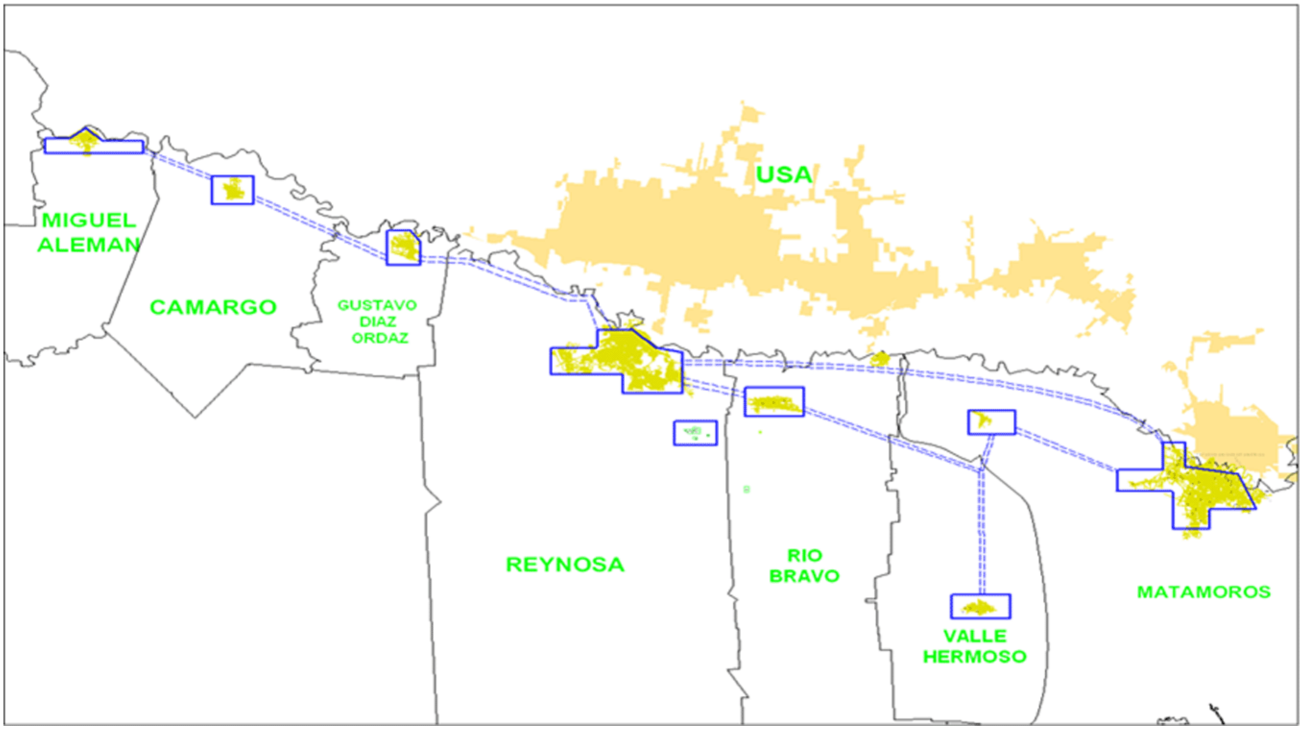
Map 12. Location of sterile Mexican fruit fly aerial release blocks in Texas in 2009.



Map 13. Location of APHIS surveillance traps and sterile Mexican fruit fly release grids in Tamaulipas, Mexico from 2006 to 2009.

