

REVIEW

Mexican Fruit Fly Protocol Helps Export Texas Citrus

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Abstract

The Mexican fruit fly (MFF), *Anastrepha ludens* (Loew) is a citrus pest of regulatory significance in Texas. It is believed that MFF are annually introduced into Texas primarily via infested fruit smuggled into the state. Both state and federal regulations place restrictions on movement of Texas citrus because MFF does not normally occur in the other citrus-producing states. A protocol was developed in 1981 to allow the exports of Texas citrus to any domestic markets in the U.S. without fumigation. The protocol requires a survey for wild MFF and releases of sterile flies. If the number of wild MFF trapped does not exceed the pre-agreed limit, then the fruit is certified for export anywhere within the U.S. without a regulatory treatment such as fumigation. The protocol has been modified numerous times primarily due to fluctuations in citrus production caused by the 1983 and 1989 freezes. The MFF Technical Advisory Committee reviews the protocol annually and recommends modifications when necessary. The costs of the program are shared by the Texas Department of Agriculture, the U.S. Department of Agriculture, and the Texas Valley Citrus Committee. Generally, the MFF protocol has served the state's citrus industry well by allowing exports of Texas citrus without a regulatory treatment, particularly to lucrative markets in the other citrus-producing states.

Infestation History and Quarantines

The Mexican fruit fly (MFF), *Anastrepha ludens* (Loew) was first detected in Texas in 1907 (Moreno et al. 1991). The first infestation in commercial orchards in the Lower Rio Grande Valley (LRGV) was recorded in 1928 (Berry 1943). MFF does not cause any significant direct economic loss to Texas' citrus; however, it's a pest of regulatory significance.

It is believed that MFF are introduced into Texas annually primarily via infested fruit smuggled from Mexico. Because the presence of MFF in Texas poses a threat to other citrus-producing states, the U.S. Department of Agriculture

quarantined all or portions of eleven counties in south Texas and placed restrictions on interstate movement of fruit of numerous species (USDA 1985). This amended MFF quarantine discounted fruit fumigation with ethylene dibromide used for regulatory treatment; only cold treatment was approved. Moreover, USDA, Animal and Plant Health Inspection Service (APHIS) soon may publish in the Federal Register its approval of two additional procedures, malathion bait spray and methyl bromide fumigation, as regulatory treatments to facilitate interstate movement of citrus and other regulated fruit produced in Texas (USDA 1991a).

Texas' regulations on MFF are given in a chapter entitled "Mexican fruit fly control," and include information on quarantines, infestation control, remedies and penalties (Texas Agriculture Code 1982). Texas quarantines only Cameron, Hidalgo, and Willacy Counties. Moreover, the recently published USDA, APHIS' interim rule (USDA 1991b) removes eight counties from their MFF quarantine and makes the MFF-quarantined counties identical in Texas and USDA quarantines.

The other citrus-producing states such as California, Arizona, and Florida are considered MFF free except for accidental introductions. Texas citrus, particularly grapefruit, is well-recognized for its premier quality. Texas exports approximately one-third of its citrus to other citrus-producing states and receives premium price for the fruit. Obviously, state and federal regulators want to ensure that Texas citrus does not pose a risk of MFF introductions through the infested fruit.

Facilities to cold treat fruit are virtually nonexistent in LRGV. The Environmental Protection Agency prohibited fruit fumigation using ethylene dibromide in 1984 because of suspected carcinogenicity. A pilot test using sterile MFF releases for suppressing the feral population was conducted in LRGV during 1981-1984 because discontinuance of ethylene

dibromide use was anticipated and an alternative to fumigation became essential.

