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Service

# Fruit Fly Cooperative Control Program

## Final Programmatic Environmental Impact Statement

## November 2018

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# Table of Contents

## Executive Summary

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) has prepared a final programmatic environmental impact statement (EIS) for the Fruit Fly Cooperative Control Program. Fruit flies feed on flowers and fruits, are highly mobile, have a high reproductive potential and, therefore, present a serious economic threat to agriculture worldwide. There are at least 80 species of exotic fruit fly pests in the genera *Anastrepha*, *Bactrocera*, *Ceratitis*, *Dacus*, *Rhagoletis*, and *Toxotrypana* in tropical, sub-tropical, and temperate habitats throughout the world. The contiguous United States, Puerto Rico, and the Virgin Islands are subject to repeated introductions of one or more of these species, and the southern States are threatened by multiple species. Of these, three species have historically posed the greatest risk to United States agriculture: the Mediterranean fruit fly (Medfly), *Ceratitis capitata*, the Mexican fruit fly (Mexfly), *Anastrepha ludens*, and the Oriental fruit fly (OFF), *Bactrocera dorsalis*. The Program is a cooperative effort between Federal and State agencies to identify and eradicate fruit fly infestations in the United States and its territories. This EIS considers potential environmental impacts from each of the alternatives proposed for the Fruit Fly Cooperative Control Program, when exotic fruit fly species are detected. USDA-APHIS can tier subsequent site-specific environmental assessments (EAs) to this EIS, incorporating, by reference, analyses included in this document, thus reducing response time for USDA-APHIS to act on new detections. This EIS will also provide the interested public with a programmatic analysis of the potential for environmental impacts from the alternatives available to USDA-APHIS to eradicate exotic fruit flies from the United States and its territories.

On August 12, 2016, USDA-APHIS published a notice of intent (NOI) in the *Federal Register* describing its intent to prepare a programmatic EIS for the Fruit Fly Cooperative Control Program (81 FR 53398-53399) (Docket number USDA-APHIS-2016-0031). The public was invited to comment on the proposed EIS; APHIS received seven comment letters during the 45-day scoping period. Comments were received from the public, non-governmental organizations, and State agencies regarding different aspects of the Fruit Fly Cooperative Control Program. On April 27, 2018 USDA-APHIS published the draft EIS for the Fruit Fly Cooperative Control Program. USDA-APHIS received two public comments regarding the draft EIS during the 45-day comment period.

Four alternatives were evaluated in this EIS. The analysis is a general assessment of the alternatives, and their potential impacts to human health and the environment. Changes in alternatives discussed in previous exotic fruit fly program National Environmental Policy Act (NEPA) documents were used to develop the list below of four alternatives for further examination in this EIS. The four alternatives include:

1. No Action - USDA-APHIS would maintain the program that was described in the 2001 EIS and Record of Decision. This alternative includes methods to exclude, detect, prevent, and control (both nonchemical and chemical) fruit fly infestations. This alternative represents the baseline against which a proposed action may be compared.

2. No Eradication Alternative - USDA-APHIS would not control or cooperate with other governmental entities to eradicate exotic fruit flies. Any control efforts would be the responsibility of State and local governments, commercial producer or producer groups, and individual citizens.

3. Quarantine and Commodity Treatment and Certification - This alternative combines a Federal quarantine with commodity treatment and certification, as stipulated under 7 CFR part 301.32. Regulated commodities harvested within the quarantine area would not be allowed to move unless treated with prescribed applications and certified for movement outside the area. Nonchemical treatment and host certification methods that may be used in this alternative include (1) cold treatment, (2) vapor heat treatment, and (3) irradiation treatment. Regulatory certification chemical treatments may include fumigation with methyl bromide and premise treatments with EPA-registered insecticides.

4. Integrated Pest Management (IPM) Approach (Preferred Alternative) - USDA-APHIS would use methods to exclude, detect, prevent, and control (both nonchemical and chemical) fruit fly infestations. This alternative would update information and technologies that were analyzed in the 2001 EIS and add in the U.S. territories of Puerto Rico, the U.S. Virgin Islands, Guam, Commonwealth of the Northern Mariana Islands, and American Samoa. These methods could be used individually or in combination with other methods on commercial or non-commercial properties.

The potential impacts from the implementation of the four alternatives suggest that there could be some effects to the human environment. The largest impacts are expected to occur under the no eradication alternative, which would allow exotic fruit flies to become established and expand their range impacting numerous agricultural commodities.

The potential impacts from the proposed alternatives, and applicable environmental laws and statutes, are discussed on a programmatic basis in this EIS. No site-specific eradication projects will be implemented as a direct result of the decision that will follow this EIS. The decision to implement any treatment project will be made after site-specific EAs are conducted and documented, as prescribed in NEPA implementing regulations adopted by the Council on Environmental Quality (Title 40 Code of Federal Regulations (CFR) §§ 1500-1508), USDA's NEPA regulations (7 CFR part 1b), and APHIS' NEPA implementing procedures (7 CFR part 372).

Site-specific EAs will evaluate similar topics as there may be changes over time in the available data regarding this analysis, as well as applicable laws and statutes.

Selection of the preferred alternative allows the Program to implement a proven eradication program that has been successful in previous exotic fruit fly eradication efforts in the United States. The preferred alternative allows the greatest flexibility to the Program when addressing site specific issues related to exotic fruit fly outbreaks while protecting the human environment.

# I. Purpose of and Need for Action

Fruit flies in the family Tephritidae threaten production of a wide variety of fruits and vegetables throughout the world. Exotic (nonnative) tephritid fruit flies spend their larval period feeding and growing in more than 400 host plants. Introduction of these pest species into the United States causes economic losses from destruction and spoiling of host commodities by larvae, costs associated with implementing control measures, and loss of market share due to restrictions on domestic and export shipment of host commodities. In addition, exotic fruit flies present obstacles to agricultural diversification and trade when they become established in new areas. The introduction of exotic fruit flies into the United States has historically been due to importation of infested fruits and vegetables, and smuggling of commodities. The purpose of the proposed action is to protect American agriculture from the adverse effects of exotic fruit flies.

## Why is there a need to eradicate exotic fruit flies?

Worldwide, exotic fruit flies have a long history of being serious pests of fruits and vegetables. There is a need to eradicate these pests wherever they occur in the United States because they are among the most destructive and costly invasive species to enter the United States, have a wide host range, a high reproductive capacity, and ability to disperse into areas distant from sites of introduction, allowing for rapid infestation of new areas. Exotic fruit fly establishment is potentially disastrous to U.S. agricultural production, and in turn, U.S. trade and economy, because it imposes risks of rejection of exported U.S. fruit by other countries. Eradication of exotic fruit flies reduces damage to fruit and strengthens market acceptance for exported fruit. USDA-APHIS is also concerned with long-distance entry of fruit fly-infested commodities into the United States from fruit fly-infested countries distant from U.S. borders, as well as the risk of northward spread into the United States of exotic fruit flies via Mexico.

## Who has authority to act?

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (USDA-APHIS) has a broad mission area that includes protecting and promoting U.S. agricultural health, and protecting and promoting food, agriculture, natural resources, and related issues. Specifically, the Plant Protection Act of 2000 (7 United States Code (U.S.C.) 7701 et seq.) provides the authority for USDA-APHIS to take actions to exclude, eradicate, and control plant pests, including exotic fruit flies. Under this authority, USDA-APHIS works to prevent new infestations of exotic fruit flies from entering the United States by restricting movement of items potentially infested with exotic fruit flies from areas under quarantine for exotic fruit flies, and by conducting programs to eradicate exotic fruit flies where they are found in the United States. This programmatic environmental impact statement (EIS) discloses the different methods and alternatives that USDA-APHIS could use to eradicate exotic fruit flies from areas in which they occur in the contiguous United States, Puerto Rico, U.S. Virgin Islands, Hawaii, Guam, Commonwealth of the Northern Mariana Islands (CNMI), and American Samoa.

## Why prepare this environmental impact statement?

As a Federal Government agency subject to compliance with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321–4347), USDA-APHIS prepared this EIS in accordance with the applicable implementing and administrative regulations (40 Code of Federal Regulations (CFR) §§1500–1508; 7 CFR §§1b, 2.22(a)(8), 2.80(a)(30), 372). This programmatic EIS presents program alternatives USDA-APHIS could adopt as part of the Fruit Fly Cooperative Control Program, and examines the potential consequences of implementing them. USDA-APHIS has prepared over 50 site-specific environmental assessments (EAs) since 2001 for exotic fruit fly cooperative eradication programs and research studies in California, Florida, Puerto Rico, and Texas (USDA-APHIS, 2018a). Specifically, these EAs include documents prepared for Oriental fruit fly in California and Florida; for Mediterranean fruit fly in California, Florida and Puerto Rico; for Mexican fruit fly in California and Texas; for West Indian fruit fly in Texas; for sapote fruit fly in Texas; for peach fruit fly in California; for melon fruit fly in California; for whitestriped fruit fly in California; for guava fruit fly in California; and for Malaysian fruit fly in California. This EIS is an update to the 2001 EIS that was prepared to assess the impacts of the USDA-APHIS Fruit Fly Cooperative Control Program. This EIS will consider potential environmental impacts from the USDA-APHIS Fruit Fly Cooperative Control Program should exotic fruit flies be discovered in the contiguous United States, including, Hawaii, Guam, American Samoa, Puerto Rico, CNMI, and U.S. Virgin Islands. USDA-APHIS can tier subsequent site-specific EAs to this EIS, incorporating by reference analyses included in this document, thus reducing response time for USDA-APHIS to act on new detections, should these occur. In addition, this EIS will provide the interested public with an analysis of the potential for environmental impacts from the alternatives available to USDA-APHIS to eradicate exotic fruit flies from the United States.

## A. Background

The family Tephritidae is characterized by species that specialize in feeding on flowers and fruits, are highly mobile, have a high reproductive potential and, therefore, present a serious economic threat to agriculture worldwide (Aluja and Mangan, 2008). There are at least 80 species of exotic tephritid fruit fly pests in the genera *Anastrepha*, *Bactrocera*, *Ceratitis*, *Dacus*, *Rhagoletis*, and *Toxotrypana* in tropical, sub-tropical, and temperate habitats throughout the world. The contiguous United States, Puerto Rico, and the Virgin Islands are subject to repeated introductions of one or more of these species, and the southern States are threatened by multiple species. Of these, three species have historically posed the greatest risk to United States agriculture: the Mediterranean fruit fly (Medfly), *Ceratitis capitata*, the Mexican fruit fly (Mexfly), *Anastrepha ludens*, and the Oriental fruit fly (OFF), *Bactrocera dorsalis*. Although the Medfly, Mexfly, and OFF have similar life histories and habits, this EIS briefly summarizes the life cycle, hosts, and current as well as projected geographical distribution for these three species.

### Life Cycle and Description

- **Mediterranean Fruit Fly**

The Medfly adult is smaller than a house fly, approximately 3.0-5.0 millimeters (mm) in length, has a dark body with two white bands on a yellow abdomen, and characteristic wide, yellowish-brown markings in the middle of its wings (Thomas et al., 2010). Adult females oviposit (lay eggs) under the skin of ripening host fruits, and lay up to 10 small, slender, curved eggs at a time, dying shortly afterward. Females may lay over 300 eggs in a lifetime, which hatch within 2 to 3 days at an optimum temperature of 26 °C (USDA-APHIS, 2003a). Larvae are white with a typical legless, maggot-like shape, and they feed and tunnel through fruit for about 6 to 10 days (USDA-APHIS, 2003a), developing through three instars. Reddish-brown pupae drop from the fruit onto the ground and develop in the soil (USDA-APHIS, 2003a; Thomas et al., 2010). Adults emerge after a 6- to 15-day pupation stage. Life cycle length is dependent on temperature, from about 21 to 30 days (Thomas et al., 2010).

- **Mexican Fruit Fly**

The Mexfly is slightly larger than a house fly, about 7.0-11.0 mm long, with a yellow to brown body, and yellowish-brown wings with distinctive stripes. Adult females have a characteristically long, tubular ovipositor, through which they lay from 1 to 23 eggs at a time under the skin of ripening fruit, which hatch within 6 to 12 days (CABI, 2015a). Females produce up to 1,500 eggs in a lifetime. Like the Medfly, Mexfly larvae are white and maggot-like in shape, and feed on and tunnel through fruit, developing through three instars (Aluja, 1994; Weems et al., 2015b) for 15 to 32 days at 25 °C (CABI, 2015a). Pupal development is temperature-dependent and takes two to four weeks (CABI, 2015a; Weems et al., 2015b). Adults can be relatively long-lived: from 11 to 16 months under ideal conditions (Aluja, 1994; Weems et al., 2015b).

- **Oriental Fruit Fly**

The OFF is slightly larger than a house fly, about 8.0 mm long, with a yellow and dark brown-black thorax, and long wings. The abdomen is distinctively marked with two horizontal black stripes, and a longitudinal median stripe extending from the base of the third abdominal segment to the apex of the abdomen, which looks like the letter T (Weems et al., 2012). During their lifetimes, adult females may lay between 1,200 and 1,500 white, elliptical eggs, which hatch within one to two days (Vargas et al., 2002; CABI, 2015b). Ripening fruit is preferred for oviposition, but females may also oviposit in immature fruit (Weems et al., 2012). The larval stage (three instars) lasts about 11 to15 days, and the pupal period, which takes place in the soil, lasts from 8 to 11 days (Vargas et al., 2002). Adults may live from one to three months under typical field conditions, or up to 12 months under cooler conditions (CABI, 2015b).

## Hosts

- **Mediterranean Fruit Fly**

Because of its wide host range (more than 300 species of fruits and vegetables) and its potential for rapidly expanding infestation, the Medfly can significantly reduce the yield and quality of many crops such as avocado, coffee, guava, mango, papaya, peach and persimmon. Its most significant host fruits are apple, citrus, peach and pear (Thomas et al., 2010). Larval feeding usually reduces fruit to a juicy, inedible mass, unfit for human consumption (USDA-APHIS, 2015c).

- **Mexican Fruit Fly**

Mexfly has a broad host range, and is a particular pest of citrus (except for lemons and sour limes (Weems et al., 2015b) and mangos (CABI, 2015a). Commercial and homegrown produce attacked by the pest is unfit to eat because the larvae tunnel through the fleshy part of the fruit, damaging it and subjecting it to decay from bacteria and fungi.

- **Oriental Fruit Fly**

OFF has been recorded infesting more than 400 kinds of fruit and vegetables, including apple, apricot, avocado, banana, citrus, coffee, fig, guava, loquat, mango, papaya, passion fruit, peach, pear, persimmon, pineapple, Surinam cherry, and tomato (Vargas et al., 2002; CABI, 2015b; USDA-APHIS, 2015f). OFF attacks up to 150 different host fruits in Hawaii (Vargas et al., 2002; Weems et al., 2012), and damages virtually every commercial fruit crop grown there (CABI, 2015b). In Hawaii, wild guava is frequently a reservoir from which OFF can infest cultivated crops (Vargas et al., 2002).

### Spread, Dispersal and Geographical Distribution

- **Mediterranean Fruit Fly**

Medfly originated in sub-Saharan Africa (CABI, 2015c; University of Arizona, No Date), and has spread to all of the tropical and warm temperate regions of the world except Asia, including Australia, Central America, South America, and Europe (CABI, 2015c). The Medfly was first discovered in Hawaii in 1907, probably introduced from Brazil (CABI, 2015c), and is widely established there. Following a first introduction to the continental United States in 1929, Medfly has been detected multiple times in California, Florida, and Texas, and eradicated each time. Medfly is ranked first among economically important fruit fly species because it is widely distributed, can tolerate cooler temperatures, and has a wide range of hosts. A permanent infestation of Medfly would be disastrous to agricultural production in States where host plants are grown such as apricot, avocado, grapefruit, nectarine, orange, peach, and cherry. Fruit infested by Medfly is unfit to eat because the larvae tunnel through the fleshy part of the fruit, damaging it, subjecting it to decay from bacteria and fungi. In addition to reduction of crop yield, infested areas incur the added expenses of control measures and sorting through fresh and processed commodities for signs of infestation (Weems et al., 2012). The importation of infested fruit or smuggling of fruit in airline passenger luggage poses the greatest risk of introduction of Medfly (CABI, 2015c). Puparia in soil also pose a risk of introduction. Once introduced to an area, Medfly may naturally disperse up to 7 kilometers (km) or more (University of Arizona, No Date). Movement of infested commodities to previously uninfested areas is the main route of spread subsequent to introduction.

- **Mexican Fruit Fly**

Mexfly is native to central Mexico and Central America as far south as Costa Rica (CABI, 2015a). It has been repeatedly introduced to Texas since 1927 (Weems et al., 2015b), primarily in the Rio Grande Valley and southern Texas, but has been eradicated multiple times (CABI, 2015a). Mexfly is frequently detected in California and Arizona, and intercepted in commercial import shipments in Florida (CABI, 2015a). New infestations are detected on an almost annual basis since first being detected in California in San Diego during the mid-1950s (Papadapoulos et al., 2013).

As with Medfly, the potential establishment of Mexfly in new areas would be disastrous to agricultural production in the United States. In particular, Mexfly poses a significant threat to the grapefruit industry in Florida (Weems et al., 2015b). The major route of introduction is through infested fruit shipments of apple, citrus, guava and mango from countries in which Mexfly is established, or smuggled in luggage. Introduction may also occur in shipments of soil and with plants that have already flowered; these may contain puparia. Mexfly is a strong flier and highly mobile, presenting a risk of dispersal and spread once introduced, particularly if environmental conditions are poor (Aluja, 1994). Flight distance has been noted as greater than 135 km (CABI, 2015a).

USDA-APHIS analyzed the potential for Mexfly colonization in the United States and predicted that the combination of low temperature, cold tolerance, and limited host availability, would likely restrict establishment to Hawaii, most of the commodity production areas of California and Florida, and the southern parts of Arizona, Georgia, Louisiana, South Carolina, and Texas (USDA-APHIS, 2001b).

- **Oriental Fruit Fly**

OFF is native to Asia, and has spread to at least 65 countries (CABI, 2015b). It is often intercepted in the United States, sometimes establishing infestations where previously eradicated. OFF was first discovered in Hawaii in 1910, and subsequently became established there in 1948, where it became widely distributed (Vargas et al., 2002; NAPIS, 2015). Eradication programs have prevented the establishment of the OFF in the contiguous United States, where it has been introduced multiple times, sometimes infesting areas in which it has previously been eradicated; reintroduction is principally due to trade (CABI, 2015b).

As with Medfly and Mexfly, major routes of introduction are international trade and smuggling in passenger baggage (CABI, 2015b). It has frequently been intercepted in commercial fruit shipments at several U.S. ports of entry (USDA-APHIS, 2015f). Because of OFF's wide host range, rapid population growth, and high mobility (from 50 to 100 km) (CABI, 2015b), a prompt response is usually desired to contain and eradicate any infestation.

In a study of susceptibility of establishment to OFF, USDA-APHIS suggested that the primary limiting factor is cold tolerance. Mortality for this species was determined to be exposure for 18 days to 1.67 °C. Degree day modeling predicted that spread within the United States should be limited to portions of California and Florida, with less likelihood of establishment in scattered areas from the States of Washington eastward to North Carolina (USDA-APHIS, 2007b).

## B. History of USDA-APHIS Eradication and Regulatory Actions against Fruit Flies

Currently, the Fruit Fly Cooperative Control Program in the United States uses a combination of methods to control and eradicate exotic fruit flies when they are detected in the United States, including quarantine, commodity certification, mass trapping, and eradication using a variety of methods.

In recent years, USDA-APHIS and its partners declared exotic fruit flies eradicated from multiple areas within the United States (USDA-APHIS, 2018e).

### Public Involvement

USDA-APHIS has prepared more than 50 site-specific EAs regarding Fruit Fly Cooperative Control Programs or research in California, Florida, Puerto Rico, and Texas since 2001 (USDA-APHIS, 2018a). USDA-APHIS provides many opportunities for public involvement and outreach regarding program activities in fruit fly-quarantined areas. As such, USDA-APHIS has:

- provided media interviews for newspapers, radio and television outlets;
- issued press releases;
- conducted an annual advertising awareness campaign;
- provided public service announcements on radio and television stations;
- had a presence at industry shows, expos, and various outreach venues;
- posted information on social media including Facebook, Twitter, Pinterest and Flickr;
- held public meetings as well as meetings with Federal and State officials, town administrators, and other impacted groups and persons; and
- provided informational materials and web sites to the public, including an online reporting function and the arrangement of a national-use fruit fly hotline telephone number.

Scoping is an open and early process to determine the issues to address in an EIS, and to identify significant issues related to the proposed action covered in the EIS. As part of this process, USDA-APHIS sent out letters to all federally recognized tribal nations in the contiguous United States to provide information about the program and provide contact information for any questions or concerns regarding the program and EIS. On August 12, 2016, USDA-APHIS published a notice of intent (NOI) in the *Federal Register* describing its intent to prepare a programmatic EIS for the Fruit Fly Cooperative Control Program (81 FR 53398-53399) (Docket number USDA-APHIS-2016-0031). The public was invited to comment on the proposed EIS.

In the NOI, USDA-APHIS identified the following environmental resources requiring further examination in this EIS:

- wildlife, including consideration of migratory bird species and changes in native wildlife habitat and populations;
- federally listed threatened and endangered species;
- soil, air, and water quality;
- human health and safety; and
- cultural and historic resources.

USDA-APHIS made available a press release regarding the NOI to media contacts in California, Florida, and Texas, and through the USDA-APHIS Stakeholder Registry that contains almost 12,000 contacts. In addition, USDA-APHIS conducted the following notification activities:

- notification to tribal contacts;
- notification to U.S. Fish and Wildlife Service (FWS) contacts;
- notification to various partners and organizations, such as:
    - USDA-APHIS–Plant Protection and Quarantine (PPQ) State Plant Health Directors in California, Florida, Puerto Rico, and Texas.
    - State agricultural agencies.

USDA-APHIS received seven comment letters during the 45-day scoping period. USDA-APHIS considered all comments in the planning of this EIS. Issues and concerns identified by the public and tribal contacts included:

- impacts to soil, air, and water quality;
- impacts of organophosphate insecticides;
- consideration of appropriate risk assessment models, including the use of regional climate data;
- support for States from USDA-APHIS to protect against exotic fruit fly infestations;
- impacts to nontarget organisms, especially those that are beneficial, such as bees;
- impacts to threatened and endangered species, migratory birds, and their habitats;
- potential for exotic fruit fly infestations through fruit and vegetable commodities; and
- climate change impacts.

USDA-APHIS and its cooperators recognize the public's concern about the potential impacts of exotic fruit flies and program activities on human health, biological resources, and the physical environment. Part of this EIS will address these concerns.

On April 27, 2018, APHIS published the draft EIS for public comment in the Federal Register and notified interested parties of its availability. The comment period ended after 45 days, or June 11, 2018. USDA-APHIS received two public comments regarding the draft EIS. The first comment was submitted by the Department of Interior – Bureau of Land Management supporting the proposed integrated pest management alternative identified in the EIS. USDA-APHIS also received a second comment letter from the U.S. Environmental Protection Agency (USEPA) - Office of Federal Activities. In the letter, USEPA requested clarification regarding water quality terms that are mentioned in the draft EIS. The letter also requested additional clarifying language about the use of special local needs (24c) labels for registered pesticides be added to the final EIS. Finally, USEPA requested that information referring to fenthion use be removed from the final EIS since the product is no longer registered. USDA-APHIS recognizes that fenthion is no longer registered for use and its inclusion in the draft EIS was related to historical use that is noted in the final EIS.

## C. Decision Framework

The 2001 USDA-APHIS Fruit Fly Control Program EIS proposed 3 alternatives: (1) No Action, in which USDA-APHIS does not cooperate with States or local governments in eradication or control programs; (2) Nonchemical program, in which only nonchemical means (such as sterile insect technique (SIT), fruit stripping and host elimination, cultural control, biological control, biotechnological control, cold treatment, irradiation treatment, and vapor heat treatment) are implemented to eradicate or control exotic fruit flies; and (3) Integrated program, in which chemical control (aerial spraying, ground treatment, soil treatment, or fumigation with insecticides), as well as mass trapping are included with the components of Alternative 2.

Changes in alternatives discussed in previous exotic fruit fly program NEPA documents were used to develop the list below of four alternatives for further examination in this EIS. (Chapter 2 describes the alternatives in greater detail.)

1. <u>No Action</u>. Under the no action alternative, USDA-APHIS would maintain the program that was described in the 2001 EIS and Record of Decision. This alternative includes methods to exclude, detect, prevent, and control (both nonchemical and chemical) fruit fly infestations. This

alternative represents the baseline against which a proposed action may be compared.

2. No Eradication Alternative. Under this alternative, USDA-APHIS would not control or cooperate with other governmental entities to eradicate exotic fruit flies. Any control efforts would be the responsibility of State and local governments, commercial producer or producer groups, and individual citizens.
3. Quarantine and Commodity Treatment and Certification. This alternative combines a Federal quarantine with commodity treatment and certification, as stipulated under 7 CFR part 301.32. Regulated commodities harvested within the quarantine area would not be allowed to move unless treated with prescribed applications and certified for movement outside the area. Nonchemical treatment and host certification methods that may be used in this alternative include (1) cold treatment, (2) vapor heat treatment, and (3) irradiation treatment. Regulatory certification chemical treatments may include fumigation with methyl bromide.
4. Integrated Pest Management (IPM) Approach. Under this alternative, USDA-APHIS would use methods to exclude, detect, prevent, and control (both nonchemically and chemically) fruit fly infestations. This alternative would update information and technologies that were analyzed in the 2001 EIS and add in the U.S. territories of Puerto Rico, the U.S. Virgin Islands, Guam, CNMI, and American Samoa. These methods could be used individually or in combination with other methods. In an integrated approach, program managers would make management decisions in such a way as to protect human health, non-target species (endangered and threatened species), sensitive areas, and other components of the environment within the potential program area.

Program eradication efforts may employ any or a combination of the following: no action; regulatory quarantine treatment and control of host materials and regulated articles; host survey for evidence of breeding exotic fruit flies; host removal; eradication chemical applications; mass trapping to delimit the infestation and monitor post-treatment populations; and use of SIT.

USDA-APHIS will not implement site-specific eradication projects as a direct result of the decision that will follow this EIS. Rather, USDA-APHIS will prepare site-specific EAs before the agency decides to implement any eradication project. EAs will address unique local issues, beyond the scope of this document, for site-specific management projects for exotic fruit fly. Site-specific EAs are more detailed and precise as to geographical locations and strategies appropriate for the type of outbreak. The decision on this EIS will serve as the primary guide for management of exotic fruit flies in the contiguous United States, including, Hawaii, Guam, American Samoa, CNMI, Puerto Rico and the U.S. Virgin Islands.

Treatments and strategies allowed by prior EA decisions will continue to be available for use. The decision whether to plan or implement an exotic fruit fly project in the United States will occur on a case-by-case basis by USDA-APHIS and its cooperators.

## D. Scope of this Document and NEPA Requirements

This EIS addresses the Fruit Fly Cooperative Control Program carried out by USDA-APHIS, directly or in conjunction with others (States, other Federal agencies, and tribal governments). The information and analysis contained in this EIS can be incorporated by reference into EAs and other environmental documents prepared for exotic fruit fly eradication program projects, in accordance with NEPA. Some exotic fruit fly-related activities and other exotic fruit fly-regulated articles at the point of entry in the United States, and research and methods development activities are outside the scope of this document and were not examined.

### Consultations

Section 7 of the Endangered Species Act (ESA) and its implementing regulations require Federal agencies to ensure their actions are not likely to jeopardize the continued existence of threatened and endangered species, or result in the destruction or adverse modification of critical habitat. If necessary, USDA-APHIS conducts Section 7 consultation with the FWS and National Marine Fisheries Service (NMFS) on a site-specific basis for exotic fruit fly eradication activities. USDA-APHIS considers whether critical habitat or listed species are present in the treatment area. If none are present, no Section 7 consultation is required. USDA-APHIS will conduct ESA Section 7 consultations with the appropriate agency, as necessary, for any eradication programs if exotic fruit flies are detected in new locations in the United States. Consultation with FWS, and NMFS, if necessary, at the local level will ensure that exotic fruit fly eradication actions will not jeopardize the continued existence of a listed species, or adversely modify critical habitat in the program area. USDA-APHIS will ensure the implementation of any protection measures for threatened and endangered species or critical habitat that result from such consultations. In addition, USDA-APHIS will ensure that site-specific evaluations will be done, as necessary, under the National Historic Preservation Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and any other laws, regulations, executive orders, and agency policies that apply to site-specific projects.

# II. Alternatives

## A. Introduction

USDA-APHIS analyzed four alternatives in this EIS. The alternatives are broad in scope, reflecting the need for a program that will accommodate emergency responses to eradicate damaging exotic fruit fly species. The purpose of the alternatives is to describe the reasonable strategies the agency could take to achieve its goal.

USDA-APHIS' authority to take action is based upon Title IV–Plant Protection Act, *Public Law 106–224, 114 Stat. 438–455,* which authorizes the Secretary of Agriculture to take measures to hold, seize, quarantine, treat, and destroy plant pests that are new to or not known to be widely prevalent or distributed within and throughout the United States.

The alternative options considered in this EIS are (1) no action, (2) no eradication, (3) quarantine and commodity treatment and certification, and (4) an IPM approach (the preferred alternative). The alternative options derive from scientific research published in peer-reviewed scientific journals and experience in exotic fruit fly control and eradication programs in the United States. The alternative options vary with regard to their practicality or feasibility based on environmental, scientific, regulatory, economic, and logistical factors. They vary considerably with regard to their effectiveness to control and eradicate exotic fruit flies, capability to attain program objectives, and immediate applicability for large-scale fruit fly eradication programs.

## B. Adaptive Management

Adaptive management refers to the inclusion of a treatment that may become available in the future should it prove as effective and safe as an existing, approved treatment. The selection of a specific or new control method depends on the circumstances, urgency of need, availability, and the efficacy as a substitute control method. In particular, the availability of chemical control methods is subject to change, based on: (1) new information relative to environmental consequences, (2) planned phase-outs of some chemicals, (3) new limitations placed on their usages, and (4) the availability of new replacement controls.

This EIS proposes the use of specific chemical treatments as part of the Fruit Fly Cooperative Control Program under the various alternatives with the exception of the no eradication alternative. The Program could add other treatment(s) that may become available in the future to currently approved treatments for managing fruit flies (adaptive management). A new treatment would be available for use upon the Agency finding that the treatment is EPA-registered or exempted for use on fruit fly species, and poses no greater risks to human health and non-target organisms than are disclosed in this EIS for the currently approved treatments. The protocol for making the necessary finding that adaptive management authorizes a treatment is as follows:

1. Conduct a human health and ecological risk assessment (HHERA). In this risk assessment, review scientific studies for toxicological and environmental fate information relevant to effects on human health and non-target organisms. Use this information and the exposure evaluation based on the use pattern of a pesticide in the program to estimate the risk to human health and non-target organisms. Include these four elements in the HHERA: (a) hazard evaluation, (b) exposure assessment, (c) dose response assessment, and (d) risk characterization. Preparation of the HHERA will require the following:

- Identifying potential use patterns, including formulation, application methods, application rate, and anticipated frequency of application.
- Reviewing hazards relevant to the human health risk assessment, including acute and chronic toxic effects via oral, inhalation, and dermal routes, skin and eye irritation, dermal absorption, allergic hypersensitivity, systemic and reproductive effects, developmental effects, carcinogenicity, neurotoxicity, immunotoxicity, and endocrine disruption.
- Estimating exposure of workers applying the chemical.
- Estimating exposure to members of the public.
- Characterizing environmental fate and transport, including drift, leaching to ground water, and runoff to surface streams and ponds.
- Evaluating the dose levels for potential human health effects including acute and chronic toxicity.
- Reviewing available eco-toxicity data, including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates.
- Estimating exposure of terrestrial and aquatic wildlife species.
- Characterizing risk to human health and wildlife.

2. Conduct a risk comparison of the human health and ecological risks of a new treatment with the risks identified for the currently authorized treatments. This risk comparison will evaluate quantitative expressions of risk (such as hazard quotients), and qualitative expressions of risk that put the overall risk characterizations into perspective. Qualitative factors include scope, severity, and intensity of potential effects, as well as temporal relationships, such as reversibility and recovery.

3. If the risks posed by a new treatment fall within the range of risks posed by the currently approved treatments, USDA-APHIS will list the new treatment on its web page and prepare a categorical exclusion for the proposed action.

The decision USDA-APHIS makes based on this EIS will be programmatic. Decisions to use specific treatments in projects (including new treatments authorized under adaptive management) will occur after USDA-APHIS conducts and documents site-specific EAs, in accordance with USDA-APHIS NEPA implementing procedures.

## C. Alternatives

The four alternatives in this EIS are (1) no action, (2) no eradication, (3) quarantine and commodity treatment and certification, and (4) an IPM approach (the preferred alternative). Table 2-1 provides a summary of the potential program actions available for use under each of the four alternatives. A description of the actions associated with each alternative follows the table.

Table 2-1. Potential Program actions under the four alternative options

| | **No action**[1] | **No eradication** | **Quarantine and commodity treatment and certification** | **Integrated pest management** |
|---|---|---|---|---|
| **Exclusion** | | | | |
| Quarantine | X | | X | X |
| Inspection and certification | X | | X | X |
| **Detection** | | | | |
| Detection trapping | X | | X | X |
| Delimitation trapping | X | | X | X |
| **Control** | | | | |
| ***Nonchemical Control Methods*** | | | | |
| Sterile insect technique | X | | | X |
| Sterile insect technique with genetically engineered flies | | | | X |
| Physical control | X | | X | X |
| Cold treatment | X | | X | X |
| Irradiation treatment | X | | X | X |

| | No action[1] | No eradication | Quarantine and commodity treatment and certification | Integrated pest management |
|---|---|---|---|---|
| Vapor heat treatment | X | | X | X |
| ***Chemical Control Methods*** | | | | |
| Aerial or ground application of spinosad or malathion bait spray for regulatory commodity movement | X | | X | X |
| Aerial or ground application of spinosad or malathion bait spray for eradication treatment | X | | | X |
| Soil treatment with lambda-cyhalothrin | | | X | X |
| Soil treatment with diazinon | X | | X | X |
| Methyl bromide fumigation | X | | X | X |
| Mass trapping | X | | | X |
| Male annihilation technique | X | | | X |

[1]Current management. Fenthion, suredye and chlorpyrifos are not part of the current program

**Alternative 1. No Action**

The no action alternative would maintain the program as described in the 2001 Programmatic EIS and Record of Decision, which is limited to the fifty states of the United States and does not include U.S. territories (USDA-APHIS, 2001a). This program includes methods to exclude, detect, prevent, and control fruit fly infestations. This alternative would not add treatment options to those approved by the 2001 decision. This alternative represents the baseline against which to compare a proposed alternative action.

