# Optimizing Pest Management: Specialty Crop Pests

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Introduction

The goal of the Specialty Crop Pests (SCP) Program is to protect U.S. fruits and vegetables, tree nuts, horticulture, and nursery crops from adverse impacts associated with invasive pests, such as crop damage or threats to international trade and interstate commerce. The U.S. Department of Agriculture’s (USDA) Plant Protection and Quarantine (PPQ) program works with State, Tribal, university, and industry partners to develop and implement practices, policies, and regulations that prevent or mitigate impacts for invasive pests of Federal regulatory significance. These activities include verifying pest distribution, identifying and mitigating risk pathways to prevent long distance spread of the pests, developing and implementing diagnostic tools and pest mitigation strategies, and communicating with the public to gain support for program strategies.

These efforts help U.S. farmers export their products, prevent damage to specialty crop production (helping to ensure the availability of fresh fruits and vegetables), and protect natural resources, including forests and residential landscapes. Among the pests and diseases, the program currently addresses are exotic fruit flies, a variety of citrus pests and diseases, the glassy-winged sharpshooter, spotted lanternfly, pale cyst nematode, the light brown apple moth, European grapevine moth, navel orange worm, and Phytophthora ramorum, among others.

Overall, the program directly protects specialty crop production worth more than $10 billion in 2020 (USDA’s Animal and Plant Health Inspection Service [APHIS]) internal analysis based on National Agricultural Statistics Survey data). The program indirectly protects additional specialty crop production valued at $7 billion in 2020, by preventing the spread of these damaging pests and diseases to new areas (based on APHIS analysis using Economic Research Service data). Without the SCP program, trading partners might not accept a variety of U.S. fruits and vegetables. The value of trade in specialty crops
that could potentially be disrupted without the SCP program was $3.8 billion in 2020, according to an internal APHIS report using data from the Foreign Agricultural Service’s Global Agricultural Trade System.

**Grape Pests**

The SCP program targets several devastating pests and diseases, including GWSS, EGVM and SLF, that could affect grape production and impact export markets.

**European Grapevine Moth (EGVM)**

In August 2016, PPQ declared the successful eradication of EGVM from California. In FY 2021, PPQ, in collaboration with the California Department of Food and Agriculture (CDFA), and industry partners, continued monitoring for EGVM with 19,800 traps placed over 37 participating counties. PPQ and cooperators found no infestations. PPQ is evaluating what level of survey to continue for EGVM.

**Glassy-Winged Sharpshooter (GWSS)**

PPQ also continued the successful, cooperative GWSS program designed to suppress populations of this pest where established in grapes, citrus, and nursery stock. GWSS is a vector for Pierce’s disease, which is lethal to grapevines. The program’s suppression and regulatory activities work to prevent the spread of the vector and disease across California. In FY 2021, the program continued to conduct surveys and other regulatory activities including inspections of nursery stock and bulk citrus for the pest in 49 California counties, and continued area-wide suppression activities in affected agricultural production areas of 4 California counties. With citrus growers’ voluntary suppression treatments, the
program covered 43,490 acres. Of the more than 28,000 shipments of nursery stock from infested areas, California county inspectors rejected 1 shipment due to GWSS life stages being present. Together, the EGVM and GWSS programs directly protected 895,000 acres of grape production worth $4.5 billion in the State of California in 2020 (National Agricultural Statistics Survey Noncitrus Fruit and Nuts 2020 Summary).

**Spotted Lanternfly (SLF)**

In FY 2021, PPQ and cooperators continued addressing SLF, which is now found in 11 States, including Connecticut, Delaware, Indiana, Maryland, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Virginia and West Virginia. This invasive pest feeds on more than 70 types of plants including apples, hops, walnuts, and other hardwood trees, but grape vineyards in impacted areas have experienced the most damage related to SLF. The insect sucks sap from stems and leaves, causing damage to plants as they feed. Over the last two years, SLF has continued to spread in the affected States and into new States. It hitchhikes on means of transportation, and can spread long distances, as evidenced by the multiple regulatory incidents documented in 2021. PPQ and cooperators conduct treatments to suppress populations on the leading edge of the infestation, and to eradicate outlying populations, with the aim of reducing the risk of SLF spread to new areas. In FY 2021, PPQ and cooperators treated more than 1,734 properties covering 57,574 acres and treated approximately 79,636 trees in the States listed above. The program is continuing to evaluate treatment strategies and implement new approaches with the goal of preventing human-assisted spread.
Citrus Diseases and Asian Citrus Psyllid

