Glassy-winged Sharpshooter and Pierce's Disease in California

BACKGROUND AND HISTORY

CDFA | Pierce's Disease Control Program | January 2018

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NATURE OF THE PROGRAM

Biology of the Pest and Nature of the Threat

The glassy-winged sharpshooter (GWSS), *Homalodisca vitripennis,* is a relatively large leafhopper belonging to the Cicadellidae family, measuring about 0.5 inches long. It obtains its nutrients by feeding on the xylem fluid of plants. Adult GWSS are generally dark brown to black when viewed from the top or side, with small yellow dots on the head and thorax (see photo on cover). Females lay their eggs in masses of about 10 to 12 under the lower surface of leaves. The sharpshooter typically has two generations per year and overwinters as an adult. These overwintering adults begin laying eggs in February, with the majority of the egg-laying occurring between late March and April. Nymphs hatch out in 10 to 14 days and feed on young succulent stems while they progress through five immature stages. The first-generation adults appear in May through July and egg-laying for the second generation occurs between June and October. The nymphs emerging from these egg masses develop into the adults which will overwinter and lay eggs the following spring.

GWSS is native to the southeastern United States and northeastern Mexico. Although it was first reported in California in 1994, it likely arrived in the state in the late 1980s as egg masses on ornamental or agricultural plant foliage.

The range of GWSS includes many habitats, including agricultural crops, urban landscapes, native woodlands, and riparian vegetation. The host list includes over 360 genera of plants and varies widely from woody plants to annual and perennial herbaceous plants. Since the insect feeds on the nutrient-poor xylem fluid of the plant it must consume copious amounts of fluid in order to gain enough nutrition to grow and reproduce. Consequently, the adults and nymphs excrete large amounts of liquid while feeding, which gives the fruit and foliage a whitewashed appearance. Host preference changes according to the availability and nutritional value of host plants at any given time.

GWSS is a significant vector of *Xylella fastidiosa,* the xylem-limited bacterium that causes Pierce's disease of grapes. Although Pierce's disease has been in California for over 100 years, native vectors do not transmit the bacterium as extensively as GWSS. GWSS is a serious threat to California vineyards because it moves faster and flies greater distances into vineyards than native sharpshooters. It also builds up large populations and can feed on the tougher, lower parts of grapevine stems. When the GWSS feeds on a plant that is infected with *X. fastidiosa,* it acquires the bacteria, which multiplies within the insect's mouthparts. The sharpshooter then transfers the bacteria to other plants when it feeds. Symptoms include chlorosis and scorching of leaves, with entire grapevines dying within one to five years. California's first indication of the severe threat posed by this new disease and vector combination occurred in Temecula, Riverside County in August of 1999, when over 300 acres of grapevines infested with the glassy-winged sharpshooter were infected with Pierce's disease and ultimately destroyed.

In California, in addition to strains of *X. fastidiosa* which cause Pierce's disease, there are also strains which cause other plant diseases such as oleander leaf scorch, almond leaf scorch, mulberry leaf scorch, sweet gum dieback, and cherry plum leaf scorch. Outside of California, other strains of the bacterium cause phony peach disease, plum leaf scald, leaf scorches in sycamore, elm, maple, and oak, and citrus variegated chlorosis. In Europe, *X. fastidiosa* causes olive quick decline syndrome. At this time there is no cure for any of these diseases.

The serious damage that occurred to vineyards in Temecula in 1999 demonstrated the significant threat which GWSS now posed. Clearly, if GWSS continued spreading in California, the state's vineyards and other agricultural and natural resources were in danger.

Primary Goals of the Program

The primary goal of the Pierce's Disease Control Program is to minimize the impacts of Pierce's disease and its vectors in California. The strategy is to slow or stop the spread of the glassy-winged sharpshooter while short- and long-term solutions to Pierce's disease are developed.

This strategy relies upon the following five elements:

1. **Contain the Spread**

   Prevent the spread of GWSS to new areas of the state by regulating shipments of host plants and other host material and suppressing populations to prevent natural spread.