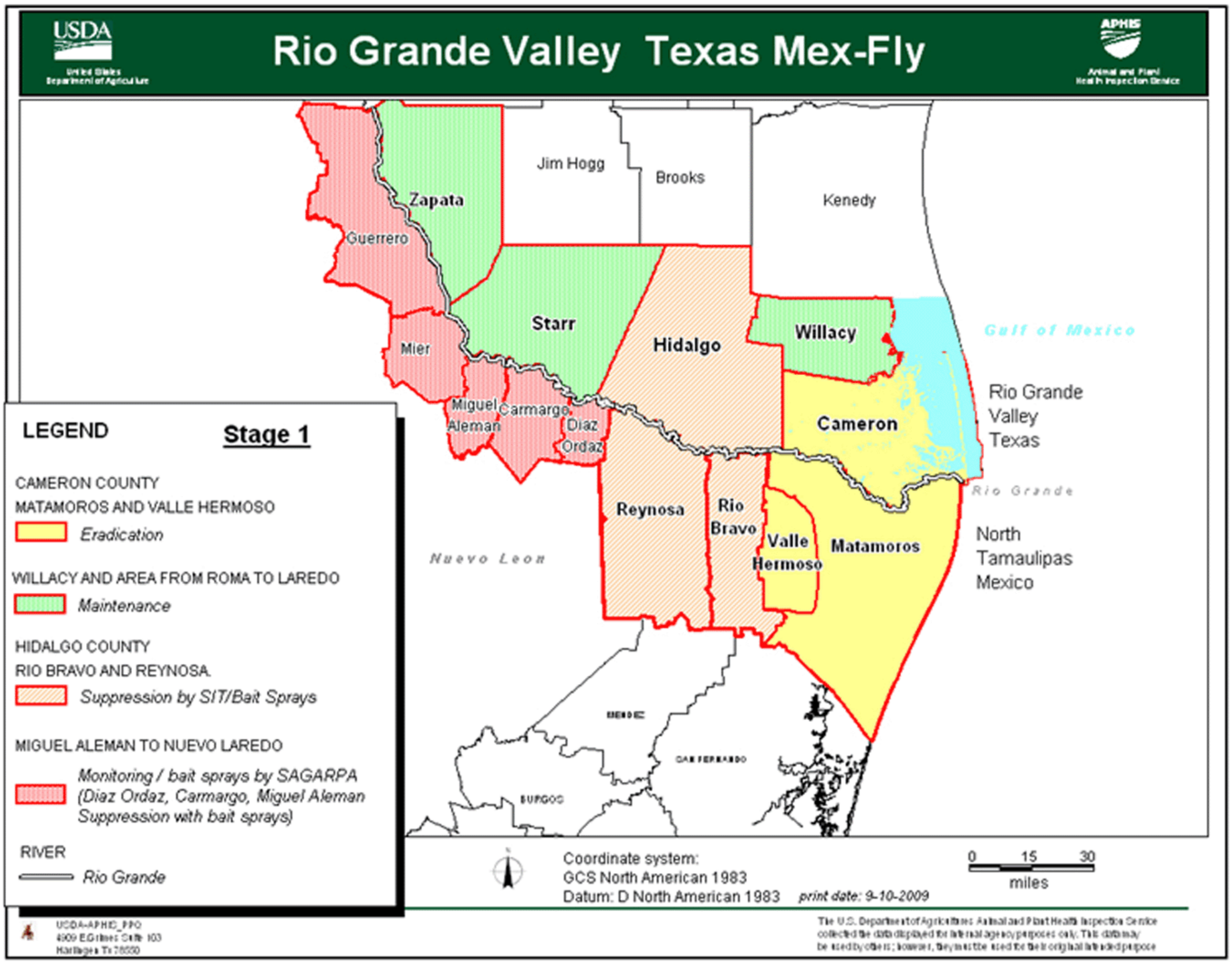


Map 14. APHIS sterile Mexican fruit fly release grids in Tamaulipas, Mexico from 2006 to 2009.