**Alternative 2. No Eradication**

The no eradication alternative does not involve USDA-APHIS cooperation to control (suppress, eradicate, or manage) outbreaks of fruit flies. State or local governments, commercial producers, or producer groups may apply control efforts, but USDA-APHIS cannot predict whether these entities would have the resources or the authority to take action to exclude or control fruit flies.

### Alternative 3. Quarantine and Commodity Treatment and Certification

This alternative combines a federal quarantine with commodity treatment and certification, as stipulated under Title 7 CFR § 301.32. This alternative slows the spread of fruit flies, but does not eradicate fruit flies from an infested area because control activities would occur on commercial premises only while the fruit fly outbreak will likely include areas extending beyond the premises. The following sections describe the actions that could occur under this alternative (see table 2-1 for a summary of actions).

a. <u>Establishment of Federal Quarantine</u>
Under the federal quarantine, USDA-APHIS would not allow regulated articles within the quarantine area to move outside of the quarantine area unless (a) appropriate treatments occur and (b) regulated articles receive certification that they are free of reproductively viable fruit flies. Regulated articles may also move outside the quarantine area under a limited permit to a processing facility or treatment facility. A regulated article is any product, article, or means of conveyance a USDA-APHIS inspector determines a risk of spreading fruit flies. The Code of Federal Regulations (7 CFR §301.32) lists berry, fruit, nut, or vegetable commodities that are regulated articles for fruit flies.

USDA-APHIS published guidelines to assist program personnel in the proper emergency response triggers and the establishment of quarantine upon detection of fruit flies. The fruit fly species and the number of mated females or larvae and pupae within a certain radius of a first find determines whether a quarantine is triggered (USDA-APHIS, 2016a). In prior exotic fruit fly outbreaks in the United States, quarantine boundaries for fruit flies were approximately a 4.5-mile radius from a triggering event (USDA-APHIS, 2015f) and an approximately 81 square mile quarantine area centered on each fruit fly infestation site (USDA-APHIS, 2015a).

USDA-APHIS notifies impacted people, businesses, and facilities of the quarantine by issuing Emergency Action Notifications (EANs, PPQ Form 523) or compliance agreements. For example, during a Medfly outbreak response, USDA-APHIS issues EANs to commercial producers and establishments within the immediate outbreak area that grow, handle, or process regulated articles that require treatment or other approved handling procedures prior to moving regulated articles outside of the quarantine area (USDA-APHIS, 2003a). USDA-APHIS contacted and placed other establishments under program compliance agreements.

The quarantine actions of this alternative reduce exotic fruit fly movement outside of quarantine areas by limiting the human-mediated transport of fruit flies in host plant materials to areas outside the quarantined area; however, the infestation could remain established within the quarantine boundaries.

b. Survey: Early Detection and Delimitation

The purpose of a survey is to determine the extent and means of pest spread, set quarantine boundaries, and determine pest-free areas. In 2015, USDA-APHIS prepared guidelines for fruit fly detection trapping to assist the program in the selection of trap sites, trap density, and trap protocols (USDA-APHIS, 2015e).

USDA-APHIS conducts early detection surveys for exotic fruit flies in areas considered high risk based on the availability of suitable hosts, conducive climate, pathways for introduction, history of prior fruit fly detections, and other factors (USDA-APHIS, 2015e). The early detection survey involves setting traps in high-risk areas and monitoring the traps for evidence of fruit flies. Fruit sampling may occur as a complement to trapping. Early detection survey is an ongoing activity and occurs even when there is no fruit fly outbreak.

Detection of one or more fruit flies in an area triggers a delimitation survey to determine the full extent of the infestation and to determine or adjust quarantine boundaries accordingly. The trigger for a delimitation survey may not be the same trigger for a quarantine. For example, a delimitation survey for *Ceratitis capitata* (Medfly) occurs upon detection of one fly while establishment of a quarantine is when two flies occur within a 3-mile radius during the first life cycle (USDA-APHIS, 2016a). Delimitation survey protocols may differ between fruit fly species. For example, a delimitation survey for *C. capitata* involves the placement of dozens of traps within 24 hours in a one square-mile area of the first find (USDA-APHIS, 2003a). The trapping area expands to approximately 81-square miles (equivalent to a quarantine area) within 72 hours for the placement of about 1,700 traps (trap density decreases further from the core area, which is approximately a 0.5 mile radius around a detection). For the Medfly program in Florida, however, the action plan calls for 2,580 traps in an 81-square mile delimitation area, while a delimitation survey for *Anastrepha ludens* (Mexfly) uses fewer traps (approximately 1,120 traps in the 81-square mile area) (Jang et al., 2015). Trap service occurs daily initially until 7 consecutive days of negative detections, and then weekly for a minimum of two or three life cycles beyond the last fly detection, depending on the species.

The type of trap and attractant depend on the fruit fly species (USDA-APHIS, 2015e). Attractants include proteinaceous baits, para-pheromones, and synthetic food lures. Proteinaceous baits are natural food baits that capture both female and male fruit flies. Para-pheromones are plant-produced chemical compounds that mimic the effect of insect pheromones that mostly capture male fruit flies. Cuelure, methyl-eugenol, and trimedlure are para-pheromones. An insecticide accompanies cuelure or methyl-eugenol in the trap to demobilize the target fruit flies. Trimedlure does not contain an insecticide. For example, a Jackson trap for *Bactrocera* species contains methyl-eugenol or cuelure with either naled, or 0.09 g insecticide dichlorvos (2, 2-Dichlorovinyl dimethyl phosphate or DDVP) impregnated strips which are EPA-approved for use in insect traps. Synthetic food lures are more pest-specific than proteinaceous baits and attract both female and male fruit flies. The 2-component synthetic food lure contains putrescine and ammonium acetate; the 3-component lure also contains trimethylamine.

Research on trap design, lure development, and trapping methods is ongoing and USDA-APHIS would consider integrating improvements into survey programs when they become available (see adaptive management).

c. <u>Regulatory Treatment and Commodity Certification</u>

Interstate movement of regulated articles would require the issuance of a certificate or limited permit contingent upon regulatory treatment to neutralize fruit flies, or the commercial producer or shipper complying with specific conditions designed to minimize pest risk and prevent the spread of fruit flies.

Regulatory treatments of commodities and premises (fields, orchards, groves, or other areas) within the quarantine area may allow regulated articles to move outside the quarantine area. Post-harvest commodity treatments are cold treatment, vapor heat treatment, irradiation treatment, and methyl bromide fumigation. These treatments occur in USDA-APHIS-inspected and approved facilities. Insecticides available for use to treat commodities in premises include lambda-cyhalothrin (for nursery stock), diazinon (for nursery stock), spinosad bait spray with protein hydrolysate, and malathion bait spray with protein hydrolysate. Below is a description of the regulatory treatments for post-harvest commodities and premises within the quarantine area.

*Regulatory Treatments for Post-harvest Commodities*

USDA-APHIS publishes a treatment manual that lists treatment schedules for commodity and pest combinations, including treatment schedules for fruit fly hosts (USDA-APHIS, 2016d).

1. Cold Treatment

   Cold treatment is a non-chemical regulatory control method that involves the refrigeration of harvested produce over an extended period. The cold treatments are commodity specific (USDA-APHIS, 2016d). Cold treatment kills fruit flies in regulated articles, which is a prerequisite for movement of those articles out of quarantine areas.

All cold treatments occur in USDA-APHIS-approved facilities. The facilities must be within the quarantine area and the cold treatments must occur before commodities move from the quarantine area.

A number of constraints, such as the duration of treatments, availability of facilities within the quarantine area, and logistical and budgetary constraints for producers tend to limit the use of this treatment. In addition, some commodities are sensitive to cold treatment and could become damaged.

Some commodities may receive a combination of cold treatment and methyl bromide fumigation (described below). USDA-APHIS prefers the use of cold treatment to methyl bromide fumigation because of the environmental concerns associated with methyl bromide and the sensitivity of some commodities to methyl bromide.

2. Vapor Heat Treatment

   Vapor heat (steam) treatment is another non-chemical regulatory control method that exposes fruit flies in regulated articles to lethal temperatures to allow movement of the regulated articles outside of the quarantine area. The temperature level and duration of exposure vary by commodity. USDA-APHIS consults its treatment manual for vapor heat treatment schedules for a range of commodities (USDA-APHIS, 2016d). For the fruit fly quarantine, vapor heat treatments must occur in USDA-APHIS-approved facilities within the quarantine area. As with cold treatments, there are constraints associated with vapor heat treatment. Treatments for bulk shipments may be logistically difficult to accomplish and may not be as cost-effective as for smaller shipments. Not all commodities are heat-tolerant. The lack of facilities equipped for vapor heat treatment inside quarantine areas limits the availability of this control method.

3. Irradiation Treatment

   Irradiation treatment is the release of gamma radiation into a commodity to sterilize or kill certain species of fruit flies without the retention of radioactivity in the commodity. USDA requires commodity irradiation to occur in a USDA-approved irradiation facility under strict safety guidelines where the equipment undergoes regular inspection in accordance with standards set by the Nuclear Regulatory Commission. The use of irradiation facilities to treat regulated commodities for fruit flies must be within the quarantine area.

   As with other regulatory commodity treatments, there are constraints associated with irradiation treatments. Treatments for bulk shipments may be logistically difficult to accomplish and may not be as cost-effective as for smaller shipments. Irradiation treatment may damage some commodities and make them unmarketable. Irradiation treatment is of limited availability as a control method because the facilities would be lacking in most quarantine areas and effective irradiation treatment schedules are undeveloped for most commodities.

4. Methyl Bromide Fumigation

   Methyl bromide is a broad-spectrum pesticide that kills fruit flies in regulated articles and allows the movement of those regulated articles from within a quarantine area to locations outside quarantine boundaries. Methyl bromide fumigations comply with the pesticide label and with all Federal, State, and local regulations. All fumigations occur under strict supervision within the quarantine area. Some commodities may receive a combination of methyl bromide fumigation and cold treatment.

*Regulatory Treatments for Premises*

Several pesticides are available for the treatment of premises where the owner/operator wants to move regulated articles outside the quarantine area. The USEPA already evaluated these pesticides. The development of new and safer pesticides may result in proposals for their inclusion in this alternative (see adaptive management). Pesticide use by premise owners depends on approval by USDA-APHIS (based on efficacy, logistical, and environmental considerations) and the acquisition of a pesticide registration or quarantine exemption. All pesticide applications associated with this program must follow State and Local laws regarding applicator/technician certification and training.

USDA-APHIS uses pesticides under a regular USEPA, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) registration (7 U.S.C. 136a); a registration for special local needs (7 U.S.C. 136v), also known as a section 24(c); or an emergency exemption (7 U.S.C. 136p), also known as a section 18. FIFRA Section 24(c) authorizes state agencies to register additional uses of federally registered pesticides. FIFRA Section 18 authorizes USEPA to allow for unregistered uses of pesticides under statutory defined emergency conditions. Most species of fruit flies are nonnative species, which manufacturers do not routinely register as a pest for coverage on pesticide labels. The introduction of nonnative species is not consistent enough for a manufacturer to justify advance registration for formulations of pesticides known to be effective against them because of the high costs of regular registrations and the unpredictable volume of sales for product use against these species. When USDA-APHIS detects these species, the department must often access available pesticides through emergency exemptions. In addition, because of differing State pesticide registration requirements, not all of the proposed chemicals are registered in the same way for each State. Some chemicals may not be registered in that State, and therefore are unavailable for use.

1. Soil Insecticide Application with Lambda-Cyhalothrin

   Lambda-cyhalothrin is a synthetic pyrethroid insecticide effective against tephritid fruit fly larvae in the soil. Lambda-cyhalothrin is a restricted-use, broad-spectrum insecticide for controlling most major aphid, caterpillar, and beetle pests on crops as well as public health pests such as mosquitoes and cockroaches in non-agricultural areas. The registered crops include fruits, vegetables, and row and field crops (e.g. alfalfa, corn, cotton, rice, soybean, and winter wheat) (USEPA, 2010b).

   USDA-APHIS uses lambda-cyhalothrin through a soil drench application in the Program. Application is in accordance with the label conditions. Since 2015, the Program follows a FIFRA Section 24(c) label for use in Florida and in New York in 2018. This label specifies an application rate of 0.4 pounds of active ingredient (lb a.i.) per acre, which equates to a single maximum rate of 0.0091 lb a.i. per 1,000 square feet (sq. ft.) of soil surface (equals 0.56 fluid ounces (fl. oz.) of product in 15.5 gallon of water per 1000 sq. ft) (FDACS, 2014). Premise owners located inside the quarantine area may apply lambda-cyhalothrin to soil of containerized non-fruit bearing host nursery stock and to soil within the dripline of host plants in the ground to allow the shipment of nursery stock outside of the quarantine area (USDA-APHIS, 2015b). After treatment, regulated nursery stock is eligible for movement outside of the quarantine area and remains eligible as long as the nursery stock remains free of fruit. If the nursery stock fruits before movement, premise owners must remove the fruit and treat the nursery stock again. A HHERA for lambda-cyhalothrin use in the Program is available at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018.

2. Soil Insecticide Application with Diazinon

   Diazinon is an organophosphate insecticide registered for use to control a variety of insect pests on fruit, nut, and vegetable crops as well as ornamentals. Diazinon is a restricted-use insecticide. The USEPA phased out all indoor and outdoor residential use products in 2004 (USEPA, 2004).

Current product labels do not specify a use to control fruit flies. Currently, only California has a special local need label for diazinon on containerized host nursery stock to control fruit flies, which is set to expire in 2020 (CDFA, 2015b). In the Program, the application of diazinon is through a soil drench. Under the special local needs label, the application rate for diazinon is 5 lb a.i. per acre or 0.11 lb a.i. per 1000 sq. ft. Application frequency is one to three applications at 14-day intervals. Premise owners located inside the quarantine area would apply diazinon to soil of containerized non-fruit bearing nursery stock to allow the shipment of nursery stock outside of the quarantine area. After treatment, regulated containerized nursery stock is eligible for movement outside of the quarantine area and remains eligible as long as the nursery stock remains free of fruit. If the nursery stock fruits before movement, premise owners must remove the fruit and treat the nursery stock again. A HHERA for diazinon used as a soil drench is available at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018.

3. Spinosad Bait Spray

Spinosad is a broad-spectrum insecticide registered for use on agricultural crops, ornamentals, tree farms/plantations, turfgrass, home gardens, and lawns (residential use). One formulation has registration for use against fruit flies.

Regulated premises may use spinosad bait spray as a pre-harvest treatment to target adult fruit flies prior to commodity movement off the property and outside the quarantine area. Spinosad bait spray is a formulation of naturally produced bacterial compounds (spinosyns) and a food-based attractant (bait) such as protein hydrolysate derived from plants or yeast. The bait attracts fruit flies to the pesticide where they then receive a lethal dose. Some proteinaceous baits act as feeding stimulant (Prokopy et al., 1992), which may increase the fruit fly’s intake of the pesticide. Baits increase the efficacy of chemical applications (Prokopy et al., 1992).

Premise owners apply spinosad bait spray through ground or aerial applications, according to label instructions. Ground and aerial applications follow the same formulation, rate, and application frequency. Ground applications are from ground-based equipment such as backpack or pump-up sprayers, or truck-mounted mist blowers and hydraulic sprayers. Applications occur approximately 30 days (one fruit fly life cycle) prior to harvest and continue at 6 to 10 day intervals through harvest. For example, during Mexfly outbreaks in Texas, bait spray treatments in commercial citrus groves take place at 6 to 10 day intervals, starting one life cycle before harvest and continuing throughout harvest (USDA-APHIS, 2010b). A HHERA for spinosad used in the Program is available at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018.

4. Malathion Bait Spray

Malathion bait spray consists of the insecticide malathion mixed with a protein hydrolysate bait. Proteinaceous baits act as an attractant and feeding stimulant to the fruit flies, which feed on it and ingest the insecticide. The use of a bait to attract fruit flies improves efficacy to the extent that the amount of malathion required is lower compared to labeled rates for most other uses.

The application of malathion would occur only on commercial nurseries as a pre-harvest treatment and would allow premise owners to move regulated articles off the property and out of the quarantine area. Treatments must start at a sufficient time before harvest, at least 30 days (to span the interval that normally would include the completion of egg, larval, and pupal development), then continue throughout the harvest period. For example, for premise treatments in commercial production areas in Texas, malathion bait sprays occur at 10- to 14-day intervals 30 days prior to and through harvest (USDA-APHIS, 2010b). The required pre-harvest treatment makes this option useful for only those commodities remaining in the field for more than 30 days after an area is quarantined.

Ground and aerial applications follow the same formulation, rate, and application frequency. Malathion ground applications are from ground-based equipment such as backpack or pump-up sprayers, or truck-mounted mist blowers and hydraulic sprayers. Ground applications are preferable for small or isolated areas of host plants, locations adjacent to sensitive sites or water (where drift from aerial applications is of special concern), and sites where aerial applications would be either less precise or the terrain unsafe for aircraft operation. Generally, the ground spray is at close range to host plants. Depending on the species of fruit fly targeted, the ground-applied malathion bait may be distributed either as bait spot treatment (squirting a small amount on a portion of the host plant) or to alternative rows until the premise is treated. Aerial applications using aircraft enable coverage of larger areas in a shorter amount of time. A HHERA for malathion is available at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018.

**Alternative 4. Integrated Pest Management Approach (Preferred Alternative)**

This alternative combines quarantine and commodity treatment and certification (alternative 3) with eradication treatments for fruit flies. Several eradication treatments USDA-APHIS uses in the current Program (guided by the 2001 EIS) are the same in this alternative.

This alternative is an IPM approach, which uses several control strategies to eradicate fruit flies. This alternative would use the following components singly, or in combination:

- Establishment of a Federal quarantine (as described in alternative 3)
- Host survey for evidence of breeding fruit flies (as described in alternative 3)
- Regulatory commodity treatment and certification (as described in alternative 3)
- Eradication chemical applications
- Physical removal of fruit or host plants
- Mass trapping
- Male annihilation technique (MAT)
- SIT

USDA-APHIS' selection of Program components would take into consideration economic (the cost and the cost effectiveness of various components in both the short- and long-term), ecological (the impact on non-target organisms and the environment), and sociological (the acceptability of various integrated control methods to cooperators, or the potential effects on land use) factors. Selection would also depend on the availability of control technology, the nature and location of the outbreak, the technological and logistical capabilities of cooperators, and the availability of resources. USDA-APHIS would maintain regulatory efforts; commercial producer groups and individuals would be encouraged and required to comply with regulations designed to reduce the potential spread of pest species.

The following sections describe the actions that could occur under this alternative (see table 2-1 for a summary of actions).

a. Establishment of the Federal Quarantine
As described in alternative 3, USDA-APHIS would establish quarantine boundaries to prevent the spread of fruit flies outside of the quarantine area.

b. Survey: Early Detection and Delimitation
As described in alternative 3, USDA-APHIS would conduct early detection surveys in high risk areas. Detection of one or more fruit flies would trigger delimitation survey to determine the extent of the infestation. USDA-APHIS would monitor fruit fly outbreaks and survey quarantine areas until the areas meet the pest-free criteria of no fruit flies detected during a minimum of three

lifecycles after the last fly find (treatment is for two lifecycles). If USDA-APHIS detects fruit flies during the second survey cycle, the Program continues survey cycles until it detects no fruit flies. The Program removes areas from quarantine when they meet the pest-free criteria.

c. Commodity Treatment and Certification
USDA-APHIS would require the same regulatory treatments and certification as described in alternative 3 before host commodities could move outside of the quarantine boundary.

d. Eradication Chemical Applications
Insecticide applications for fruit fly control and eradication is a component of alternative 4. The regulatory chemical treatments (described in alternative 3) enable a commodity to leave a quarantine area whereas the eradication chemical applications are to eliminate fruit fly populations from an area in order to declare eradication in the quarantine area.

The development of new and safer insecticides may result in proposals for their inclusion in the eradication program (see adaptive management).

Human health and ecological risk assessments for lambda-cyhalothrin, diazinon, spinosad, and malathion are available at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018.

1. Soil Insecticide Application with Lambda-Cyhalothrin

As described in alternative 3, lambda-cyhalothrin is effective against tephritid fruit fly larvae and pupae in the soil and premise owners apply the insecticide to the soil of host nursery stock to allow movement outside of the quarantine area. In addition to this use pattern, under alternative 4, the Program may use lambda-cyahalothrin as part of an eradication strategy by applying lambda-cyhalothrin within the drip line of fruit-bearing fruit fly host plants located within a 400-meter radius of mated female fruit flies, larvae, pupae, or eggs. However, the Program would require the removal and destruction of fruit from host plants that received soil drench applications to prevent larvae in the fruit from infesting the soil. For eradication purposes, the Program may use this insecticide on commercial premises, in residential areas, and on other public properties. The proposed use of lambda-cyhalothrin as a treatment is not part of the 2001 EIS.

2. Soil Insecticide Application with Diazinon

As described in alternative 3, diazinon is effective against tephritid fruit fly larvae, pupae, and emerging adults in soil. Currently, only one product is eligible for a label registration (a 24(c) special local needs label) for use on containerized host plants in commercial premises, and the product is only registered for use in a few states/territories. For eradication purposes, it is possible that States would apply for additional special local needs labels to allow the application of diazinon within the drip line of fruit fly host plants located within the vicinity of mated female fruit flies, larvae, pupae, or eggs. However, the Program would require the removal and destruction of fruit from host plants that receive soil drench applications to prevent larvae in the fruit from infesting the soil. For eradication purposes, the Program may use this insecticide on commercial premises. The proposed use of diazinon as a treatment is part of the 2001 EIS; however, current label restrictions apply.

3. Spinosad Bait Spray

In addition to the use of spinosad in regulated premises prior to the movement of regulated articles (described in alternative 3), the Program may use spinosad bait to target adult fruit fly life stages during eradication efforts. Ground and aerial applications follow the same formulation, rate, and treatment interval as described in alternative 3. The Program uses aerial and ground-based applications of spinosad bait in eradication areas to reduce the population of gravid adult female fruit flies and often combines this technique with other control strategies, such as SIT (described below). Baits (protein hydrolysate) combined with toxicants increase the efficacy of chemical applications, and may reduce the proportion of the area receiving toxicants (Prokopy et al., 1992).

The Program uses aerial applications in areas that are not in proximity of residential, commercial, government, institutional or other structures. In urban areas of most states (Florida is the exception), application is usually limited to ground applications. Ground applications involve the localized spray of host trees and plants within a 200-500 meter radius of a fruit fly find (USDA-APHIS, 2010b). The Program continues to use spinosad bait spray for a minimum of two fruit fly generations or until no fruit flies are detected in subsequent survey cycles. However, if the insecticide reduces fruit fly populations to low levels, the Program may stop using the insecticide and instead use SIT. SIT is effective against low-level fruit fly populations where high over-flooding ratios are possible to achieve. The Program surveys the area for three more lifecycles to assure eradication after the last detection.

4. Malathion Bait Spray

In addition to using malathion in regulated commercial premises prior to the movement of regulated articles (described in alternative 3), the Program may use malathion to eradicate fruit flies. In recent years, the Program has not used malathion bait spray but used spinosad bait spray instead. The last reported use of malathion bait spray was during the eradication of Mexican fruit fly in 2002 in California (USDA-APHIS, 2017a). The Program applied ground applications of malathion bait to all hosts within 200 meters of fruit fly finds.

Ground and aerial applications of malathion follow the same formulation, rate, and treatment interval as described in alternative 3. The Program uses aerial applications in areas not in proximity of residential, commercial, government, institutional or other structures. In urban areas, application is limited to ground applications. The malathion bait aerial and ground applications (described in alternative 3) reduce fruit fly populations to a level of infestation where mating thresholds are difficult to achieve. The reduction in fruit fly populations enhances the effectiveness of other eradication techniques such as SIT. The Program continues to use malathion bait spray for a minimum of two fruit fly generations or until no more fruit flies are detected in subsequent survey cycles. However, if the insecticide reduces fruit fly populations to low levels, the Program may stop using the insecticide and instead use SIT. The Program surveys the area for three more lifecycles to assure eradication after the last detection.

e. <u>Physical Control</u>

Fruit removal and host elimination are two principal physical control methods. The physical elimination of fruit fly host material, when possible and appropriate, may be especially helpful in the elimination of small, isolated infestations.

For example, in Medfly eradication programs, when trapping and subsequent fruit cutting determine that fruit flies infested the property, the Program promptly removes and disposes of all host fruit on the property and immediately adjacent properties. The area stripped of host fruit normally includes all properties within 200 meters (656 feet) of confirmed detection sites. With fruit removal, the Program only removes the actual host material (the fruit), causing little or no harm to the plant. Destruction of the host fruit may be by burial, incineration, or a combination of both methods at an approved landfill or refuse site. The legal and logistical aspects of collecting and disposing of the fruit are a limitation to its operational use. For example, the size of the infested area and the ability to gain access to residential properties may limit the method’s area of coverage.

Although the goal of host elimination is the same as fruit stripping, its methods and effects differ substantially. In a moderate scenario, host elimination might mean the removal of only a few plants from an urban environment. In an extreme scenario, host elimination could involve the destruction of numerous host plants. Except in very limited circumstances, host elimination is unacceptable because of environmental considerations, time, and resource constraints.

f. Mass Trapping and Male Annihilation Technique (MAT)

Mass trapping reduces fruit fly populations by attracting fruit flies to traps (conventional fruit fly traps, sticky panels, fiberboard squares, and wicks) or bait spot treatments where they become stuck to a sticky substance or killed with a small amount of insecticide. In traps, the Program could use naled, DDVP, or spinosad. In bait spot treatments, the Program uses naled or spinosad. For example, mass trapping for melon fly (*B. cucurbitae*) uses the Jackson traps containing the male-attractant cuelure and the pesticide naled placed in trees, shrubs, and inanimate objects (USDA-APHIS, 2010a).

Mass trapping is no different from regular detection or delimitation trapping other than in the increased number of traps placed in the field per defined area. Mass trapping has the potential to control many species of fruit flies, but is not effective for all species.

The type of trap and attractant depend on the fruit fly species, as described under alternative 3 and in the Fruit Fly Detection Trapping Guidelines (USDA-APHIS, 2015e).

USDA-APHIS uses MAT as an eradication treatment because it is effective against some fruit fly species when a powerful attractant is available that works on all of those species. For example, methyl-eugenol attracts several species of *Bactrocera* (including Oriental and peach fruit flies). In MAT for *Bactrocera*, the Program places bait spot treatments (each 5-10 ml) containing methyl-eugenol and an insecticide (spinosad, DDVP, or naled) in a 1.5-mile radius from each fruit fly detection site for a minimum of 9 square miles. The Program applies up to 600 bait spots per square mile to utility poles and street trees at least 6 feet above the ground. The Program uses traps where there are no surfaces to place bait spot treatments. The Program repeats the treatment every 2 to 6 weeks for a maximum 15 total applications per acre per year, depending on the severity of the infestation (CDFA, 2015c). The bait spot attracts male fruit flies looking for an opportunity to breed and kills the flies as they feed on the bait spot. The females go unmated and, therefore, do not produce offspring, leading to eradication of the population.

Mass trapping and MAT, in combination with other actions, can lower the population of fruit flies to levels where eradication is achievable through the combined use of other control methods, often including SIT (described below). In addition, mass trapping and MAT can be an important tool in urban areas due to citizen concerns about the use of pesticide sprays.

There are some limits to the use of mass trapping. The approach is costly and labor-intensive. It may require placement and servicing of 1,000 or more traps per square mile within the infestation area. Reductions in effectiveness occur when the public, livestock, or pets dislodge or inadvertently destroy traps. USDA-APHIS finds mass trapping most effective upon detection of a new infestation and when used in conjunction with other control methods. However, mass trapping is not as effective for large outbreak areas. Finally, the lures (natural and synthetic) are not equally effective on all species of fruit flies.

g. Sterile Insect Technique (SIT)

USDA-APHIS uses SIT in the Program because the technique successfully reduces fruit fly populations. SIT reduces fruit fly populations through the intentional release (using aircraft or ground vehicles) of sterile male fruit flies into the environment. The sterile males mate with wild female fruit flies to produce only infertile eggs. In practice, the frequent release of sterile insects in sufficient numbers will cause the feral population to decline and eventually lead to eradication. SIT performs best when fruit fly populations are low so that the sterile males outnumber the wild type males for mating opportunities. Prior to the use of SIT, chemical bait sprays may be necessary in eradication programs to reduce the population density and increase the ratio of sterile male flies to wild male flies.

USDA-APHIS uses SIT in preventative release programs, which involve releasing sterile insects on an ongoing basis in high-risk areas. For example, in the Mexfly program in Texas, the Program releases sterile flies year round at a rate of 900 flies per acre in high-risk counties (USDA-APHIS, 2015d).

Sterile fruit fly production occurs under sanitary laboratory conditions. Exposure of fruit fly pupae to radiation from gamma rays or electron beams makes them sterile. The rearing of sterile Medflies is located at facilities in Waimanalo, Hawaii, and El Pino, Guatemala. Sterile Mexfly rearing is located at facilities in Edinburg, Texas and Petapa, Guatemala.

In 2008, USDA-APHIS evaluated the development and use of genetically engineered (GE) fruit fly insects in SIT applications (USDA-APHIS, 2008). Specifically, USDA-APHIS could augment their use of SIT by 1) mass-rearing only male fruit flies that have a marker gene and are subject to sterilization by radiation; 2) mass-rearing genetically sterilized (not radiation-sterilized) male fruit flies that have a marker gene and that compete more effectively for mates than radiation-sterilized male insects; or 3) by mass-rearing fruit flies that produce only male offspring which carry a sterility gene resulting in only males that pass on this sterility gene and no female offspring. GE fruit flies were not part of the SIT treatment option in the 2001 EIS.

## D. Alternatives Not Considered

1. Cultural Control

   USDA-APHIS may provide advice to commercial producers on cultural control practices that would reduce the number and severity of fruit fly outbreaks, but USDA-APHIS would not be responsible for carrying out the cultural control practices; rather, the commercial producers would oversee these practices and likely get cooperative extension service advice and guidance. USDA-APHIS considers cultural control methods to be complementary to the control methods for fruit flies.

   Cultural control reduces pest populations through manipulation of agricultural practices to make the crop environment as unfavorable as possible for the insect pest. Cultural control methods could include host fruit sanitation, special timing, trap cropping, use of resistant varieties, crop rotation, varying plant locations, and manipulation of alternate hosts (Aluja, 2009). Several of these methods (but not all) may have applicability for control of fruit flies and are summarized below.

   Clean cultural practices, or careful and complete harvesting combined with destruction of infested and unmarketable fruit fly host crops, can be important in reducing fruit fly populations. Collecting and burying host fruit left after harvest, destroying damaged fruit, and removing unwanted or wild alternate hosts in and around fields help reduce fruit fly infestations. Collecting and destroying potential host fruit eliminates the fruit fly host stages in the fruit as well as the host fruit, which is a possible source of continued infestation.

   Special timing involves the planting of early-season or short-season fruit and vegetable crops so that fruit ripening does not coincide with peak fruit fly activity, or by harvesting the fruit before it reaches a stage of ripeness highly susceptible to fruit fly attack. Although this technique theoretically could reduce fruit fly populations, it is not likely to do so for a variety of reasons. First, the development of most fruit flies generally coincides with the development (growth) of their host crops. In addition, it is doubtful that commercial producers can exercise enough control over commercial agricultural practices to make the technique effective or worthwhile. Finally, the presence of multiple hosts that are susceptible to fruit fly infestations limits the applicability of this method in many areas.

   Trap cropping involves the planting of a crop that the pest favors, to attract and concentrate the pest in a limited area, followed by pest destruction by chemical or cultural methods. For other insect pests, trap cropping often involves planting a small plot of the favored host crop earlier than the main crop so that overwintered life stages of the pest will be concentrated and destroyed by pesticides or by plowing the crop under before there is infestation of the main crop. It is unlikely that this method could be applicable to most fruit fly programs because of the perennial nature of many host species, the availability of multiple host species in the program areas, and the lack of data on effectiveness of trap crops in attracting fruit flies from distant areas.

Crop rotation and varying the locations of plantings have little applicability to fruit fly programs. These techniques are not applicable to perennials (like oranges, grapefruit, and apples). Even if commercial producers rotate annual host crops, this action probably would not prevent fruit fly pests from finding suitable hosts in the surrounding area.

2. Biological Control

Biological control (or biocontrol) is a pest control strategy making use of living natural enemies, antagonists or competitors, and other self-replicating biotic entities. Biological control differs from natural control of pest organisms in that human intervention is involved in the dissemination of the pest’s enemies (parasites, predators, and pathogens).

USDA-APHIS and its cooperators successfully use biological control agents in several insect and weed control programs. USDA-APHIS believes that biological control, appropriately applied and monitored, is an environmentally safe and desirable form of long-term management of pest species. USDA-APHIS further believes that biological control is preferable when applicable, but recognizes its limited application to emergency eradication programs.

Biological control of fruit flies in Hawaii as well as other countries reduced fruit fly infestations in commercial crops (Stibick, 2004; Vargas et al., 2008; Ovruski and Schliserman, 2012). In spite of the reduction of some fruit fly populations in response to a biological control agent, biological control has major limitations that influence its suitability for eradication and control programs. These limitations include a lack of immediate results; potential lack of effectiveness; logistical difficulties; and incomplete or unavailable information about rearing techniques, natural dispersal, and effects on nontarget species. In Hawaii, the augmentative release of certain parasitoids during fruit fly outbreaks did cause an increase in parasitism in the field; however, limited rearing capacity and the high cost of implementation made it unfeasible to continue release for fruit fly population suppression (Vargas et al., 2008).

Biological control agents normally are not capable of achieving total elimination of a pest species, but instead reduce pest populations by varying percentages ((Ovruski and Schliserman, 2012); research summaries in (Stibick, 2004)). If the biological control agent killed the entire pest population, it would destroy itself in the process; natural mechanisms usually prevent this from occurring. In addition, the consumer tolerance for infested fruit is very low (less than one larva per fruit), so even a minimal population of fruit fly pests are undesirable. Since most potential biological control agents parasitize or prey on immature fruit fly life stages, the extant adult fruit flies continue to reproduce, move, or be carried to other areas to spread the infestation. This characteristic is unacceptable for eradication programs where the objective is to destroy the pest population before it can reproduce, fly, be carried or blown out of the quarantine area. Thus, the nature of most fruit fly eradication programs (which require early detection and elimination of the populations while they are small) tends to rule out biological control as an option for eradication, even though it may offer promise for some suppression programs.