2. **Statewide Survey and Detection**

   Find new GWSS infestations quickly and confirm that uninfested areas remain free of infestation by conducting systematic trapping in uninfested at-risk areas.

3. **Rapid Response**

   Respond quickly to detections of GWSS in new areas by intensively surveying the area and applying treatments if necessary.

4. **Outreach**

   Raise awareness about Pierce's disease and its vectors while responding to the concerns of growers and the public by conducting outreach and education activities.

5. **Research**

   Develop long-term, sustainable solutions to Pierce's disease and its vectors by sponsoring and facilitating research and development.

The CDFA Pierce's Disease Control Program is a cooperative effort that combines the resources and expertise of federal, state, and county agriculture departments, the university, and industry. The Program works cooperatively with the county agricultural commissioners to conduct the first four program elements discussed above, through workplans that are established between the Program and the agricultural commissioners using funding primarily from the USDA. The fifth element (research) is accomplished by supporting research at universities, using funding provided by winegrape growers through a statewide value-based assessment.

CONTAIN THE SPREAD

The Contain the Spread element of the Program is designed to prevent the spread of GWSS to uninfested areas of the state by regulating shipments of host plants and other host material and suppressing populations in infested areas. Emergency regulations governing the movement of nursery stock and bulk grapes were first adopted in July 2000. Regulations on bulk citrus were added later, following finds of live sharpshooters in bulk citrus shipments. Permanent program regulations were adopted in July 2003. In areas already infested with GWSS, area-wide management programs were established to suppress GWSS populations and thereby reduce their damage and spread.

Nursery

Nursery stock is a high-risk commodity for spreading the GWSS. Approximately 53% of California's 13,000 licensed nurseries are located in sharpshooter-infested counties. Many of these nurseries ship to the uninfested areas of the state. Activities to mitigate the risk of moving the GWSS on nursery stock include:

1. Inspection of nursery stock in infested areas prior to shipping to uninfested areas;
2. Treatment of nursery stock when necessary;
3. Certification of shipments;
4. Inspection of nursery stock at receiving nurseries prior to sale; and
5. Trapping in and near nurseries shipping to uninfested areas.

Inspection Results

In 2016, there were 36,000 shipments of nursery stock from infested areas to uninfested areas. Viable life stages of GWSS were discovered in only nine of these shipments at destination. Origin county inspectors stopped 165 egg masses, two nymphs, and eight adults from moving in nursery stock shipments.

Over 90% of all rejections between 2001 and 2016 have been for viable GWSS egg masses. The table on the right presents the results of the ongoing nursery inspection and shipment certification program since 2001.

YEAR	NUMBER OF SHIPMENTS	GWSS FOUND AT DESTINATION	% FREE OF GWSS
2001	57,600	149	99.74%
2002	65,800	77	99.88%
2003	65,000	40	99.94%
2004	76,700	64	99.92%
2005	72,600	84	99.88%
2006	69,000	47	99.93%
2007	73,100	46	99.94%
2008	62,600	37	99.94%
2009	53,700	23	99.96%
2010	50,600	6	99.99%
2011	44,500	4	99.99%
2012	44,600	2	99.99%
2013	45,800	6	99.99%
2014	44,000	12	99.97%
2015	38,000	6	99.98%
2016	36,000	9	99.97%