Citrus fruits are high-value specialty crops and a nutritious food for consumers across the world. The United States was the sixth largest exporter of citrus by value and volume in 2020 (International Trade Centre database). PPQ supports the citrus industry’s continued ability to produce, harvest, process, and ship citrus fruits and nursery stock despite the presence of diseases such as citrus canker, citrus greening or Huanglongbing (HLB), sweet orange scab, and citrus black spot, which decrease fruit quality, increase production costs for producers, and threaten export markets in areas when found.

HLB is the most serious disease of citrus currently impacting Florida and Texas, and threatening the citrus crop in Arizona, California, and Louisiana. The insect vector, the Asian citrus psyllid (ACP), spreads the disease. Through the Citrus Health Response Program, PPQ and State partners also conduct surveys for other diseases not known to occur in the United States, including citrus leprosis virus and citrus variegated chlorosis.

PPQ and cooperators in citrus-producing States surveyed more than 3 million acres of citrus across the country, providing timely information about the presence of pests and diseases to growers and State government partners. This information allows growers to take necessary actions to manage their groves and allows PPQ and States to update quarantine boundaries and regulations to prevent the spread of serious citrus pests and diseases through the movement of regulated materials. Based on the results of surveys, PPQ adjusted quarantine boundaries during FY 2021, for HLB and sweet orange scab in California, for HLB and citrus canker in Texas, and for citrus black spot in Florida.

In areas affected by citrus pests and diseases, PPQ’s flexible regulatory protocols have minimized the impact of the quarantines on growers, who can move citrus out of quarantined areas to packinghouses if
they follow mitigation procedures to prevent the disease or its insect vector from spreading. PPQ works with citrus nurseries across the United States to ensure that nursery stock produced in areas quarantined for citrus diseases is free from the pests, ensuring that clean plants are moving between the states and available for citrus producers and residential use. In FY 2021, approximately 12,800 businesses moved regulated host materials such as citrus fruit and nursery stock under compliance agreements with PPQ.

PPQ and cooperators continued extensive surveys that establish citrus black spot-free production units, and low prevalence areas for citrus canker in Florida, for export packing to the European Union. PPQ also supports area-wide management efforts in Texas and California. The Agency manages five citrus canker quarantines around Texas (with two quarantine areas added in FY 2021) and is updating regulations to add an additional two areas.

In FY 2021, PPQ and cooperators continued to conduct risk-based surveys for HLB in residential and commercial citrus areas in California to ensure they detect the disease quickly if it is present. Additionally, PPQ assists CDFA in aggressively responding to positive detections of HLB (thus far in residential areas only) and implementing an area-wide management approach for ACP population control. PPQ continued biological control efforts targeting ACP. This program, which employs a predatory wasp against ACP, augments other management methods, especially in residential areas in Arizona, California, Louisiana, and Texas, where use of chemical pesticides is undesirable. These citrus health activities directly protect citrus production on 681,300 acres in the United States worth approximately $3.31 billion for the 2020-2021 growing season (National Agricultural Statistics Survey Citrus Fruits 2021 Summary). Without PPQ’s activities, citrus exports could be at risk each year. In 2020, the value of U.S. citrus exports totaled approximately $887 million (Foreign Agricultural Service Global Agricultural Trade System).
PPQ established the HLB Multi-Agency Coordination (MAC) response framework in December 2013, to help address the citrus industry’s immediate and long-term needs in dealing with this devastating disease. In addition to PPQ, the MAC is comprised of representatives from USDA’s Agricultural Research Service (ARS), National Institute of Food and Agriculture, and Office of Pest Management Policy; the Environmental Protection Agency; State departments of agriculture in Arizona, California, Florida, and Texas; citrus research organizations in California, Florida, and Texas; and citrus industry organizations in California, Florida, and Texas. Since FY 2014, the HLB MAC group has funded a total of 105 projects carried out by State cooperators, universities, private companies, and Federal agencies. The projects have focused on strategies for vector control, therapies for infected trees, sustainability of new plantings, early detection technologies, best management practices for citrus groves, and support for the development of HLB-resistant citrus varieties.