If biological control of a fruit fly species becomes efficacious and reliable as a method in an eradication program, several advantages might be associated with its use. It could be self-perpetuating under conditions where populations of the host or an alternate host remain and where climatic conditions allow the agent to overwinter. Even under conditions that would not allow a self-perpetuating population of biological control agents, inundative releases might still be of value in reducing fruit fly populations. Biological control may reduce or help to reduce fruit fly populations so that other control methods can be more effective. Biological control methods are rarely compatible with chemical control methods because the control organism is likely to be susceptible to the chemical's toxicity.

3. Biotechnological Control

Biotechnological control would involve the use of genetic engineering techniques to control fruit fly pests. Areas of genetic engineering for control of insect pests include bio-engineering crop plants to improve pest resistance, production of genetic mutations of the pest to reduce its reproductive capabilities, transfer of a gene into a wild population through breeding that becomes lethal under a physiological or environmental trigger, and improvement of insect-infecting viruses and microorganisms. Other than the potential uses of GE strains of fruit flies in the SIT program (see alternative 4), USDA-APHIS is not currently using biotechnological control for use against fruit flies. There are several reasons, including: (a) control techniques take time to develop; (b) control techniques take time to implement, particularly for host resistance, as the replacement of perennial crop stands would require years; (c) control techniques are variable in their effectiveness or are cost prohibitive; and (d) the information relative to the environmental impacts of bioengineered organisms may be incomplete or unavailable. Nevertheless, the Program reserves the right to develop and employ biotechnological control in the future after the development of effective control techniques, and appropriate environmental and risk evaluations.

# III. Environmental Consequences

## A. Introduction

The environmental consequences of the Program result from its actions. This is a programmatic EIS and generally describes the environmental consequences. When a site-specific program is necessary, USDA-APHIS considers the features of that area in an EA and adjusts the Program's actions to meet the area's needs.

The geographic scope of the EIS is the contiguous United States, Hawaii, Puerto Rico, the U.S. Virgin Islands, Guam, CNMI, and American Samoa where exotic fruit flies occur or may occur. Exotic fruit fly survival and establishment in the United States and U.S. territories depend on available host plants and suitable environmental conditions. Models suggest that exotic fruit flies can establish in a range that is broader than the southern tier states or tropical islands. For example, the European cherry fruit fly (*Rhagoletis cerasi* L.) has an obligatory winter diapause and can remain dormant for up to three winters (Canadian Food Inspection Agency, 2018). However, cold temperature and availability of year-round hosts are limiting factors for survival of most exotic fruit fly species (USDA-APHIS, 2001b; Stephens et al., 2007).

This chapter has three sections. In the first section, for each alternative, is an analysis of the effects a Program action may have on the physical environment (air, water, and soil), human health and safety, and biological resources. These potential effects are discussed in context to the baseline or the affected environment. The next section covers how the Program actions may effect economic and social (socioeconomic) factors, cultural and visual resources, threatened and endangered species, historic properties, and other considerations, including Executive Orders. The last section covers the potential cumulative effects of the combined use of pest control methods.

## B. Potential Environmental Consequences

**Alternative 1. No Action**

The no action alternative would maintain the Program as described in the 2001 Programmatic EIS and Record of Decision, which is limited to the fifty states of the United States and does not include the U.S. territories (USDA-APHIS, 2001a). This alternative would not add new Federal actions or treatment options to those approved by the 2001 decision (see table 2-1 for a summary of actions). The potential environmental consequences to the physical environment, human health and safety, biological resources, socioeconomics, and cultural and visual resources are therefore expected to be the same as described in the 2001

Programmatic EIS and incorporated by reference. A brief summary of these environmental consequences is provided below.

Non-chemical control methods such as SIT and physical control, both of which are part of alternative 4 (preferred alternative) of the current EIS, could cause minor impacts to soil from vehicular and foot traffic or removal of plant material. Soil disturbance could potentially limit or disrupt populations of soil microorganisms because of soil desiccation or erosion. The 2001 EIS found none of these potential effects exceeded the impacts on soil, air, and water resources associated with routine procedures that commercial producers and homeowners use during planting, gardening, or yard maintenance activities. Similarly, cultural control, such as clean culture or complete harvesting, has not resulted in adverse effects on soil, water, or air quality. Cultural control is not part of the other alternatives within this EIS. Human health risks associated with SIT, physical control, and cultural control is limited to workers, and the use of personal protective equipment (PPE) mitigated most of the risks (USDA-APHIS, 2001a).

The only potential human health risk is associated with exposure to unknown types and concentrations of pesticide residues from applications by the commercial producer or homeowner. USDA-APHIS also evaluated the potential human health risk from the possibility of occasional spills associated with pesticide use, and determined the risk to be minimal (USDA-APHIS, 2001a).

Cold, irradiation, and vapor heat treatments are conducted in approved facilities under strict supervision and have negligible environmental and human health impacts (USDA-APHIS, 2001a). These treatments are also part of alternatives 3 and 4.

Bait spray applications of malathion, spinosad, and SureDye described in the 2001 Programmatic EIS have the potential to affect soil, water, and air, but these effects are minimized by low application rates, standard program protective measures, and program mitigation. Minor soil and vegetation disturbance could result from ground applications that use truck-mounted equipment. Surface water contamination could occur from applications through drift or run-off; however, natural degradation processes make it unlikely that chronic exposures will result from program activities. Air quality impacts are localized and minimal. Human health risks are lower for ground applications than aerial applications, but USDA-APHIS determined it was an acceptable level of risk for both application methods. In addition, USDA-APHIS determined that there are no unacceptable risks for workers (USDA-APHIS, 2001a). SureDye is not part of the other alternatives in this EIS. The use of malathion and spinosad for regulatory commodity movement is considered in alternatives 3 and 4 of this EIS. In addition, the use of malathion and spinosad for eradication treatment is considered in alternative 4.

Similar to the bait spray applications, soil treatments such as chlorpyrifos, diazinon, and fenthion are described as having the potential to cause surface water contamination. Chlorpyrifos and fenthion are no longer used in the program and fenthion is no longer registered, therefore, the following discussion will be limited to diazinon use. Very little to no concentrations of diazinon is expected to be detected in the air following a treatment. Diazinon presents a concern if a child enters a soil treatment area immediately following application; however, these concerns are mitigated with the use of public notifications. There are no unacceptable risks to workers associated with the use of diazinon (USDA-APHIS, 2001a). The use of diazinon is further discussed in alternatives 3 and 4 of this EIS.

Commodity fumigation with methyl bromide is not expected to reach the soil, and solubility of methyl bromide in water is low. Methyl bromide, however, is highly volatile and can be hazardous to workers or the general public if it settles in low-lying areas before dissipating (USDA-APHIS, 2001a). The use of methyl bromide is also considered in alternatives 3 and 4 of this EIS.

Mass trapping and MAT as described in the 2001 Programmatic EIS, included the use of the insecticides naled, malathion, and dichlorvos (DDVP), and was not expected to adversely affect soil, air, or water quality. Most humans will not come in contact with spot treatments or the panels associated with MAT; therefore, USDA-APHIS did not anticipate any adverse human health effects (USDA-APHIS, 2001a). An evaluation of mass trapping and MAT, and summaries of the naled and DDVP HHERAs are included under alternative 4 of this EIS.

**Alternative 2. No Eradication**

The no eradication alternative does not involve Federal action to control (suppress, eradicate, or manage) outbreaks of fruit flies. This alternative does, however, include Federal delimitation and monitoring activities. State governments may implement control or eradication efforts for fruit flies. On the local level, commercial producers would use measures to minimize fruit fly damage to their crops.

Without USDA-APHIS coordination to eradicate fruit flies, these pests will likely establish in the United States, and eventually spread to all areas with suitable climates and host plants. Producers will experience yield losses and increases in pre- and post-harvest costs. Fruit flies damage fruit directly making it inedible or making is susceptible to secondary pest and disease damage. It is possible that commercial producers will be unable to produce certain crops due to excessive damage from fruit flies or will lose market access. Some countries will decline U.S. agricultural commodities grown in fruit fly infested areas, increasing economic losses from reduced export markets. See the next section 'Other

Considerations' for additional discussion about socioeconomic and market impacts.

In the United States and its territories, commercial agriculture producers grow many fruit fly host plants (Appendix 3). Historically, the vast majority of fruit fly outbreaks in the continental United States occurred in CA, FL, and TX (USDA-APHIS, 2017a). Two potential reasons these states consistently need eradication programs include: 1) they have ports-of-entry that receive high volumes of agricultural imports (a pathway for exotic fruit fly entry), and 2) there is high likelihood of exotic fruit flies finding host plants (USDA-APHIS, 2018b). Although exotic fruit fly outbreaks can occur in agricultural areas outside these states, we use host crop data from these states to describe potential effects on commercial production (Appendix 3). We also reviewed host crop data for Hawaii, Guam, American Samoa, Puerto Rico, and the U.S. Virgin Islands, which are part of the geographic scope of this EIS. The crop data includes only the top ranking commercially grown host plants in production value in these states and territories. The next section includes an analysis of the potential socioeconomic impacts from Program actions.

In 2014, of the top 55 commodities grown in California (based on production value), 31 are hosts to at least one species of exotic fruit fly. These host plants encompassed more than 3.2 million acres and accounted for more than $19 billion (CDFA, 2015a). Twenty-one are perennial crops, meaning commercial producers would not easily be able to switch cropping systems, as they can with annual crops, to avoid fruit fly damage.

In 2016, of the top 23 commodities by production value grown in Texas, nine are hosts to at least one species of exotic fruit fly. These host plants encompass more than 5.3 million acres and account for more than $2.7 billion in production value (USDA-NASS, 2016c). Two host plants are perennial crops, which reduces a commercial producer's flexibility to plant non-host plants.

In 2016, of the top 20 commodities by production value grown in Florida, 13 are hosts to at least one species of exotic fruit fly. These host plants encompass more than 728,000 acres and account for more than $2.6 billion in production value (USDA-NASS, 2016b). Four of the host plants are perennial crops.

Hawaii's top crop plants are, in order, seed crops, coffee, sugarcane, macadamia nuts, aquaculture plants, algae, landscaping plants, bananas, papayas, and lettuce (USDA-NASS, 2017). Several of these crops are hosts to at least one exotic fruit fly species. Tephritid fruit flies, including melon, Mediterranean, Oriental, and Malaysian fruit flies, were among the early invasive insects to Hawaii. These species have reduced the types, quantities, and quality of agricultural products, increased pesticide use, and reduced trade (Jang, 2007).

Puerto Rico's top agricultural crops (all are hosts to at least one exotic fruit fly species (USDA-APHIS, 2004) are, in order: plantains, bananas, oranges, mangoes, and lemons and limes (Appendix 3) (USDA-NASS, 2014). The Virgin Islands' top agricultural crops are, in order: cucumbers, bananas, mangoes, coconuts, and tomatoes (Appendix 3) (USDA-NASS, 2009b). Most are hosts to at least one exotic fruit fly species. Guam's primary crops are cucumbers, bananas, bitter melons, cantaloupes, and papayas. These crops are a host to at least one exotic fruit fly species (USDA-APHIS, 2004). In 2007, the market value of vegetables and melons in Guam was about $1.5 million. Fruit and nut sales totaled about $300,000 (USDA-NASS, 2009a). The melon fruit fly occurs on Guam and the CNMI and reduces the quality and yield for cucurbits, especially bitter melon (Dhillon et al., 2005). American Samoa's principal agricultural crops are all perennials, and include banana (valued at $7 million), breadfruit (valued at $2.3 million), coconut (valued at $2.9 million), and papaya (valued at $1.1 million) (USDA-NASS, 2011). Breadfruit and bananas are rarely infested by Medfly, and papaya is only occasionally infested (Thomas et al., 2010).

An outbreak or establishment of an exotic fruit fly population could affect nurseries that grow hosts of these pests. In a 2006 survey of the nursery crop industry in 17 states, Florida and California were among the top ranking states in number of producers (USDA-NASS, 2007). Florida had 40,706 acres in production of nursery crops and California had 25,901 acres in production (USDA-NASS, 2007). California accounted for 60 percent of the fruit and nut nursery plants across the 17 states, making more than $165 million (USDA-NASS, 2007). Gross sales of fruit and nut plants in Florida were more than $22 million (USDA-NASS, 2007). In Puerto Rico, commercial producers planted about 1,500 acres (open field) to nursery and floriculture crops (USDA-NASS, 2014).

The establishment and expansion of exotic fruit fly populations in agricultural production areas is likely to increase production costs through expanded use of pesticides and additional release of pesticides into the environment. In areas where fruit flies survive all year, acceptable pest control will require continual effort. Producers of fruit fly hosts are likely to use pesticides labeled for use on fruit flies; however, they may not necessarily select pesticides with a lower environmental impact.

USDA-APHIS finds outbreaks of exotic fruit flies generally occur in urban areas near ports of entry. While current pesticide use could be responsible for eliminating fruit fly populations in residential and commercial agricultural areas, similar protection would not occur in organic production. However, USDA-APHIS' experience is that outbreaks of exotic fruit flies rarely occur in commercial organic production.

**Alternative 3. Quarantine and Commodity Treatment**

This alternative may slow the spread of exotic fruit flies but is not a strategy to eradicate exotic fruit flies from an infested area. The Program imposes a quarantine and regulated commodities are restricted from leaving the quarantine area unless the crop receives Program-approved treatments or a permit allowing movement. Program-approved premise treatments include the soil application of lambda-cyhalothrin or diazinon, and ground or aerial application of spinosad bait spray or malathion bait spray. Program-approved post-harvest commodity treatments include cold, vapor (heat), irradiation, and methyl bromide fumigation. Prescribed pre- and post-harvest treatments of affected premises are required for as long as the quarantine remains in effect.

### 1. Quarantine and Survey Impacts

The Program conducts early detection surveys in high-risk areas by setting and monitoring traps for evidence of fruit flies, as described in Chapter 2, Alternatives. The Program uses Jackson, Multi-lure®, McPhail, and yellow sticky panel traps during detection and delimitation (Table 3-1). The Program uses naled or DDVP as the insecticides in Jackson traps. Lures used in these traps include cuelure, methyl-eugenol, trimedlure, nulure, a 2-component lure (ammonium acetate, putrescine), a 3-component lure (ammonium acetate, putrescine, and trimethylamine), and ammonium bicarbonate. The Program traps and trap lures do not affect the quality of agricultural crops because their use patterns do not result in measurable residues of lures or insecticides on crops in proximity to the traps. Please refer to alternative 4 for information pertaining to the use of the insecticides, naled and DDVP in traps and their potential impact on agricultural crops and the surrounding environment.

Table 3-1. Types of traps, carriers, attractants, and insecticides used in the fruit fly eradication program for early detection, delimitation, control, and eradication.

| Method | Early detection | Delimitation | Commodity treatments | Eradication |
|---|---|---|---|---|
| Type of Trap | | | | |
| Jackson | X | X | | X |
| McPhail | X | X | | |
| Yellow panel sticky | X | X | | X |
| Multi-lure® | X | X | | |
| Champ | X | X | | |

| Method | Early detection | Delimitation | Commodity treatments | Eradication |
|---|---|---|---|---|
| Bucket | X | X | | |
| Steiner | X | X | | |
| Type of Carrier | | | | |
| Min-U-Gel® | | | | X |
| SPLAT | | | | X |
| Para-pheromone and other attractants (food based) | | | | |
| Cuelure | X | X | | X (male annihilation) |
| Methyl-eugenol | X | X | | X (male annihilation) |
| Trimedlure | X | X | | |
| Nulure | X | X | | X (mass trapping) |
| 2-component lure (ammonium acetate, putrescine) | X | X | | |
| 3-component lure (ammonium acetate, putrescine, and trimethylamine) | X | X | | |
| Ammonium bicarbonate | X | X | | |
| Insecticide | | | | |
| Naled | X | X | | X (mass trapping; male annihilation technique) |
| STATIC Spinosad ME™ | | | | X (male annihilation technique) |
| DDVP | X | X | | X (mass trapping (strips); male annihilation technique) |

Under the Plant Protection Act of 2000, USDA-APHIS may prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of plants or plant products if it is necessary to prevent the introduction of exotic fruit flies into the United States. Each state and territory is responsible for prohibiting or restricting movement of plants, plant products, or associated articles within its borders. Exotic fruit fly quarantines restrict the spread of an invasive pest that could damage agricultural crops. Producers that want to ship regulated commodities outside of the quarantine area would need to comply with regulatory treatments and certify that their commodities are free of fruit flies. The public may be affected if producers change the crops they plant to avoid growing fruit fly hosts or choose not to plant a crop until removal of a quarantine.

Shipping delays, increased costs, lost markets, and spoiled harvests may occur under this alternative. Interstate movement of regulated articles is only authorized for commercial producers, and requires premises and commodity inspection, followed by the issuance of a certificate or limited permit. The certification is contingent upon (1) the commodity receiving an appropriate treatment to hosts in order to control fruit flies, and (2) the commercial producer or shipper complying with specific conditions designed to minimize the risk of moving fruit flies outside of the quarantine area.

During exotic fruit fly outbreaks, some suppression of pest and beneficial insect populations can occur from the application of regulatory treatments on commercial premises. However, these treatments are not required if a premise does not plan to move regulated commodities within or outside of the quarantine area. Outbreak areas may also have exotic fruit fly populations on non-agricultural sites; under alternative 3, these populations would not receive treatments. Therefore, exotic fruit fly populations might become established in some locations, forcing quarantines to remain in place permanently. In addition, quarantine boundaries could expand if exotic fruit fly populations expand into new areas. In this way, a quarantine by itself does not necessarily impact the quality of agricultural crops growing inside of the quarantine area. Instead, the application of commodity treatments in response to the quarantine restrictions causes impacts to the environment over time.

Potential Impacts to Air, Water, and Soil

Different Federal, State, and local air regulatory agencies have created laws, rules, and regulations for the control and reduction of air pollutants. Under the Clean Air Act (CAA), last amended in 1990, USEPA set National Ambient Air Quality Standards for pollutants considered harmful to public health and the environment (USEPA, 2012a). Non-attainment areas are areas that violate the air quality standards for the criteria pollutant(s), whereas attainment areas meet air quality standards. Non-attainment areas typically occur in large metropolitan areas with many mobile (e.g., vehicle) and stationary (e.g., power plants and factories) sources. Despite the downward trend in pollutant levels observed across the United States, numerous counties have reported nonattainment for one or more of the six criteria pollutants (USEPA, 2015d). In 2016 in California, ozone and particulate matter levels exceeded USEPA air standards in many counties, and ozone levels exceeded standards in several counties in Texas. There were no instances of criteria pollutants going beyond USEPA standards in Florida (USEPA, 2017a).

Although some volatilization of insecticides and lures may occur from some types of traps (particularly with naled), any impacts to air quality outside the trap are negligible because of the small quantities involved. Pest survey activities will release vehicle emissions. Due to the transient nature of the Program throughout the United States, USDA-APHIS cannot predict which or how many vehicles it will use in a given year, nor can it estimate fuel efficiency of vehicles due to variations in the age of each vehicle, in addition to the frequency, speed, and temperatures in which each vehicle is driven.

Average fuel consumption of light duty vehicles is 21.6 miles per gallon (FHWA, 2015). Fuel combustion by motor vehicles results in emissions of primary pollutants, including volatile organic compounds (VOC), nitrogen oxides (NOx), particulate matter (PM) and carbon monoxide (CO) into the atmosphere (FHWA, 2016). The emissions from vehicles performing Program activities under this alternative is expected to be minimal compared to the background emissions from daily drivers and other primary pollutant sources.

Survey, quarantine, inspection, and certification activities will have negligible effects on water resources. Traps and trap lures remain in place unless there is an extreme weather event or vandalism. They are placed above land and not above water resources. For these reasons, traps and lures are highly unlikely to be transported or fall into water resources. Vehicle use during survey activities is unlikely to contribute a significant amount of emission particulates into water resources because of the distances between the areas where vehicles are used and water resources. Particulates released from vehicles are expected to settle out of the air far away from water resources.

Vehicular and foot traffic have the potential to impact soil, depending on the frequency of monitoring and replacement of traps and soil properties (including the potential for compaction and erosion). Quarantine, inspection, and certification will have a negligible effect on soil that is indistinguishable from the background impacts associated with normal human activities.

Potential Impacts to Human Health

Pest survey and monitoring is a routine practice in agriculture and the placement of Program traps will have a negligible effect on agricultural communities because of their small size and low density in the environment. The Program oversees early-detection trap placement in high-risk areas (USDA-APHIS, 2015e), which may occur on public or government property or on private property with permission or notification. Early detection of fruit flies enables commercial producers to implement control measures while fly populations are still low. The traps used for early detection and delimitation would have no impact on human health while trap lures would have negligible effects. The use of naled, spinosad, and DDVP in traps and their potential impact on human health is discussed further in alternative 4.

USDA-APHIS uses a variety of attractants for its Program (Table 3-1). The attractant used is dependent on the target species and may consist of either a pheromone or a food attractant. In addition, the Program may use borax or propylene glycol as a preservative. Propylene glycol is used in the Multilure® traps while USDA-APHIS uses borax as a preservative in torula yeast pellets, or with Nu-lure. The risk to human health and the environment from the use of attractants and preservatives is very low (USDA-APHIS, 2017e). The low risk arises from the lack of significant human exposure and release of the chemicals into the environment. Attractants are applied in small quantities to plugs, wicks, or other material contained within a trap where exposure would be low to the public as well non-target organisms. Many of the attractants have low mammalian toxicity as well as low toxicity to other non-target organisms (USDA-APHIS, 2017e). Available toxicity data for the attractants and preservatives is available in the summary document titled "Risk evaluation summaries for attractants used in the Fruit Fly Eradication Program" located at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018 (USDA-APHIS, 2017e).

Quarantine and commodity treatment does not have a direct human health impact but may cause financial impacts associated with pre-harvest and commodity treatments (see socioeconomic factors in the Other Considerations section for discussion of potential indirect impacts such as economic loss and mental health). The processes involved with inspection and certification are administrative and not associated with human health effects.

Potential Impacts to Biological Resources

The activities associated with quarantine, inspection, and certification will not impact non-target species, whereas detection and delimitation traps have the potential to impact non-target species as they release small amounts of chemicals into the environment. Trapping networks used for the detection of fruit flies occur in high-risk areas such as ports of entry, land borders, fruit markets, and roadsides. Delimitation surveys may occur in national and state parks, conservation lands, wildlife preserves, and other protected natural areas that support a different array of wild animals and plant species than those found in urban and agricultural environments. For example, in Texas, Mexfly program activities often occur near the Las Palomas National Wildlife Management Area, Falcon State Park, Bentsen-Rio Grande Valley State Park, Resaca De La Palma State Park and World Birding Center, and the Laguna Atascosa, Santa Ana, and Lower Rio Grande Valley National Wildlife Refuges.

Traps using liquid food attractants, such as the McPhail trap, have the potential to catch non-target insects (FAO, 2016). In addition, traps may attract saprophagous (feeding on decaying animal matter) species due to the accumulation of dead flies (Leblanc et al., 2009). Placing traps in disturbed habitats, such as urban and agricultural areas, and away from native forests and other non-agricultural areas minimizes the potential for catching non-target insects (Leblanc et al., 2009). The use of naled, spinosad, and DDVP in traps and their potential impact on non-target species is discussed in alternative 4.

Detection and delimitation trapping may minimally impact vegetation from the inadvertent breakage of stems and branches as individuals place and service traps. These activities may minimally disturb the soil with footsteps; heavy machinery is not used. These activities occur infrequently (generally once per week), and each occurs for a short duration (averaging less than 30 minutes per site). Trap placement for detection usually occurs on previously disturbed properties, including agricultural properties, government and public lands, and residential properties with permission. Placement on these types of properties further minimizes the potential for environmental impacts to undisturbed lands.

Biological resources may include animals residing or transiting through an area where surveys occur. Program personnel placing and servicing traps may encounter these animals. Program personnel only enter residential areas with permission. Personnel commonly encounter dogs, cats, tropical pet birds, and occasionally, livestock and poultry. Goldfish or koi ponds and stock ponds occur in some locales. Program activities are short in duration as Program personnel place and service traps. Traps are placed out of the reach of most animals, and their design features make them unappealing as bird roosts. Personnel remove any trash associated with the survey activities. Program personnel take reasonable safety precautions when working around domestic animals to protect both themselves and the animals.

### 2. Potential Impacts from Treatments to a Premise

The Program-approved pesticide treatments enable commercial producers to move regulated commodities outside the quarantine area. Under this alternative, the insecticides for use on regulated commodities grown on commercial premises include lambda-cyhalothrin, diazinon, spinosad bait spray, and malathion bait spray. This section examines each chemical for its potential to impact the physical environment, human health, and biological resources. Premise treatments do not harm the health of host plants or affect the quality of the commodity.

The premise treatment consisting of fruit removal from nursery stock prior to shipping may affect the desirability of the commodity because some purchasers may want to see the fruit and/or ensure the plant is of an age to bear fruit. Removal of unripe fruit does not harm plants. By removing fruit, larvae cannot mature and there is no release of the next generation of the exotic fruit flies into the environment. Label restrictions often require removal of fruit prior to treatment of the remaining plant material with a chemical.

**(a) Lambda-cyhalothrin**

Lambda-cyhalothrin is a broad-spectrum, pyrethroid insecticide registered for use in a variety of agricultural crops as well as non-agricultural areas. It targets a susceptible insect's nervous system by disrupting sodium channels in nerve cells leading to the stoppage of feeding, loss of muscular control, paralysis, and death. The Program proposes to use the Warrior II with Zeon Technology® formulation (EPA Reg. No. 100-1295), which is a restricted use pesticide and only certified applicators may handle the product. The insecticide kills fruit fly life stages that are in the soil.

To move a nursery commodity outside of a quarantine area, certified applicators would apply lambda-cyhalothrin as a soil drench to containerized host plants and to soil within the drip line of fruit-bearing host plants on the commercial premise. Premise owners would only need to treat the areas of their property from which they intend to ship commodities.

The following information summarizes the HHERA for lambda-cyhalothrin use in the exotic fruit fly program, which is located at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, URL last accessed April 9, 2018 (USDA-APHIS, 2017c).

Potential Impacts to Air, Water, and Soil

Applicators make soil drench treatments using ground-based equipment. Soil drench applications may temporarily release aerosol droplets of lambda-cyhalothrin in the immediate treatment area, but these droplets would settle on the soil surface or plant parts growing near the soil surface. Impacts to air quality are unlikely as lambda-cyhalothrin is considered nonvolatile based on its low Henry's Law constant and vapor pressure (He et al., 2008). Volatilization of lambda-cyhalothrin from soil occurs slowly. The amount of lambda-cyhalothrin settling on foliage will be minor as application occurs via a soil drench.

Impacts to water quality are unlikely from treatments using lambda-cyhalothrin based on the proposed use pattern under this alternative and label restrictions designed to protect water quality. The application through soil drench reduces the chance of any significant drift from these applications, and the environmental fate and label restrictions will reduce the likelihood of runoff. Lambda-cyhalothrin has low water solubility and a high binding affinity for soil and sediment (not mobile in soil), and these properties reduce runoff (Laabs et al., 2000). Material that is not bound to soil or organic matter will preferentially bind to sediment once it enters water, reducing the bioavailability and risk to most non-target aquatic species. Current label requirements regarding application buffers near water bodies, and the presence of a vegetative filter strip, will further reduce the potential for significant aquatic residues. Application buffers are setback distances from a body of water where no applications will be made. Vegetative filter strips are areas of natural or planted vegetation that are designed to protect water quality. These mitigation measures have been shown to be beneficial for reducing runoff of pesticides, including lambda-cyhalothrin (Moore et al., 2001; He et al., 2008).

Soil drench applications will affect soil in the immediate treatment area. Lambda-cyhalothrin has a high binding affinity for soil and is not mobile (Laabs et al., 2000), indicating it will remain in the treated area and not move offsite. Lambda-cyhalothrin is moderately persistent in soil. A representative soil half-life for lambda-cyhalothrin is 30 days with values ranging from 28-84 days (NPIC, 2001). A 28-day leaching study showed that a majority of the lambda-cyhalothrin residues were recovered within the top 15 cm of the soil where the top 10-cm soil layer contained 50 percent clay and 26.3 grams/kilogram (g/kg) organic carbon (Laabs et al., 2000).

Lambda-cyhalothrin degrades in the environment through a combination of biotic and abiotic mechanisms (photolysis, hydrolysis, and microbial biodegradation) (USEPA, 2007; He et al., 2008).

Potential Impacts to Human Health

Based on acute oral, dermal, and inhalation toxicity, USEPA/OPP classifies lambda-cyhalothrin as moderately toxic (Category II). The eye irritation data shows that it is a moderate eye irritant (Category II). Technical grade lambda-cyhalothrin is not a skin irritant (Category IV) or a skin sensitizer; however, the Warrior® II formulation is moderately skin irritating (Category III). Dermal exposure to lambda-cyhalothrin may cause numbness or tingling of the skin (commonly referred as paresthesia).

Symptoms of human exposure to lambda-cyhalothrin reported in USEPA's incident data system (2007–April 2010) include headache, dizziness, confusion, numbness, muscle weakness, muscle spasms, vomiting, diarrhea, abdominal pain, difficulty breathing, and burning sensations of the skin, throat, and eyes (USEPA, 2010a). USEPA's recent review on human incidents and epidemiology (2017) identified numerous lambda-cyhalothrin incidents reported to the Incident Data System (2011–2016) and Sentinel Event Notification System for Occupational Risk-Pesticides (SENSOR)-Pesticides (1998–2013). Less than 1 percent of the cases were classified as having major severity, and there were no deaths reported. The majority of the incidents (96 percent in the Incident Data System and 89 percent in SENSOR-Pesticides) were of minor severity. This means that the symptoms are minimally traumatic, resolved rapidly, and usually involve skin, eye, or respiratory irritation (USEPA, 2017b).

The result of a 3-generation reproduction study in rats that examined lambda-cyhalothrin toxicity showed a decrease in adult and fetal body weight at 5 milligrams/kilogram (mg/kg) bodyweight/day (bw/day) (USEPA, 2002a). There were no effects in reproductive parameters (i.e., gross signs of toxicity, the length of the estrous cycle, assays on sperm and other reproductive tissue, and the number, viability, and growth of offspring). Developmental studies evaluate the potential to cause birth defects (teratogenic effects) and other effects during development or immediately after birth. The results of the developmental studies for lambda-cyhalothrin in both rats and rabbits did not show developmental toxicity (USEPA, 2002a). At doses of 10 mg/kg bw/day, there were no signs of toxicity.

USEPA classifies lambda-cyhalothrin as "not likely to be carcinogenic to humans" based on the lack of evidence of carcinogenicity in mice and rats (USEPA, 2002a, 2007). Among eight mutagenicity studies (four studies for technical lambda-cyhalothrin and four studies for technical cyhalothrin) reviewed by USEPA (2002a), five of the studies did not indicate mutagenic activity, and three other studies for cyhalothrin were inconclusive because of issues associated with the experimental designs of the studies.

USEPA (2002a) concludes that "There is no evidence that lambda-cyhalothrin induces any endocrine disruption." Three studies indicate lambda-cyhalothrin may affect endocrine function. A 21-day gavage study in rats showed significant suppression of serum thyroid hormones and their ratios and significant increases in serum thyroid stimulating hormone levels (Akhtar et al., 1996). In an *in vivo* study, pregnant rats exposed to ICON® (a formulation of lambda-cyhalothrin used in Sri Lanka) resulted in increased pre-implantation losses at the two highest test concentrations, which was blocked by co-administration of progesterone (Ratnasooriya et al., 2003). A study in a breast carcinoma cell line (Zhao et al., 2008) indicated that lambda-cyhalothrin may have estrogenic activity.

Lambda-cyhalothrin is a restricted use insecticide due to its toxicity to fish and aquatic organisms. Only certified applicators, or people working under their supervision, may use the product. As such, certified applicators are the most likely human population segment subject to exposure. The potential exposure pathway for applicators is through direct contact (i.e., incidental ingestion, inhalation, and dermal contact) during application. However, the use of PPE minimizes direct contact exposure. The label requires the applicator to wear a long-sleeved shirt and long pants, chemical-resistant gloves, shoes plus socks, and protective eyewear. Accidental exposure may occur from a splash or transfer from contaminated gloves or clothing to an unprotected skin area (such as the face). The occurrence for accidental exposure is unlikely with well-trained certified applicators.

The public is not recognized as a potentially exposed segment of the human population because, under this alternative, applications occur on commercial premises by certified applicators. The likelihood of drift into residential areas from the soil drench application is minimal because large coarse droplets are applied in close proximity to the targeted soil area. Exposure through the consumption of fruit or drinking water is unlikely based on the Program removal and destruction of fruit from treated plants. Label restrictions and the environmental fate properties of the chemical minimize the potential for exposure through drinking water resources.

Potential Impacts to Biological Resources

*Terrestrial species*

Available oral and dietary dosing studies suggest lambda-cyhalothrin is practically non-toxic to birds (USEPA, 2015h). USEPA/OPP assumes that avian toxicity is similar to reptile toxicity in their risk assessment process, even though reptile toxicity data for lambda-cyhalothrin is not available in the scientific literature.

Under this alternative, soil drench applications of lambda-cyhalothrin will be within the dripline of commercial host plants. Based on this proposed use pattern for lambda-cyhalothrin, soil invertebrates would be the most likely non-target terrestrial invertebrates at risk of exposure.

Other non-target terrestrial species, including wild mammals, birds, and reptiles have a low probability of exposure. There is the potential for terrestrial vertebrates to forage for soil-inhabiting invertebrates leading to consumption of treated soil and soil invertebrates containing lambda-cyhalothrin residues. However, based on the typical food consumption rates for various sized mammals, birds, and reptiles, combined with the toxicity profile for lambda-cyhalothrin, there is not a plausible exposure scenario where terrestrial vertebrates would consume enough lambda-cyhalothrin residues from soil or soil-inhabiting invertebrates to result in adverse effects (USDA-APHIS, 2017c).

Studies indicate lambda-cyhalothrin is highly toxic to pollinators, and in particular, honeybees (USDA-APHIS, 2017c). However, the application of lambda-cyhalothrin is directly to soil and not to flowering parts of host plants, making exposure negligible to pollinators. Lambda-cyhalothrin is not systemic in terrestrial plants. Soil applications would not result in detectable levels of lambda-cyhalothrin in pollen and nectar (USDA-APHIS, 2017c). Program personnel are unlikely to disturb ground nesting or solitary miner bees when applying a soil drench because they can see the entrances and active bees in an area.

Terrestrial phytotoxicity data does not appear to be available for lambda-cyhalothrin. The mode of action for lambda-cyhalothrin suggests that phytotoxicity would be low. Lambda-cyhalothrin has a variety of agriculture and non-agricultural uses and there is no information from those uses that would demonstrate impacts to target crops.