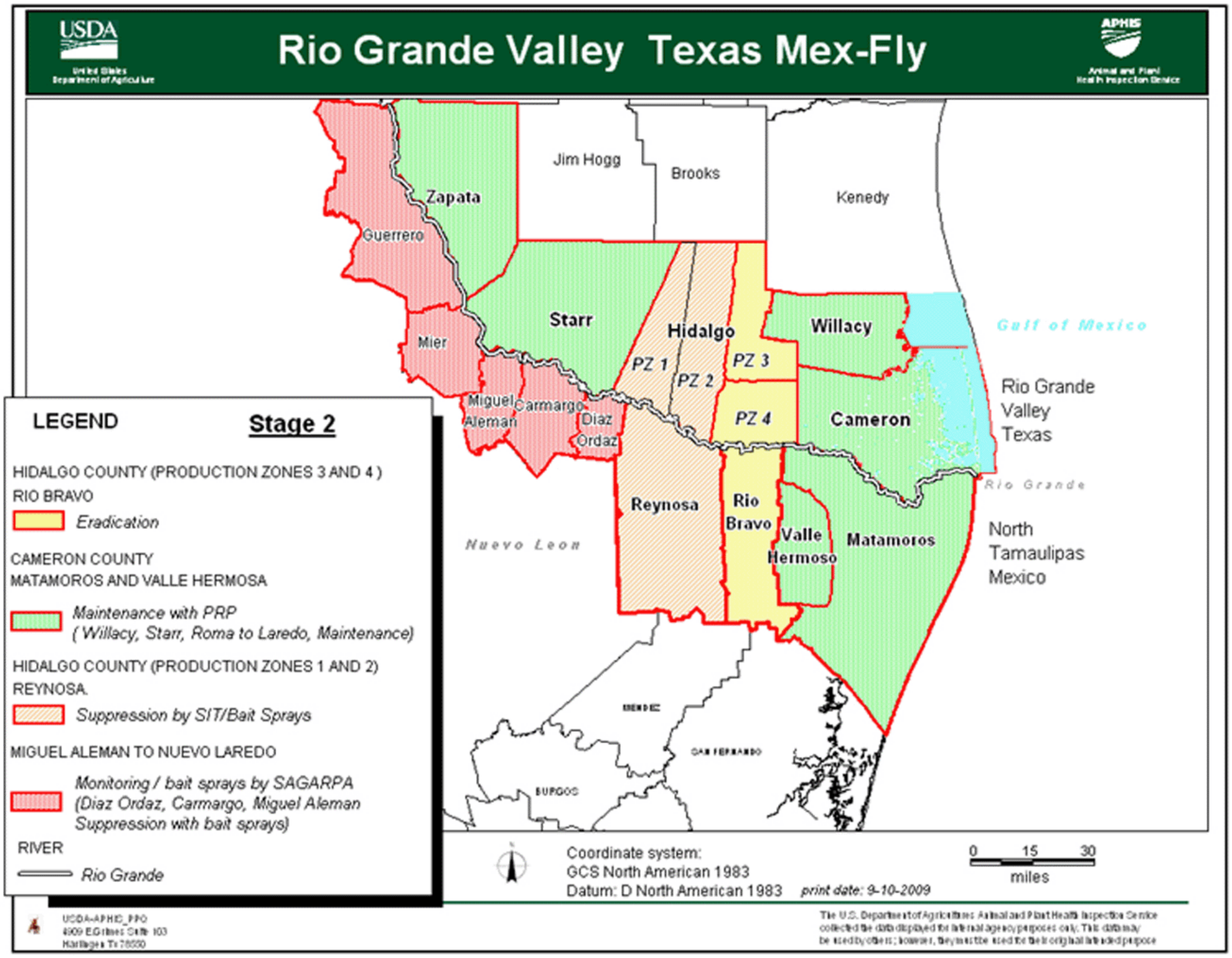


Map 15. Location of SAGARPA recognized Mexican fruit fly areas in Mexico in 2009.