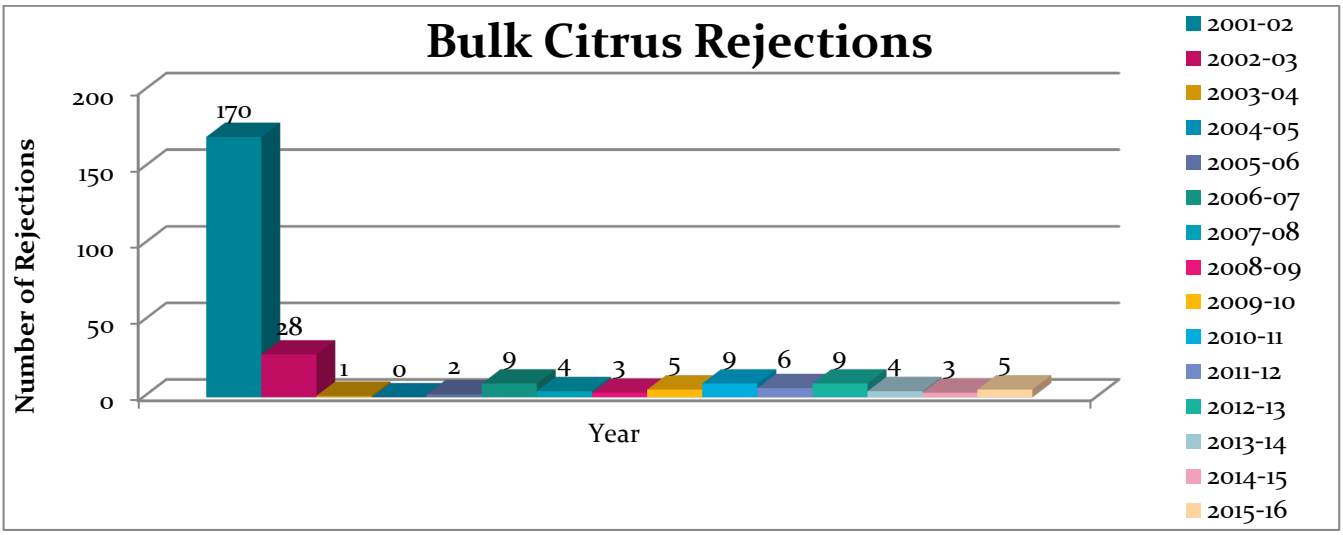
Regulated nursery shipment results

There are different ways that nursery stock can qualify for shipment out of infested areas, depending upon the presence or absence of GWSS in or near the nursery and the treatment, safeguarding, and inspection actions taken. Because of this, nursery locations are referred to as "Program Regulation" or "Master Permit" premises. A third approach, known as the "Approved Treatment Protocol," requires nurseries to follow a rigorous systems approach for keeping nursery stock free of GWSS. As part of the protocol these nurseries treat their stock with specified materials that are 100% efficacious at killing emerging GWSS nymphs. After the safeguarding treatment, the nursery is allowed to ship its nursery stock to uninfested areas without an origin inspection being required.

Bulk Citrus

Citrus trees are primary hosts for the GWSS throughout the year. When the weather is warm the insects are active and will flee the disturbances associated with harvest. However, once the weather turns cold, the sharpshooters are relatively inactive, and can end up in picking bags with harvested fruit, ultimately turning up at processing facilities in other parts of the state.

During the 2015-16 citrus-shipping season (October 2015 through September 2016), live GWSS were found in only five out of approximately 38,904 certified shipments of bulk citrus.



Overall, GWSS containment efforts on nursery stock and bulk citrus have consistently resulted in greater than 99.7% of shipments being free of GWSS at destination.

Area-wide Management Programs

Area-wide management programs are conducted in GWSS-infested areas to suppress GWSS populations. This reduces the likelihood of GWSS spreading to new areas and protects vineyards in the area from Pierce's disease. The programs involve systematic deployment and monitoring of insect traps throughout the area and, when trapping results indicate that GWSS populations are exceeding thresholds, coordinating treatments in citrus, the preferred overwintering host of GWSS. The programs are currently conducted in infested viticultural areas in Fresno, Kern, Madera, Riverside, and Tulare County. Approximately 14,800 traps are deployed in the area-wide program areas during the peak trapping season.