Valley-wide Test Using Sterile Flies

In this test, sterile MFF were released in 893.6 sq km (345 sq mi) of the western LRGV while the remaining 2,033 sq km of LRGV were used as a control. The fly release area contained 15,607.3 ha (38,550 acres) of commercial citrus whereas the control area 12,753 ha. Flies were trapped using McPhail traps and fruit examined for the presence of MFF larvae. Overall, 193 McPhail traps per 100 sq km (five traps per sq mi) were employed, and an average 42 sterile MFF were released per hectare per week (Worley et al. 1988). Of the 250,609 citrus fruit examined during January through May 1983, two MFF infested fruit were found in the sterile fly release area and 45 in the control (Holler et al. 1984); in general, the number of feral flies trapped in the release area were not reduced as dramatically (Holler et al. 1984 and Worley et al. 1988). Nevertheless, the fruit examination showed the infestation in the sterile fly release area to be below probit 9 (32 infested fruit per million). It is generally accepted among the regulatory community that an infestation level below probit 9 does not pose a regulatory hazard.

Development of Protocol for Shipping Texas Fruit

A protocol was developed in 1981 for certifying fruit originating from LRGV based partly on trapping and sterile fly releases. Texas citrus was shipped without use of any regulatory treatment for the first time in 1981. The protocol has been modified numerous times since its inception and the historical modifications made in the protocol will not be presented here. Nevertheless, basic concepts of the protocol have remained the same: MFF survey using McPhail traps, and releases of sterile MFF. If the number of trapped feral MFF exceeds those given in the protocol, then a regulatory treatment must be used for shipping fruit to other citrus-producing states. The protocol facilitates shipment of Texas citrus without any destination restrictions. Once the test mentioned in the section "Valley-wide test using sterile flies," was completed, the aerial releases of sterile MFF over the majority of LRGV began in October 1984. The number of sterile flies released over 1,554 sq km (600 sq mi) (Worley et al. 1988). LRGV was 35.1 in 1984-85, 54.3 1985-86, and 48.9 flies in 1986-87; in 1987-88; 130.6 flies per hectare per week were released over 231 sq km (600 sq mi) (Worley et al. 1988).

In addition to sterile MFF releases in LRGV, approximately 800,000 flies are released per week in about a 24 km (15 mi) by 128 km (80 mi) area between Matamoros and Miguel Aleman (Mexican side of the Valley). This probably helps reduce MFF infestation in the LRGV.

Mexican Fruit Fly Technical Advisory Committee

The MFF Technical Advisory Committee was formed in 1979 to determine if alternatives to fumigation could be

developed. The committee usually meets annually to address various issues dealing with MFF. The committee is chaired by a representative of the Texas Department of Agriculture and is comprised of representatives of the Plant Protection and Quarantine (PPQ), APHIS, USDA; International Services, APHIS, USDA; Agricultural Research Service, USDA; Texas A&M University; Texas A&I University Citrus Center, and; Agriculture Departments of Arizona, California, Florida and Louisiana.

The committee's meeting agenda includes updates on the state's citrus crop and the potential fruit export, trappings and sterile MFF releases in the previous 12 months, MFF interceptions at borders, MFF programs in Mexico, a review of the Texas Valley MFF protocol for the upcoming fiscal year, research on MFF, etc. The minutes of the meeting are prepared and distributed to interested parties. The Program Planning and Development Staff on PPQ, APHIS, USDA uses the recommendations of the committee to finalize the Texas Valley MFF Protocol for the forthcoming fiscal year.

Funding of Mexican Fruit Fly Program

USDA funded the production and releases of sterile MFF during 1981-1985. From 1986 onwards, MFF production and aerial release costs have been shared by USDA, APHIS, PPQ; the Texas citrus industry represented by the Texas Valley Citrus Committee, and the Texas Department of Agriculture. In addition, employees of TDA and USDA, APHIS, PPQ service McPhail traps in the LRGV. The MFF Steering Committee comprised of a representative from each of the three organizations was formed to oversee funding for MFF production and to summarize recommendations of the MFF Technical Advisory Committee. PPQ administers finances of the MFF production laboratory at Mission, Texas.