In FY 2019 and 2020, PPQ provided HLB MAC funds towards the Florida Citrus Research and Field Trials (CRaFT) project to conduct field evaluations of strategies that showed previous scientific evidence of success in combating the disease to determine the best management practices and methodologies for producing citrus under the threat and pressure of HLB. This long-term project brought in growers, as collaborators, to evaluate interactions between methods, treatments, environments, rootstock/scion combinations, and growing practices.

In 2021, building on the CRaFT approach in Florida, PPQ initiated similar projects in California and Texas. Each State is at a different stage of disease progression, but they share the common goal of robust healthy trees and a productive industry. This approach offers a window to evaluate the impact of tools...
available for the challenges that HLB poses in different environmental conditions. The goal is to provide citrus growers with simple and proven strategies for keeping their groves productive. The results of these CRaFT-like projects will benefit all citrus-growing regions in the United States that are threatened by this devastating disease. Also in 2021, PPQ provided funds to ARS and Colorado State University to develop a data management tool for use CRaFT projects in California and Texas.

Over the last several years, HLB MAC funded projects have:

- Removed nearly 6,000 acres of abandoned groves in Florida, eliminating uncontrolled ACP habitat and prompting State legislation to incentivize further removal of abandoned groves.
- Developed and released training methods to teach canines to detect ACP and HLB in commercial and residential settings.
- Developed planting designs that reduce ACP pressure and produce healthier trees and better fruit with reduced water and herbicide use.
- Developed an ACP attract and kill device that can reduce ACP intensity by over 60 percent.
- Developed soil acidification technology that could be used on a broad scale to lower the pH of infected tree roots, helping to improve overall tree health and production.
- Developed harmonized methodology for evaluating greenhouse and field trials to combat HLB across growing areas and regions.
- Initiated a rapid propagation project to accelerate field testing of 35 varieties of HLB-tolerant mandarin and sweet orange trees, which will make them available 2 years earlier than traditional propagation practices.
Growers are using one out of every three HLB MAC-funded shovel-ready technologies today. PPQ will continue working closely with partners in industry, private research, State departments of agriculture, and other government agencies to support continued development of tools to address HLB.

**Tree Fruit and Nursery Stock Pests**

PPQ takes the threat of exotic fruit fly outbreaks very seriously. These insects are among the most destructive, feared, and well-publicized pests of fruits and vegetables around the world. Working with State partners, we aim to detect an outbreak early and respond rapidly. Our swift and effective action protects crops and the industries that depend on them, as well as valuable foreign export markets.

**Exotic Fruit Flies**

PPQ protects a wide variety of specialty crops (particularly tree fruit and citrus) through exotic fruit fly exclusion and detection activities. One of the Agency’s key strategies is maintaining a barrier against the northward movement of Mediterranean fruit fly (Medfly).

Medfly is one of the most destructive agricultural pests in the world, attacking more than 300 cultivated and wild fruits and vegetables.

PPQ and cooperators produced an average of 1.2 billion sterile Medflies per week in FY 2021, to maintain the barrier in Mexico, Guatemala, and Belize, and to release in high-risk areas of California and Florida on a preventative basis. In FY 2021, the international cooperative program continued addressing Medfly outbreaks that began in FY 2019, in the program-designated free areas of Mexico and Guatemala. The program continued providing sterile pupae to cooperators in Mexico for release in areas
with outbreaks. Mexico continues to enforce its enhanced quarantine area inside the State of Chiapas, providing its government authority to conduct additional actions necessary to eradicate the Medfly outbreaks, such as maintaining quarantine stations to control the movement of host materials out of the affected area.

Overall outbreaks were reduced from 3,109 in FY 2020, to 1,619 in FY 2021, with detection in September in the single digits. PPQ and cooperators also continued the production and release of sterile Medflies and aerial bait spray treatments in the program area of Guatemala. Through these and other efforts, the program focuses on maintaining the Medfly-free area in Belize, Guatemala, and Mexico, at approximately 148,000 square kilometers.