Biological Control

Biological control is a method of controlling target pests using other living organisms, such as predators, parasitoids, and pathogens. Since 2001, the Pierce's Disease Control Program has been using biological control as an important component of its integrated pest management approach to controlling GWSS. More than 2.56 million biological control agents have been reared and released since the start of the program. Three species of wasps in the genus *Cosmocomoidea* (formerly *Gonatocerus*) are currently being reared and released for GWSS biological control. These tiny wasps insert their eggs into GWSS eggs, destroying the developing GWSS as the wasp larva feeds and develops.

Emerging parasitoid

Parasitoid emergence holes

STATEWIDE SURVEY AND DETECTION

The Statewide Survey and Detection element of the Program is designed to find new GWSS infestations quickly and confirm that uninfested areas remain free of infestation. It utilizes systematic trapping of at-risk urban and residential areas and nurseries to determine if GWSS are present. Large numbers of yellow panel traps with adhesive on the surface are deployed in 43 uninfested and partially-infested counties. The GWSS are attracted to the trap's bright yellow color and become stuck on the adhesive. County and state personnel service traps on a regular basis during the trapping season. Each trap is checked every second or third week and moved to a new location every six weeks. New traps are used as needed. During the peak trapping season, approximately 33,000 traps are deployed and serviced statewide for GWSS detection and survey.

RAPID RESPONSE

The Rapid Response element of the Program involves responding quickly to new GWSS detections in partially-infested or uninfested counties. When one or more GWSS are found in a new area a delimitation survey is conducted by county biologists, occasionally with help from state biologists, to determine if an infestation is present and, if so, to identify the boundaries. Treatments in urban and residential areas are applied under the supervision of the County Agricultural Commissioner and funded by the Pierce's Disease Control Program using winegrape grower assessment funds. In agricultural settings, treatments are the responsibility of the grower and must be conducted in a manner approved by the County Agricultural Commissioner. Over the course of the program 18 incipient infestations of GWSS have been successfully eradicated.

Pre-Treatment Communication with Stakeholders

Specific steps are taken before an infested area is treated to ensure residents are properly advised and environmental concerns are addressed. A public meeting or other outreach efforts for community members precedes treatment in urban and residential areas. This provides residents the opportunity to learn about and discuss the treatment process with program and environmental health specialists. Door-to-door contacts, direct mail, and/or local media sources are used to inform residents of public meetings. Occupants of all properties scheduled for treatment are provided advance notification of the treatment date and time, information on the material to be used, and a phone number to call for more information. A database of threatened and endangered species is consulted to determine if any listed species are present in the treatment area. The U.S. Fish and Wildlife Service, the California Department of Fish and Wildlife, the California Department of Pesticide Regulation, the California Department of Health Services, and other agencies are notified prior to treatment.

Treatment

Public safety is the Department's number one concern whenever treatments are applied. Program staff and cooperators ensure that only registered materials are applied, in strict compliance with label and other restrictions.

Imidacloprid has proven very effective against the GWSS. It is used in treatment programs in urban and residential settings and can be used for both foliar and soil treatment applications.

OUTREACH

Public outreach and education was used early in the program to quickly raise awareness about Pierce's disease, GWSS, and the new regulations and requirements for shipping and handling GWSS host material. It continues to be important for maintaining compliance and awareness about GWSS and the threat it presents to California's agriculture, economy, and environment.

As in other parts of the program, California's county agricultural commissioner partners play a key role in maintaining program visibility and stakeholder awareness. County public outreach and education efforts include the distribution of informational material to local retail, production, and shipping nurseries, landscape companies, and other members of the community. Industry trade publications, cooperative extension newsletters, and media interviews also proved to be successful methods of outreach. Some counties also participate in continuing education seminars and conduct training for landscapers, pest control operators, nursery employees, and nursery association members. The Pierce's Disease Control Program maintains a website that provides information on GWSS and Pierce's disease. The website is located at https://www.cdfa.ca.gov/pdcp/.