Salient Features of 1988/1989 Protocol

The 1988/1989 Texas Valley MFF Protocol will be summarized because it was the last formal protocol issued by PPQ, APHIS, USDA (USDA 1988). For operational purposes, the protocol area (the commercial citrus-producing area of Texas) is divided into four production areas: (1) Hidalgo County west of Highway 281, (2) Hidalgo County east of Highway 281, (3) Cameron County, and (4) Willacy County. The square-kilometer blocks in the respective production areas are 671, 632, 782 and 137.

Regulated articles (grapefruit, oranges, etc.) can be certified for shipment without a commodity treatment, such as fumigation, to all domestic markets provided: (1) MFF are surveyed continually using McPhail traps at a density of 193 traps per 100 sq km (5 traps per sq mi) in the production areas wherever MFF host material is present, and traps are serviced weekly, (2) an average of at least 1,235 sterile MFF are released per hectare per week on all commercial citrus and peaches throughout the year, and (3) no wild flies have been detected within 1.6 km (1 mi) of the orchard.

The trapped MFF are classified as sterile and wild flies. Prior to their release, sterile MFF are marked externally with a fluorescent powder so they can be distinguished from wild MFF. In addition, the trapped flies are dissected when an additional confirmation of this identity is needed.

Detection of one wild MFF will initiate deploying ten additional traps within 400 meters (quarter-mile) of the find, and releasing 200,000 additional sterile MFF per week in the 2.59 kilometers surrounding the detection. These activities will continue through two projected MFF generations. When a wild fly is detected in a grove, numerous restrictions are placed on fruit originating from that grove (both on the fruit harvested and held in packing sheds, and the fruit present on trees) including fruit segregation or fruit fumigation using methyl bromide or both.

Local infestations are defined as two or more wild MFF recovered within 30 days and within 1.6 sq km of each other, or detection of a single larva. Once the criterion of a local infestation is met, the fruit originating within 1.6 km of the detection must be fumigated for certification. Malathion bait sprays applied in orchards before and during harvest could also be used for certification. All the fruit originating from a production area would require fumigation if 5% of the total square mile blocks in the production area have one or more wild MFF, or 1.5% of the blocks have two or more wild flies.

FY 1989 (October 1, 1988 through September 30, 1989) MFF program activities were implemented following guidelines given in the 1988/1989 MFF protocol. Beginning October 1988, the LRGV-wide releases of sterile flies were abandoned and flies were released only in commercial citrus and peach orchards. The protocol required releasing at least 1,235 sterile MFF per hectare per week. However, approximately 1,729 flies per hectare per week were released. A total of 127 wild MFF were trapped in 2,450 traps deployed in commercial citrus and peach orchards, and dooryards.

FY 1990 Mexican Fruit Fly Protocol

For FY 1990, the MFF Technical Advisory Committee adopted the FY 1989 Texas Valley MFF protocol without any change. However, the protocol was modified after the December 1989 freeze. The freeze destroyed all the fruit, and 68% of the 14,575 ha of citrus. Because there was no fruit for commercial shipments, two modifications were made in the MFF program; (1) trapping for MFF in citrus groves was discontinued, whereas the trapping in dooryards and peach orchards was maintained without any changes, and (2) sterile MFF releases over the commercial citrus and peaches were discontinued. According to the newly adopted strategy, when a single wild MFF was trapped, 386,100 sterile MFF were to be released per week in the one square kilometer surrounding the find. These releases would continue for the duration of two projected MFF generations computed using a MFF day-degree model. This strategy was in effect for the remainder of FY '90. Sterile fly releases were not needed because not a single wild MFF was detected in 809 traps deployed in dooryards and peach orchards.