Since 2015, when the first Medfly outbreak occurred in the Caribbean, PPQ has worked with partner countries in the region to improve surveillance for Medfly and other exotic fruit flies. In FY 2021, 20 Caribbean countries participated in this effort with active trapping and surveillance programs. Going forward, PPQ will continue to support surveillance in the Caribbean through the supply of basic trapping supplies and capacity building, to maintain the early warning network for the occurrence of this damaging pest close to U.S. shores.

Domestically, PPQ and State cooperators maintain the cooperative Preventative Release Program, which releases sterile fruit flies in high-risk areas to prevent any introduced Medflies or Mexican fruit flies (Mexflies) from reproducing and establishing a population in the United States. In the Los Angeles area in California, PPQ and cooperators release 120 million sterile Medflies per week, and in 4 port areas in Florida, 83 million per week. PPQ and cooperators also maintain a detection network of more than
160,000 traps in California, Florida, Puerto Rico, Texas, New York, and other States vulnerable to exotic fruit fly incursions.

When outbreaks occur, PPQ and cooperators implement immediate emergency response activities to eradicate them. Near the end of FY 2021, PPQ detected Oriental fruit fly in both Florida and California. PPQ implemented enhanced delimiting surveys in Florida and did not make any further detections in that State, but the program confirmed an outbreak in California on September 30, 2021. With support from PPQ, the California Department of Food and Agriculture is implementing eradication activities for the outbreak, with the quarantine covering 94 square miles in a mostly residential area of Santa Clara County. One small farm (eight acres) with tomatoes, peppers, squash, and eggplant is impacted, and PPQ and State officials will work with the grower to determine whether the produce can be moved. PPQ expects the response to be completed within several months.

In FY 2021, the program continued response activities for a Mexfly outbreak in the Lower Rio Grande Valley, the home of the Texas citrus industry, which experiences frequent incursions of the pest. During FY 2021, the size of the quarantined area expanded and contracted several times as new detections occurred on the edges of the response area. PPQ is evaluating this unusual Mexfly outbreak in Cameron County, and a small area of Hidalgo County, that did not follow typical patterns, and determining what activities will help prevent similar outbreaks in the future.

In November 2020, PPQ also established a new Mexfly quarantine in Willacy County. PPQ completed quarantine and regulatory activities and released the area in June 2021. At the end of the year, 677 square miles remain under quarantine. PPQ produced and released an average of 180 million sterile Mexflies per week in Texas and northern Mexico in FY 2021, to support eradication and control programs in that region.
PPQ continued to address the European cherry fruit fly (ECFF) in New York during FY 2021. This temperate fruit fly species differs from the tropical species that PPQ more typically detects and eradicates in Florida, Texas or California, by having only one lifecycle per year, whereas other species have many lifecycles per year and can usually be eradicated within several months. PPQ declares an outbreak eradicated if there are no detections within three lifecycles. Additionally, one of ECFF’s primary hosts is the honeysuckle plant, which is widespread throughout New York, surrounding States, and Canada.

PPQ and cooperators in New York are enforcing quarantine regulations to reduce the risk that it will spread to other cherry-producing areas. The ECFF quarantine expanded in FY 2021, from 2,182 square miles to 3,223 square miles in northwestern New York. Cherry producers can mitigate damage the pest might cause to crops through management practices. Growers also use a systems approach that PPQ developed for the movement of cherries from the quarantine zone to processing plants outside the quarantine area to prevent ECFF from spreading through this movement.

Light Brown Apple Moth (LBAM)

In FY 2021, PPQ and the State of California continued to monitor for LBAM across California and found that the pest had not spread to any new counties. The quarantined area included 22 counties in California. PPQ required entities shipping regulated products out of the quarantined area to take measures to prevent the spread of LBAM to new areas. PPQ coordinated with State cooperators and trading partners on how best to manage the pest in the future following a decade of experience with the pest and learning that it can be managed effectively through current integrated pest management.
methods. On Dec. 17, 2021, PPQ removed the LBAM quarantine in California and Hawaii and is continuing preparation to change import requirements.