Additionally, using winegrape grower assessment funds, the Pierce's Disease Control Program employs the services of an outreach and education contractor to help with outreach efforts statewide. The program and the contractor have worked together on outreach and education since 2004. This outreach effort focuses on keeping winegrape growers, stakeholders, and other interested parties informed about activities including research and other program activities. The methods utilized include print media, monthly and quarterly emailed newsletters, and in-person attendance at trade shows and other wine and grape events.

RESEARCH

Research is an integral part of the Pierce's Disease Control Program and is the means by which long-term, sustainable control and management methods for Pierce's disease will be developed. Funding of research projects began in 1999 and has continued every year since then, with much of the funding coming from a statewide value-based assessment paid annually by California's winegrape growers. Funded projects have ranged from lab-based investigations at the molecular and genomic levels to area-wide projects in major agricultural areas. The information being generated is providing valuable insight into the biology, ecology, and behavior of Pierce's disease and its vectors, increasing the knowledge base available for developing management solutions. Examples of discoveries and approaches that show good potential for leading to solutions include using conventional plant-breeding methods to develop grapevines resistant to Pierce's disease, using non-virulent strains of *Xylella fastidiosa* to displace and outcompete pathogenic strains, identifying the mechanisms and processes leading to bacterial infection and spread, and elucidating the biochemical pathways which result in disease symptoms and death. Scientists have developed plant metabolites that block damage-causing pathways and processes and are experimenting with ways to introduce them into the plants via specially-developed rootstocks, topical applications, and other means. Several grapevine scions and rootstocks bred for resistance to Pierce's disease using traditional methods have been field tested and provided to Foundation Plant Services at UC Davis for possible commercialization, and in April 2017 five cultivars were pre-released to nurseries for testing purposes. Small lots of wine have been produced from some of these new disease-resistant cultivars and have tested well in wine tastings. Additionally, field testing of grapevine plant material developed using transgenic approaches began in 2010 and is continuing.

Beginning in 2001, the Pierce's Disease Control Program has organized 14 annual research symposia to foster communication and information sharing among scientists and stakeholders on the latest research progress and findings on Pierce's disease. Additionally, every year since 2001 a compilation of progress reports on current research projects on Pierce's disease and the glassy-winged sharpshooter has been prepared by the Program. The compilations of research progress reports can be accessed electronically on the Program's website at

https://www.cdfa.ca.gov/pdcp/Research.html. Additional research progress reports and other research-related information are available on another website that is maintained by the Program (http://www.piercesdisease.org/).

Program Successes and Challenges

SUCCESSES

- Quickly established a statewide comprehensive cooperative pest prevention program to protect California's agricultural and natural resources from the spread and damage caused by the glassy-winged sharpshooter (GWSS) and Pierce's disease.
- Prevented glassy-winged sharpshooter from spreading to new areas of California.
- Protected viticulture areas from Pierce's disease.
- Enabled grape growers to produce crop volumes and quality at pre-threat levels or higher.
- Established area-wide programs in several GWSS-infested areas of the state, utilizing systematic trapping and coordinated treatments to reduce GWSS populations and the occurrence of Pierce's disease.
- Established regulations, requirements, methods, and mechanisms for enabling the safe movement of GWSS host commodities out of infested areas.
- Funded numerous research projects, leading to increased knowledge on the pest and disease and potential solutions for growers.
- Organized 14 research symposia and prepared 17 annual compilations of research progress reports (1,050 reports total).
- Conducted outreach activities that informed industry, the public, and others of the new pest and disease threat and the new regulations and requirements for moving host materials.
- Developed a GWSS host list / list of regulated commodities based on field interceptions and observations.

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- Developed an approved treatment program for nursery stock shipped from GWSS-infested areas.
- Intercepted and prevented the movement of live GWSS on nursery stock and bulk citrus shipments 870 times in the last 16 years.
- Detected and eradicated 18 incipient infestations of GWSS.
- Established biological control rearing facilities in four locations in California.
- Reared and released 2.56 million GWSS biological control agents at 180 release sites in 17 counties.
- Established and administered a California winegrape grower assessment, advisory board, and task force. The assessment has collected $55 million over 16 years and has been used for funding research and related PD/GWSS program activities.