*Aquatic species*

Toxicity studies indicate lambda-cyhalothrin is very highly toxic to aquatic vertebrates and invertebrates. Representative toxicity data for warm water and cold-water fish species show typical median lethality values ranging from the low part per billion to less than a part per billion (USDA-FS, 2010; Kumar et al., 2011; USEPA, 2015h). Aquatic invertebrates show greater comparative sensitivity with median lethality values in the low part per trillion range for most test species. Chronic toxicity to fish was also reported to be high in an early life stage study using the sheepshead minnow (*Cyprinodon variegatus variegatus*), and in a fish full life cycle study using the fathead minnow (USDA-FS, 2010). During a 21-day reproductive study, chronic toxicity was also high with a reported No Observed Effect Concentration (NOEC) of 0.002 µg/L for the freshwater cladoceran, *Daphnia magna* (Maund et al., 1998).

Lambda-cyhalothrin strongly adsorbs to soil and becomes unavailable for uptake by the roots of vascular plants (ATSDR, 2003b). However, the roots of aquatic macrophytes can take up lambda-cyhalothrin in water and translocate the chemical throughout their plant biomass. The uptake rates of various macrophytes are species specific.

The Program's use pattern and label restrictions reduce the likelihood of lambda-cyhalothrin entering waterbodies. The low probability of exposure of aquatic vertebrates, invertebrates, and plants to lambda-cyhalothrin results in low risk to aquatic species.

### (b) Diazinon

Diazinon is an organophosphate insecticide that causes acetylcholinesterase inhibition (Klaassen et al., 1986; Smith, 1987; USEPA, 2016b). Diazinon is a restricted-use insecticide and only certified applicators may use the product (CA special local needs label). Under this alternative, premise owners would apply diazinon as a soil drench to containerized nursery stock. The following information summarizes the HHERA for diazinon use in the fruit fly program found on the Program's website (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, last accessed April 9, 2018) and is incorporated by reference ((USDA-APHIS, 2018c)).

Potential Impacts to Air, Water, and Soil

Diazinon application will be through a soil drench that uses a large droplet size to minimize drift. During application, spray droplets may be in the air near the ground for a short period but will rapidly settle onto the soil surface of containerized nursery stock and nearby exposed lower branches or foliage of the plant.

Diazinon may be transported in air either as a vapor or in a particulate form. Diazinon in the air degrades by reaction with hydroxyl radicals (a half-life of 4 hours) or by photolysis (a half-life of greater than 1 day) (Muñoz et al., 2011). The air degradation half-lives estimated for the average 12-hour day time concentration of hydroxyl radicals in the troposphere were 1.3 hours at 40 ºC for diazinon and 4.1 hours at 30 ºC for its degradate diazoxon, demonstrating short half-lives for the parent and metabolite (USEPA, 2016c).

Diazinon volatilizes slightly from soil (Burkhard and Guth, 1981). A laboratory study using the AG500 liquid formulation reported 74 percent of diazinon volatilized from a wet soil and only 2.6 percent from a dry soil (USEPA, 2016c). Air volatility of diazinon applied to soil in an orchard was negligible after the fourth day (Glotfelty et al., 1990). Consequently, a small amount of diazinon is likely to be detected in the air following a treatment to dry soil.

Diazinon has been detected in waterways in the United States, including California (USGS, 2014). Aquatic life benchmarks are those chemical concentration values measured in water or other biota above which impacts would be expected to occur. Benchmarks include standards and guidelines, with standards being values that are legally enforceable compared to guidelines which are threshold values that have no regulatory authority. The USGS conducted a comparison study from two decades (1992–2001 and 2002–2011) of monitoring for pesticides in U.S. streams and rivers. The study showed that in the second decade of the study, diazinon was among the pesticides detected less frequently in streams, and there was a lower percent of streams exceeding chronic aquatic life benchmarks (Stone et al., 2014). There is also a downward trend of diazinon concentrations and exceedance frequencies in California's surface waters, with the detected diazinon concentrations posing a *de minimis* risk to aquatic organisms in 2012 to 2014 (Wang et al., 2017). These trends are attributed to changes in the use and regulations for diazinon.

Surface and groundwater contamination with diazinon is not expected based on current label requirements and the Program's use pattern. The label does not allow application to surface water or to intertidal areas (Diazinon AG500 label). Under this alternative, the application of diazinon is through a soil drench applied to containerized nursery stock. Most of the formulation will stay in the container. Diazinon could contact the ground during application if the application is not precise or if some of the formulation flows out the bottom of the container. Diazinon could also leach from the container if, after treatment, the containers receive a large amount of water (e.g., a rainstorm occurs after treatment).

Diazinon is moderately to slightly mobile in soils, and binds to organic matter in soil (Arienzo et al., 1994). There is potential for diazinon to reach groundwater in high-permeability soils with low organic-carbon content and/or the presence of shallow groundwater (USEPA, 2016c). However, organic matter in nursery stock media would reduce or prevent insecticide from leaching out of the container. Diazinon escaping from the container as runoff would leach slowly into the soil profile and is unlikely to reach groundwater (Sumner et al., 1987). When applied as a soil drench, diazinon tends to remain in the upper 10 cm of the soil, with the majority of the chemical found in the upper 1 cm (USDA APHIS, 2011). In turf grass, 96 percent of diazinon remained in the top 10 mm. An increase in irrigation caused diazinon to break down more quickly, but did not increase the rate of leaching of the pesticide into the soil (Branham and Wehner, 1985).

Diazinon degrades by hydrolysis, and the rate is pH dependent. Under acidic conditions, hydrolysis occurs rapidly with a half-life of 12 days (USEPA, 2004). Under neutral and alkaline conditions, the hydrolysis half-life is 138 days at pH 7 and 77 days at pH 9 (USEPA, 2004). Diazinon also degrades by microbial activity with aerobic aquatic metabolism half-life values ranging from 10 to 16 days in water-soil, 6 to 41 days in surface water, and an anaerobic aquatic metabolism half-life of 24.5 days (USEPA, 2008a). The oxidation break down product, diazoxon, hydrolyzes faster than diazinon with a half-life of 25 days at pH 7.4 (30 ºC).

Only certified applicators will handle and apply diazinon as part of the Program. All mixing of the insecticide and loading of equipment will not occur next to a waterbody. Following these methods reduces the potential impacts to aquatic resources.

Diazinon is not persistent in soil based on a reported half-life as less than 60 days (with aerobic microbial metabolism ranging from 9 to 57 days, an anaerobic half-life of 17 days, and photolysis half-lives of 2.8 to 8.8 days) (USEPA, 2008a, 2016c). The persistence of diazinon in soil increases with lower soil moisture content, increasing pH, decreasing temperature, and increasing organic matter content (Burkhard and Guth, 1979).

There is potential for diazinon to reach surface water through runoff and soil erosion after treatment to containerized nursery stock because diazinon is only moderately to slightly mobile in soil, especially those low in organic matter (USEPA, 2016c). The current Diazinon AG 500 label (Makhteshim Agan of North America Incorporated, 2017) specifies not to apply within 100 feet upslope of "sensitive aquatic sites" such as any irrigation ditch, drainage canal, or body of water that may drain into a river or tributary unless a suitable method is used to contain or divert runoff. Leaching studies observed oxypyrimidine and diazinon residues in the leachate at 30 cm in soil suggesting mobility (USEPA, 2008a). Nursery operations are highly unlikely to drain directly into sensitive aquatic sites unless they are closely sited to each other.

Potential Impacts to Human Health

Diazinon can inhibit the enzyme acetylchlolinesterase (AChE) and affect the human nervous system (USEPA, 2016b). Symptoms of short exposures to high levels of diazinon include headache, dizziness, weakness, feelings of anxiety, constriction of the pupils of the eye, and inability to see clearly. Exposures to very high levels can cause more severe symptoms including: nausea, vomiting, abdominal cramps, diarrhea, slow pulse, pinpoint pupils, difficulty breathing, passing out (coma) (ATSDR, 2008), and death (USEPA, 2016e). The acute oral, dermal, and inhalation toxicities of diazinon are low to very low (Category III or IV) in testing animals (rats and rabbits) (USEPA, 2016b). The Diazinon AG500® formulation has moderate acute oral toxicity (Category II) (Makhteshim Agan of North America Incorporated, 2014). Diazinon is a mild eye and dermal irritant in rabbits, but is not a dermal sensitizer in guinea pigs (USEPA, 2016b).

Subchronic oral, dermal and inhalation studies using the rat, dog and rabbit show decreased red blood cell AChE at diazinon doses below those eliciting clinical signs of neurotoxicity (USEPA, 2016b).

Chronic testing indicates plasma cholinesterase inhibition in rats. In addition, chronic testing revealed decreased brain and red blood cell AChE, decreased body weight gain, decreased food consumption, and increased serum amylase activity in dogs at higher doses (USEPA, 2016b).

Neurotoxicity of AChE is the most sensitive endpoint for diazinon and its degradate diazoxon (USEPA, 2016b). An acute neurotoxicity study in rats reported decreased red blood cell AChE, abnormal gait, decreased body temperature, decreased rearing (standing up on its hind legs) count, repetitive movements, and decreased fecal consistency. A subchronic neurotoxicity study in rats reported reduced red blood cell AChE and reduced brain AChE activity along with decreased body weight gain, deceased food consumption, involuntary muscle twitches, hyper-responsiveness and tremors, and decrease in grip strength at 180 mg/kg/day ((USEPA, 2016b)).

A multi-generational reproduction study in rats reported decreased male and female mating and fertility indices and increased gestation length (USEPA, 2016b). The study observed decreased body weight gains in both parents and offspring, as well as pup mortality at lower doses. Prenatal developmental toxicity studies in rats reported reduced body weight gains, and in rabbits, there were deaths with tremors and convulsions, reduced body weight gains, and gastrointestinal hemorrhages and erosions (USEPA, 2016b). Adverse effects were not observed in fetuses in rats and rabbits (USEPA, 2016b). These studies did not indicate increased susceptibility of AChE inhibition in fetuses (USEPA, 2016b).

Diazinon is probably carcinogenic to humans based on limited evidence in experimental animals and humans with a positive association observed for non-Hodgkin’s lymphoma, leukemia, and cancer of the lung (IARC, 2016a). However, USEPA classified diazinon as “not likely to be carcinogenic in humans” because of the lack of evidence of carcinogenicity and mutagenicity in rats and mice (USEPA, 2016b). USEPA’s review on the association of diazinon exposure with lung cancer and non-Hodgkin’s lymphoma identified in the Agricultural Health Study (Alavanja et al., 2014; Jones et al., 2015) concluded that there is insufficient evidence for a causal or clear associative relationship (USEPA, 2016c). USEPA’s review on another study reported a significant, positive association of diazinon exposure with soft tissue sarcoma (Pahwa et al., 2011), concluding the positive association has not yet been replicated in other populations (USEPA, 2016e).

Diazinon does not interact with the estrogen, thyroid, or androgen hormone pathways based on USEPA’s endocrine disruptor screening program Tier 1 screening determinations (USEPA, 2015e). Diazinon may cause immune effects based on immunosuppression effects or immunotoxicity effects (Neishabouri et al., 2004), administered orally (Alluwaimi and Hussein, 2007) or via food consumption (Handy et al., 2002). The USEPA acceptable guideline immunotoxicity study in mice did not observe immunotoxicity or reduced body weights at 75 mg/kg/day, and no observed adverse effects at 32 mg/kg/day (USEPA, 2016b).

The risk to the general public from diazinon exposure associated with soil drench applications is expected to be negligible to minimal because (1) the program uses diazinon only for control of fruit fly pests in the family *Tephritidae,* subject to state quarantine action occurring in commercial nurseries (all containerized nursery stock), (2) compliance with label requirements includes a restricted entry interval, (3) there is elimination of potential dietary exposure to diazinon by the label requirement for the removal and destruction of all fruit from fruit-bearing host plants prior to the soil drench applications, and (4) there is rapid degradation of diazinon in the environment (USDA-APHIS, 2018c).

As a restricted-use insecticide, California's program use occurs under a special local needs label for Diazinon AG500 (EPA Reg. No. 66222-9), which allows application to containerized nursery stock at commercial premises and not residential areas. Certified applicators or persons under their direct supervision (workers) are highly likely to be the only sector of the human population exposed to diazinon because of its low volatility and directed application. USDA-APHIS quantified the potential risks associated with accidental exposure of diazinon for workers during mixing, loading, and application based on the proposed program use. The quantitative risk evaluation results indicate there are no concerns for adverse health risk for program workers during program uses. The special needs label requires workers to wear long-sleeved shirts, long pants, shoes plus socks, chemical-resistant gloves, and a chemical resistant apron while mixing or loading the chemical (Makhteshim Agan of North America Incorporated, 2017). The safety datasheet (Makhteshim Agan of North America Incorporated, 2014) also recommends splash goggles or a face shield for eye and face protection, as well as suitable respiratory equipment in case of inadequate ventilation. These types of engineering controls are designed to prevent inhalation of mist or vapors. Dermal and eye exposure through spilling or splash could occur during mixing, loading, and application. PPE will guard against spills or splash reaching the skin of workers. If diazinon gets on their skin, workers would wash with soap and water (Makhteshim Agan of North America Incorporated, 2017).

Potential Impacts to Biological Resources

Diazinon is a broad-spectrum organophosphate insecticide whose mode of toxic action is primarily through AChE inhibition. AChE inhibition can cause muscle tremors, convulsions, behavioral changes, and a variety of other symptoms. Death usually occurs due to respiratory failure, but death of wild animals may also be the result of behavioral changes (i.e., loss of ability to evade predators) (USDA-APHIS, 2018c). For those terrestrial species that feed in, traverse across, or inhabit areas treated with diazinon, the primary route of exposure is ingestion. This usually occurs through consumption of insects killed or being incapacitated by the chemical.

*Terrestrial Species*

Diazinon is very highly toxic to mammals, birds, reptiles, and terrestrial amphibians from an acute oral exposure (USEPA, 2008a; USDA-APHIS, 2018c). Acute oral toxicity studies and subacute dietary studies in birds found that diazinon is highly to very highly toxic (USEPA, 2004). Field studies show all birds are sensitive to diazinon including songbirds and other birds commonly found in backyard settings (Smith, 1987). Reptile toxicity data does not appear to be available for diazinon; however, the USEPA uses effects data for birds to represent sensitivity to reptiles. Based on the high toxicity of diazinon to birds, diazinon is expected to have high toxicity to reptiles.

The potential for terrestrial vertebrate exposure to diazinon used in soil drench treatments will be reduced by the proposed use pattern under the special needs local permit in California. Currently, this registration is only for use on containerized nursery stock. These commodities do not typically serve as foraging areas for invertebrate prey by birds, mammals, or reptiles.

Diazinon is toxic to most terrestrial invertebrates in, on, or transiting through the containerized nursery. Diazinon is highly toxic to bees (USEPA, 2004). The use as a soil drench, and not an application to flowers or foliage, minimizes exposure to pollinators. Diazinon is taken up from the soil into roots and subsequently translocated to leaves, but due to its rapid degradation, bioaccumulation is not generally a concern in plants (USDA-APHIS, 2018c). Diazinon degrades rapidly on plants with a typical half-life of fewer than 14 days (USDA-APHIS, 2018c). Both dermal exposure and ingestion of contaminated soil or prey contribute substantially to the diazinon dose an insect receives. Impacts to terrestrial invertebrates will be localized to those species that are in the soil where soil drench applications will occur.

*Aquatic Species*

Diazinon is moderately to highly toxic to fish and very highly toxic to aquatic invertebrates (USEPA, 2004; USDA-APHIS, 2018c). Aquatic invertebrate populations were shown to remain constant following environmental exposure, but the species diversity shifts in favor of those invertebrates more tolerant of diazinon (USDA-APHIS, 2001a).

The risk of diazinon treatments reaching aquatic resources will be minimized based on the proposed use pattern in the Program (USDA-APHIS, 2018c). Drift will not be a significant exposure pathway because applications to soil are typically directed and use a large droplet size. Significant runoff from containerized nursery stock would only occur if there was excessive watering directly after treatment resulting in diazinon transport from the container onto the surrounding soil and drainage away from the nursery. This pathway is not likely because it deviates from the label directions for treatment.

Historically, diazinon soil drench treatments were infrequently used in the Program. Data from fruit fly outbreaks over the past 20 years show soil drench treatments were used less than 5 percent of the time. The historically low frequency of use combined with the proposed use pattern for containerized nursery plants results in an overall low probability of exposure to aquatic resources during an eradication program.

**(c) Spinosad bait spray (GF 120 Naturalyte Bait)**

To enable commodity movement (premise treatment) outside of the quarantine area, commercial host-plant premises may apply spinosad bait spray using aerial or ground equipment. Aerial applications would occur using helicopters or fixed-wing aircraft, whereas ground applications use backpack sprayers or vehicle-mounted sprayers. The information in this section is a summary of the HHERA for spinosad usage in the Program, which is located on the Program's website (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, last accessed April 9, 2018) and incorporated by reference (USDA-APHIS, 2014).

Spinosad is an insecticide that is a mixture of macrocyclic lactones produced biologically from the fermentation culture of *Saccharopolyspora spinosa,* a bacterial organism isolated from soil (Kollman, 2002). The active ingredients in spinosad bait spray are spinosyn factor A and spinosyn factor D (The Dow Chemical Company, 2014). The insecticidal action of spinosad occurs through dermal exposure or ingestion by fruit flies (USDA-APHIS, 2003b). Spinosad is registered for use on various crops, including organic agriculture, and has permanent tolerances for most fruits (including citrus), nuts, vegetables, cotton, and meat (USDA-APHIS, 2003b). Spinosad products for use in spot treatments to artificial targets and non-crop tree trunks are part of alternative 4 but are not part of premise treatments in this alternative.

Potential Impacts to Air, Water, and Soil

Spinosad persists for a few hours in air. Spinosad is not volatile based on its low vapor pressure and Henry's Law Constant values (USEPA, 1997b; California Department of Pesticide Regulation, 2002; Cleveland et al., 2002; USDA-APHIS, 2014). Ground-based applications (targeting plant foliage) are unlikely to affect air quality outside of the target area. Drift from aerial applications may deposit on plants, topsoil, open water, or other surfaces (USDA-APHIS, 2014). Photodegradation of spinosad residues occurs in the air and spinosad does not persist in the atmosphere (Adak and Mukherjee, 2016). This means that adverse effects to ambient air quality are not expected for Program applications (USDA-APHIS, 2003b).

USDA-APHIS may use aircraft to apply spinosad to quarantine areas. Aircraft produce the same types of emissions as a vehicle, and approximately 70 percent are $CO_2$, CO, $NO_x$, and sulfur oxides ($SO_x$) (FAA, 2005). Historically, the contribution of pollutants to the atmosphere from aerial application of spinosad is very low. Between 2006 and 2016, the Program used aircraft only once to apply spinosad during an outbreak of *B. dorsalis* in Florida (USDA-APHIS, 2017a).

There is a potential for runoff and drift from spinosad treatments to reach water resources, but spinosad is not applied directly to water bodies (USDA-APHIS, 2003b). The active ingredient spinosyn A readily binds to organic matter in soil and water, which precludes leaching into groundwater or chemical suspension in water (Borth et al., 1996; USDA-APHIS, 2003b). Spinosad breaks down rapidly in water in the presence of light with a reported photolytic half-life of less than 1 day (Cleveland et al., 2002). Adverse effects to water quality would not be expected from these applications (USDA-APHIS, 2003b).

Spinosad exposed to sunlight on the surface of soil readily degrades with a soil photolysis half-life of 13.6 days (Indianapolis, IN) and 73.7 days (Greenfield, IN) for spinosyn A and 41.3 days (Greenfield, IN) for spinosyn D (USEPA, 2016h). Spinosad also rapidly degrades in soil under aerobic conditions, suggesting susceptibility to microbial degradation (Hale and Portwood, 1996) with half-lives of approximately 9 to 17 days (USEPA, 2016h). Spinosad is not considered mobile based on the available soil adsorption studies on a range of soil types (California Department of Pesticide Regulation, 2002) and will not leach into groundwater (USEPA, 1998). Spinosad A has a low to moderate water solubility. It has a low to slight mobility in sandy soils, and is immobile in silt loam and clay loam soils. The terrestrial field dissipation studies with Spinosad A on bare ground plots reported a half-life of <1 day with no leaching observed, and 3.1% of the application was recovered in runoff (USEPA, 2016h). Rapid breakdown and lack of movement in the environment ensures that permanent effects to soil are highly unlikely to result from applications during the Program.

Potential Impacts to Human Health

The acute toxicity of spinosad is low by all routes of exposure (oral, dermal, and inhalation). The USEPA classifies spinosad in Toxicity Category III for acute oral and dermal toxicity and Toxicity Category IV for acute inhalation toxicity. Spinosad is not an eye or skin irritant nor a skin sensitizer (USEPA, 2016i). Subchronic and chronic studies of spinosad also indicate it is a low hazard (USEPA, 2016i). The primary observed toxic effect from spinosad exposure was histopathological changes in numerous organs with vacuolization of cells and/or macrophages as the most common histopathological finding. The acute and subchronic neurotoxicity studies found no evidence of neurotoxicity or neurobehavioral effects. The immunotoxicity study observed systemic effects including decreased body weights, increased liver weights, and abnormal hematology results at the highest dose tested (141 mg/kg/day); however, there was no evidence of immunotoxicity.

Spinosad is classified as “not likely to be carcinogenic to humans” based on lack of evidence of carcinogenicity in rats and mice and mutagenic effects (USEPA, 2016i). The developmental studies in rats and rabbits did not observe maternal or developmental effects. Reproductive toxicity studies in rats have found effects at doses that exceed those that cause other toxic effects to the parent animal (USEPA, 2016i).

The exposure risk to the public will be low because, under this alternative, applications would occur only on commercial premises. Label restrictions allow applications only with ground equipment in the immediate proximity of structures where people may be present (Dow AgroSciences, 2006). Exposure of workers to spinosad could occur during mixing and loading of the product into ground and aerial equipment and during applications but label requirements for workers to wear protective clothing (including long sleeves, long pants, socks, and shoes) reduces their exposure. The use of PPE and the low acute, chronic, and subchronic toxicity of spinosad indicate a low risk of harm to workers’ health.

Potential Impacts to Biological Resources

*Terrestrial Species*

Acute, subacute, and chronic toxicity of spinosad to wild mammals is considered low based on the available mammalian toxicity data used to evaluate impacts to human health (USDA-APHIS, 2014; USEPA, 2016i). In one study on rats, there was a 95 percent elimination of spinosad residues within 24 hours (USEPA, 1998). This rapid excretion of spinosad in mammals accounts for its low acute toxicity (USDA-APHIS, 2003b). Bioconcentration potential is low (Dow AgroSciences, 1998). There is no evidence of carcinogenicity or mutagenic effects (USEPA, 2016i).

Spinosad is practically non-toxic to birds (Dow AgroSciences, 1998). Spinosad applications with aerial equipment could expose birds in the treatment area, and birds may rapidly return to treated areas; however, the low toxicity to birds indicates even a direct spray is unlikely to cause harm. Birds may ingest insects containing spinosad residues, but harm is unlikely because of the number of insects they would need to consume to receive a harmful dose. Applications with ground equipment are even less likely to expose adult birds because they move away from disturbances.

The toxicity of spinosad to terrestrial invertebrates depends on the species and life stage (USDA-APHIS, 2003b). Spinosad ranges from very highly toxic for the native budworm to slightly toxic for cotton leafworm (both are lepidopterans) (Sparks et al., 1995; Thompson et al., 1995). The Program's spinosad bait spray application rate would not result in mortality to tolerant caterpillars like the cotton leafworm (USDA-APHIS, 2003b). Argentine ants are tolerant of spinosad while other hymenopterans, such as the red headed pine sawfly are more sensitive (Thompson et al., 1995; Borth et al., 1996; Mayes et al., 2003).

Most of the crop plants attacked by exotic fruit flies are pollinated by insects such as honey bees (*Apis* spp.), bumble bees (*Bombus* spp.), solitary bees (Hymenoptera: Apidae), wasps (Hymenoptera: Vespidae, Sphecidae, Chrysididae, and Chalcid), and flies (Diptera). Dependence on honey bees for pollination rather than other insect pollinators varies significantly from crop to crop. Citrus, cucumbers, and watermelons are 90 percent dependent on honey bees for pollination, while crops such as pumpkins and squash are only 10 percent dependent on honey bee pollination (Calderone, 2012).

Honey bees appear to be one of the more sensitive terrestrial invertebrates to spinosad (Mayes et al., 2003). Contact toxicity from spinosad decreases rapidly after applications are allowed to dry (Edwards et al., 2003). Studies using honey bees and bumblebees exposed to spinosad residues on alfalfa, strawberries, almonds, citrus, and kiwifruit show a lack of impacts to pollinators from applications occurring while bees are inactive, and after residues are weathered (USDA-APHIS, 2014). The low application rate of spinosad in the bait formulation that is used for fruit fly control does not pose risks to foraging honey bees, honey bee brood development, and hive condition (Burns et al., 2001; Mangan and Moreno, 2009). Other beneficial arthropods observed to not be affected by spinosad in treated cotton fields include trichogrammatid wasps, assassin bugs, ladybird beetles, predatory mites, fire ants, big-headed bugs, damsel bugs, green lacewings, and spiders (Peterson et al., 1996).

While spinosad is toxic to invertebrates, GF-120 NF Naturalyte was specifically designed to reduce attractiveness to bees and is used in the Program. Studies designed to test foraging for GF-120 and its components by honey bees during a period of high nutrient stress indicated the odors of the fruit fly attractants in the bait are effective at repelling bees (Mangan and Moreno, 2009). Subsequently, USDA-APHIS determined GF-120 poses minimal risk to bees.

Based on field-collected data, there were no effects on abundance and diversity of Lepidoptera, Coleoptera, or Hymenoptera when sampled using malaise traps 2 and 6 days after spinosad treatment for emerald ash borer (USDA-APHIS, 2007a). Aerial broadcast applications were made to several plots ranging in size from 8 to 20 acres at a rate (0.23 lb a.i./ac) that is greater than two orders of magnitude above the use rate proposed in the Program (USDA-APHIS, 2014).

Reptile toxicity data does not appear to be available for spinosad. USEPA uses effects data for birds to represent sensitivity to reptiles. Based on the low toxicity of spinosad to birds, mammals, and aquatic vertebrates, toxicity to reptiles is expected to be low (USDA-APHIS, 2014).

Rapid photodegradation of spinosad is expected to result in little persistence of residues on leaf surfaces (USEPA, 1998). Spinosad degrades quickly on plant surfaces with reported half-lives ranging from 2.0 to 11.7 days (California Department of Pesticide Regulation, 2002; Sharma et al., 2008; USDA-APHIS, 2014). Terrestrial phytotoxicity has not been noted using spinosad at rates up to 0.18 lb a.i./ac, which is well above the rates proposed in the Program (USEPA, 1998; USDA-APHIS, 2014).

*Aquatic Species*

Spinosad is slightly to moderately toxic to fish (Borth et al., 1996). The toxicity of spinosad to aquatic forms of amphibians would be expected to be comparable to fish. Spinosad is slight to moderately toxic to most aquatic invertebrates and to algae (Borth et al., 1996; Dow AgroSciences, 1998; USDA-APHIS, 2003b). Impacts to aquatic species are not expected given the Program’s use pattern and label restrictions that reduce exposure of water bodies.

### (d) Malathion bait spray

Malathion is a non-systemic organophosphate insecticide used to control a variety of pests in agriculture and forestry, on residential properties, and in mosquito control. Malathion is metabolized to malaoxon, which combines with and inhibits AChE, leading to death of the target pest.

In the Program, commercial premises located within the quarantine area may apply malathion bait spray through ground or aerial applications to enable their commodities to move outside of the quarantine area. Treatments must start at least 30 days before harvest and then continue throughout the harvest period. The information in this section is a summary of the HHERA for malathion usage in the Program, which is located on the Program's website (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home, last accessed April 9, 2018) and incorporated by reference (USDA-APHIS, 2018d).

Potential Impacts to Air, Water, and Soil

Label requirements for malathion allow application to temporary standing bodies of water for mosquito control, but the Program does not apply malathion to surface waters. Malathion can enter surface waters during or shortly after premise treatments through drift and runoff, particularly if a rainfall occurs after application. Accidental spillage near or in surface waters is another potential avenue for contamination. Treatments with malathion are made with a fruit fly bait that enhances the efficacy of the treatments. Applications are made with a large droplet size (6-8 mm) significantly reducing the potential for drift

Malathion is water-soluble and has a potential for transport in surface water and groundwater (Mulla et al., 1981). In 2012, California reported several waterways with 303(d) violations for malathion (USEPA, 2015b) and concentrations exceeded aquatic benchmarks in some other locations in the United States. However, this is primarily due to urban uses and is not tied to malathion use in the Program (Gilliom et al., 2007) because the Program has not used malathion since 2002 (USDA-APHIS, 2017a). The downward trend in the frequency and magnitude of malathion detections in surface waters is attributable to changes in the use and regulation of malathion.

Degradation of malathion in water is mostly through hydrolysis (pH dependent) and microbial degradation. Hydrolysis occurs rapidly at alkaline pH (USEPA, 2009d), has a half-life of about 6 days at pH 7, and becomes more hydrolytically stable under acidic aqueous conditions (a half-life of 107 days at pH 5) (USEPA, 2009d). Higher temperatures increase the rate of hydrolysis (Freed et al., 1979), and malathion is not expected to adsorb to soil sediment in water. The half-life of malathion was calculated from program monitoring data for natural waters during the 1997 Medfly Cooperative

Control Program in Florida to be 8 hours in a retention pond, and 32 hours in the Hillsborough River (USDA-APHIS, 1997).

USEPA's chronic water quality criterion for malathion is 0.1 part per billion for both fresh water and salt water (USEPA, 2017e), which is near or below the limit of detection for malathion using standard analytical techniques. The criterion for aquatic life is much lower than for human drinking water—the California Department of Health Services has established a Health Advisory Level of 160 µg/L for malathion in human drinking water (California Environmental Protection Agency, 2000). Directly sprayed water within the treatment area could temporarily have malathion concentrations exceeding the USEPA chronic freshwater and saltwater criteria immediately following malathion aerial bait application, but any risks would rapidly dissipate as the chemical became diluted and underwent hydrolysis.

Under the Program’s proposed use, malathion would be released to soil through the direct deposit of bait spray from aerial and ground applications. Accidental spillage during processing or handling could occur; however, spillage has not occurred to date in the Program. Malathion rapidly degrades to compounds of lower toxicity in soil, mostly through microbial degradation and a variety of other factors, including pH, and organic matter content. Malathion's half-life in natural soil ranges from less than 1 day to 6 days, with 77 to 95 percent of the degradation occurring through microbial activity (Walker and Stojanovic, 1973; Neary, 1985). Aerobic metabolism appears to be the primary route of degradation in surface soils with half-life ranges from several hours to nearly 11 days (USEPA, 2009d). Degradation through hydrolysis occurs in soil with higher moisture content (Miles and Takashima, 1991). Photodegradation and volatilization in soil do not appear to occur (Chukwudebe et al., 1989; USEPA, 2009d). Although malathion is mobile in soil (USEPA, 2009d), it binds to organic matter, and therefore does not penetrate much beyond the soil surface (Jenkins et al., 1978). These properties make it unlikely that detectable quantities of malathion would leach to groundwater (LaFleur, 1979; HSDB, 1991).

Some studies indicate that malathion degrades to malaoxon in microbially inactive environmental conditions such as dry soil (USEPA, 2009d). Half-life values for malaoxon in soil range from 3–7 days (Pascal and Neville, 1976; Bradman et al., 1994).

After aerial and ground applications, malathion will be present in the air through drift, and then be transported through volatilization, fog, and wind until it settles onto vegetation and the ground. The atmospheric vapor phase half-life of malathion is 1.5 days (HSDB, 1990), and because of malathion's low volatility, high concentrations are unlikely to be detected in air. Agricultural and other uses, such as mosquito control, may lead to low-level background residues of malathion in the air at certain locations. The Program has not used malathion since 2002, when it made ground applications within 200 meters of exotic fruit fly finds (USDA-APHIS, 2017a). Drift and transport through the atmosphere will also be reduced with the use of a large droplet size (4-8 mm) consistent with its use as a bait spray.

Potential Impacts to Human Health

Malathion primarily affects the nervous system in humans with symptoms including tremors, salivation, urogenital staining, and decreased motor activity (USEPA, 2016d). Exposure to high levels of malathion may cause difficulty breathing, chest tightness, vomiting, cramps, diarrhea, watery eyes, blurred vision, salivation, sweating, headaches, dizziness, loss of consciousness, and death (ATSDR, 2003a).

Under this alternative, human exposure would mostly be limited to people conducting the applications or located on the commercial premises during or shortly after aerial or ground application. Dermal exposure is a primary route of exposure to malathion in people. Off-site drift could potentially expose people located close to the treatment area, but there is limited information available on inhalation exposures. Accidental or intentional exposure would most likely occur orally (ATSDR, 2003a).

Malathion causes AChE inhibition in red blood cells as the most sensitive endpoint in oral and dermal exposures (USEPA, 2016d). Malathion caused low acute toxicity in small mammals after oral, dermal, or inhalation exposure (USDA-FS, 2008). Malathion is a slight dermal irritant and a slight eye irritant (USEPA, 2009d). Inhalation leads to red blood cell AChE inhibition and histopathological lesions of the nasal cavity and larynx effects at lower doses (USEPA, 2016d). USDA-APHIS proposes to use the Malathion 8 Aquamul formulation, which is a skin sensitizer in guinea pigs and causes moderate eye irritation in rabbits (USEPA, 2016d).

Malathion is probably carcinogenic to humans (IARC, 2016b). USEPA classifies malathion as having "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential" (USEPA, 2016d).

Malathion does not interact with estrogen, androgen, or thyroid pathways (USEPA, 2015f), but may affect the immune system (ATSDR, 2003a; USDA-FS, 2008). The recent USEPA guideline immunotoxicity study in mice found inhibition of red blood cell AchE but did not observe immune toxic effects (USEPA, 2016d).

Program workers are the most likely segment of the human population to be exposed to malathion. The label requires workers to wear PPE including long-sleeve shirts and long pants, shoes plus socks, and protective gloves (chemical resistant gloves made of barrier laminate or butyl rubber, nitrile rubber, or viton > 14 mils) (Loveland Products Incorporated, 2015), and recommends goggles or shielded safety glasses for eye protection, along with suitable respiratory equipment in case of inadequate ventilation or to reduce the risk of inhalation of mists or vapors (Loveland Products Incorporated, 2016). Label requirements also include general safety hygiene practices and restricted entry intervals into treated areas after application. Adverse health risks to workers are expected to be minimal based on the low potential for exposure to malathion during applications made according to label directions. The quantitative risk evaluation from an accidental exposure during the Program application indicates no concerns of adverse health risk for program workers (USDA-APHIS, 2018d).