**Navel Orangeworm (NOW)**

In FY 2021, PPQ and cooperators in California and Arizona continued implementation of the NOW areawide program, targeting the NOW moth which is a serious pest of tree nut crops, including almonds, pistachios, and walnuts. Adult moths exploit gaps or splits in the nut shells or hulls where they lay eggs inside the nuts. Newly hatched larvae damage the nuts through feeding, and contaminate the final product with insect waste, and they also transfer secondary fungal invaders that produce potentially poisonous aflatoxins rendering the nut inedible.

The pistachio and almond industries provided the initial funding for PPQ to develop sterile insect technology (SIT) for NOW at its Phoenix, Arizona Rearing facility, where PPQ previously reared sterile moths for the successful pink bollworm eradication program. In FY 2020, PPQ and cooperators implemented an area-wide integrated pest management (IPM) program on 1,280 acres that incorporated SIT with grower-managed pheromone mating disruption treatments, coordinated pesticide applications, and field sanitation practices that remove NOW host material. In FY 2021, PPQ and cooperators expanded the acreage by adding 4 new sites (2 pistachio; 2 almond) and doubled the sterile NOW releases to 2,560 acres.

PPQ doubled its production and shipping outputs from approximately 750,000 to 1,500,000 sterile moths per day, maintaining the release rate of approximately 585 sterile NOW moths per acre, per day during the growing season). Additionally, PPQ provided sterile insects to researchers from USDA’s Agricultural Research Service and University of California, Riverside, for large-scale field trials aiming
to guide the NOW program towards the most effective use of SIT within a broad tree-nut IPM program. PPQ and cooperators continue to evaluate the impact of SIT and the other IPM measures on NOW in tree nut crops.

**Plum Pox Virus (PPV)**

PPV is one of the most devastating viral diseases of stone fruit in the world. On October 17, 2019, USDA declared the United States free of this disease. PPQ conducted a final year of post-eradication monitoring in FY 2021, with no positive samples. The New York State Department of Agriculture and Markets (NYSDAM) will continue to conduct surveillance along the U.S.-Canada border and other fruit-producing areas in New York using Plant Protection Act Section 7721 funds. PPQ continues to support yearly PPV detection surveys through Plant Protection Act Section 7721 to ensure that any PPV would be found if it appeared in other States.

**Phytophthora ramorum (P. ramorum)**

PPQ protects natural resources and nursery stock production and trade by limiting the spread of *P. ramorum* from quarantine areas and affected nurseries through regulatory strategies and adoption of mitigations and changes to cultural practices. *P. ramorum*, which causes sudden oak death, can be moved through host nursery stock and can affect a variety of forest trees. The disease is present in coastal northern California and a small area in Curry County, Oregon. On May 21, 2021 PPQ issued a Federal Order adding Del Norte County, California to the quarantine area. This county connects the quarantined areas in California and Oregon and brings the number of California counties affected to 16.
In March 2021, PPQ confirmed that a sample from Curry County, Oregon was positive for *P. ramorum*. This sample was collected outside of the current quarantine area, and PPQ and State officials are updating quarantine regulations to include this new area (as of October 2021). Because of the presence of *P. ramorum* in the surrounding environment, nurseries within the quarantine area that ship interstate must meet annual certification survey and sampling requirements to prevent the movement of potentially infested material. The program also regulates nurseries outside the quarantine areas which ship host nursery stock interstate from the time they test positive.

The nurseries must remain negative for three years to be deregulated. Any positive interstate shipping nurseries must participate in a compliance program using protocols to eliminate the pathogen and implement required mitigations focused on critical control points to reduce the risk of reintroduction. Currently, 18 nurseries are participating in the program. In FY 2021, four nurseries completed the program, and PPQ released them from the program.

Through all these activities, PPQ directly protects nursery stock production worth approximately $1.3 billion in 2019, and tree fruit production worth approximately $1.5 billion in 2020 (APHIS internal analysis based on National Agricultural Statistics Survey data). By preventing pests and diseases like exotic fruit flies, PPV, and *P. ramorum* spreading to new areas, the program indirectly protects approximately $6.8 billion in fruit and nursery stock production (APHIS internal analysis based on National Agricultural Statistics Survey data).
Potatoes

PPQ addresses two major potato pests, pale cyst nematode (PCN) in Idaho and the golden nematode (GN) in New York. PPQ and cooperators have confined each to a relatively small area, and continued survey and regulatory efforts to protect export markets for U.S. potatoes from 36 States.