CHALLENGES

- GWSS populations in some areas appear to be developing resistance to one of the main pesticides (imidacloprid) used in control programs.
- Regulatory actions may reduce the usability and availability of currently-used control materials.
    - Pollinator protection language on pesticide labels has increased the restrictions on pesticide use in urban and rural residential areas. This could impact GWSS suppression and eradication activities.
- Untreated vineyards, citrus groves, and windbreaks can serve as sources of GWSS.
    - Effective, inexpensive treatment options for controlling GWSS are not available for use in organic citrus groves and organic vineyards.
- GWSS population sizes and disease incidence can vary unexpectedly, indicating that better understanding is needed of the crop-pest-disease system.
    - Fluctuations in pest populations and disease epidemiology are likely tied to unpredictable and uncontrollable biotic and abiotic factors. Warmer winters likely lead to longer periods of GWSS activity, less GWSS mortality, more movement of

GWSS northward, and more generations of GWSS per year. The incidence of Pierce's disease will also likely increase with warmer winters because of increased vector activity and less cold-weather curing of grapevines. The impacts of drought and wet years on the disease and the vector are unknown.

- Program funding is decided and allocated annually, creating uncertainty in program planning and resource availability.
- Some types of nursery stock may not have effective insecticides registered for use on them.

Impact on Foreign and Domestic Trade

The California and U.S. grape and wine industry are economic, social, and cultural powerhouses, contributing significantly to trade, tourism, employment, taxes, transportation, and quality of life. Not properly addressing this pest and disease issue would have serious repercussions on all of these sectors.

FOREIGN TRADE

- More than 95 countries receive grape products from the U.S.
- Ninety-nine percent of U.S. table grapes are produced in California.
- Canada is the largest market for U.S. fresh grapes, with exports in 2015 totaling $221.4 million.
- Information on 2016 fresh grape exports:
  - Australia and New Zealand received shipments valued at a total of $60.5 million.
  - China and Hong Kong received $86.2 million.
  - Mexico received $77.3 million.
  - Thailand and Vietnam received $34.5 million.
- The Australia market
  - Australia continues to reduce the number of Australian inspectors assigned to the U.S. each year to pre-inspect table grapes and four other fruits in California,

Oregon, and Washington under the U.S. industry-requested Offshore Pre-shipment Inspection programs.

- If pest issues of concern to Australia were to get out of control in any state where they receive exports from, then Australia could take significant action.
- In 2017 Australia identified *Xylella fastidiosa*, the bacterium that causes Pierce's disease, as its number one national priority plant pest (see http://www.agriculture.gov.au/pests-diseases-weeds/plant/xylella/international-symposium-xylella-fastidiosa).

DOMESTIC TRADE

- A recent report from WineAmerica (www.wineamerica.org; *2017 Economic Report on Wine*) estimated the total annual economic benefit of the U.S. wine industry to be $219.9 billion. The report estimates the U.S. wine industry accounts for 1.74 million jobs, $75.8 billion in annual wages, $17.7 billion in tourist expenditures, and $31.3 billion in total taxes. Nationwide vineyard acreage is estimated to be 677,581 acres. California is estimated to account for about 85% of the nation's total output.
- A report from the Wine Institute (www.wineinstitute.org; *The Economic Impact of the California Wine and Winegrape Industry, 2015*) estimated the annual national economic benefit of the California wine industry to be $114 billion in economic activity. It accounts for 786,000 jobs, $34.9 billion in wages, and $15.2 billion in taxes.
- In 2015, a total of 1.14 million tons of table grapes valued at $1.74 billion were produced on 112,000 acres in California, while 2.01 million tons of raisins valued at $697 million were produced on 184,000 acres.
- The European Union is greatly concerned about the spread of *Xylella fastidiosa (*Xf*).* The represented European Union states concluded December 1, 2017 at the Ministerial Conference on Xf, held in Paris, that Xf is the most dangerous plant bacteria known worldwide and preventing further introduction and spread within the Union is crucial.