The general public is another sector of the human population that may inadvertently become exposed to malathion. The potential exposure and risk to the general public from malathion exposure during program application is expected to be minimal because (1) the Program only uses the malathion bait spray for commercial and ornamental planting of crops, (2) a notification process occurs in advance of treatments, (3) application methods minimize the potential for drift and runoff, (4) the Program restricts post-entry as required by the label requirements, and (5) the Program destroys fruit in treated areas.

Potential Impacts to Biological Resources

Malathion is a neurotoxin and vertebrates, including mammals, birds, reptiles, amphibians, and fish may be affected by exposure. Sublethal impacts are noted in various vertebrate species. These impacts are typically related to suppressed AChE levels resulting in behavioral and physiological changes to exposed organisms (USDA-APHIS, 2018d).

*Terrestrial Species*

The Program proposes to apply malathion on commercial premises, which are highly disturbed areas that are actively managed and include other pest treatments. Impacts to terrestrial species will be reduced by the use of a large droplet size that is consistent with bait applications.

Malathion is slightly to moderately toxic to mammals based on data for mammalian effects related to human health. Malathion is also slightly to moderately toxic to birds (Hudson et al., 1984; USEPA, 2006b).

Malathion is non-systemic in plants (USDA-APHIS, 2018d). There is limited data on the degradation of malathion in plants, but it occurs by hydrolysis (Mulla et al., 1981). One study shows a rapid decrease in malathion in strawberry flowers and immature fruits (Belanger et al., 1990). The half-life of malathion on plant surfaces ranges from <0.3 to 8.7 days (Newhart, 2006).

Malathion is a broad spectrum insecticide and non-target insects are likely to be adversely affected if sprayed during premise treatments. Malathion is highly toxic to honeybees (USDA-FS, 2008). The alkali and alfalfa leafcutter bees appear to be similar in sensitivity (USDA-APHIS, 2018d). Plant residue toxicity studies using the honeybee suggest there is greater malathion toxicity during direct contact in comparison to contact with residues on plants.

Malathion treatment is likely to temporarily depress the population numbers of sensitive terrestrial invertebrates within a treated area. The size of the treatment area and number of treatments will influence the ability of any impacted invertebrate populations to recover. Treatments will only occur on actively managed commercial premises. Any impacts to terrestrial invertebrates would mostly be limited to these areas because malathion treatments are made using a large droplet size with a bait to attract the target fruit fly species. The larger-sized droplet will minimize off-site transport, and reduce the risk to terrestrial invertebrates that are not attracted to the bait. The use of ground applications, when feasible, will further reduce the potential for exposure and risk to any off-site terrestrial invertebrates.

Indirect effects could also occur to local populations of vertebrates that depend on invertebrate prey as food items. Field studies show that mammals, birds, reptiles, and terrestrial amphibians are unlikely to be affected by direct toxicity, but some species dependent upon insects for food (insectivore) or pollination of food plants could be stressed by environmental conditions after malathion applications (USDA-APHIS, 2018d).

Insectivorous vertebrates with small home ranges within commercial premises would be at greatest risk from the loss of invertebrate prey food items. Large scale treatments are not anticipated based on use patterns for malathion over the last 20 years.

*Aquatic Species*

Acute toxicity to fish and amphibians is variable. Amphibian toxicity is based on the sensitivity of different species and time of exposure. The acute toxicity of malathion varies from moderately toxic to some species of fish to very highly toxic to other species (Mayer and Ellersieck, 1986; Beyers et al., 1994; USDA-FS, 2008). (Beauvais et al., 2000) noted changes in four measured swimming responses of rainbow trout (*Oncorhynchus mykiss*) after exposure to 20 and 40 µg/L malathion, and these effects were correlated with detectable cholinesterase inhibition during the study. In an acute sublethal exposure study, researchers found survival, hatching, body length, and eye diameter were not significantly affected by a short duration (120 hour) exposure to malathion (Cook et al., 2005). However, in longer-term continuous exposure studies, skeletal malformations, reproductive effects, and behavioral effects did occur in fish exposed to malathion (USEPA, 2006b).

Studies demonstrate malathion can bioaccumulate in fish tissues (USEPA, 2000). However, malathion is metabolized by aquatic organisms making biomagnification in the food chain unlikely (USDA-FS, 2008).

Malathion is moderately to very highly toxic to most aquatic invertebrates on an acute basis, depending on the sensitivity of the species. Amphipods and cladocerans are the most sensitive groups of aquatic invertebrates (Mayer and Ellersieck, 1986).

The metabolite, malaoxon, can form in aquatic systems and is approximately 1.5 to 6 times more toxic to fish and 1.8 to 93 times more toxic to amphibians (USDA-APHIS, 2018d). However, it has a rapid rate of breakdown and low percentage of occurrence in aquatic systems. Little data appear to exist for malaoxon toxicity to aquatic invertebrates. The conversion of malathion to malaoxon in aquatic environments can range from approximately 1.8 to 10 percent (California Department of Pesticide Regulation, 1993; Bavcon et al., 2003; USDA-APHIS, 2018d). For these reasons, malaoxon is not anticipated to pose a greater aquatic risk in comparison to malathion.

The exposure and risk to aquatic resources from malathion bait applications will be minimized by following label requirements that reduce the potential for off-site transport. Examples of label requirements include mitigation measures to reduce drift and application buffer zones around aquatic areas. Risk will be greatest when making aerial applications, but the use of a large droplet size, which is consistent with bait applications, will reduce exposure to aquatic resources. Malathion degrades quickly under most conditions so there is only a short-term potential for exposure. The low frequency of use of malathion, the proposed use pattern in the Program, and label restrictions suggest malathion will have a low potential for direct and indirect risk to aquatic resources.

### 3. Post-Harvest Commodity Treatment Impacts

In the Program, post-harvest treatments include cold treatment, vapor (heat) treatment, irradiation, and methyl bromide fumigation. USDA-APHIS discussed the use of these methods in its 2001 programmatic EIS, and is incorporating this discussion by reference (USDA-APHIS, 2001a). USDA-APHIS anticipates that cold and vapor treatments will have similar potential environmental impacts; therefore, a single discussion combining these methods follows.

### (a) Cold Treatment and Vapor Heat Treatment

Potential Impacts to Air, Water, and Soil

The impacts on the physical environment from cold and vapor treatments would not be expected to differ from those resulting from cold storage facilities and vapor treatment facilities of comparable size. The use of cold and vapor treatment is expected to have negligible environmental impact to soil, water, or air resources or quality.

Agricultural commodities moved to off-site (but within the quarantine area), USDA-APHIS-approved cold treatment and vapor treatment facilities will require the use of fuel during transport. The type of truck, weight transported, number of trips, and the distance to the endpoint will all determine the amount of fuel used. Petroleum-based fuels (e.g., gasoline and diesel fuel) consist of hydrocarbons and other organic compounds. The burning of these fuels can lead to byproducts that may contribute to smog, acid rain, climatic changes, and human health impacts (USEPA, 2016g). USDA-APHIS anticipates that effects from fuel consumption will be localized and minimal compared to the background of vehicular use in urban areas, especially since the duration of treatments, availability of facilities within a quarantine area, and logistical and budgetary constraints tend to limit the use of these treatments.

Potential Impacts to Human Health

The use of cold and vapor treatments is expected to have negligible adverse effects on human health. The strict supervision of these treatments within access-controlled facilities ensures that Program personnel and the general public do not enter the cooling or vapor chambers during treatment.

Potential Impacts to Biological Resources

The treatment chambers are sealed to prevent entry of non-target species during cold and vapor heat treatment. The only non-target species affected would be any additional organisms present on the commodity being treated, and the level of impact would depend on their sensitivity to heat or cold. The use of cold and vapor heat treatments is expected to have negligible impact on non-target species.

### (b) Irradiation Treatment

Potential Impacts to Air, Water, and Soil

Impacts to the physical environment are not anticipated from the use of irradiation equipment under USDA-APHIS permits. The treated commodity does not retain any radioactivity from the exposure and would not carry radioactivity into the environment. Therefore, the use of irradiation treatment is expected to have negligible impact to soil, water, and air quality.

Agricultural commodities moved to off-site (but within the quarantine area) USDA-APHIS-approved irradiation treatment facilities will require the use of fuel during transport. The environmental effects from fuel consumption during transport of commodities to an irradiation facility are the same as those described under the cold and vapor heat treatment section.

Potential Impacts to Human Health

USDA-APHIS conducts irradiation treatments within approved facilities in accordance with stringent safety guidelines. The irradiation equipment releases radiation to only the host plants within the unit.

USDA-APHIS certifies irradiation facilities. Facilities using radioactive isotopes must also be certified by the U.S. Nuclear Regulatory Commission or state agencies that have an agreement with the U.S. Nuclear Regulatory Commission to certify facilities. Recertification of a facility is not required unless there are changes to the operations, infrastructure, or if the facility has operational problems (USDA-APHIS, 2016d). Monitoring of radiation facilities demonstrates only ambient background radiation levels at facility boundaries; any stray radiation from proper equipment use is negligible, suggesting there is only minimal risk to workers. The public does not have access to irradiation facilities; therefore, exposure and risk to the public is negligible. Dietary consumption of irradiated fruit is safe because treated commodities do not retain radioactivity.

Potential Impacts to Biological Resources

The irradiation equipment is designed to release radiation only to the host plants within the unit, and minimize stray radiation from proper equipment use. The treated commodity does not retain any radioactivity from the exposure and poses no risks to non-target species. The irradiation equipment is sealed to prevent entry of non-target species to the irradiation chamber and therefore, there is no risk to non-target wildlife.

### (c) Methyl Bromide Treatment

Methyl bromide, a colorless and odorless gas, is a broad-spectrum biocide used to effectively fumigate agricultural commodities, structures, and soil infested with plant pests. Methyl bromide was widely used for post-harvest commodity treatments because it is inexpensive, easy to use, and effective over a wide range of temperatures. Post-harvest fumigation with methyl bromide is a treatment option in the Program to allow the movement of regulated articles from within the quarantine area to locations outside the quarantine boundary. Treatment options include fumigating under a tarp, and in a container, chamber, or facility. The use of methyl bromide in this capacity is regulated by the USEPA via the Montreal Protocol on ozone-depleting substances under the Quarantine Pre-Shipment Exemption.

While an effective fumigant, methyl bromide contributes to depletion of the ozone layer; therefore, most uses in the United States were phased out (USEPA, 2017d). The USEPA classified methyl bromide as a "Restricted Use Pesticide", which requires purchase and use only by certified applicators or persons under their direct supervision (USEPA, 2016f).

Any use of methyl bromide by USDA-APHIS in the management of fruit flies must comply with USEPA pesticide label requirements, the requirements of the USDA-APHIS-PPQ Treatment Manual (USDA-APHIS, 2016d), and applicable international phytosanitary standards. The USEPA updated the methyl bromide label and use requirements in 2015 (USDA, 2015; USDA-APHIS, 2016d).

USDA-APHIS prefers the use of cold treatment to methyl bromide fumigation because of the environmental concerns associated with methyl bromide and the sensitivity of some commodities to methyl bromide. USDA-APHIS has not used methyl bromide in the Program since 2013. Even though methyl bromide has not been used recently, it remains possible that USDA-APHIS could use methyl bromide fumigation to treat some commodities at a later date.

<u>Potential Impacts to Air, Water, and Soil</u>

After fumigation of an infested commodity under a tarp, or in a container, chamber, or facility, methyl bromide gas vents from the facility to the atmosphere. Formulations of methyl bromide used in the Program are generally >99.5 percent pure, so emissions of other compounds would be minimal. In most cases, the majority of the gas is expelled within the first 5 minutes. However, as a gas, methyl bromide is three times heavier than air and naturally diffuses downward and outward. Hence, any pockets of gas that may form will take longer to disperse. Atmospheric concentrations of exhausted methyl bromide will be greatest near the ventilation source. Because methyl bromide is volatile, environmental media potentially affected by methyl bromide gas are principally air, and to much lesser extent, water and soils.

Methyl bromide is classified by the USEPA as both a hazardous air pollutant and a volatile organic compound, and is regulated as an ozone-depleting substance (USEPA, 2017d). In 1995, methyl bromide was added to the list of ozone-depleting chemicals that were scheduled for phase-out (University of California, 2017). In accordance with the Montreal Protocol and the Clean Air

Act, those quantities of methyl bromide needed to comply with USDA-APHIS quarantine treatment requirements are exempt from the phase-out. Therefore, USDA-APHIS' use of methyl bromide has been preserved until a replacement has been registered for a similar use. Methyl bromide is specifically authorized with an exemption under Title VI (Stratospheric Ozone Protection) of the Clean Air Act.

The main degradation pathway for gas-phase methyl bromide is reaction with photochemically-generated hydroxyl radicals (ATSDR, 1992). In the troposphere, methyl bromide has a half-life that has been estimated to range between 0.4 to 1.6 years at -8 °C and 0.29 – 1.1 years at 25 °C due to its low rate of photolysis in the troposphere (OECD, 2001). Other estimates have the tropospheric half-life to be about 11 months, relative to the concentration of atmospheric hydroxyl radicals present (ATSDR, 1992).

Upward diffusion of methyl bromide to the stratosphere is believed to be the dominant loss mechanism of methyl bromide from the troposphere (ATSDR, 1992). Molecules that diffuse upward and reach the stratosphere may undergo direct photolytic degradation by ultraviolet radiation, but this degradation pathway accounts for only a small fraction (about 3 percent) of atmospheric methyl bromide degradation (ATSDR, 1992; OECD, 2001). Hence, breakdown of atmospheric methyl bromide is relatively slow, and methyl bromide will tend to become widely dispersed in the atmosphere.

Relative to other ozone-depleting substances such as chlorofluorocarbons and halons that have atmospheric lifetimes on the order of hundreds or thousands of years, the half-life for methyl bromide is comparatively short, around 0.8 years (USEPA, 2017f). Considering that USDA-APHIS did not use methyl bromide in 2014, 2015, and 2016, the overall contribution of fruit fly control activities to atmospheric methyl bromide concentrations and ozone depletion would be very minor relative to the volume and variety of other sources of ozone-depleting substances. Adverse impacts on tropospheric ozone as a result of the Program are expected to be minimal even if Program use resumes.

Partitioning of methyl bromide from air into water will be quite small because methyl bromide is only slightly soluble in water (Pubchem, 2017). Conversely, the rate of methyl bromide volatilization from water into air will be quite high, depending on mixing, temperature, and depth. This means that if methyl bromide released from a treatment area reaches surface water, we expect volatilization from water surfaces to occur. The volatilization half-life for methyl bromide from surface water ranges from 3.1 hours to 5 days (TOXNET, 2017). Volatilization half-lives for a model river and model lake were estimated to be around 3.0 hours and 3.9 days, respectively (ATSDR, 1992; TOXNET, 2017).

Most methyl bromide will volatize from water before extensive hydrolysis occurs because it hydrolyzes very slowly in water, yielding methanol, bromide ion, and hydrogen ion (Pubchem, 2017). Hydrolytic half-lives range between 20 and 38 days, depending on temperature and pH (TOXNET, 2017). Methyl bromide is not expected to adsorb to suspended solids and sediment (TOXNET, 2017). Because methyl bromide is exhausted to the atmosphere after use, and will volatilize from soil and water fairly rapidly (if deposition on soil or water occur), ground water contamination is unlikely. Considering the factors discussed for methyl bromide treatments, methyl bromide aquatic chemistry, its limited use, and use requirements (USEPA, 2015g; USDA-APHIS, 2016d), it is highly unlikely that use of methyl bromide for fumigation under alternative 3 will adversely affect surface waters or groundwater.

Methyl bromide use during post-harvest treatment activities is not expected to have any adverse effect on soils. Methyl bromide, either as a gas or dissolved in water, has relatively low affinity for soils and exhibits very high mobility (ATSDR, 1992; TOXNET, 2017). Volatilization from soil is relatively rapid with half-lives ranging from 0.2 to 0.5 days, depending on depth (TOXNET, 2017). Methyl bromide may hydrolyze abiotically in soils (i.e., chemically) to methanol and bromide ion with an experimentally derived half-life of 20 to 26 days (OECD, 2001). In a real-world setting, the rate of degradation would depend on soil type and moisture content, with soils richer in organic matter more likely to produce bromide ion (OECD, 2001).

Potential Impacts to Human Health

Methyl bromide exhibits moderate acute toxicity by the oral and inhalation routes of exposure (USEPA, 2011). Toxicity by inhalation, the primary route of exposure, is time and concentration dependent. Human exposure to high concentrations of methyl bromide can cause central nervous system and respiratory system failures and can harm the lungs, eyes, and skin (USEPA, 2015g). Methyl bromide is readily absorbed through the lungs. There have been suggestions that it can be absorbed through the human skin, but absorption through the skin has not been shown to be an important factor in methyl bromide intoxication (Pubchem, 2017). Early symptoms include dizziness, headache, nausea and vomiting, weakness, and collapse. Lung edema may develop 2 to 48 hours after exposure, accompanied by cardiac irregularities, which can also lead to death (USEPA, 2015g). Repeated exposure can result in blurred vision, staggering gait, and mental imbalance, with probable recovery after a period of no exposure (USEPA, 2015g).

Developmental effects as a result of exposure to methyl bromide are inconclusive, although animal tests show that this substance possibly causes toxicity to human reproduction or development (OECD, 2001; Pubchem, 2017). The majority of *in vitro* and *in vivo* studies indicate that methyl bromide is genotoxic, inducing gene and chromosome mutations (OECD, 2001; Pubchem, 2017). While genotoxic, long-term and reproductive *in vivo* tests do not show evidence of carcinogenicity (OECD, 2001).

Workers are the segment of the human population with the potential to be exposed to methyl bromide via inhalation, incidental ingestion, and dermal contact. Work practices show workers are not likely to incur dermal exposure. Inhalation of methyl bromide by workers is prevented by respiratory protection and other requirements discussed below. Due to the highly regulated nature of methyl bromide use, and requirements for application (USEPA, 2015g; USDA-APHIS, 2016d), worker exposures to harmful levels of methyl bromide are unlikely when appropriate handling procedures are followed. Because methyl bromide is three times heavier than air and can accumulate briefly in low areas, treatment areas must be set up to avoid exposure of applicators or the general public in areas downwind from treatments.

The general public who live or work in the vicinity of a fumigation facility could potentially be exposed through incidental inhalation. USDA-APHIS takes appropriate precautions to minimize the potential for exposure of the general public to methyl bromide (USEPA, 2012c, b; USDA-APHIS, 2016d). These safety measures include agricultural worker protections, buffer zone and posting requirements, emergency preparedness and response requirements, and applicator training programs. Fumigations would occur at a facility, under a tarp, or in a chamber or container located within the quarantine area. Throughout this EIS, we mention that the Program use usually occurs near ports-of-entry and residential areas, and generally not in rural areas.

To reduce the risk of exposure of the general public to methyl bromide, label requirements include treatment and aeration buffer zones, which are specific to the enclosure being fumigated (USDA-APHIS, 2016d; National Pest Management Association, 2017; USEPA, 2017c). USDA-APHIS mitigates risks by stipulating that a treatment buffer zone must be no less than 30 feet, and the aeration buffer zone may be no less than 200 feet for the first 10 minutes of aeration (USDA-APHIS, 2016d). Access to these spaces is limited. Buffer zones are in place when aeration begins, and end when the air concentration of methyl bromide surrounding the treatment area is 5.0 ppm or less, and minimum time requirements are met (National Pest Management Association, 2017; USEPA, 2017c).

The possibility exists for accidental release of methyl bromide through a tear in a tarp, or a leak in a hose or canister. In the event of an accident, workers, and in extremely rare circumstances the public, may be exposed to methyl bromide. Monitoring of fumigation sites reduces the potential for exposure of people who may be near a buffer zone during or after the treatment. Emergency response information for neighbors is provided through mail, telephone, and door hangers.

The permissible exposure limit established by the Occupational Safety and Health Administration is set at a ceiling limit of 20 ppm. The concentration immediately dangerous to life and health is 2,000 ppm, and at this concentration, methyl bromide produces pulmonary edema, seizures, and death (Pubchem, 2017). While inhalation of methyl bromide by the general public near fumigation operations is possible, exposure to levels exceeding 5 ppm is improbable. Additionally, the majority of data suggests that significant adverse effects do not occur at inhalation exposures of 5 ppm (Pubchem, 2017).

Considering the extant protection measures implemented before, during, and after methyl bromide fumigation, as prescribed by USEPA label and USDA-APHIS-PPQ Treatment Manual requirements, the risk of human exposure to methyl bromide is considered minimal. Environmental air monitoring data collected between 2008 and 2014 in fields after soil application indicates limited risk to the human population. Approximately 119 samples were collected over this time period with approximately 81 percent of the samples having methyl bromide residues below the limit of analytical detection. Of the collected samples, most were at trace levels (0.2 ppm and 0.5 ppm) of methyl bromide, which is below established regulatory threshold limits (USEPA, 2011). It is important to note that if USDA-APHIS used methyl bromide, it would be for post-harvest commodities and not for field treatments. Therefore, methyl bromide residues from Program use would be expected to be even lower.

As previously discussed, methyl bromide can contribute to depletion of the ozone layer. The human health effects from thinning of the ozone layer include skin cancer, cataracts, and immunosuppression due to increased ultraviolet radiation reaching the earth’s surface. These concerns are mitigated through mandated reductions, and currently limited uses for methyl bromide, as described above (UNEP, 2014).

Non-Target Species

Methyl bromide is toxic to invertebrates and vertebrates alike. For non-target organisms, the risk of inhalation exposure is limited to the site of fumigation, which could occur when the gas is exhausted from a fumigation chamber through a vent and allowed to disperse into open air. This process is facilitated by fans capable of blowing 5,000 cubic feet per minute. The majority of the gas will be expelled within the first 5 minutes, although some pockets of gas may be partially trapped and will take longer to dissipate. When exhausted from an enclosed facility, methyl bromide quickly dissipates in air. Atmospheric concentrations of methyl bromide will be greatest near the vent.

Fumigations will have little effect on vertebrate non-target species because methyl bromide is likely to rapidly disperse outside the fumigation chambers. Noise and human activity involved in setting up and implementing the fumigation are expected to repel most terrestrial vertebrate non-target animals from the vicinity of the fumigation site. The safety precautions instituted for methyl bromide fumigations make exposures possible for only those species in close proximity to the venting area outside the fumigation chamber or stack. This is likely to include terrestrial/avian non-target organisms that are undeterred by the noise and human activity in the area, which increases their risk of experiencing harm or mortality.

Soil invertebrates present during the fumigation and unable to escape the area during treatment are expected to succumb to, or be adversely affected by, fumigation. The fumigated areas, however, are typically small and likely to be recolonized within a short period of time, with no long-term effects on invertebrate populations.

Aquatic organisms will not be impacted by Program activities, as it is highly unlikely that methyl bromide used for fumigation will affect surface waters.

A recent USEPA review of the Ecological Incident Information System (version 2.1), the Incident Data System, the Aggregate Summary Module (v.1.0) of Office of Pesticide Program's Incident database, and the Avian Incident Monitoring System for ecological incidents involving methyl bromide applications, completed in October 2011, found there were no aquatic or terrestrial incidents reported (USEPA, 2011). Review of the Aggregate Summary Module database resulted in one minor plant incident from the use of methyl bromide from 8/1/2005 to 10/31/2005; the report provided no further details of this incident. Review of the Avian Incident Monitoring System database, which reports incidents to birds, indicated no incidents (USEPA, 2011).

## Alternative 4. An Integrated Pest Management Approach

This alternative is an integrated pest management approach that combines quarantine, commodity treatment and certification, and host surveys with eradication treatment methods. These methods include the use of chemical applications for eradication, mass trapping, MAT, SIT, and physical control or fruit removal. Potential environmental impacts for quarantine and commodity treatment and certification were considered under alternative 3. Therefore, this section will focus on environmental impacts associated with the eradication of fruit flies. Under alternative 3, only commercial premises planning to ship their commodities outside the quarantine area were subject to premise treatments or post-harvest commodity treatments. Under alternative 4 this requirement still applies and in addition, commercial premises with no interest in shipping products outside the quarantine area, residences, and other agricultural areas also would be subject to eradication treatments (as described below). This alternative also considers potential environmental impacts associated with the use of the insecticides, naled and DDVP in traps.

The extent of the treatment area depends on the distribution of fruit flies during an outbreak (quarantine area) and the location (urban and/or rural areas) of the outbreak. Under alternative 4, it is possible that a larger geographic area would be subject to treatment compared to alternative 3 because of the additional commercial premises receiving treatment. Nevertheless, there is likely to be a reduced total amount of pesticides used in the program under alternative 4 because of the shorter time interval that will be needed for eradication and the ability to use SIT.

### 1. Quarantine and Survey Impacts

USDA-APHIS anticipates the impacts from quarantines under alternative 4 to be similar to the impacts described under alternative 3. When USDA-APHIS conducts surveys, traps collect fruit flies by attracting and killing them using various chemicals. This section focuses on the use of naled and dichlorvos in these traps or as spot treatments.

#### (a) Naled use in traps and as spot treatments

Naled is an organophosphate insecticide that acts on the nervous system of animals. It is a cholinesterase enzyme inhibitor, which results in the accumulation of acetylcholine at cholinergic nerve endings, causing continual nerve stimulation. Sufficient doses kill insects. Naled degrades to DDVP, which is another organophosphate insecticide with an identical mode of action. The Program uses both insecticides in fruit fly traps and spot treatments. See section 1b below for the discussion of DDVP's environmental consequences. The information in this section is a summary of the HHERA for naled usage in the Program found on the Program's website (last accessed April 9, 2018 at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home), which is incorporated by reference (USDA-APHIS, 2017d).

The Program uses the insecticide naled (DIBROM® 8 Emulsive [EPA Reg. No. 5481-479] and Dibrom® Concentrate [EPA Reg. No. 5481-480]) in fruit fly traps during pest detection and surveys. DIBROM® 8 Emulsive contains 62 percent naled and 38 percent inert ingredients and DIBROM® Concentrate contains 87.4 percent naled and 12.6 percent inert ingredients.

Based on the special local needs label requirements for the traps, DIBROM® 8 Emulsive is diluted to 25 percent a.i. with an approved lure for eradication trapping. Approximately 5 ml of diluted material is applied to absorbent wicks using calibrated equipment (e.g., a dropper, syringe, or a bottle top dispenser). The traps are baited monthly. The traps are placed at approximately 1,000 traps per square mile in a 1.5-mile radius from each fruit fly detection site on tree trunks and limbs.

Spot treatments have typically involved a gel-like mixture of an attractant such as methyl-eugenol or cuelure, naled, and a carrier such as Min-U-Gel® that is applied as a dollop to fences, utility poles, trees, or other inanimate objects at heights that are out of reach of children and pets. However, California and Florida are moving toward the use of STATIC Spinosad ME for spot treatments. If naled is used in spot treatments in these two states, the protocol is as follows:

- For spot treatments in California, approximately 5 ml of material are applied for each treatment (California Department of Pesticide Regulation, 2007). The material is a mixture of 19 fluid ounces of Dibrom® Concentrate in each gallon of attractant, and ordinarily 2 to 3 pounds of the carrier Min-U-Gel®.
- For spot treatments in Florida, 3 ml to 10 ml of formulated mix is applied per spot treatment (FDACS, 2016). The formulated mixture is a ratio of 1.7 ounces of naled to 12.7 ounces of methyl-eugenol or cuelure, adding Min-U-Gel® as a thickener and carrier ingredient to obtain the desired consistency.

In both California and Florida, the spot treatments are applied at a minimum of 600 treatments per square mile using hand spray equipment. Applications are repeated every one to four weeks.

<u>Potential Impacts to Air, Water, and Soil</u>

Naled can volatize into the atmosphere (USEPA, 2002b, 2008b) and rapidly degrades in the presence of sunlight. Naled degrades in the aquatic environment with short half-lives under various conditions: hydrolysis (half-life of less than one day to 4 days with decreasing pH), biodegradation (anaerobic aquatic half-life under one day to 4.5 days), and photolysis (half-life between 4 and 5 days) (USEPA, 2008c). The short half-life of naled and the Program’s use of traps and spot treatments in areas without sources of water contribute to the likelihood that USDA-APHIS’ actions under this alternative will have minimal or no impact to water sources or air quality.

Naled degrades quickly in soil. In sunlight, naled in soil has a half-life of 0.4 days (USEPA, 2008b). Under aerobic conditions, soil microbes degrade naled with a reported half-life of one day (USEPA, 2008b). Although naled has moderate mobility in soil, naled and its associated degradates are unlikely to move to surface or groundwater due to the method of application (traps and spot treatments), low water solubility, and rapid degradation. USDA-APHIS disposes used traps by placing them in a container where they are typically disposed of at a landfill and little to no impacts to the soil are anticipated. Guidance for disposal of traps and trap waste varies locally and will be discussed in site-specific EAs.

Potential Impacts to Human Health

Naled causes severe acute eye irritation, corrosive dermal irritation, and neurotoxicity (USEPA, 2002b). Symptoms of cholinesterase inhibition include nausea, dizziness, and confusion. Exposure to high doses of naled can result in respiratory paralysis and death (NIH, 2016). Because of these attributes, the naled formulations proposed for use in the Program are restricted use insecticides and only certified applicators, or persons under their direct supervision, may use the products. The DIBROM® 8 Emulsive product label (AMVAC, 2013) also specifies it is not for use in, and around, residential areas except when used by Federal, State, Tribal, or local government officials responsible for area-wide public health pest or vector control. USDA-APHIS use of the products in or near residential areas for exotic fruit fly eradication complies with requirements of the FIFRA Section 24(c) Special Local Need labels.

USDA-APHIS notifies residential property owners about traps and spot treatments on their properties to reduce the potential for exposure. The general public (e.g., residents) is not recognized as a potentially exposed population group due to the combination of public notification and the method of application that eliminates off-site movement of naled via drift or runoff.

Workers in the Program are the most likely segment of the human population to be exposed to naled based on the proposed application method. Occupational exposure to naled may occur through inhalation and dermal contact during mixing and application. However, the use of PPE minimizes direct contact exposures. Drift from applications will not occur based on how the Program uses naled in traps and spot treatments.

USEPA classifies naled as a "Group E – Evidence of Non-carcinogenicity for Humans" pesticide based on the lack of evidence of carcinogenicity in mice (89-week carcinogenicity study) and rats (two-year carcinogenicity study) (USEPA, 2001, 2015a). Naled is not mutagenic based on an *in vivo* gene mutation study on mouse spots in pregnant mice, a gene mutation assay in *Salmonella* (Ames assay), the DNA damage test in bacteria, a cytogenetic effects *in vivo* mouse bone marrow micronucleus assay, and an *in vivo* cytogenetics study in rats (USEPA, 2001). Naled was screened as a pesticide a.i. using the ToxCast "Endocrine Receptor Model" for estrogen receptor bioactivity and showed negative results (USEPA, 2015c).

In the risk assessment prepared in support of this EIS, the risk of accidental dermal and inhalation exposure for workers mixing the naled concentrate product was found to be low.

Potential Impacts to Biological Resources

Naled is moderately toxic in oral, inhalation, or dermal acute exposures for mammals (see mammalian studies discussed with respect to human health). In birds, acute oral toxicity studies indicate naled is moderately toxic (Hudson et al., 1984). In subacute dietary studies, birds exhibit slight toxicity to naled (USEPA, 1997a). There does not appear to be data on chronic avian toxicity.

A review of the literature did not indicate any available reptile toxicity data testing using naled. Similar to other compounds discussed in this EIS, the USEPA assumption of comparative sensitivity between reptiles and birds applies.

Naled is considered highly toxic to terrestrial invertebrates, including pollinators. The contact toxicity value for the honey bee is high (USEPA, 1997a). Toxicity is also high for other bee species such as the alfalfa leafcutter bee (*Megachile rotundata*) and alkaline bee (*Nomia melanderi*).

There does not appear to be information available regarding the effects of naled to terrestrial plants. Toxicity would be expected to be low based on the proposed formulation, and the mechanism of action of naled.

Naled is moderately to highly toxic to fish (USEPA, 1997a). Amphibians have similar naled sensitivity as warm water fish (Sanders, 1970).

Naled is considered highly toxic to most aquatic invertebrates. Freshwater cladocerans are the most sensitive test species (USEPA, 1997a) while the eastern oyster is the least sensitive (USEPA, 2006c).

Naled has low toxicity to the aquatic macrophyte, *Lemna gibba*. The freshwater diatom, *Navicula pelliculosa*, was the most sensitive test organism (USEPA, 2006c).

The use pattern for naled suggests that exposure to non-target species is unlikely to occur. Naled is applied to a wick that is inserted into a trap or is mixed with a carrier and applied directly to inanimate objects. Removal of traps by a scavenging small mammal that could be exposed to naled has not been noted in previous trapping efforts during exotic fruit fly outbreaks. In the case that a small mammal came into contact with the trap, it would be highly unlikely that it would consume the wick due to its composition (e.g., fiberboard blocks, cotton wicks, or molded paper fiber). Inhalation and dermal exposure would also be low because naled is contained within the trap preventing significant exposure. Exposure to naled applied in a carrier agent (Min-U-Gel®) to poles and other structures could be slightly more compared to a trap, but would still be very low because non-target species would not be attracted to those applications. The lack of exposure to terrestrial vertebrates suggests negligible risk to this group of organisms. Similarly, risk to aquatic vertebrates and invertebrates are expected to be negligible based on the use pattern for naled. Any non-target invertebrate exposure would be incidental and not expected to be significant for any group of terrestrial invertebrates other than the target pest.

**(b) Dichlorvos (DDVP) use in traps and as spot treatments**

The Program uses a lure, such as methyl-eugenol or cuelure, and DDVP-impregnated strips in fruit fly traps to attract and kill exotic fruit flies in early detection surveys, delimitation surveys, and as part of an eradication effort (mass trapping and male annihilation technique). DDVP is an organophosphate insecticide that targets the nervous system. DDVP is registered for livestock, commercial, and residential uses including cattle, poultry, swine, agricultural equipment, feedlots, animal kennels, warehouses, mushroom houses, greenhouses, picnic areas, manure piles, refuse and solid waste sites, and residential dwellings (USEPA, 2009a). The range of application methods for these use patterns include aerosols, fogging equipment, spray equipment, and through slow release from impregnated materials (e.g., resin strips) (USEPA, 2009b). The information in this section is a summary of the HHERA for DDVP usage in the Program found on the Program's website (last accessed April 9, 2018 at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home), which is incorporated by reference (USDA-APHIS, 2017b).