Pale Cyst Nematode

As of September 30, 2021, PPQ processed 9,836 soil samples for the PCN eradication effort in Idaho, and 7,490 samples from detection surveys in other States. PCN has not been detected outside of Idaho, and fumigations of infested fields in Idaho have reduced PCN populations by 99 percent since the pest was first detected in 2006.

The program conducted 1,581 regulatory treatments in FY 2021, of farm equipment to prevent the spread of PCN out of regulated areas. There are currently 31 PCN-infested fields and the current regulated area is 7,083 acres, of which 3,446 acres are infested fields, and 3,637 are associated fields. The infested fields are in an 8.5-mile radius that spans a portion of northern Bingham County and southern Bonneville County. In FY 2021, the program conducted eradication treatments on 5 infested fields with a total of 505 acres. In the treated fields that no longer show PCN viability, according to a greenhouse bioassay test, producers can plant potatoes with continued monitoring by PPQ and cooperators to ensure PCN is not present.

During the greenhouse bioassay (three rounds of greenhouse bioassay that is the equivalent of three crop cycles), the program tests the viability of any PCN nematodes found in the soil. If the nematodes are found to be non-viable (they fail to reproduce under favorable conditions in the presence of a host), the
fields from which they came are eligible to immediately return to potato production at the landowners’ discretion.

The PCN program requires infested fields that return to potato production to undergo full-field surveys following each of three subsequent potato crops to check for viable PCN populations. These fields remain regulated but benefit from reduced sanitation requirements. In 2021, farmers planted potatoes in two eligible fields; this will be the first crop for one field and the second crop for the other field since before PCN was found on those fields. The fields will be sampled following harvest and analyzed for the presence of viable nematodes. The program is working with USDA’s Agricultural Research Service (ARS), the University of Idaho, and other cooperators to develop PCN-resistant potato varieties. PPQ has funded several projects on PCN-resistant potato varieties through Plant Protection Act 7721 for this long-term effort.

Golden Nematode

In FY 2021, PPQ and New York cooperators continued an effective survey and regulatory program targeting GN with a focus on deregulation of all eligible land. Adopting strategies used in the more recently established PCN program, the GN program is focusing on fields that are either infested or associated with infested fields rather than political boundaries such as townships. PPQ, working closely with the NYSDAM, has removed 1,186,693 acres from the GN regulated area in New York since 2010, allowing several farmers to grow their crops without continued restrictions.

PPQ continues to manage an active control and mitigation program to prevent GN from spreading from the remaining 101,955 regulated acres, including 5,945 acres that are infested with GN in portions of 8 New York counties. The program enforces regulations designed to prevent the spread of GN and
requires sanitation treatments of on farm equipment and other items moving out of the quarantined area. As of September 30, 2021, the program processed 2,386 soil samples for the GN deregulation effort in New York. The program conducted 349 regulatory treatments of farm and earthmoving equipment to prevent the spread of GN out of regulated areas and certified 24 shipments of potatoes to Canada, totaling 1,432,650 pounds.

PPQ has cooperated with USDA’s ARS, NYSDAM, and Cornell University to develop GN-resistant potato varieties for several decades. The program is now headquartered at a newly renovated laboratory on the Cornell University campus to continue this and other work on methods of eradicating GN. The program has developed a total of 45 GN-resistant varieties. Because the pest can overcome resistant potato varieties over time, continued development of new GN-resistant varieties is necessary.

Together, these efforts to address PCN and GN protected 300,000 acres of potatoes in Idaho, valued at $981 million in 2020 (National Agricultural Statistics Survey Quick Stats), and 14,300 acres in New York valued at $45 million in 2018 (National Agricultural Statistics Survey 2018 Potatoes Summary). These programs indirectly protect approximately one million acres of potato production nationwide worth $2.9 billion in 2020 (APHIS analysis using National Agricultural Statistics Survey data).