Emergency measures provide strict import requirements for more than 300 plant species entering the Union (see website https://ec.europa.eu/food/sites/food/files/plant/docs/ph_biosec_legis_emer_measu_xylella_detailed_conclusions_paris_en.pdf).

PROGRAM FUNDING

Federal Funds Awarded to CDFA

Agreement Period*	Amount Awarded
Oct 2012 –Dec 2013	$15,074,754
Oct 2013 – Sept 2014	$15,074,754
Oct 2014 – Sept 2015	$15,574,754
Oct 2015 – Sept 2016	$15,574,754
Oct 2016 – Jan 2018	$15,574,754

* Most recent five years

State/Industry/Stakeholder Cost Sharing

FUNDING FOR PIERCE'S DISEASE ACTIVITIES (a)

State Funding (by State Fiscal Year)										
	FY 1999-00	**FY 2000-01**	**FY 2001-02**	**FY 2002-03**	**FY 2003-04**	**FY 2004-05**	**FY 2005-06**	**FY 2006-07**	**FY 2007-08**	**FY 2008-09**
AB 1232 Funds for Research	$750,000	$750,000	$750,000							
SB 671 Allocation	$6,900,000									
State Budget Act		$6,900,000	$8,287,500	$6,401,000	$6,408,000	$4,408,000	$4,341,000	$4,500,225	$4,548,681	$4,088,825
UCR Greenhouse			$375,000							
Total:	$7,650,000	$7,650,000	$9,412,500	$6,401,000	$6,408,000	$4,408,000	$4,341,000	$4,500,225	$4,548,681	$4,088,825

Local Government Funding (by State Fiscal Year)										
	FY 1999-00	**FY 2000-01**	**FY 2001-02**	**FY 2002-03**	**FY 2003-04**	**FY 2004-05**	**FY 2005-06**	**FY 2006-07**	**FY 2007-08**	**FY 2008-09**
City of Temecula	$125,000									
Riverside County	$125,000									
Napa County (PD/GWSS only)				$180,000	$164,500	$150,400	$78,092	$179,727	$109,984	$190,281
Total:	$250,000	$0	$0	$180,000	$164,500	$150,400	$78,092	$179,727	$109,984	$190,281

Industry Funding (by State Fiscal Year)										
	FY 1999-00	**FY 2000-01**	**FY 2001-02**	**FY 2002-03**	**FY 2003-04**	**FY 2004-05**	**FY 2005-06**	**FY 2006-07**	**FY 2007-08**	**FY 2008-09**
AVF Funds to Match AB 1232	$250,000	$250,000	$250,000							
Statewide Winegrape Assessment (incl. interest) (b)			$6,162,998	$3,926,646	$3,777,144	$4,108,621	$5,592,557	$4,944,256	$3,592,241	$2,810,638
Napa County Winegrape Assessment (PD/GWSS portion only)				$180,000	$164,500	$150,400	$78,092	$179,727	$109,984	$190,281
Table Grape Pest Control District(s) (PD/GWSS portion only)							$399,277	$439,915	$447,825	$480,042
Other (Kern/Tulare GWSS Update)					$8,500	$11,000	$11,000	$11,000		
Total:	$250,000	$250,000	$6,412,998	$4,106,646	$3,950,144	$4,270,021	$6,080,926	$5,574,898	$4,150,050	$3,480,961