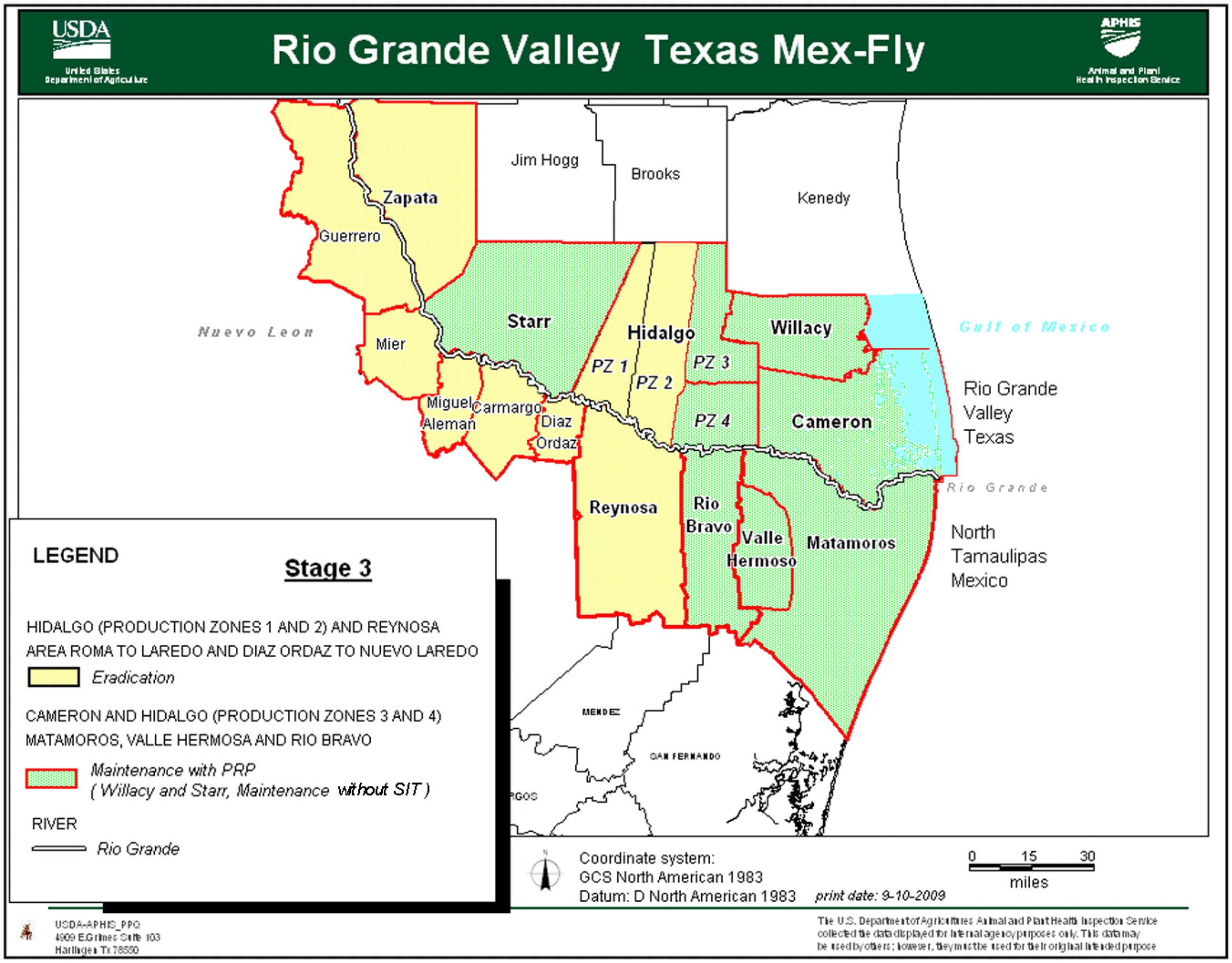
Map 16. Location and type of APHIS LRGV Mexican fruit fly program activities in Stage 1 of the Multi-stage Eradication Plan.