The two formulations the Program uses are Hercon® Vaportape™ II formulation (EPA Reg. No. 8730-50) (Hercon Environmental, 2016) and Plato Industries Insecticide Strip formulation (EPA Reg. No. 65458-5) (Plato Industries Incorporated, 2013). The Vaportape™ II formulation contains 10 percent DDVP, 0.75 percent DDVP-related compounds, and 89.25 percent other ingredients. This formulation is registered only for use in insect traps. The Plato Insecticide Strips contain 6.98 percent of DDVP, 0.52 percent of related compounds, and 92.50 percent of other ingredients. Each square contains 0.09 g of a.i.. The current recommendation is to use 0.09 g a.i. in traps compared to higher doses (0.59 to 4.64 g a.i.) that have been used in other types of traps (USDA-APHIS, 2016c).

Potential Impacts to Air, Water, and Soil

DDVP has a high vapor pressure, volatilizes to air, and dissipates rapidly through volatilization under field conditions (USEPA, 2009c). Some DDVP will volatize from the impregnated strips in the traps. DDVP has low persistence in the atmosphere (USEPA, 2009c). The use pattern of DDVP as a pest strip in traps and its rapid degradation in the atmosphere suggest that impacts to air quality are negligible.

There is negligible impact to water resources from DDVP because of the Program's proposed use pattern and label instructions that indicate not to apply directly to water, to areas where surface water is present, or to intertidal areas (Plato Industries Incorporated, 2013; Hercon Environmental, 2016). Should a trap dislodge and fall into a waterbody, the small amount of DDVP in the strip and its rapid degradation through hydrolysis make significant impacts to surface water and groundwater unlikely (USEPA, 2006a).

The use of DDVP strips in traps prevents them from contacting the soil. Should a trap dislodge, the strip will likely remain inside the trap and not fall out. Should the strip encounter soil, the small amount of DDVP in the strip and its rapid volatilization and degradation make significant impacts unlikely (USEPA, 2006a).

USDA-APHIS disposes of traps with DDVP residue in accordance with label restrictions and addresses local variations in disposal in site-specific EAs. Residue levels in trap waste will be minimal because DDVP rapidly volatilizes and degrades and traps contain a small quantity of DDVP. Little to no impacts to soil from disposal is anticipated.

Potential Impacts to Human Health

DDVP can be toxic to humans. DDVP is well absorbed through all routes of exposure. Technical DDVP has high acute toxicity (Category I) via dermal exposure, and moderate acute toxicity (Category II) from oral and inhalation exposures (USEPA, 2006a).

Records associated with the Program indicate there are no reports of harmful exposure of the public or applicators to DDVP strips. Reports of human health incidents from exposure to DDVP resin strips come from non-program treatment activities. USEPA's review of DDVP incidents through 1996 attributed use of resin strips to only one percent of the total incident reports involving human exposure (about 33 cases per year) (USEPA, 2006a). Similarly, Tsai et al. (Tsai et al., 2014) identified 31 acute illness cases associated with the use of DDVP pest strips in seven U.S. States and Canada between 2000 and 2013. Among the reported cases, 26 individuals had mild health effects of short duration with neurologic, respiratory, and gastrointestinal symptoms such as headache, breathing difficulty, and nausea. Five people experienced moderate health effects with symptoms including asthma, respiratory distress requiring hospitalization, a tingling sensation, and incoordination. The majority of these illnesses were caused by improper use of the product in occupied living areas with more than 4 hours exposure per day, which is inconsistent with label requirements. None of these exposures were to strips used in the Program.

Exposure of the public to DDVP is negligible due to public notification about exotic fruit fly eradication activities and the method of application, which would eliminate off-site movement of DDVP from drift or runoff. Volatilization of DDVP from the trap occurs, but the potential for inhalation exposure is low due to the small quantities used in each trap and the outdoor placement of the traps. Trap placement is above the normal reach of children. If traps were accidently dislodged, there could be potential exposure mainly via dermal contact and incidental ingestion through hand-to-mouth contact with the DDVP strip. The potential for dietary exposure to DDVP from trap placement in host plants is negligible because the strips are contained inside the trap and do not touch the plant or fruit. In addition, fruit are stripped from residential and commercial host plants growing in the 200 meter eradication treatment area.

Potential Impacts to Biological Resources

In general, DDVP is moderately to highly toxic in oral, inhalation, or dermal acute exposures for vertebrates and invertebrates. In mammals, technical-grade DDVP has high acute toxicity via dermal exposure and moderate acute toxicity from oral and inhalation exposures (USEPA, 2006a). DDVP is considered highly toxic to birds based on available acute oral toxicity data (Schafer et al., 1983; USEPA, 2005b; Mohammad et al., 2008). DDVP is considered moderately to practically non-toxic to birds in subacute dietary exposures (WHO, 1989; USEPA, 2005b).

DDVP is considered highly toxic to many terrestrial invertebrates due to its broad-spectrum activity. Toxicity to pollinators such as honey bees is high (WHO, 1989; USEPA, 2016a). DDVP has also been shown to be highly toxic to butterflies and moths.

There is a lack of significant exposure to non-target terrestrial vertebrates and invertebrates due to the formulation of DDVP and its use in traps in combination with a fruit fly lure. Removal of traps by a scavenging small mammal that could be exposed to DDVP has not been noted in previous trapping efforts during exotic fruit fly outbreaks. In the case that a small mammal contacted a trap, it would be highly unlikely that it would consume the strip due to its fiber or paper composition. Any non-target terrestrial species exposure would be incidental and not expected to be significant for any group other than the target pest.

Aquatic organisms are unlikely to be exposed to DDVP from Program uses based on the requirements for the placement of traps, and low amounts of chemicals in each trap. Fruit fly traps are placed on tree trunks and limbs, not in waterbodies or where surface water is present, and not in intertidal areas below the mean high water mark.

Nevertheless, fish and aquatic invertebrates exhibit moderate to high toxicity to DDVP in acute and chronic exposure studies (Johnson and Finley, 1980; WHO, 1989; USEPA, 2005b). The available DDVP toxicity data demonstrates a comparable range of sensitivities as with acute exposures in fish (Geng et al., 2005). There are four studies showing low toxicity of DDVP to most species of aquatic plants (USEPA, 2005b; Yeh and Chen, 2006).

Information is not available regarding the effects of DDVP to terrestrial plants. USDA-APHIS expects toxicity to be low based on the proposed formulation and mechanism of action of DDVP.

### 2. Premise treatments

Under both alternatives 3 and 4, commercial premises that intend to ship regulated nursery stock or fruits and vegetables outside of the quarantine area treat the commodities using Program-approved pre- and post-harvest treatments. Alternative 4 also requires commercial premises without an interest in shipping products outside the quarantine area, residences, and other agricultural areas within the quarantine area to treat the commodities. Pre-harvest treatments include (1) soil drench applications of lambda-cyhalothrin or diazinon and (2) aerial or ground applications of spinosad bait spray or malathion bait spray. Post-harvest treatments include cold treatment, heat (vapor) treatment, irradiation, or methyl bromide fumigation.

Under alternative 4, the types of impacts on the physical environment, human health, and biological resources would be similar to those identified in alternative 3. Regardless of their commodity distribution intentions, under alternative 4, producers would experience added costs, delays, and an increased potential for pesticide exposure. Although more premises would be treated, the impacts would be of shorter duration because alternative 4 is an eradication strategy. Elimination of fruit fly populations (eradication) and lifting the quarantine would remove requirements for pre- and post-harvest treatments prior to shipment. This would lead to an overall reduction of insecticides applied to regulated nursery stock and commodities over time, and a reduction of potential environmental impacts associated with these treatments.

## 3. Eradication Chemical Applications

To achieve eradication of fruit fly populations, USDA-APHIS needs to apply additional chemical applications in ways that reduce additional pest life stages. These options can be considered as additional use patterns for lambda-cyhalothrin, diazinon, spinosad, and malathion. If the insecticide treatments reduce fruit fly populations to low levels, the Program may apply SIT. Commercial premises within the quarantine area would be subject to eradication treatments using spinosad or malathion bait sprays regardless of their market intentions.

### (a) Soil Insecticide Application with Lambda-Cyhalothrin

Under alternative 4, the Program proposes to use lambda-cyahalothrin as part of an eradication strategy by applying it within the drip line of fruit-bearing fruit fly host plants located within a 400-meter radius of mated female fruit flies, larvae, pupae, or eggs on commercial premises, in residential areas, and on other public properties. This use would be in addition to premise owners applying the insecticide to the soil of nursery stock to allow movement outside of the quarantine area. As with alternative 3, the Program requires the removal of fruit from treated host plants. The types of impacts remain the same as described in alternative 3. The discussion below focuses on the potentially larger treatment area and potential for exposure of the public from chemical applications that may occur in residential areas and on other public properties.

Potential Impacts to Air, Water, and Soil

The method of application reduces the chance of any significant drift from these applications, and the environmental fate and label restrictions will reduce runoff. Impacts to air quality are unlikely as lambda-cyhalothrin is considered nonvolatile based on its low Henry's Law constant and vapor pressure. Lambda-cyhalothrin has low water solubility and a high binding affinity for soil and sediment (not mobile in soil), which will reduce runoff (Laabs et al., 2000). Material that is not bound to soil or organic matter will preferentially bind to sediment once it enters water, reducing the bioavailability and risk to non-target aquatic species. It is moderately persistent in the soil (NPIC, 2001) and degrades in the environment through a combination of biotic and abiotic mechanisms (USEPA, 2007; He et al., 2008). Current label requirements regarding application buffers near water bodies, and the presence of a vegetative filter strip, will further reduce the potential for significant aquatic residues.

Potential Impacts to Human Health

Under alternative 4, workers (pesticide applicators) remain the sector of the human population with the greatest potential for exposure to lambda-cyhalothrin. Workers wear PPE per label requirements to minimize exposure through direct contact (i.e., incidental ingestion, inhalation, and dermal contact).

Potential for exposure by members of the public is very low. USDA-APHIS notifies residents, in writing, 24 hours prior to treatment if their property will be treated with a soil drench. The label requires applicators to apply treatments in a way that prevents the mixture from remaining on the soil surface. Dietary consumption of fruit from treated trees is not likely to occur because the program requires removal and destruction of fruit from host plants that receive soil drench applications. In addition, lambda-cyhalothrin will not be present in the fruit because uptake by terrestrial plant roots is unlikely (ATSDR, 2003b). Consumption through drinking water is also not likely as the label restricts applications near waterbodies, and lambda-cyhalothrin has low water solubility and adsorbs strongly to soil limiting leaching and runoff.

There is the potential for a child to be exposed to lambda-cyhalothrin in treated soil via pica behavior (a pattern of eating non-food materials such as soil or paper). Ten to 32 percent of children ages 1 to 6 exhibit this type of behavior (MedlinePlus, 2014). In this exposure scenario, the potential exposure for a child is expected to be limited because families would be notified of treatments on residential properties, only host plants would be treated, and the label requires restricted-entry during the first 24 hours of application, preventing direct contact to lambda-cyhalothrin. The calculated acute and chronic hazard quotient values were below USEPA's level of concern suggesting minimal risk to lambda-cyhalothrin exposure from soil ingestion behavior by children. More information is available in the lambda-cyhalothrin risk assessment located on the Program's website.

Potential Impacts to Biological Resources

While alternative 4 may encompass a larger treatment area than alternative 3, the potential exposure of mammals, birds, reptiles and pollinators to lambda-cyhalothrin remains similar in both alternatives. Available toxicity data for mammals and birds and the proposed use pattern suggest that the probability of exposure to a significant amount of lambda-cyhalothrin that would result in adverse effects is very low. Primary exposure and risk for terrestrial vertebrates would be through the consumption of treated soil and any associated soil invertebrates. The low frequency of these treatments in the Program and the soil application in a small area suggest that non-target birds and mammals would have to consume many times their daily food consumption rates to receive a dose that could result in an effect. Indirect effects through loss of prey items for insectivores are also not expected because non-target mammals and birds would not forage solely on or near treated host plants. USDA-APHIS will continue to adhere to product label requirements preventing the use of lambda-cyhalothrin near water sources, which minimizes exposure and risk to aquatic species.

**(b) Soil Insecticide Application with Diazinon**

Under this alternative, States could apply for special local needs permits to allow the application of diazinon to containerized nursery stock or within the drip line of fruit fly host plants located on commercial premises that are part of a fruit fly quarantine. Application rates would be the same as described in alternative 3, and diazinon applications also would occur to containerized nursery stock on commercial premises. Applications would not occur on residential or public lands.

<u>Potential Impacts to Air, Water, and Soil</u>

The impacts to the physical environment will be similar to the impacts described under alternative 3. Diazinon may be transported to the atmosphere as vapor or in particulate form. Little to no diazinon would be found in the air because application is through soil drench; diazinon volatilizes only slightly from soil, although more volatilization occurs in wet soil (USEPA, 2016c). Diazinon binds to organic matter in soil (Arienzo et al., 1994) and has a short half-life in soil (USEPA, 2008a). Diazinon in the atmosphere will degrade as discussed in alternative 3 (Muñoz et al., 2011; USEPA, 2016c). Surface and groundwater contamination with diazinon is not expected based on restrictions prohibiting use near surface water.

<u>Potential Impacts to Human Health</u>

The potential for exposure and health risk to workers is described under alternative 3. Risks to the public's health are negligible as exposure is unlikely given the use pattern and label restrictions.

<u>Potential Impacts to Biological Resources</u>

The impacts to biological resources will be similar to those described in alternative 3. Diazinon is a broad-spectrum insecticide and arthropods in the treated soil would likely die. Diazinon is highly toxic to bees but the use as a soil drench and not to flowers or foliage minimizes exposure to bees and other pollinators. Birds are unlikely to be in the treatment area during applications. However, they may enter the area shortly after treatment and contact treated soil or eat insects exposed to diazinon. The low frequency of these treatments in the Program and the application to soil in containers suggest that non-target birds and mammals would have to consume many times their daily food consumption rates to receive a dose that could result in an effect. Indirect effects through loss of prey items for insectivores are also not expected because non-target mammals and birds would not forage solely on or near treated containerized host plants. Diazinon is toxic to fish but aquatic exposure is negligible. USEPA uses effects data for birds to represent sensitivity to reptiles, consequently, it appears that reptiles receiving a dose of diazinon during an application would likely be negatively affected in the same ways as described for birds.

**(c) Spinosad Bait Spray (GF-120 NF Naturalyte)**

Under alternative 4, commercial premises within the quarantine area would be subject to eradication treatments with spinosad bait spray regardless of their market intentions. Residential properties are also treated for eradication. In addition to the uses described in alternative 3 for spinosad bait spray in regulated premises prior to the movement of regulated articles, the Program uses spinosad in eradication efforts. Ground and aerial applications for eradication would follow the same formulation, rate, and treatment interval as described in alternative 3. The Program would not use aerial applications in residential or other public areas. Rather, in these areas, the Program would use ground applications that involve the localized spray of host plants and other vegetation as needed within a 200–500 m radius of a fruit fly find. The Program continues to use spinosad bait spray for a minimum of two fruit fly generations or until no fruit flies are detected in subsequent survey cycles. However, if the insecticide reduces fruit fly populations to low levels, the Program may stop using the insecticide and apply SIT (see section 4a below).

STATIC™ Spinosad ME would also be used as part of alternative 4 and is described under mass trapping. The formulation contains a combination of spinosad and the attractant methyl-eugenol. The method of application is by hand as dollops or large droplets to sites on telephone poles, light poles, fences, non-crop tree trunks or limbs, non-edible foliage, etc. USDA-APHIS prepared a risk assessment evaluating the use of STATIC™ Spinosad ME, which is available on the Program's website (last accessed April 9, 2018 at https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/fruit-flies/ct_fruit_flies_home), which is incorporated by reference (USDA-APHIS, 2014).

Potential Impacts to Air, Water, and Soil

Under alternative 4, the geographic area receiving treatment is likely to be larger than that under alternative 3 because treatments will occur throughout the entire quarantine area. The impacts to the physical environment from spinosad bait spray applications for eradication purposes are similar to those described under alternative 3. Due to the rapid breakdown and lack of movement of spinosad in the environment, USDA-APHIS does not anticipate permanent effects to the quality of air, soil, and water (USDA-APHIS, 2003b).

Potential Impacts to Human Health

As described in alternative 3, the acute toxicity of spinosad is low by all routes of exposure (oral, dermal, and inhalation) (USEPA, 2005a; USDA-APHIS, 2014). Subchronic and chronic studies of spinosad also indicate low hazard (USDA-APHIS, 2014; USEPA, 2016i).

Under alternative 4, workers are still the most likely group with the potential to become exposed to spinosad. Since eradication treatments would occur throughout the quarantine area, there is a slight chance of exposure by members of the public. The Program would not use aerial applications in residential areas. The general public would not be exposed to STATIC™ Spinosad ME because it is applied to areas on telephone poles, light poles, fences, non-crop tree trunks or limbs, non-edible foliage, etc., and the application sites are out of the reach of humans (USDA-APHIS, 2014). In an earlier risk assessment, USDA-APHIS looked at several exposure scenarios and determined the greatest potential public exposure to spinosad bait spray applications rose during the scenario of a child consuming contaminated runoff. However, even under this scenario, adverse effects are not anticipated due to the regulatory reference value for spinosad being more than 1,000-fold greater than the potential exposure (USDA-APHIS, 2003b).

Potential Impacts to Biological Resources

USDA-APHIS anticipates the same impacts on biological resources as described in alternative 3. Ground applications are to host plants and the number of non-target insects exposed will be less than from aerial applications. Since 2002, the Program mostly used ground applications of spinosad bait spray (as opposed to aerial applications) because most fruit fly outbreaks occur in urban areas where ground applications would be more effective (USDA-APHIS, 2017a).

**(d) Malathion Bait Spray**

Under alternative 4, ground and aerial applications of malathion would follow the same formulation, rate, and treatment interval as described in alternative 3. Malathion bait spray applications will only occur on commercial premises, as described under alternative 3. For eradication purposes, the Program continues to use malathion bait spray for a minimum of two fruit fly generations or until there are no more fruit flies detected in subsequent survey cycles. As with spinosad bait spray, if fruit fly populations are reduced to low levels, the Program may stop applying malathion and instead use SIT.

Potential Impacts to Air, Water, and Soil

Despite the potential for a wider use area that includes all commercial premises, USDA-APHIS anticipates the same types and intensity of impacts will occur in the physical environment as described in alternative 3.

Potential Impacts to Human Health

As described in alternative 3, humans and other mammals exhibit low acute toxicity from oral, dermal, or inhalation exposure of malathion (USDA-FS, 2008). Malathion is a very slight dermal irritant and a slight eye irritant. Workers (applicators) remain the most likely segment of the human population at risk of potential exposure. The risk of exposure risk continues to be minimized through the use of PPE and by following label instructions. Similar to alternative 3, treatment under this alternative is restricted to commercial premises. The Program's use pattern and label restrictions minimize the potential for exposure by members of the public.

Potential Impacts to Biological Resources

USDA-APHIS anticipates the same effects on biological resources as described in alternative 3. Applications under alternative 4 are to eradicate fruit flies and may involve a larger geographic area.

**(e) Mass Trapping**

The program will use traps containing lures for detection, delimitation trapping, and monitoring of populations. Mass trapping differs from detection because it involves the placement of numerous traps within a quarantine area to attract and kill male or female fruit flies with the intention of reducing, and then eradicating, fruit fly populations. Mass trapping would involve a higher number of traps than trapping for detection and monitoring. The Program could use traps containing an attractant combined with naled, DDVP, or STATIC Spinosad ME™. The impacts for these insecticides would be the same as reviewed above, and as described on the Program website. Mass trapping with an insecticide could also include a carrier such as Min-U-Gel®.

Potential Impacts to Air, Water, and Soil

The trap's design places both the lure and insecticide into the interior of the trap. This significantly minimizes exposure of the chemicals to weathering effects in the environment, and at the same time, also minimizes chemical release into the environment. No direct effects to soil or water are anticipated from trapping. Although some volatilization of insecticides is known to occur from some traps, the effects to air quality outside the trap are still negligible because of the small quantities involved. The low concentration of insecticide used in program applications is insufficient to adversely affect soil, air, or water resources and quality. Although insecticide could be washed by rainfall from spot treatments, the small amount of insecticide that could be carried to soil or in runoff water following rain would have negligible effects on soil or water resources and quality. Depending on the frequency of monitoring and replacement of traps, slight soil impacts could result from vehicular and foot traffic.

Potential Impacts to Human Health

To minimize the potential of exposure, workers setting and collecting traps will wear appropriate PPE as required by the label. Adverse health risks to workers are not expected based on the application method, trap design, and low potential for exposure to DDVP, spinosad or naled when applied according to label directions (USDA-APHIS, 2014, 2017b, d). Adverse health effects for a worker from accidental inhalation are not expected because both the assembly and placement of traps occurs outdoors.

There is moderate to high social acceptance by the general public who regard trapping and bait station techniques as safe (Suckling et al., 2014). If USDA-APHIS chose this alternative, it would notify agricultural workers and others in the vicinity of traps and spot treatments so they know about the traps and avoid contact with them. Unless vandalized, traps and spot treatments are unlikely to be disturbed by humans, and in nearly all situations, trap and bait station placement is above the reach of the general public.

Potential Impacts to Biological Resources

Mass trapping will pose little threat to non-target plants and animals, especially if insecticides are not used. The proposed use of DDVP-impregnated strips in traps, and adherence to label requirements, substantially reduces the potential for exposure to humans and the environment, including non-target biological organisms (USDA-APHIS, 2017b). Similarly, naled and spinosad pose little risk to fish, wildlife, and other biological organisms when applied according to label directions because of the application method and overall low amounts of chemical used in the Program (USDA-APHIS, 2014, 2017d).

Incidental collection of non-target invertebrates attracted to the trap design, para-pheromones, or other attractants, occurs with any sampling protocol, but the Program finds the number of non-target invertebrates collected over time is generally very low (Dowell, 2015). Trapping also removes fruit flies as prey items for some animals, but this potential impact is not expected to be significant because of the placement and low numbers of traps used in the

Program. Based on their species-specific nature, the pheromones used in mass trapping generally are nontoxic to beneficial insects and to vertebrates (El-Sayed et al., 2006).

### (e) Male Annihilation Technique

MAT involves traps, sticky panels, or spot treatments baited with male attractant lures (cuelure or methyl-eugenol), a carrier (Min-U-Gel® or SPLAT) and an insecticide (naled, spinosad, or DDVP) to trap and kill male fruit flies. The lure-insecticide mixture can be applied to tree trunks, utility poles, and fences using hand-held equipment (e.g. pressurized tree marking spray gun). This technique reduces fruit fly populations by eliminating males and reducing the availability of males to mate with females.

Potential Impacts to Air, Water, and Soil

Although the lure-insecticide mixture could be washed by rainfall from a trap or treated spot, the small amount of insecticide that could be carried to soil or in runoff following rain would have negligible effects on soil or water resources and quality. Depending on the frequency of spot treatments or trap placement, slight soil impacts could result from vehicular and foot traffic during the application or monitoring of traps. Although some volatilization of lures or insecticides is known to occur, the effects to air quality are still negligible because of the small quantities involved. Therefore, the low concentration of insecticide combined with the low quantities used in Program applications are insufficient to adversely affect soil, air, or water resources and quality.

Potential Impacts to Human Health

MAT poses a low risk to human health. Adherence to label requirements substantially reduces the potential for exposure to humans from the insecticides (naled, spinosad, or DDVP) used in this technique (USDA-APHIS, 2014, 2017d, b). The quantities of lures (cuelure or methyl-eugenol) are minor and the method of use further reduces the potential for exposure resulting in a lack of risk to human health (USDA-APHIS, 2014).

Potential Impacts to Biological Resources

Most non-target organisms will not come into contact with the traps, spot treatments, or the chemicals within them. The temporary disruption of sensitive plants and nesting birds during treatment applications and monitoring does not cause lasting adverse effects. Neither naled, spinosad, or DDVP is expected to have significantly adverse effects on fish, wildlife, and other biological organisms because of the application method when applied according to label directions, and the low amounts used in the Program

(USDA-APHIS, 2014, 2017b, d). The quantities of cuelure and methyl-eugenol used during the Program are below the level to detect any adverse impacts to biological resources (USDA-APHIS, 2014).

### 4. Non-chemical Eradication Approaches

APHIS relies on SIT and physical controls for its non-chemically based eradication approaches. The male sterile fruit flies being released can be produced either from genetic engineering or traditional techniques. Based on the population size of any individual outbreak, the effectiveness of these techniques may be limited. For this reason, the Program does not rely on them in the absence of chemical eradication approaches.

#### (a) Sterile Insect Technique

SIT reduces fruit fly populations through the intentional release of sterile male fruit flies by aircraft or ground vehicles into the environment where they mate with wild female fruit flies to produce only infertile eggs. The frequent release of sterile insects in sufficient numbers will cause the feral population to decline and eventually become eradicated.

<u>Potential Impacts to Air, Water, and Soil</u>

SIT programs are considered to have few environmental detriments except to the target insect (Alphey et al., 2010). Irradiated flies are sterile, but they are not radioactive.

SIT release and monitoring operations should not adversely affect water resources because they do not introduce chemicals into water. SIT release and monitoring operations are similar to routine procedures that commercial producers and homeowners use during gardening, yard maintenance, and waste disposal operations. For this reason, any disturbance to soil from SIT operations is not expected to exceed the impacts associated with those types of activities.

The use of small aircraft to disperse sterile flies will release some pollutants such as $CO_2$, $NO_x$, CO, $SO_x$, and water vapor associated with the operation of the aircraft. However, since agricultural aviation is currently used to treat crops, it is highly unlikely that the infrequently used planes that release flies would add significantly to pollutant loads. This also applies to the use of road vehicles to move to treatment points, or to release sterile flies by ground.

<u>Potential Impacts to Human Health</u>

Workers in USDA production labs rearing sterile flies are subject to a safety protocol, which lowers the risk to minimal levels. Released sterile fruit flies do not pose any human health risks to the public that differ from wild fruit flies. Consequently, impacts to the human population from the use of SIT as a control method are highly unlikely. Only members of the public involved in an airplane or ground vehicle accident would be impacted by this eradication method.

Potential Impacts to Biological Resources

USDA-APHIS determined SIT to be safe for use in all habitats, including endangered and threatened species habitats, based on the species-specific nature of sterile releases that greatly minimizes any non-target impacts (Alphey et al., 2010).

For a limited amount of time, the population of fruit flies becomes augmented with the addition of sterile flies who feed on host plants and fruit. However, this temporary impact caused by releases is rapidly outweighed by the benefits of the overall population decline over time. Sterile flies will also compete with other fruit fly species for food items, and this may cause some short-lived shifts in trophic relationships. Consumption of sterile flies by birds or other predators should pose no risk since the flies are not different from wild flies except for the inability to reproduce.

Migratory birds may be temporarily disturbed by noise and air flow changes associated with the use of small aircraft. Because airfields may provide locations for key bird resources such as foraging areas and nesting sites (Belant et al., 2013), special care should be taken to avoid disruption of bird activity (Lambertucci et al., 2015). When planning any flights for the program, bird migration and daily use patterns should be considered, including adjustment of flight times as necessary. The program may need to defer to ground treatment in known flyways or near bird refuge areas. APHIS will consider specific treatment areas and plans on a case-by-case basis, taking care to locate nesting sites and flight patterns of migratory birds before implementing treatments or sterile releases. Collisions among planes may also be a risk based on the reported higher probability of collision at lower altitudes where small aircraft fly (Belant et al., 2013; Lambertucci et al., 2015).

**(b) Sterile Insect Technique with Genetically Engineered Flies**

USDA-APHIS evaluated the potential environmental consequences associated with the release of GE fruit flies into the environment in the *Use of Genetically Engineered Fruit Fly and Pink Bollworm in USDA-APHIS Plant Pest Control Programs* Final Environmental Impact Statement—October 2008. The analysis is incorporated into this EIS by reference. The potential environmental consequences of using GE fruit flies would be similar to those from the traditional SIT fruit fly program.

Potential Impacts to Air, Water, and Soil

Risks to the physical environment from the use of GE fruit flies do not differ from those discussed for sterile insects produced by traditional methods.

Potential Impacts to Human Health

The use of PPE minimizes the limited occupational risks to laboratory workers exposed to chemicals during processes in the production of GE sterile fruit flies.

GE flies do not differ from wild flies except that they are sterile. Consequently, humans encountering released GE flies should have no risk from contact and they are highly unlikely to be able to discern any differences between the two types of flies. Public attitudes and general acceptance of this technology may be a problem in some geographic areas (USDA-APHIS, 2008; Liebhold et al., 2016).

Potential Impacts to Biological Resources

Impacts on biological resources from the use of GE fruit flies are not expected to differ from those of traditionally produced sterile fruit flies, including impacts to the target population of wild fruit flies and non-target organisms. Release of sterile males usually leads to a rapid collapse of the target population (e.g., (Leftwich et al., 2014)). Since the purpose of the release of GE flies is to reduce the overall target population through unsuccessful reproduction, any temporary increase in that population (created by the initial release of GE males) is more than compensated for by the ultimate benefits of lowering or eradicating the overall fruit fly population. GE flies may serve as prey items for insectivorous animals, and because only the genetic sequences governing reproduction of the flies were manipulated, there should be no harm to consumers (USDA-APHIS, 2008).

**(c) Physical Control**

Potential Impacts to Air, Water, and Soil

The evidence of a breeding population (mated female, larvae, pupae, or multiple adult captures) results in the physical removal of host fruit from all known infested and adjacent properties within and up to a 100−200 meter radius. Fruit is placed in heavyweight plastic bags and removed to a landfill site for burial under at least one foot of fill. These activities may result in some soil disruption, and may increase soil erosion by removing plant material. In the southwest and western program areas where little natural vegetative cover exists, soil disturbances may be exacerbated by runoff during heavy rainstorms. The host fruit and plants may be destroyed by burial, incineration, or a combination of both methods at an approved landfill or refuse site. Potential impacts to soil, water, and air are not expected to exceed those associated with routine procedures that commercial producers or homeowners use during planting, gardening, or yard maintenance operations.

Potential Impacts to Human Health

The risk of injury to workers removing fruit and/or host plants is comparable to the risks associated with harvesting or any other agricultural activity. If fruits or plants were previously treated with pesticides, then following with label restrictions regarding reentry intervals and PPE reduces the risk to workers.

Potential Impacts to Biological Resources

Host removal and fruit stripping is not expected to impact biological resources other than the possibility that fruit fly predators would need to find alternative prey items. Disturbance to soil during physical methods of control may temporarily limit or disrupt populations of soil microorganisms, earthworms, and other soil fauna if there is soil desiccation or erosion. With respect to other plants in the vicinity, weedier plants could take the place of the removed plants, and increase competition for resources.

## C. Other Considerations

The socioeconomic factors, market, and non-market effects associated with the Program alternatives are discussed in this section. In addition, USDA-APHIS described the analyses and consultations it conducts to determine potential impacts of the alternatives on minority and/or low-income communities, federally-recognized tribes, and historic and cultural sites in site-specific program areas. Finally, this section discusses potential environmental impacts of program activities on threatened and endangered species, migratory birds, and bald and golden eagles.

### Socioeconomic Factors

People potentially affected by fruit fly infestations and resulting fruit fly control (alternative 3) or eradication (alternative 4) efforts include commercial producers; residential and commercial property owners within quarantine areas; home gardeners; beekeepers; pesticide applicators; processors and retailers of affected commodities; and consumers. Fruit fly program actions targeting eradication will result in short-term costs, yet provide long-term benefits for people within all of these groups.

The introduction and/or establishment of fruit flies causes economic losses through the destruction of host agricultural commodities by larvae; costs associated with prevention, control, and quarantine; potential environmental impacts due to increased pesticide use to manage fly populations; and loss of market share due to restrictions on the shipment of host commodities potentially infested with fruit flies. The damage caused to fruits by larval feeding renders those commodities unfit for human consumption, and the presence of an established pest population results in significant domestic and international economic impacts. In addition to revenue loss from decreased yields and increased costs due to monitoring and management, fruit fly infestations can reduce commercial producers' ability to produce and export their crops; importing countries could ban shipments from infested areas (Goodhue et al., 2011). The loss of international markets creates significant economic consequences for both the importing and exporting countries. Once a fruit fly population establishes, the area must use costly pre- and post-harvest treatments to produce a crop, as well as certify commodities for movement.

For example, four species of fruit fly are established in Hawaii and have cost the state more than $300 million annually in lost markets for locally grown produce since their establishment. This estimate does not include potentially high-value export markets (USDA-ARS, n.d.). Countries with established fruit fly populations have significant trade barriers imposed on their exports. The California Department of Food and Agriculture estimated that an established infestation of Medfly would cost from $855 million to $1.4 billion during the first year of establishment (USDA-ARS, n.d.).

An OFF outbreak in 2015 caused at least $4.1 million in direct crop damages in Miami-Dade County, Florida (Alvarez et al., 2016) while the eradication cost exceeded $2.7 million (USDA-APHIS, 2017a). Estimates of the total regional impact of the infestation include $10.2 million and 124 jobs (Alvarez et al., 2016).

**Market Effects**

The potential for the rapid spread of fruit fly infestations requires that programs be initiated as soon as possible after initial detection to limit long-term damage to host agricultural commodities and markets. Imposition of a quarantine would initially increase costs for commercial producers and markets, and perhaps consumers as increased production costs are passed along. After a quarantine is lifted, control costs are likely to decrease as potential economic impacts on producers, consumers, and domestic and international markets stabilize.

As part of an OFF eradication program in Florida, commercial producers and packers in the quarantine area were required to comply with the prescribed procedures for harvesting, handling, and post-harvest processing of agricultural commodities. If flies or any larval stages were found, properties with host plants located within 200 meters had fruit removed and destroyed, and the soil was treated with a pesticide. Plant nurseries, such as tree farms, incurred losses from the requirement to treat soil with pesticides, and from having fruit stripped from the trees offered for sale, even though there were no sale restrictions or destruction of the trees (Alvarez et al., 2016). The regulated area surrounding a fruit fly find is approximately a 4.5 mile radius from the detection site for all species.

Under alternatives 3 and 4, commercial producers within a quarantine area would experience short-term economic losses through the requirement to treat their commodities before shipment outside of the quarantine area. Approved treatment facilities may not be located inside the quarantine area and it may be difficult to move produce to a treatment facility. In addition, post-harvest treatment may affect the quality or shelf life of the commodity. Commercial producers in the quarantine area but outside the 0.05 mile radius quarantine core area must apply a 30-day pre-harvest treatment or an approved post-harvest treatment prior to moving their produce. Some commercial producers will experience crop loss, and the loss of associated income, as some commodities are ready for harvest before the 30-day pre-harvest treatment cycle. Depending on the timing of a fruit fly outbreak, some commercial producers may opt to not plant annual crops. For nursery stock, quarantine requirements could affect sales because consumers may prefer to purchase plants that have fruit. Commercial producers located outside a quarantine boundary are likely to benefit from the quarantine, which protects unaffected areas from fruit fly infestations.