FY 1991 Mexican Fruit Fly Protocol

Because of the December '89 freeze, not enough citrus was produced in FY 1991 to make any commercial shipments. However, MFF trappings in commercial citrus was resumed in October 1990, and the following strategy was adopted to tackle MFF finds: When a wild MFF was trapped in commercial citrus, ten additional McPhail traps would be placed within 400 m of the detection site, and the trappings would continue through two MFF generations as projected using a day-degree-model. If a second wild MFF was trapped within the 400 m, and if host material was present in the fruiting stage, then 386,100 sterile MFF would be released per week within the square kilometer of the find, and the releases would continue through two projected generations. The strategy for dealing with a wild MFF trapped in a dooryard was the same as for the commercial citrus except that dooryards would not be examined for presence of fruiting host plants, and sterile fly releases would begin as soon as the second wild MFF was trapped. A total of nine wild MFF was trapped in the 909 traps placed in dooryards, peach and citrus; however, none of the finds required releasing sterile flies.

FY 1992 Mexican Fruit Fly Protocol

Of the 909 traps employed in FY 1991, 82% were in dooryards and the remaining in peach and citrus orchards. As the citrus branches grow strong enough (after the 1989 freeze) to support the weight of McPhail traps, the density of five traps per 2.6 sq km will be re-established. As a result of the '89 freeze, the FY 1992 citrus crop will be quite small and most will be consumed locally. According to a survey conducted in the latter part of 1991, fruit-bearing citrus is located in 3,409 ha west of Highway 281 and in 1,206 ha east of the Highway (Ruben Garcia, unpublished data). The citrus west of Highway 281 is concentrated in a small area, whereas the citrus east of the Highway is scattered over a larger area.

The MFF Technical Advisory Committee adopted the following strategy for FY 1992: Release by air 243-283 sterile MFF per hectare per week only in the fruit-bearing 3,409 ha of commercial citrus west of Highway 281, and in commercial peach orchards. If a wild MFF is detected in any other commercial citrus or in dooryards, release manually 2,200 sterile MFF per week within 183 m (600 ft) of the detection for the two projected generations. The guidelines for initiating delimiting surveys, infestation criteria, aerial releases of additional sterile flies, regulatory treatments, etc. will be the same as outlined in the 1988/1989 Texas Valley MFF protocol (USDA 1988).

The cost involved in routinely releasing sterile flies east of Highway 281 was considered as too high. Thus, only citrus originating west of Highway 281 will be considered for certification because sterile MFF are released there. Sterile flies will very likely be released in all four LRGV citrus production areas beginning FY 1993 making all commercial citrus eligible for certification.

Future Outlook

In general, releases of sterile MFF allow shipping of Texas citrus without a regulatory treatment (fumigation with methyl bromide, or cold storage treatment) to lucrative markets in California and other citrus-producing states. In 1988, the number of wild MFF trapped exceeded the "general infestation" criterion in Hidalgo County, whereas in 1989, all four production areas surpassed this criterion. Fortunately, in both years, the general infestation was attained during the last week of March or later when most of the fruit was already harvested. Thus, only a small portion of the crop needed fumigation for export.

The program comprised of MFF survey and releases of sterile flies serves the citrus industry well because very seldom have citrus growers sought the use of malathion bait spray (as an alternative to sterile fly releases) during the last four years. In general, costs of the MFF program are comparable to bait sprays and fumigation, if not less. The 1983 and 1989 freezes have dramatically reduced the citrus acreage and subsequent fruit export. Nevertheless, Texas' citrus industry continues to rebound. The Texas Valley MFF protocol, particularly its strategies for MFF trapping and sterile fly releases, was modified after each freeze depending primarily upon the availability of citrus for export. The protocol should remain dynamic to accommodate changes that occur due to natural disasters in citrus production.

The MFF Technical Advisory and Steering Committee will continue to meet the needs of LRGV citrus growers and shippers, and state and federal regulatory authorities. The Technical Advisory Committee will also help identify the important areas that need further research to refine the MFF program. The scientific community, particularly the U.S. Department of Agriculture scientists, have already made important contributions within the last five years to make the MFF program more efficient.

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