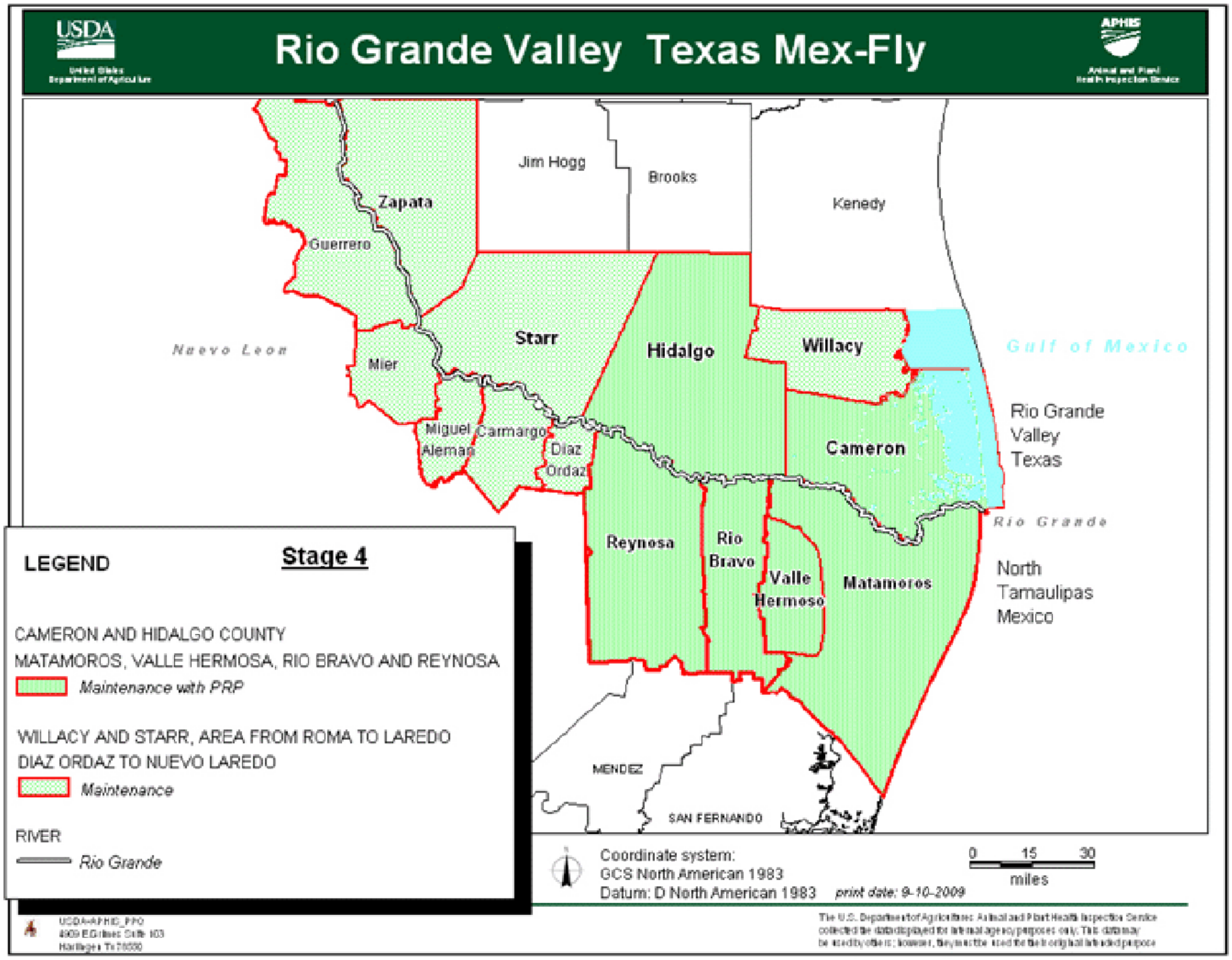
Map 17. Location and type of APHIS LRGV Mexican fruit fly program activities in Stage 2 of the Multi-stage Eradication Plan.



Map 18. Location and type of APHIS LRGV Mexican fruit fly program activities in Stage 3 of the Multi-stage Eradication Plan.



Map 19. Location and type of APHIS LRGV Mexican fruit fly program activities in Stage 4 of the Multi-stage Eradication Plan.



Map 20. APHIS International Services programs in Mexico in 2009.