Use of pesticides in a fruit fly management program presents risks to commercial producers and home gardeners using biological pest controls if the populations of biological controls decline as a result of pesticide exposure. Pesticide use during fruit fly control and eradication efforts could, theoretically, present risks to honey bees, but notifications to local beekeepers would allow them to take precautions to protect their hives and substantially reduce the risk of harm. With proper precautions, there should be no loss of hives due to pesticide use (see program mitigation measures).

For pesticide applicators, program activities under alternatives 3 and 4 will entail both benefits and risks. Premise and post-harvest commodity treatments will likely create additional income for pesticide applicators. While there are health risks for pesticide applicators, applications applied pursuant to USEPA and USDA-APHIS requirements (USDA-APHIS, 2016d) limit the types and amounts of health risks to applicators (see section on human health).

Implementation of the commodity certification requirement would create a new layer of ongoing governmental presence in the marketplace. This situation could create inspection jobs, however, it would restrict trade of affected host commodities until they were inspected and certified for movement outside of the quarantine area. Some host plants could cease being grown in the area as landowners shift to non-fruit fly host plants.

The fruit fly program will benefit consumers by preserving the availability of a wide range of produce. Program activities will enhance agricultural productivity allowing commercial farms and orchards to provide produce locally, nationally, and internationally. As fruit fly control becomes part of the costs of doing business, Federal regulations restricting pesticide residues on produce will protect the general public from pesticide-associated risks (see section on human health).

**Non-market Effects**

The owners of residential and commercial properties infested with fruit flies could incur both costs and benefits from the fruit fly program. The benefits will include the long-term protection of fruit bearing and ornamental host plants from fruit flies; however, residential and commercial properties with fruit bearing or other host plants could incur short-term damage from fruit fly infestations and associated costs. Alternative 3, which targets control rather than eradication, is less likely to be effective at eliminating fruit fly populations. Alternative 3 would also be expected to result in more widespread use of pesticides by residential and commercial property owners, as well as commercial producers. Hence, there would be increased costs for some of these land owners in managing fruit fly populations, with a correspondingly greater potential for adverse environmental impacts. During quarantine, residents may also be responsible for removing all fruit from their trees and picking up fallen fruit on their property to facilitate control and eradication of fruit fly populations.

A lack of federal action (as would occur under alternative 2) could result in adverse economic and health impacts on affected producers and consumers, such as decreased harvests, higher consumer prices, loss of local employment, reduced nutritional options, or loss of market share. These indirect impacts may occur to a lesser extent under alternative 3; however, USDA-APHIS does not anticipate these types of adverse effects to occur as a result of carrying out the activities described under alternative 4.

Because fruit fly outbreaks often occur in urban/residential areas, the distribution of costs and benefits of a quarantine or other control/eradication efforts among various social groups can be somewhat inequitable. Even under the no action alternative, state and private control programs would create costs to residential and commercial property owners similar to those that might result from USDA-APHIS' fruit fly program. Because the potential inequity in distribution of costs as a result of program activities is unavoidable, every effort is made to reduce costs and associated risks from the Program among all social groups.

### Social, Cultural, and Visual Resources

Visual resources that could occur near fruit fly eradication program activities include rangeland, pastures, refuges, rivers, buildings, streets, view corridors, and vistas. Any visual, atmospheric, or auditory effects during application of program treatments will be limited in duration, intensity, and area.

The National Historic Preservation Act of 1966, as amended (16 United States Code (U.S.C.) § 470 et seq.), requires Federal agencies to consider the impact of their proposed actions on properties included in, or eligible for inclusion in, the National Register of Historic Places (36 CFR §§ 63 and 800). Subsequently, USDA-APHIS consults with the appropriate State Historic Preservation Office when preparing site-specific EAs. USDA-APHIS may handpick fruit from landscape plants surrounding historic places. In general, USDA-APHIS' fruit fly eradication program is compatible with the preservation of historic sites because it discreetly integrates control activities into the site. Program activities do not cause significant ground disturbance, and the treatments do not affect human-made structures. USDA-APHIS restricts program treatments and activities to an as-needed basis, and also can modify normal program activities at historically significant locations to reduce pesticide release, if necessary. Therefore, USDA-APHIS' fruit fly program activities are unlikely to alter directly or indirectly characteristics of a historic property that qualify it for inclusion in the National Register of Historic Places.

Federal agencies identify and address the disproportionately high and adverse human health or environmental effects of their proposed activities, as described in Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." USDA-APHIS identifies demographics within site-specific treatment and quarantine areas and engages locally impacted people in collaborative decisions on trap placement whenever possible. During its analyses, USDA-APHIS considers the potential environmental impacts of implementing various program methods on minority and/or low-income communities, tribal interactions, and historical and culturally sensitive sites in a program area, and modifies its proposed actions as needed.

Federal agencies must ensure their programs and activities comply with Executive Order 13166, "Improving Access to Services for Persons with Limited English Proficiency." To meet this need, USDA-APHIS conducts outreach to non-English-speaking communities through a variety of public notices and informational brochures about fruit fly eradication program activities. Providing notice ensures people avoid exposure during trap placement and maintenance.

Federal agencies consider a proposed action's potential effects on children to comply with Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks." The intermittent presence of children at shelters, playgrounds, parks and picnic areas, religious centers, public/private campgrounds and trailer parks, athletic fields, bus depots, and outdoor community facilities means they are likely to be at locations where bait traps are in use. However, the placement of these traps is designed to be above a child's reach. Residential areas, schools, outdoor play areas, and roads children routinely use for transit are located throughout the potential program areas. Generally, zoning restrictions ensure separation of agricultural areas from residential areas. This situation means children (and other residents) are unlikely to see or be aware of program activities, including pesticide use.

USDA-APHIS will maintain traps and apply pesticide applications only when children are not present in the immediate area. Where possible, the Program will not apply baits on school property. When pesticide applications are essential, the Program will consider ground applications such as the use of a backpack sprayer prior to considering the use of aerial applications. Any exposure of children to applied products is negligible based on the Program's routine application methods and product formulations. Subsequently, the proposed programs in alternatives 3 and 4 are not expected to pose any highly disproportionate adverse effects to children, minority, or low-income populations because (1) these individuals are unlikely to be present when the Program applies treatments or maintains bait traps, and (2) exposure to applied pesticides is negligible.

Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," calls for agency communication and collaboration with tribal officials when proposed Federal actions have potential tribal implications. The Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa-mm), secures the protection of archaeological resources and sites on public and tribal lands. USDA-APHIS uses the Native American Graves Protection and Repatriation Act Online Databases (NPS, 2016; 25 U.S.C. §§ 3001 et seq.) to find Federal reservations located near proposed fruit fly eradication program areas. USDA-APHIS also reaches out to federally-recognized tribes that may have historic or cultural resources in an area, or tribes that have land claims in an area. Because the actions described in alternatives 3 and 4 are unlikely to disturb the ground, it is unlikely that USDA-APHIS will affect Native American sites or artifacts. If USDA-APHIS discovers any archaeological resources, it will notify the appropriate individuals. In addition, USDA-APHIS will initiate consultation with governing tribal authorities and local Tribal Historic Preservation Officers if fruit fly eradication program actions on tribal lands are desired.

**Endangered Species Act**

Section 7 of the ESA and its implementing regulations require Federal agencies to ensure their actions are not likely to jeopardize the continued existence of listed threatened or endangered species, or result in the destruction or adverse modification of critical habitat.

### a) Potential Effects of Fruit Flies on Threatened and Endangered Species

Although there are few records of native host plants of fruit flies because collections have concentrated on commercial fruits (Uramoto et al., 2008), widespread establishment of exotic fruit flies in the United States could have adverse impacts to listed plant species. For instance, for several *Bactrocera* and *Dacus* species, cucurbits (plants in the family Cucurbitaceae, the gourd family) are preferred hosts. The Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*) is an endangered cucurbit species in Florida, and attack of fruits by exotic fruit flies could pose a threat. Several insects, including striped cucumber beetles, pickleworm, and melonworm, already cause damage to Okeechobee gourd plants (USFWS, 2009). The endangered St. Thomas prickly-ash (*Zanthoxylum thomasianum*), which belongs to the citrus family (Rutaceae), could potentially be adversely affected by exotic fruit fly species such as the Medfly that are attracted to citrus hosts. Similarly, *Prunus* species are preferred hosts of the Medfly, and establishment of that pest in Florida could potentially adversely affect the endangered scrub plum (*Prunus geniculata*). The endangered Puerto Rican plant erubia (*Solanum drymophilum*) would be a likely host for the OFF, a fly species that has many *Solanum* hosts (USDA-APHIS, 2016b).

Establishment of exotic fruit flies may also affect listed animal species. Wild lime (*Zanthoxylum fagara*) and sea torchwood (*Amyris elemifera*) are the only known host plants for the larvae of the endangered Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*) found in southern Florida (USFWS, 1999). These plants belong to the citrus family Rutaceae, and the Medfly may attack their fruits. It is likely that there are other potential host plant species that are primary constituent elements of critical habitat for listed animal species (e.g., food or nectar source, shelter location), and may be affected if exotic fruit flies were to establish in the environment.

### b) Potential Effects of Fruit Fly Eradication Programs on Threatened and Endangered Species and Critical Habitat

Effects to listed species from the proposed alternatives for treating and eradicating exotic fruit flies may pose a risk to listed species and their designated critical habitat without proper mitigation.

<u>Quarantine Establishment and Treatments for Interstate Movement of Regulated Articles</u>

Establishment of a federal quarantine where USDA-APHIS would not allow regulated articles within the quarantine area to move outside of the quarantine area would have no effect on listed species or critical habitat. Treatments applied to allow interstate movement of regulated articles, including irradiation, cold treatment, vapor heat treatment, and methyl bromide will have no effect on listed species or critical habitat. These treatments are covered or conducted in enclosed facilities, and listed species and their habitats would not be exposed to them.

Eradication Treatments

*Fruit Stripping*

The evidence of a breeding population (mated female, larvae, pupae, or multiple adult captures) results in the removal of host fruit from all known infested and adjacent properties within a 100−200 meter radius. Fruit is placed in heavyweight plastic bags and removed to a landfill site for burial under at least one foot of fill. Fruit stripping as described in alternatives 3 and 4 is not expected to have an effect on threatened or endangered species because this normally involves removal of dooryard or commercial fruit.

*Sterile Insect Technique*

SIT involves releasing millions of sterile insects over a wide area to mate with any fertile insects that may be present. Fertile females that mate with the sterile males produce non-viable eggs, leading to an interruption in any target pest population's reproductive cycle. This technology is currently only available for Medfly and Mexfly, but in the future, other sterile fruit fly species may become available for use. SIT principles and practices are an internationally accepted area-wide integrated pest management tool. This technology, using radiation to sterilize insects, was first developed in the United States, and is currently applied on six continents. The use of SIT poses no impacts to non-target wildlife other than providing a temporary source of food for some insectivorous species. The use of SIT is also compatible with protection of endangered and threatened species of wildlife and their habitats. Release of sterile fruit flies will have no effect on listed species or their habitats.

*Insecticide Treatments*

For fruit fly eradication programs, effects could occur from insecticide treatments including MAT using naled, DDVP, or spinosad, aerial and ground foliar application of spinosad or malathion bait sprays, and soil drenching with lambda-cyhalothrin or diazinon. Direct effects are those that result from the immediate effects of the application on a listed species or its habitat. For listed animals in the treatment areas, direct effects could result from exposure to program insecticides. Indirect effects to listed species are those effects that are caused by or would result from the project and are later in time, but are still reasonably certain to occur. For instance, application of program insecticides can result in a reduction in pollinators of listed plants. Most plant species are dependent on animal pollination for reproduction, thus, pollinator decline from insecticide application may reduce plant reproduction and the persistence of listed plant populations.

MAT spot treatments contain a male attractant (methyl-eugenol) that is mixed with a small amount of the pesticide naled, DDVP, or spinosad. There is low potential for exposure of listed species to these insecticides because treatments are limited to spot applications of the bait to areas of non-food plants, fence posts, utility poles, and other inanimate surfaces that are not readily accessible to most non-target species. Methyl-eugenol, the lure ingredient in the MAT formulation, is considered moderately toxic to mammals if ingested, and can attract certain non-target invertebrates (USDA-APHIS, 2014). Methyl-eugenol poses a slight risk to certain terrestrial invertebrates that are attracted to the bait due to its presence, and they could receive a lethal dose of naled, DDVP, or spinosad. However, based on the selective nature of the attractant, the impacts would be localized and transient, and are not anticipated to result in population level effects to sensitive taxa, including beneficial arthropods.

Aerial and ground application of spinosad and malathion could affect listed species in the treatment area. Use of malathion and aerial application of either insecticide are rarely, if ever, proposed as part of an eradication program, but may be considered under certain circumstances. Ground application of spinosad or malathion bait sprays are targeted to the foliage of host plants up to 400 meters from a fruit fly detection, and are not likely to affect listed species or habitat. Aerial applications of insecticides are more likely to have possible effects to listed species or critical habitat if they occur within the treatment area because aerial applications are less targeted and drift of the applied material could occur. Protein hydrolysate is a common attractant used in fruit fly treatments, increasing the efficacy of chemical applications and reducing the area of pesticide treatments needed for control (Prokopy et al., 1992). Protein hydrolysate alone is expected to have minimal impacts to environmental quality and non-target species because of its low toxicity.

Soil drenching applications occur with diazinon and lambda-cyhalothrin. Lambda-cyhalothrin applications are made to fruit fly host plants up to 400 meters from a fruit fly detection. These applications are made only to soil within the dripline of the host plant. Drift from the soil drench application is minimal because large, coarse droplets are applied in close proximity to the targeted area. Diazinon is applied to the soil of containerized nursery stock on commercial premises. The method of application of both insecticides results in a low probability of exposure of listed species. There is the potential for terrestrial vertebrates to forage for soil-borne invertebrates under treated areas where they could consume treated soil and soil invertebrates that may contain lambda-cyhalothrin or diazinon residues. However, based on the typical food consumption rate for various sized mammals, birds, and reptiles, and the toxicity profile for these insecticides, it is unlikely that adverse effects to listed species could occur ((USDA-APHIS, 2017c, 2018c)). Significant exposure to pollinators is also not expected because lambda-cyhalothrin is being applied directly to soil, and diazinon is being applied directly to containerized non-fruit bearing nursery stock; neither insecticide is applied to flowering parts of host plants. Lambda-cyhalothrin and diazinon are not systemic and soil applications would not result in detectable levels of lambda-cyhalothrin or diazinon in pollen and nectar.

### c) Endangered Species Act Consultations with FWS and NMFS

USDA-APHIS considers whether listed species, species proposed for listing, or critical habitat are present in the proposed program area. If none are present, no Section 7 consultation is required. If species or critical habitat are present in the proposed treatment area, USDA-APHIS conducts Section 7 consultation with the FWS and/or NMFS on a site-specific basis for exotic fruit fly eradication activities. USDA-APHIS, or cooperators, in Florida, Texas, California, and Puerto Rico have conducted ESA section 7 consultation with the FWS and/or NMFS since the 1990's when outbreaks of fruit flies have occurred and the eradication program required Federal involvement. The first biological assessment for fruit fly species was prepared for the Mediterranean Fruit Fly Cooperative Control Program (USDA-APHIS, 1993). Since that time, protection measures developed from that consultation have been refined and built upon primarily through discussions with FWS and NMFS on site-specific programs, rather than through broad programmatic reviews. Timely consultation is important to the rapid response required for the emergency actions of most fruit fly cooperative control programs.

For Texas, USDA-APHIS has a programmatic consultation in place for Mexfly eradication programs in Brooks, Starr, Webb, Zapata, Willacy, Hidalgo, and Cameron Counties. Those counties have the highest frequency of eradication programs in Texas. Prior to implementing a Mexfly eradication program, USDA-APHIS personnel contact the FWS, Texas Coastal Ecological Services Field Office. FWS personnel review maps of the quarantine area and indicate whether listed species or critical habitat occur in the area. If present, USDA-APHIS implements conservation measures developed in the programmatic consultation process. The conservation measures require a buffer for insecticide use from listed species or critical habitat locations, with use of SIT and/or fruit stripping within the buffer zone. USDA-APHIS keeps the Mexfly programmatic consultation up to date, and reinitiates the consultation if new species are listed or critical habitat is designated within the three counties, or if the Program intends to use a control method that is not included in the consultation. Consultation is initiated on a site-specific basis if Mexfly eradication programs are proposed for counties other than Cameron, Willacy, and Hidalgo.

The State of California has developed a Natural Diversity Data Base that assists programs in accessing the location of listed species and their critical habitats. This information allows the Program to readily determine whether there are listed species occurring within the proposed treatment area. Currently, as fruit fly eradication programs are proposed in California, ESA consultations occur with the appropriate FWS and NMFS offices on a site-specific basis. This is to ensure that the appropriate protection measures are in place so that program activities will have no effect or are not likely to adversely affect listed species or their habitats. However, because of the frequency of exotic fruit fly eradication programs in California, USDA-APHIS is preparing programmatic biological assessments for both NMFS and FWS for exotic fruit fly eradication programs wherever they may occur in California. USDA-APHIS anticipates that it will take two to three years to complete these consultations.

For Florida, exotic fruit fly eradication programs are uncommon, and consultations occur on a site-specific basis. When they occur, USDA-APHIS contacts FWS, South Florida Ecological Services Office for emergency consultation. FWS reviews maps of the treatment area and reviews the project description and determines if there are potential effects for listed species. USDA-APHIS prepares a biological assessment and submits it to FWS after the emergency activities are completed. The consultation process is similar for Puerto Rico because exotic fruit fly eradication programs are very rare there.

**Migratory Bird Treaty Act**

The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703–712) established a Federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird.

USDA-APHIS fruit fly eradication programs could affect migratory birds through disturbance of nests, exposure of birds to insecticides, or a reduction in insect prey from insecticide application. In a July 2015 letter, the FWS made recommendations regarding the protection of migratory birds during the implementation of exotic fruit fly eradication programs (USFWS, 2015). The FWS recommended that activities requiring vegetation removal or disturbance avoid the peak nesting period of March through August to avoid destruction of individual birds, nests, or eggs. If project activities must be conducted during this time, FWS recommends surveying for nests prior to commencing work. If a nest is found, if possible, FWS recommends a buffer of vegetation (≥ 50 feet) remain around the nest until young have fledged or the nest is abandoned.

**Bald and Golden Eagle Protection Act**

The Bald and Golden Eagle Protection Act (16 U.S.C. 668–668c) prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle…[or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.”

During the breeding season, bald eagles are sensitive to a variety of human activities. Fruit fly eradication program activities could cause disturbance of nesting eagles, depending on the duration, noise levels, extent of the area affected by the activity, prior experiences that eagles have with humans, and tolerance of the individual nesting pair (USFWS, 2007). Also, disruptive activities in or near eagle foraging areas can interfere with bald eagle feeding, reducing chances of survival (USFWS, 2007).

FWS has recommended buffer zones from active nests for activities applicable to fruit fly eradication programs (USFWS, 2007). They are as follows:

1. For off-road vehicle use, no buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.
2. Avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

FWS has provided recommendations for avoiding disturbance at foraging areas and communal roost sites that are applicable to fruit fly eradication programs (USFWS, 2007). They are as follows:

1. Minimize potentially disruptive activities and development in the eagles’ direct flight path between their nest and roost sites and important foraging areas.
2. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

## D. Cumulative Effects

Cumulative impacts result from the incremental impact of a program action when added to other past, present, and reasonably foreseeable future actions. The cumulative impacts for alternative 1 have been summarized in the previous EIS (USDA-APHIS, 2001a). In this EIS, USDA-APHIS will summarize the cumulative impacts from alternatives 2 and 3 together since neither alternative results in the eradication of exotic fruit fly populations that may be detected in the United States. Cumulative impacts assessed in this EIS under the preferred alternative (alternative 4) include nonchemical and chemical methods. The integration of these methods provides for a pest management plan designed to eradicate exotic fruit flies.

**Alternatives 2 and 3**

Alternatives 2 and 3 would allow for the establishment and expansion of exotic fruit fly populations in the United States. The establishment and expansion would be greatest under alternative 2 since there would be no federally funded program or quarantine in place to manage exotic fruit fly outbreaks. Under alternative 3, the quarantine and commodity treatments of host plants on commercial premises would occur, slowing the spread of fruit fly infestations, but it would not eradicate populations. Future fruit fly introductions may expand the quarantine area and increase the number of premises required to apply commodity treatments. There would be reinfestation in areas where a quarantine was in place.

Alternatives 2 and 3 would require additional insecticide treatments, increasing the potential for insecticide resistance to occur in treated fruit fly populations. For both alternatives, growers would experience an increase in production costs and a potential loss in market access. Under alternative 3, Federal and State agencies may experience costs associated with managing quarantines. This includes costs associated with notifying premises of the quarantine and implementing quality assurance and quality control on quarantine compliance.

Alternatives 2 and 3 would result in additional pesticide use to reduce the damage from exotic fruit fly infestations because fruit flies would continue to spread and neither alternative eradicates fruit fly populations. Fruit fly species can survive year round in many locations in the United States, which would require year round applications of pesticides. This could include increased use of insecticides that are currently used in the Program as well as others that are registered for fruit fly use but not part of the Program. Other insecticides may pose a greater risk to human health and the environment compared to those used in the Program due to their toxicity and use pattern. The Program currently minimizes broadcast applications by the use of trapping and nonchemical treatments; however, if these are reduced, broadcast applications could increase. Broadcast applications have a greater potential for off-site drift and runoff. Increased pesticide loading into the environment could result in increased risk to human health and the environment related to potential exposures to residues from these applications.

**Alternative 4 (preferred method)**

Alternative 4 is an eradication program that uses a combination of nonchemical and chemical methods. USDA-APHIS maintains records of its fruit fly eradication efforts, and a review of those records shows, on average, that it can take approximately three months to eradicate a fruit fly outbreak. The length of time to eradicate fruit flies depends on the geographic location and range of the outbreak. Based on historical outbreaks in the United States, the probability of repeated outbreaks occurring in the same area where treatments have occurred previously is very low. There have been cases where outbreaks have occurred in the same county over a two year span; however, it is a rare event for an outbreak to occur in the same area where previous treatments were made for fruit flies. The duration of treatment activity, which is relatively short, and the lack of repeated treatments in the same area reduces the possibility of significant cumulative impacts.

**Nonchemical methods**

The lack of significant effects on human health and the environment from the use of nonchemical methods in the Program suggests that significant cumulative impacts would not occur. Physical removal of fruit or host plants, expanding sterile insect releases, and survey and quarantine work in the Program may result in additional costs and allocation of resources; however, they would be less than costs in the other alternatives since eradication would occur under alternative 4. These costs, however, are minimized by rapid implementation of eradication activities.

The majority of fruit fly eradication program activities take place in urban areas where daily agricultural activities cause similar effects. Use of nonchemical methods may result in localized environmental impacts such as minimal habitat disturbance from vehicular or foot traffic. Wildlife may be inadvertently disturbed as traps are serviced or surveys are conducted. The short duration of program activities, combined with an integrated pest management approach, will keep the potential for cumulative impacts associated with nonchemical methods used in fruit fly eradication programs to a minimum.

**Chemical methods**

The purpose of this section is to address the potential for cumulative impacts related to insecticide use that could occur under the preferred alternative as well as other chemicals that may be used in the Program. Insecticide use can occur in trap bait stations, or liquid ground or aerial applications. Chemical attractants and preservatives used in the traps or with bait applications will not result in cumulative impacts. Available effects data summarized in this EIS show these compounds to have low toxicity and are used in the exotic fruit fly program in a way that eliminates significant exposure to soil, water and air. The lack of significant routes of exposure to human health and the environment, along with favorable toxicity profiles for these compounds, suggest cumulative impacts would not occur with their use.

The use of insecticides can result in various potential cumulative impacts, regardless of the pest program. Issues that may have cumulative impacts when using pesticides in a pest management or eradication program include:

- insect pest resistance;
- chemical mixture effects to human health and the environment; and
- persistence and bioaccumulation.

Cumulative impacts related to potential fruit fly pesticide resistance are not anticipated. Pesticide resistance has been noted in chemistries similar to those proposed for use in this program; however, they have occurred under laboratory conditions after multiple generations (ex. spinosad), or in areas where fruit fly populations are established requiring treatment over a long period of time (Hsu and Feng, 2006; Jin et al., 2011). Exotic fruit fly outbreaks in the United States occur infrequently and typically last no more than three months during eradication efforts.

Resistance in other pests that may occur in treated areas is also not anticipated since exotic fruit fly treatments are focused on fruit flies using attractants in traps, or as foliar or soil treatment directed to host plants. In addition, the exotic fruit fly program uses an integrated approach using various nonchemical and chemical control methods to ensure eradication, which also reduces selection for resistance in pest populations.

During exotic fruit fly outbreaks, there will be increased pesticide applications to meet the goal of eradication. These treatments will co-occur with pesticide applications growers use to manage other pests. In addition, since the insecticides proposed for use in the fruit fly program have a variety of agricultural and non-agricultural uses, there may be an increased use of these pesticides in an area under eradication. Other pesticide applications could occur by private, State or Federal entities to control other pests.

USDA-APHIS manages several pest programs that operate within areas of the United States where exotic fruit flies are detected. Currently, USDA-APHIS programs such as the Asian Citrus Psyllid and Imported Fire Ant programs operate in nurseries in parts of the United States where fruit fly detections have occurred. Other USDA-APHIS programs may also have pesticide applications that could occur in areas where fruit flies have been detected in the past and could be detected in the future. Estimating the potential for overlap between USDA-

APHIS programs is difficult due to uncertainty in where pests may occur and what new pests may be detected in the future, and which ones will require pesticide treatment.

The Program selects eradication methods that address the spatial and temporal factors of a fruit fly outbreak and does not follow one strategy for all fruit fly outbreaks (this is covered in more detail below). This makes it difficult to predict the Program's potential overall pesticide usage. That said, the increased pesticide loading during a fruit fly outbreak relative to other uses is expected to be minor, and not result in a significant cumulative impacts based on how the various insecticides are used in the Program. Naled and dichlorvos use is within traps; therefore, the increased use would not result in any significant residues in soil, water or air. Spinosad and malathion use can occur as broadcast applications; however, the use of attractants, and using a larger droplet size as a bait application, reduces the probability of off-site transport to soil, water or air where other pesticides and contaminants may be present. In addition, these types of applications are typically directed to foliage of host plants that may occur within a small area of an exotic fruit fly detection. Soil drench treatments using lambda-cyhalothrin and diazinon reduce the chance of offsite transport to terrestrial and aquatic environments since these types of applications are made directly to soil using a large droplet size within a limited radius of the host plant or to soil of a containerized plant.

Malathion and diazinon have been detected in surface waters throughout the United States, including areas where fruit fly eradication activities may take place. Both insecticides have numerous use patterns; however, diazinon is used less frequently as a result of the regulatory process eliminating some use patterns. The contribution of malathion and diazinon residues to surface waters from fruit fly applications is expected to be minor.

Malathion applications are used infrequently in the fruit fly program, but when applications are made, it has a large droplet containing a bait that is attractive to fruit flies. The large droplet size reduces the probability of drift to surface water. Since malathion has a short half-life in the environment, it suggests off-site risk would be short-lived.

Diazinon is currently only registered for use in California, and use is restricted to soil drench applications to containerized plants in nurseries. It could be registered in other states in the future; however, lambda-cyhalothrin is also available. Residues in the environment for both insecticides have trended downward over the past ten years due to reductions in use and additional restrictions designed to reduce off-site transport (Stone et al., 2014).

Other pesticides also occur in surface waters throughout the United States resulting in potentially synergistic or additive effects to aquatic biota (USGS, 2014). Aquatic life benchmarks were exceeded 61 percent, 90 percent and 46 percent of the time by one or more pesticides in agricultural, urban and mixed use watersheds, respectively (Stone et al., 2014). The significant number of waterbodies currently with pesticide levels exceeding aquatic life criteria suggests any additional pesticide inputs would cause additional negative cumulative impacts. The addition of potential insecticide residues from fruit fly treatments to those that are currently being measured in surface waters is difficult to quantify due to temporal and spatial variability when insecticide applications would occur. In addition, other anthropogenic and natural stressors occur in water bodies making the cumulative impacts of all stressors difficult to quantify. Label restrictions for program insecticides along with their use patterns suggest that contributions to surface water would be negligible. Risk would be greatest for aerial applications; however, available monitoring data suggest that applications would not result in residues that would have individual or cumulative impacts to aquatic environments. California Department of Pesticide Regulation collected water samples related to an aerial spinosad application in 2003 to control the Mexfly in San Diego County, CA (California Department of Pesticide Regulation, 2008). Collected surface water and runoff samples had spinosad levels below detection, and drift card samples collected within the application buffer zone were approximately ten-fold less than concentrations within the treatment area. In addition, aerial applications are rarely used in the Program decreasing the possibility of residues that could result in cumulative impacts in the presence of other stressors in the environment.

Cumulative impacts to fish and wildlife from program pesticides are expected to be negligible. Risk assessments for naled and dichlorvos show minimal risk to fish and wildlife based on the use pattern, which includes use in traps (Stone et al., 2014). The risk to fish and wildlife from methyl bromide treatments is negligible due to how treatments are made and the low frequency of use in the Program.

Spinosad and malathion risk to fish and wildlife is greater based on the effects profile and use pattern, which can include ground or aerial applications. The frequency of aerial applications is very low in the Program based on historical data (USDA-APHIS, 2017a). Between 1997 and 2017, there were approximately 135 exotic fruit fly outbreaks in the United States that required some form of treatment to achieve eradication. The methods for eradication vary based on the fruit fly species detected, and size of the quarantine. Only 5 percent of all treatments during the past 20 years used aerial applications of spinosad or malathion. Four of the seven aerial applications occurred prior to 2000 suggesting that these types of applications are becoming less common as the Program has evolved. This would suggest that any cumulative impacts related to aerial applications of either insecticide would be negligible. Also, the use of ground applications of either product with bait applications typically occurring to host vegetation within a 200 yard radius of a positive fruit fly detection reduces non-target risks and potential cumulative impacts from these types of applications.

USDA-APHIS does not anticipate the use of soil drench applications using either diazinon or lambda-cyhalothrin to result in significant cumulative impacts. Lambda-cyhalothrin and diazinon use patterns reduce exposure to non-target organisms with effects primarily to soil borne invertebrates that may be in soil immediately under host plants that are treated. In addition, use of soil drench applications in the Program is not common; in the last 20 years, soil drench applications occurred in less than 5 percent of the outbreaks. Lambda-cyhalothrin use is expected to increase as it replaces diazinon; however, the frequency of soil drench use is still expected to remain low based on historical treatments.

Risk to terrestrial wildlife from program pesticide use is expected to be greatest in the area of treatment. Lambda-cyhalothrin and diazinon will pose the greatest risk to soil borne organisms; however, cumulative impacts are not anticipated. Treatments will occur in small areas immediately under the dripline of a host plant, and in the case of diazinon, will only occur to containerized nursery stock on commercial properties that are already highly disturbed. Cumulative impacts to pollinators are not anticipated for soil drench treatments or insecticide use in traps due to lack of significant exposure. Cumulative impacts will be minimized for spinosad and malathion applications by the use of a bait and large droplet size during application, as well as following label precautions to protect pollinators. In addition most of these treatments take place in commercial nurseries or in developed areas that are intensively managed and already impacted from other management activities. Applications in developed areas and the use patterns for each of the insecticides that are proposed for use in the fruit fly eradication program minimizes risk to terrestrial vertebrates with incrementally negligible cumulative impacts. Available risk assessments for each program insecticide shows low risk to most terrestrial vertebrates based on their intended use pattern.

The insecticides proposed for use under this alternative are not anticipated to persist in the environment or bioaccumulate. Therefore, a fruit fly outbreak that occurs in an area previously treated for fruit flies is unlikely to cause an accumulation of pesticides from program treatments. Insecticides used in traps or bait stations have environmental fate properties that indicate no persistence and their use pattern minimizes contact with water, soil or air. Spinosad, malathion and diazinon have environmental fate characteristics that suggest rapid degradation under field conditions and would not persist in aquatic or terrestrial environments. Diazinon may persist longer in the environment compared to spinosad or malathion but is still relatively short and with treatments confined to containerized plants the potential for cumulative impacts is negligible. All three insecticides have chemical properties suggesting they do not bioaccumulate in the environment. Lambda-cyhalothrin does have environmental fate and chemical properties that suggest it could persist and potentially bioaccumulate. The infrequent use pattern of soil drench to containerized plants or under the dripline of host plants would suggest that impacts will be confined to highly disturbed soils and would not result in cumulative impacts. Methyl bromide use in the Program is negligible; however, any use results in rapid volatilization into the atmosphere where it would not bioaccumulate.

The potential for cumulative acute or chronic impacts to human health, and in particular, the public are not expected based on how and where treatments are typically made in the Program. In residential areas the use of traps, direct applications of insecticides to host plants, and soil drench treatments minimize the potential for exposure to the public, including those who may be sensitive to chemicals. In addition, residential treatments only occur after public notification further reducing exposure and risk. Residents are provided with contact information for the appropriate Federal and State agencies should any questions or concerns arise.

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## Appendix 3. Agricultural Production Overview

**Table 1. 2014 California Agriculture Overview** (CDFA, 2015a)

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| **1** | Almond | 870,000 | 5,891,930,000 | WIFF |
| **2** | Grape | 865,000 | 5,237,034,000 | medfly, mexfly |
| **3** | Strawberry | 41,500 | 2,481,496,000 | medfly |
| **4** | English walnut | 290,000 | 1,841,100,000 | medfly, OFF |
| **5** | Hay | 1,345,000 | 1,737,024,000 | |
| **6** | Pistachio | 221,000 | 1,593,400,000 | |
| **7** | Lettuce | 87,000 | 962,481,000 | |
| **8** | Orange | 166,000 | 942,171,000 | guava FF, medfly, mexfly, OFF, WIFF |
| **9** | Broccoli | 122,000 | 806,561,000 | |
| **10** | Rice | 442,000 | 713,965,000 | |
| **11** | Carrot | 65,500 | 574,304,000 | |
| **12** | Raspberry | | 450,900,000 | medfly |
| **13** | Cotton | 210,000 | 391,872,000 | |
| **14** | Peach | | 356,136,100 | guava fruit fly, medfly, melon fly, mexfly, OFF |
| **15** | Bell pepper | 21,900 | 332,963,000 | medfly, OFF, solanum FF |
| **16** | Avocado | 53,800 | 328,000,000 | medfly, melon fly, mexfly, OFF |
| **17** | Cauliflower | 33,900 | 309,040,000 | |
| **18** | Celery | 27,200 | 288,423,000 | |
| **19** | Garlic | 27,200 | 255,888,000 | |
| **20** | Prune | 48,000 | 232,960,000 | mexfly, OFF |
| **21** | Onion | 29,300 | 212,618,000 | |
| **22** | Melons | 36,000 | 196,560,000 | guava fruit fly, melon fly, OFF, SACFF, solanum FF |
| **23** | Spinach | 26,000 | 189,280,000 | |
| **24** | Potato | 33,100 | 184,891,000 | OFF |
| **25** | Sweet corn | 31,900 | 184,382,000 | |
| **26** | Cabbage | 16,400 | 177,710,000 | |
| **27** | Nectarine | 21,000 | 168,206,000 | medfly, mexfly |
| **28** | Sweet potato | 19,000 | 148,390,000 | |
| **29** | Cherry | 33,000 | 141,281,000 | guava FF, medfly, OFF |
| **30** | Wheat | 220,000 | 128,475,000 | |
| **31** | Blueberry | 4,800 | 119,093,000 | medfly |
| **32** | Plum | 18,000 | 103,167,000 | mexfly, OFF |
| **33** | Pear | 11,100 | 88,642,000 | medfly, mexfly, OFF, WIFF |
| **34** | Corn | 520,000 | 73,673,000 | medfly |

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| 35 | Olive | 37,000 | 72,904,000 | medfly, OFF, olive FF |
| 36 | Bean | 47,500 | 69,472,000 | melon fly, OFF |
| 37 | Apple | 15,000 | 57,060,000 | guava FF, medfly, mexfly, OFF |
| 38 | Artichoke | 7,300 | 55,517,000 | |
| 39 | Apricots | 9,500 | 43,045,000 | medfly, mexfly, OFF |
| 40 | Asparagus | 11,000 | 39,215,000 | |
| 41 | Grapefruit | 9,800 | 37,824,000 | guava FF, medfly, mexfly, OFF, WIFF |
| 42 | Squash | 6,100 | 37,027,000 | OFF, striped FF |
| 43 | Dates | 8,200 | 34,510,000 | |
| 44 | Kiwifruit | 3,900 | 32,678,000 | medfly, OFF |
| 45 | Pumpkin | 6,200 | 30,944,000 | melon fly, OFF, SACFF, striped FF |
| 46 | Safflower | 52,500 | 255,620,000 | |
| 47 | Fig | 7,000 | 18,141,000 | carib FF, medfly, OFF, guava FF, melon fly |
| 48 | Cucumber | 3,800 | 16,553,000 | melon fly, OFF, SACFF, striped FF |
| 49 | Sunflower | 47,500 | 15,434,000 | |
| 50 | Pecans | | 10,700,000 | medfly |
| 51 | Barley | 25,000 | 9,308,000 | |
| 52 | Peppermint | 2,000 | 4,024,000 | |
| 53 | Oats | 10,000 | 3,400,000 | |
| 54 | Lemons | 46,000 | | guava FF, medfly, mexfly, OFF, WIFF |
| 55 | Tangerines | 46,000 | | medfly, mexfly, OFF, WIFF |

**Table 2. 2014 Florida Agriculture Overview** (University of Florida, 2012b; Weems, 2015; Weems et al., 2015b; USDA-NASS, 2016b)

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| 1 | Orange | 418,700 | 1,288,665,000 | carib FF, medfly, mexfly, OFF, WIFF |
| 2 | Strawberry | 10,900 | 306,508,000 | medfly, OFF |
| 3 | Bell pepper | 11,900 | 164,291,000 | carib FF, medfly, OFF |
| 4 | Grapefruit | 43,100 | 153,775,000 | carib FF, medfly, mexfly, OFF, WIFF |
| 5 | Peanut | 167,000 | 144,956,000 | |
| 6 | Hay | 320,000 | 133,120,000 | |
| 7 | Potato | 29,300 | 131,498,000 | OFF |
| 8 | Sweet corn | 34,000 | 129,897,000 | |

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| **9** | Melons | 19,700 | 80,128,000 | guava FF, OFF, SACFF |
| **10** | Bean | 26,600 | 77,406,000 | OFF |
| **11** | Blueberry | 4,300 | 75,620,000 | |
| **12** | Cucumber | 22,700 | | OFF, SACFF |
| **13** | Cotton | 105,000 | 60,672,000 | |
| **14** | Tangerine | 10,900 | 57,028,000 | carib FF, medfly, mexfly, OFF, WIFF |
| **15** | Cabbage | 8,800 | 49,966,000 | |
| **16** | Squash | 6,800 | 40,640,000 | OFF |
| **17** | Avocado | 7,000 | 21,582,000 | carib FF, medfly, mexfly, OFF |
| **18** | Grain corn | 70,000 | 19,440,000 | |
| **19** | Soybean | 37,000 | 14,160,000 | |
| **20** | Tangelo | 3,600 | 9,839,000 | medfly, mexfly, OFF |
| **21** | Wheat | 10,000 | 1,989,000 | |
| **22** | Pecan | | 175,000 | medfly |
| **23** | Tomato | | | medfly, OFF |
| **24** | Sugarcane | 408,000 | | |
| **25** | Sweet potato | 5,900 | | |

**Table 3. 2014 Texas Agriculture Overview** (USDA-NASS, 2016c)

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| **1** | Cotton | 4,616,000 | 1,753,814,000 | OFF |
| **2** | Grain corn | 1,990,000 | 1,310,614,000 | |
| **3** | Hay | 5,440,000 | 978,257,000 | |
| **4** | Sorghum | 2,250,000 | 553,392,000 | |
| **5** | Wheat | 2,250,000 | 432,000,000 | |
| **6** | Rice | 146,000 | 158,628,000 | |
| **7** | Peanut | 127,000 | 135,439,000 | |
| **8** | Potato | 20,600 | 119,387,000 | OFF |
| **9** | Pecan | | 107,800,000 | medfly |
| **10** | Onion | 9,000 | 56,160,000 | |
| **11** | Soybean | 135,000 | 51,475,000 | |
| **12** | Grapefruit | 16,600 | 50,087,000 | carib FF, medfly, mexfly, OFF, WIFF |
| **13** | Melons | 20,000 | 49,920,000 | medfly, OFF, SACFF |
| **14** | Sunflower | 92,000 | 35,540,000 | |
| **15** | Cabbage | 6,200 | 33,325,000 | |
| **16** | Orange | 7,100 | 23,467,000 | mexfly, OFF, WIFF |
| **17** | Grape | 4,000 | 13,170,000 | |
| **18** | Bean | 21,000 | 11,776,000 | OFF |

| Rank | Commodity | Harvested Acres | Value in Dollars | Potential Tephritid Pests |
|---|---|---|---|---|
| 19 | Cucumber | 4,200 | 10,568,000 | medfly, OFF, SACFF |
| 20 | Oat | 45,000 | 10,175,000 | |
| 21 | Spinach | 1,500 | 9,900,000 | |
| 22 | Chile pepper | 3,100 | 9,693,000 | medfly |
| 23 | Carrot | 1,400 | 7,560,000 | |
| 24 | Squash | 1,500 | 7,425,000 | OFF |
| 25 | Peach | 3,100 | 6,600,000 | medfly, mexfly, OFF, WIFF |
| 26 | Sweet corn | 2,950 | 6,160,000 | |
| 27 | Sweet potato | 900 | 4,144,000 | |

**Table 4. 2012 Puerto Rico Agriculture Overview** (USDA-NASS, 2014)

| Rank | Commodity | Potential Tephritid Pests |
|---|---|---|
| 1 | Plantain | guava FF, OFF |
| 2 | Banana | OFF |
| 3 | Orange | medfly, mexfly, OFF |
| 4 | Mango | carib FF, guava FF, medfly, melon fly, mexfly, OFF, WIFF |
| 5 | Lemon and lime | medfly, mexfly, OFF |
| 6 | Avocado | mexfly, OFF |
| 7 | Chironja | |
| 8 | Grapefruit | medfly, mexfly |
| 9 | Coconut | mexfly, OFF |
| 10 | Citron | mexfly, OFF |
| 11 | Soursop | carambola FF, medfly, OFF |

**Table 5. 2007 Virgin Islands Agricultural Overview** (USDA-NASS, 2009b)

| Rank | Commodity | Potential Tephritid Pests |
|---|---|---|
| 1 | Cucumber | melon fly, OFF, SACFF, striped FF |
| 2 | Banana | OFF |
| 3 | Mango | carib FF, guava FF, medfly, melon fly, mexfly, OFF, WIFF |
| 4 | Coconut | mexfly, OFF |
| 5 | Tomato | carambola FF, medfly, melon fly, OFF |
| 6 | Eggplant | medfly, OFF |
| 7 | Pepper | carambola FF, carib FF, OFF |
| 8 | Sugarcane | |
| 9 | Plantain | guava FF, OFF |
| 10 | Avocado | medfly, melon fly, mexfly, OFF |
| 11 | Papaya | papaya FF |
| 12 | Okra | |

| | | |
|---|---|---|
| **13** | Lemon and lime | carambola FF, carib FF, medfly, mexfly, OFF |
| **14** | Yam | |
| **15** | Breadfruit | carambola FF, medfly, OFF |
| **16** | Lettuce | |
| **17** | Sweet potato | |
| **18** | Spinach | |
| **19** | Cabbage | |
| **20** | Grapefruit | carambola FF, guava FF, medfly, mexfly, OFF, WIFF |
| **21** | Cassava | |
| **22** | Orange | carib FF, medfly, mexfly, OFF, WIFF |
| **23** | Dry corn | |
| **24** | Celery | |
| **25** | Squash | OFF, striped FF |
| **26** | Green bean | |
| **27** | Pineapple | |
| **28** | Tanier | |
| **29** | Dry bean | |
| **30** | Onion | |

## Acronyms and Glossary

### A

| | |
|---|---|
| **Absorption** | The taking up of liquids by solids, or the passage of a substance into the tissues of an organism as the result of several processes (diffusion, filtration, or osmosis); the passage of one substance into or through another (e.g., an operation in which one or more soluble components of a gas mixture are dissolved in a liquid). |
| **Acetylcholinesterase (AChE)** | An enzyme produced at junctions between nerve cells that hydrolyzes acetylcholine, thereby ending transmission of a nerve impulse. |
| **Active ingredient (a.i.)** | In any pesticide product, the component which kills, or otherwise controls, target pests; pesticides are regulated primarily on the basis of active ingredient. |
| **Acute exposure** | A single exposure to a toxic substance that results in severe biological harm or death; acute exposures are usually characterized as lasting no longer than 1 day. |
| **Acute toxicity** | The potential of a substance to cause injury or illness when given in a single dose or in multiple doses over a period of 24 hours or less. |
| **Acute toxicity study** | A study with single (or multiple administration for no more than 24 hours) dose exposure with short-term monitoring for effects (up to 14 days); may include median lethality and effective does (LD50, LC50, ED50, EC50), eye toxicity, dermal toxicity (excluding skin sensitization tests), and inhalation toxicity studies. |
| **Adsorption** | Attraction or bonding of ions or compounds, usually temporarily to the surface of a solid (compare with Absorption). |
| **Adverse effect** | An undesired harmful effect. |
| **Aerobic** | Occurring or growing in the presence of oxygen; life or processes that require, or are not destroyed by, oxygen. |

**a.i.** See Active Ingredient

**Annual** A plant that completes its entire life cycle from seed germination to seed production and death within a single season.

**APHIS** Animal and Plant Health Inspection Service; an agency within the United States Department of Agriculture.

**Application rate** The amount of pesticide product applied per unit area.

**Aquatic life** Organisms inhabiting water for all or part of their life cycle.

**Assay** A test or measurement used to evaluate a characteristic of a chemical; see Mutagenicity Assay.

**Atmosphere** The mass of air surrounding the earth, composed largely of oxygen and nitrogen

**Attractant, insect** A natural or synthesized substance that lures insects by stimulating their sense of smell; sex, food, or oviposition attractants are used in traps or bait formulations.

## B

**Bacteria** A group (division) of microscopic organisms; bacteria consume or break down organic matter and other chemicals, thereby reducing potential for pollution; bacteria in soil, water or air can also cause human, animal, and plant health problems.

**Bioaccumulation** Uptake and temporary storage of a chemical in or on an organism; over a period of time a higher concentration of chemical may be found in the organism than in the environment.

**Bioconcentration** The property of some chemicals to collect in tissues of certain species at concentrations higher than the surrounding environment; term is used primarily for aquatic species; see Bioaccumulation.

**Biodegradation** — The processes by which living systems, particularly microorganisms, break down chemical compounds; the products of biodegradation may be more or less toxic than their precursors.

**Biodiversity** — The relative abundance and frequency of biological organisms within ecosystems.

**Biological control** — The reduction of pest populations by means of living organisms encouraged by humans; utilizes parasites, predators, or competitors to reduce pest populations (also called biocontrol).

**Biotechnological control** — Use of genetic engineering to control a pest; may involve genetic engineering of host plants, biocontrol agents, or the pest itself to achieve control.

**Buffer zone** — An area where treatments do not occur or are modified to protect an adjacent environmentally sensitive area.

## C

**Carcinogen** — A cancer-producing substance.

**Certified applicator** — Commercial or private applicator certified as competent to apply pesticides.

**CFR** — Code of Federal Regulations (U.S.)

**Chlorpyrifos** — An organophosphate insecticide, analyzed for use in this program as a soil drench.

**Chronic toxicity** — An adverse biologic response, such as mortality or an effect on growth or reproductive success, resulting from repeated or long-term (equal to or greater than 3 months) doses (exposures) of a compound usually at low concentrations; see Acute Toxicity, Subchronic Toxicity.

**Clay** — Soil particles less than 0.0002 mm in diameter; the soil textural class characterized by a predominance of clay particles.

| | |
|---|---|
| **Concentration** | The ratio of the mass or volume of a solute to the mass or volume of the solution or solvent; the amount of active ingredient or herbicide equivalent in a quantity of diluent (e.g., expressed as lb/gal, ml/liter, etc.), or an amount of a substance in a specified amount of medium (e.g., air and water). |
| **Contaminant** | An undesired physical, chemical, biological, or radiological substance that can have an adverse effect on air, water, soil, etc. |
| **Criteria pollutants** | The 1970 amendments to the Clean Air Act required EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health; EPA has identified and set standards to protect human health and welfare effects of these pollutants. |
| **Critical habitat** | Habitat designated as critical to the survival of an endangered or threatened species, and listed in 50 CFR 17 or 226. |
| **Cultural control** | Reduction of insect populations by utilization of agricultural practices such as crop rotation, clean culture, or tillage. |
| **Cumulative effects or impacts** | Those effects or impacts that result from incremental impact of a program action when added to other past, present, and reasonably foreseeable future actions. |
| **Cytogenetic** | Pertaining to the formation or production of cells. |

## D

| | |
|---|---|
| **Decomposition** | The breakdown of materials by bacteria and fungi; the chemical makeup and physical appearance of materials are changed. |
| **Degradation** | Breakdown of a compound by physicochemical or biochemical processes into basic components with properties different from those of the original compound; see Biodegradation. |
| **Deoxyribonucleic acid** | The molecule in which the genetic information for most living cells is encoded; viruses also contain DNA. |

**Deposit** A quantity of a pesticide deposited on a unit area.

**Dermal exposure** The portion of a toxic substance that an organism receives as a result of the substance coming into contact with the organism's body surface.

**Dermal sensitization** Dermal exposure to an allergen that results in the development of hypersensitivity.

**Developmental toxicity** The adverse effects on a developing organism that may result from its exposure to a substance prior to conception (either parent), during prenatal development, or postnatal to the time of sexual maturation; adverse developmental effects may include lethality in the developing organisms, structural abnormalities, altered growth, and functional deficiency.

**Diazinon** An organophosphate insecticide, analyzed for use in this program as a soil drench.

**Direct effect** The effects caused directly by activities at the same time and in the same place; direct exposure to a toxin or something that causes a change

**Diversity** The distribution and abundance of different plant and animal communities and species within an area; the number of species in a community or region; see Biodiversity.

**DNA** See Deoxyribonucleic Acid

**Dose** A given quantity of material that is taken into the body; dosage is usually expressed in amount of substance per unit of animal body weight often in milligrams of substance per kilogram (mg/kg) of animal body weight, or other appropriate units; to radiology, the quantity of energy or radiation absorbed; see Concentration.

**Drench** Saturation of a soil with pesticide, usually to control root diseases.

**Drift** The airborne movement of a pesticide away from the targeted site of an application.

## E

**$EC_{50}$** Median effective concentration; the concentration of a drug, antibody, or toxicant that induces a response halfway between the baseline and maximum after a specified exposure time.

**EIS** See Environmental Impact Statement.

**Endangered species** A plant or animal species identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act, as amended, that is in danger of extinction throughout all or a significant portion of its range.

**Environment** The sum of all external conditions affecting the life, development, and survival of an organism; all the organic and inorganic features that surround and affect a particular organism or group of organisms.

**Environmental assessment (EA)** A concise public document that provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or Finding of No Significant Impact. It aids in compliance with the National Environmental Policy Act (NEPA) when no Environmental Impact Statement is needed.

**Environmental fate** The result of natural processes acting upon a substance; including transport (e.g., on suspended sediment), physical transformation (e.g., volatilization, precipitation), chemical transformation (e.g., photolysis), and distribution among various media (e.g., living tissues); the transport, accumulation, or disappearance of a chemical in the environment.

**Environmental impact statement (EIS)** A document prepared by a Federal agency in which anticipated environmental effects of alternative planned courses of action are evaluated; a detailed written statement as required by section 102(2)(C) of the National Environmental Policy Act (NEPA).

**EPA** U.S. Environmental Protection Agency

**Eradication** The complete elimination of a pest species; for some agricultural pests, this may mean the reduction of the pest populations to nondetectable levels.

**Erosion** The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff, but can be intensified by land cleaning practices related to farming, residential or industrial development, road building, or timber cutting.

**Exposure** The condition of being subjected to a substance that may have a harmful effect.

**Exposure analysis** The estimation of the amount of chemicals to which organisms are subjected during the application of pesticides.

**Exposure scenario** Overall description of the potential contact of an organism or population under specified conditions (i.e. routes of contact, exposure duration) used to estimate possible exposure during pesticide application.

## F

**Fenthion** An organophosphate insecticide, historically used in this program as a soil drench.

**Feral** Wild; applies to fruit fly pest populations rather than fruit fly sterile releases.

**FIFRA** Federal Insecticide, Fungicide, and Rodenticide Act; the Act establishes procedures for the registration, classification, and regulation of pesticides.

**Finding of no significant impact (FONSI)** A document prepared by a Federal agency that presents the reasons why a proposed action would not have a significant impact on the environment and thus would not require preparation of an Environmental Impact Statement. A FONSI is based on the results of an Environmental Assessment.

**FONSI** See Finding of No Significant Impact

**Formulation** The way in which a basic pesticide is prepared for practical use; includes preparation as wettable powder, granular, or emulsifiable concentrate; a pesticide preparation supplied by a manufacturer for practical use; a pesticide product ready for application; also, refers to the process of manufacturing or mixing a pesticide product in accordance with the EPA-approved formula.

**Fumigant** Pesticide applied as liquid or powder, which volatilizes to gas; usually applied beneath a tarp, sheet, or other enclosure.

**Fumigation** Use of chemicals in gaseous form to destroy pests, usually applied under a cover or shelter.

**Fungi (singular, fungus)** A group of organisms that lack chlorophyll (i.e., are not photosynthetic) and which are usually multicellular, filamentous, and nonmotile; they include the molds, mildews, yeasts, mushrooms, and puffballs; some decompose organic matter, some cause disease, others stabilize sewage and break down solid wastes in composting.

**FWS** Fish and Wildlife Service; an agency of the U.S. Department of the Interior

## G

**Gene** A short length of a chromosome that influences a set of characters; a length of DNA that directs the synthesis of a protein.

**Genotoxicity** A specific adverse effect on the genome (the complement of genes contained in the haploid set of chromosomes) of living cells, that upon the duplication of the affected cells, can be expressed as a mutagenic or a carcinogenic event because of specific alteration of the molecular structure of the genome.

**Gravid** Bearing eggs.

**Groundwater** The supply of freshwater found beneath the Earth's surface (usually in aquifers), which is often used for supplying wells and springs. Because groundwater is a major source of drinking water, there is growing concern over areas where leaching agricultural or industrial pollutants or substances from leaking underground storage tanks are contaminating groundwater.

## H

**Habitat** — The place occupied by wildlife or plant species; includes the total environment occupied.

**Half-life** — The time necessary for the concentration of a chemical to decrease by 50 percent; a measure of the persistence of a chemical in a given medium (the greater the half-life, the more persistent a chemical is likely to be).

**Hazard** — The potential that the use of a pesticide would result in an adverse effect on man or the environment; the intrinsic ability of a stressor to cause adverse effects under a particular set of circumstances.

**Herbicide** — Chemical designed to kill or inhibit unwanted plants or weeds.

**HHERA** — See Human Health and Ecological Risk Assessment

**Host** — Any plant or animal attacked by a pest or a parasite.

**Human health and ecological risk assessment** — A process to estimate the nature and probability of adverse health effects in humans and on non-target organisms that may be exposed to chemicals.

**Hydrolysis** — The decomposition of chemical compounds through a reaction with water.

**Hypersensitivity** — Abnormal or excessive reactivity to any substance.

## I

***In vitro*** — In glass; a test-tube culture; any laboratory test using living cells taken from an organism.

***In vivo*** In the living body of a plant or animal; in vivo tests are those laboratory experiments carried out on whole animals or human volunteers.

**Indirect effect** Secondary impacts; effects caused by activities that occur later in time and at some distance from the project.

**Inhalation** Exposure of test animals through breathing, to either vapor or dust, for a predetermined time.

**Inhalation toxicity** The quality of being poisonous to man or animals when breathed into the lungs.

**Insecticide** A pesticide compound specifically designed to kill or control the growth of insects.

**Integrated pest management** The selection, integration, and implementation of pest control actions on the basis of predicted economic, ecological, and sociological consequences; the process of integrating and applying practical methods of prevention and control to keep pest situations from reaching damaging levels while minimizing potentially harmful effects of pest control measures on humans, nontarget species, and the environment.

**IPM** See Integrated Pest Management

**Irrigation** Technique for applying water or waste water to land areas to supply the water and nutrient needs of plants.

## L

**Label** All printed material attached to or part of the pesticide container.

**Lambda-cyhalothrin** An insecticide that belongs to the pyrethroid class of pesticides. It disrupts the target insect's nervous system.

**$LC_{50}$** Median lethal concentration; the concentration of a toxicant necessary to kill 50 percent of the organisms, in a population being tested; usually expressed in parts per million (ppm), milligrams per liter (mg/L) or milligrams per cubic meter (mg/m3).

**$LD_{50}$** Median lethal dose; the dose necessary to kill 50 percent of the test organisms; usually expressed in milligrams of chemical per kilogram of body weight (mg/kg).

**Leaching** Downward movement of materials in the soil through water or other aqueous media. Soluble nutrients, such as nitrate, are often leached out of the seedling root zone.

**Lipophilicity** Relative tendency of a chemical substance to bind to fat tissues in an organism (as opposed to binding to water).

**LOAEL** See Lowest Observed Adverse Effect Level

**Lowest observed adverse effect level (LOAEL)** The lowest exposure level at which there is statistically significant increases in frequency or severity of specific adverse effects among individuals of the tested population when compared to the control population.

## M

**Malathion bait** An insecticide formulation consisting of the active ingredient malathion mixed with a protein hydrolysate bait; may be applied aerially or from the ground.

**Male annihilation** A control method that reduces fruit fly populations by employing mass trapping to lure and kill male fruit fly before they have a chance to mate.

**Medfly** Mediterranean fruit fly

**Media** Specific environments (e.g., air, water, soil) that are the subject of regulatory concern and activities.

**Mexfly** Mexican fruit fly

**mg/kg** Milligrams per kilogram; used to designate the amount of toxicant required per kilogram of body weight of test organisms to produce a designated effect; usually the amount necessary to kill 50% of the test animals.

**mg/kg/day** Milligrams per kilogram of body weight per day.

**Microbial degradation** The breakdown of a chemical substance into simpler components by bacteria.

**Microorganism** Living organisms, usually so small that individually they only can be seen through a microscope.

**Mist blower** A mechanical pesticide application device that can be used to apply ultra low volume (ulv) pesticides; usually truck mounted.

**Mitigate** To lessen the effect; to make less harsh or harmful.

**Model** A description, analogy, or abstraction used to help visualize or conceptualize something that cannot be directly observed or measured.

**Modeling** An investigative technique using a mathematical or physical representation of a system or theory that accounts for all or some of its known properties.

**Monitoring** The act of measuring environmental conditions through time with periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media, humans, animals, or other living things; also the act of measuring operational components or results to verify the efficacy of treatments.

**Mutagen** A substance that tends to increase the frequency or extent of genetic mutations (changes in hereditary material); any substance that can cause a change in genetic material.

**Mutagenicity** Capacity of a chemical to cause a permanent genetic change in a cell other than that which occurs during normal genetic recombination.

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| **Mutation** | A change in the genetic material of a cell. |

## N

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| **National ambient air quality standards** | Outdoor air quality standards established by the USEPA under the authority of the Clean Air Act. |
| **NEPA** | The National Environmental Policy Act of 1969 and subsequent amendments. |
| **Neurotoxic** | Toxic to nerves or nervous tissue. |
| **Neurotoxicity** | The quality of exerting a destructive or poisonous effect upon nerve tissue. |
| **No observed adverse effect level** | The highest dose level at which there are no observable differences between the test and control populations. |
| **NOAEL** | See No Observed Adverse Effect Level |
| **No observed effect level** | The highest dose level at which there are no observable differences between the test and control populations. |
| **Nontarget organisms** | Those organisms (species) that are not the focus of control efforts. |

## O

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| **OFF** | Oriental fruit fly |
| **Oral toxicity** | Toxicity of a compound when given or taken by mouth, usually expressed as number of milligrams of chemical per kilogram of body weight of animal. |
| **Organic matter** | Material composed of living and/or once-living organisms (plant, animal, and microbial); organic matter increases the buffer capacity, cation exchange capacity, and water retention of the soil and provides a substrate for microbial activity. |

**Organism** Any living thing.

**Organophosphate insecticide** Class of insecticides (also one or two herbicides and fungicides) derived from phosphoric acid esters, e.g., as malathion and diazinon.

**Oviposition** To deposit or lay eggs.

**Oxidation** The addition of oxygen by bacterial and chemical means, which breaks down organic waste or chemicals such as cyanides, phenols, and organic sulfur compounds; the combination of oxygen with other elements; the process in chemistry whereby electrons are removed from a molecule.

**Ozone** A structural form of oxygen, found in the earth's upper atmosphere; ozone provides a protective layer shielding the earth from the harmful health effects of ultraviolet radiations on humans and the environment; lower in the atmosphere, ozone is a chemical oxidant and pollutant emitted by combustion sources; ozone can seriously affect the human respiratory system and is one of the most prevalent and widespread of all the criteria pollutants for which the Clean Air required EPA to set standards.

**Ozone depletion** Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to life; caused by certain chlorine- and/or bromine-containing compounds (chlorofluorocarbons or halons) which break down when they reach the stratosphere and catalytically destroy ozone molecules.

## P

**Parameter** An attribute or characteristic that can be measured (a measuring tool); in statistics, refers to attributes of models or populations; in chemistry, often refers to the attributes of samples (for example, a water sample); may refer to variables in some contexts.

**Parasite** An organism that lives in or on another organism from which it derives its nourishment.

**Parasitoid** A parasite that lives within its host only during its larval development, eventually killing the host.

**Pathogen** A disease-causing organism.

**Perennial** A plant that continues growing from year to year; tops may die back in winter, but roots or rhizomes persist (compare with Annual).

**Persistence** The quality of an insecticide or a compound to persist as an effective residue; persistence is related to volatility, chemical stability, and biodegredation.

**Pest** An insect, rodent, nematode, fungus, weed, or other form of terrestrial or aquatic plant or animal life, or virus, bacterial, or microorganism that is injurious to health or the environment.

**Pesticide** Any substance or mixture of substances designed to kill insects, rodents, fungi, weeds, or other forms of plant or animal life that are considered pests; see Herbicide, Insecticide.

**Pesticide tolerance** The amount of pesticide residue allowed by law to remain in or on a harvested crop; by using various safety factors, EPA sets these levels well below the point where the chemicals might be harmful to consumers.

**pH** Numerical measure (negative logarithm of the hydrogen ion activity) of the acidity or alkalinity in a soil or solution; a pH reading of 7 is neutral, less than 7 is acidic, and more than 7 is alkaline (basic).

**Photodegradation** A substance or object that decomposes by the action of light, especially sunlight

**Photolysis** The decomposition or dissociation of a molecule resulting from light (ultraviolet) absorption; thus, the decomposition of molecules by sunlight; see Photodegradation.

**Physical control** Physical actions (e.g., fruit stripping or host destruction) taken to control a pest.

**Phytotoxicity** Causing injury or death to plants.

**Pica behavior** Pathological behavior characterized by the persistent eating of nonnutritive, generally nonfood, substances.

**Population** A potentially interbreeding group of organisms of a single species, occupying a particular space; generically, the number of humans or other living creatures in a designated area.

**PPE** Personal protective equipment

**ppm** Parts per million; the number of parts of chemical substance per million parts of the substrate in question.

## R

**Region** A defined geographic area; regions may be defined administratively (e.g., EPA Region III), politically (e.g., Texas), geographically (e.g., the Southwest), biogeographically (e.g., short-grass prairie), physiographically (e.g., Rocky Mountains), or by other means.

**Registration** Formal EPA approval and listing of a new pesticide before it can be sold or distributed in intrastate or interstate commerce; registrations are in accordance with FIFRA; EPA is responsible for registration (premarket licensing) of pesticides on the basis of data demonstrating that they will not cause unreasonable adverse effects on human health or the environment when used according to approved label directions.

**Regulatory control** A combination of control methods including quarantines and certification treatments; regulatory controls may include chemical and/or nonchemical treatment methods.

**Reregistration** The reevaluation and reapproval of existing pesticides originally registered prior to current scientific and regulatory standards; EPA reregisters pesticides through its Registration Standards Program.

**Residue** Quantity of pesticide and its metabolites remaining on and in a crop, soil, or water.

**Resistance** The ability of a population or system to absorb an impact without significant change from normal fluctuations; for plants and animals, the ability to withstand adverse environmental conditions and/or exposure to toxic chemicals or disease.

**Risk** The probability that a substance will produce harm under specified conditions.

**Risk assessment** The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific pollutants.

**Risk characterization** Description of the nature and magnitude of risk; risk characterization uses the information gathered in other stages of risk assessment to represent the overall situation; the toxicity and exposure are considered jointly in the estimation or characterization of risk.

**Runoff** The part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water; it can carry chemicals such as insecticides from the air and land into the receiving waters.

## S

**Scoping** A process for determining the span of issues to be addressed and for identifying the significant issues related to a proposed action.

**Silt** Fine particles of sand or rock that can be picked up by the air or water and deposited as sediment; a soil textural class characterized by a predominance of silt particles.

**Socioeconomic** Sociological and economic factors considered together.

**Solubility** — The property of being able to dissolve in another substance; the mass of a dissolved substance that will saturate a fixed volume of a solvent under static conditions.

**Species** — A group of closely related, morphologically similar individuals, which actually or potentially interbreed; a reproductively isolated aggregate of interbreeding populations of organisms.

**Spinosad** — An insecticide based on chemical compounds found in the bacterial species *Saccharopolyspora spinosa*. It affects the nervous system in insects.

**Spot treatment** — A pesticide application to a small, or otherwise restricted area of a whole unit.

**Stratosphere** — The second major layer of the Earth's atmosphere, located just above the troposphere, contains approximately 20 percent of the atmosphere's mass.

**Subchronic toxicity** — Adverse biologic response of an organism, such as mortality or an effect on growth or reproductive success, resulting from repeated or short-term (3 month) doses (exposures) of a compound, usually at low concentrations; see Acute Toxicity, Chronic Toxicity.

**Sublethal** — Having an effect that is less than lethal.

**Suppression** — Reduction of a pest population to below some predetermined economic threshold.

**SureDye** — An insecticide formulation under development consisting of a mixture of two xanthene dyes, phloxine B and uranine, combined with a protein hydrolysate bait; may be applied aerially or from the ground.

**Susceptibility** — Capacity to be adversely affected by pesticide exposure.

**Systemic** — Entering and then distributing throughout the body of an organism, as in the movement of a toxicant.

## T

**Target** The plants, animals, structures, areas or pests to be treated with a pesticide application.

**Teratogenic effects** Physical birth defects in offspring following exposure of the pregnant female to a substance.

**Threatened species** Any species listed in the Federal Register that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

**Tolerance** Amount of pesticide residue permitted by Federal regulation to remain on or in a crop, expressed as parts per million (ppm); capacity to withstand pesticide treatment without adverse effects on normal growth and function; the maximum residue concentration legally allowed for a specific pesticide, its metabolites, or breakdown products, in or on a particular raw agricultural product, processed food, or feed item, expressed as parts per million.

**Toxic** Poisonous to living organisms.

**Toxicant** A poisonous substance such as the active ingredient in pesticide formulations that can injure or kill plants, animals, or microorganisms.

**Toxicity** The capacity or property of a substance to cause any adverse effects, based on scientifically verifiable data from animal or human exposure tests; that specific quantity of a substance, which may be expected, under specific conditions, to do damage to a specific living organism; capacity of a chemical to induce an adverse effect.

**Trophic level** Functional classification of organisms in a community according to feeding (energy) relationships; the first trophic level includes green plants, the second trophic level includes herbivores, and so on.

**Troposphere** The lowest region of the atmosphere, extending from the earth's surface to a height of about 3.7–6.2 miles (6–10 km), which is the lower boundary of the stratosphere.

## U

**Uncertainty** May be due to missing information, or gaps in scientific theory; whenever uncertainty is encountered, a decision, based upon scientific knowledge and policy, must be made; the term "scientific judgment" is used to distinguish this decision from policy decisions made in risk management.

**USDA** United States Department of Agriculture.

## V

**Volatility** The tendency of a substance to evaporate at normal temperatures and pressures.

**Volatilization** The vaporizing or evaporating of a substance chemical; phase conversion of a liquid or solid into vapor.

## W

**Watershed** A terrestrial area that contributes to water flow.

# Index