5 Appendix E

Photos

Mexican Fruit Fly Production Facility, Edinburg, TX

PHOTO 6: Building Exterier

PHOTO 7: Colony and Egg Collection

PHOTO 8: Larval Diet Dispensing Disposal

PHOTO 9: Larval Tray Handling

PHOTO 10: Larval Sifting

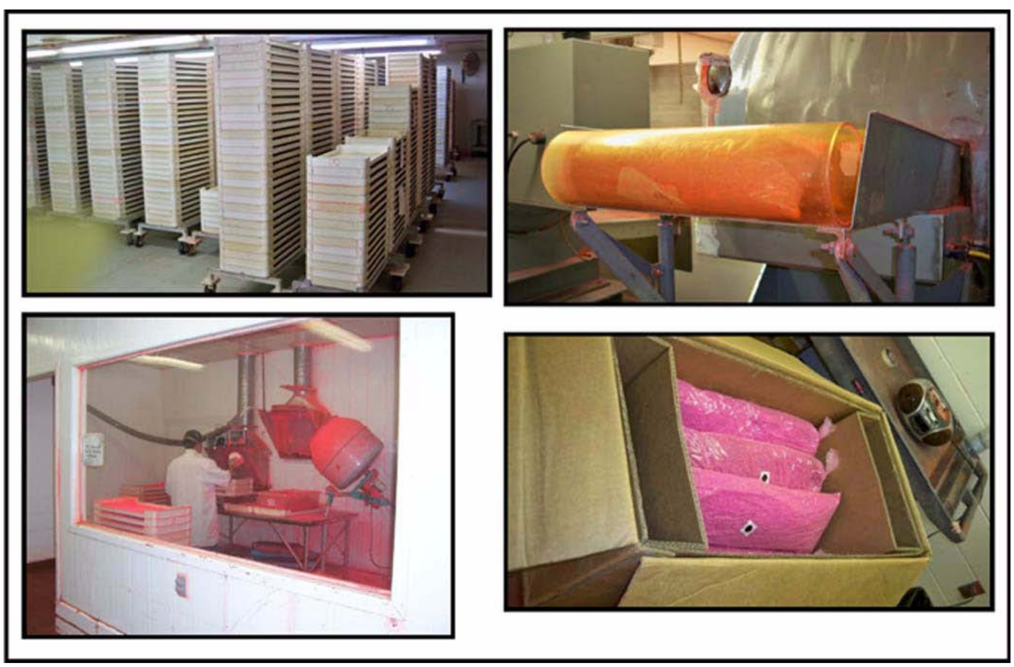


PHOTO 11: Pupae Handling

PHOTO 12: Cage and Tray Washing

PHOTO 13: Quality Control Laboratory

APHIS Mexican Fruit Fly Emergence and Release Facility, Edinburg, TX

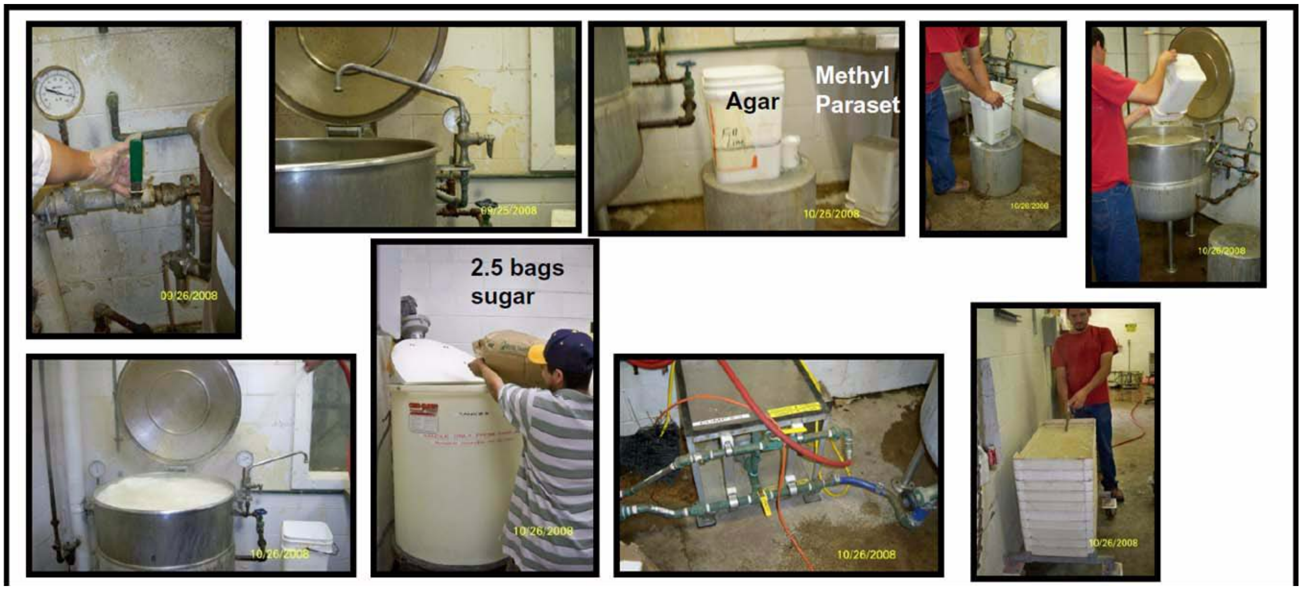


PHOTO 14: Edingburg ERF: Adult Diet Preparation

PHOTO 15: Edinburg ERF: Tower Assembly

PHOTO 16: Edinburg ERF: Knockdown Process

PHOTO 17: Edinburg ERF: Transfer of Release Boxes to Aircraft

APHIS Mexican Fruit Fly Emergence and Release Facility, Harlingen, TX

PHOTO 18

PHOTO 19: Haringen ERF: Adult Diet Preparation

PHOTO 20: Haringen ERF: Tower Assembiy and Holding

PHOTO 21: Haringen ERF: Knockdown and Release Machine Loading

PHOTO 22: Haringen ERF: Tower Tray Wash and Waste Disposal

PHOTO 23: Haringen ERF: Transfer of Release Boxes to Aircraft

PHOTO 24: Haringen Hanger and Runway

APHIS Mexican Fruit Fly Surveillance Program, McAllen, TX

PHOTO 25: Texas Surveillance Program: Trap Placement and Servicing

PHOTO 26: Texas Surveillance Program: Sample collection and Handling

PHOTO 27: Texas Surveillance Program:: Trapping Equipment and Supplies

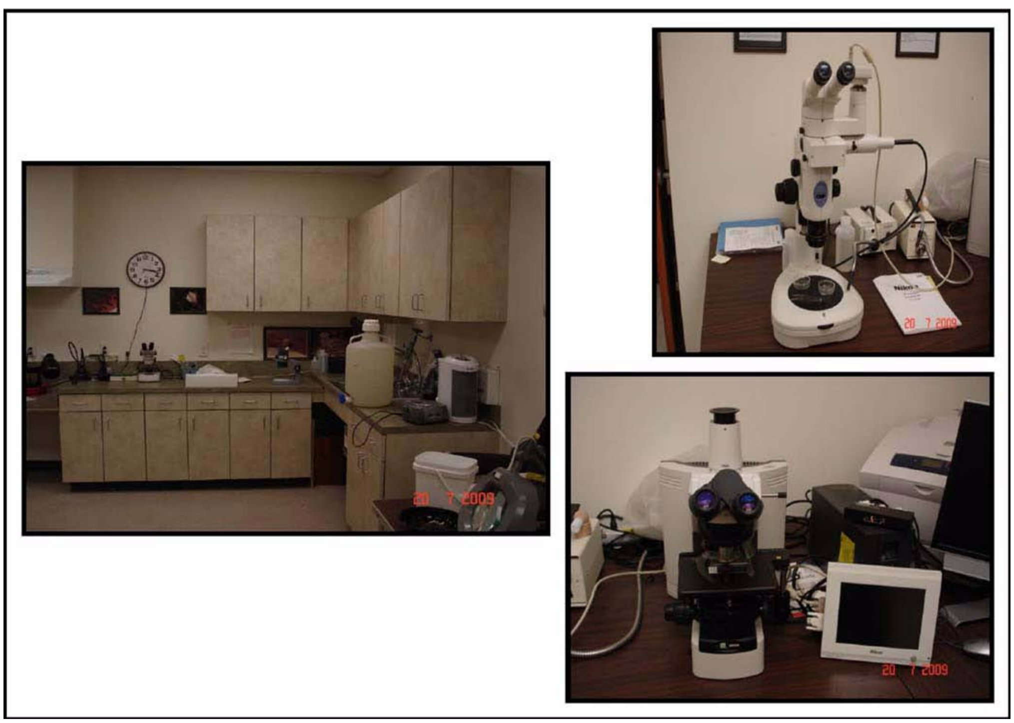


PHOTO 28: Texas Surveillance Program: Identification Laboratory

PHOTO 29: Texas Surveillance Program: Sample Identification

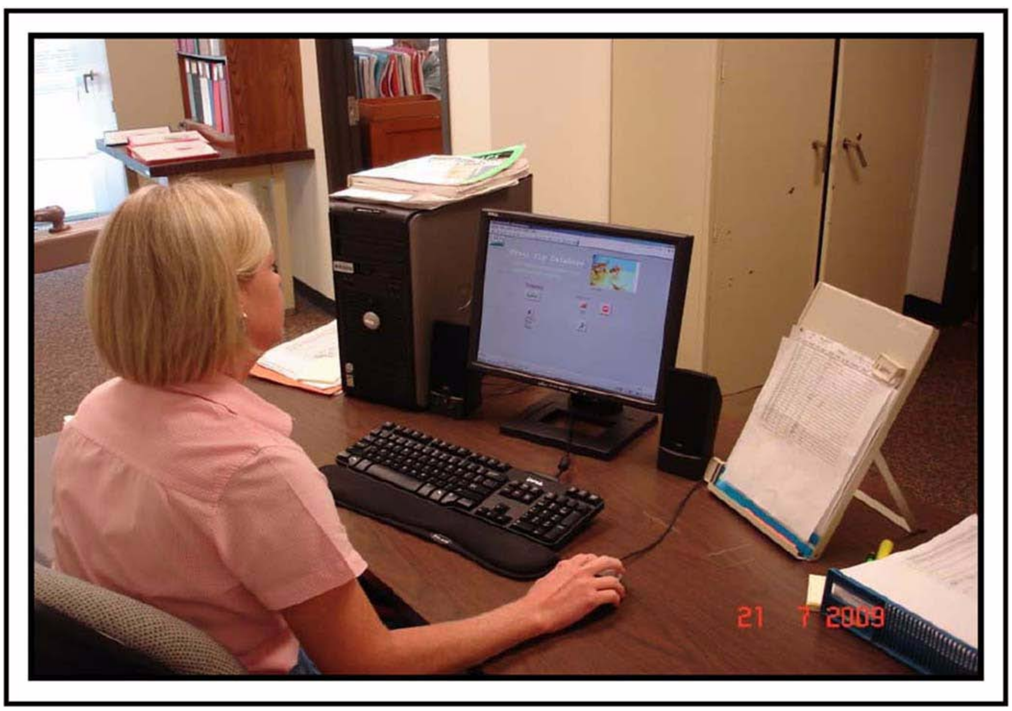


PHOTO 30: Texas Surveillance Program: Data Management

APHIS Mexican Fruit Fly Suppression Activities, Reynosa, Tamaulipas, Mexico

PHOTO 31: Reynosa: Fruit Sampling

PHOTO 32: Reynosa: Field Sanitation

Mixture: 1% malathion, 9% protein, 90% water

PHOTO 33: Reynosa: Malathion Bait Sprays

PHOTO 34: Reynosa: Emergence Towers

PHOTO 35: Reynosa: Receiving Pupae

PHOTO 36: Tower Loading and Operation

PHOTO 37: Reynosa: Tower Knockdown Process

PHOTO 38: Reynosa: Tray Emptying Process