Federal Funding (by Federal Fiscal Year)										
	FY 2000	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**FY 2008**	**FY 2009**
USDA APHIS Funds for Temecula	$360,000									
USDA Allocation for APHIS & CDFA			$8,500,000	$17,500,000	$22,119,000	$23,003,000	$24,079,000	$24,079,000	$23,175,000	$23,175,000
CCC Emergency Funds	$22,289,289		$8,714,152	$8,769,736	$5,182,000					
USDA ARS Funds for PD/GWSS		$1,098,000	$4,023,000	$4,702,000	$5,245,000	$5,298,000	$6,242,000	$6,273,000	$6,229,000	$6,210,000
CSREES & NIFA Funds for UC PD Research Grant Program		$1,700,000	$1,833,308	$2,089,016	$1,880,481	$1,933,462	$2,043,451		$1,520,476	$1,427,332
Grapevine Loss Assistance Program		$7,140,000								
Total:	$22,649,289	$9,938,000	$23,070,460	$33,060,752	$34,426,481	$30,234,462	$32,364,451	$30,352,000	$30,924,476	$30,812,332

	FY 1999-00	**FY 2000-01**	**FY 2001-02**	**FY 2002-03**	**FY 2003-04**	**FY 2004-05**	**FY 2005-06**	**FY 2006-07**	**FY 2007-08**	**FY 2008-09**
Total:	$30,799,289	$17,838,000	$38,895,958	$43,748,398	$44,949,125	$39,062,883	$42,864,469	$40,606,850	$39,733,191	$38,572,399

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State Funding (by State Fiscal Year)										
	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	Total
AB 1232 Funds for Research										$2,250,000
SB 671 Allocation										$6,900,000
State Budget Act	$3,721,272	$3,836,531							$5,000,000	$62,441,034
UCR Greenhouse										$375,000
Total:	$3,721,272	$3,836,531	$0	$0	$0	$0	$0	$0	$5,000,000	$71,966,034

Local Government Funding (by State Fiscal Year)										
	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	Total
City of Temecula										$125,000
Riverside County										$125,000
Napa County (PD/GWSS only)	$193,378	$182,560	$203,545	$159,229	$135,820	$121,792	$101,790	$93,226	(pending)	$2,244,324
Total:	$193,378	$182,560	$203,545	$159,229	$135,820	$121,792	$101,790	$93,226	$0	$2,494,324

Industry Funding (by State Fiscal Year)										
	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18	Total
AVF Funds to Match AB 1232										$750,000
Statewide Winegrape Assessment (incl. interest) (b)	$2,847,786	$1,960,570	$1,917,849	$3,574,688	$2,823,929	$2,593,255	$2,191,110	$4,561,353	(pending)	$57,385,641
Napa County Winegrape Assessment (PD/GWSS portion only)	$193,378	$182,560	$186,387	$186,387	$186,387	$184,757	$184,757	$134,630	(pending)	$2,492,227
Table Grape Pest Control District(s) (PD/GWSS portion only)	$383,199	$346,229	$268,800	$273,375	$291,375	$291,375	$291,375	$287,375	(pending)	$4,200,162
Other (Kern/Tulare GWSS Update)										$41,500
Total:	$3,424,363	$2,489,359	$2,373,036	$4,034,450	$3,301,691	$3,069,387	$2,667,242	$4,983,358	$0	$64,869,530

Federal Funding (by Federal Fiscal Year)										
	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	Total
USDA APHIS Funds for Temecula										$360,000
USDA Allocation for APHIS & CDFA	$22,983,000	$22,937,034	$20,277,000	$18,707,857	$19,100,000	$19,100,000	$19,100,000	$21,100,000	(pending)	$328,934,891
CCC Emergency Funds										$44,955,177
USDA ARS Funds for PD/GWSS	$6,356,000	$6,344,000	$5,539,000	$5,127,000	$5,164,000	$5,164,000	$5,164,000	$5,164,000	(pending)	$89,342,000
CSREES & NIFA Funds for UC PD Research Grant Program	$1,861,335									$16,288,861
Grapevine Loss Assistance Program										$7,140,000
Total:	$31,200,335	$29,281,034	$25,816,000	$23,834,857	$24,264,000	$24,264,000	$24,264,000	$26,264,000	$0	$487,020,929

Notes

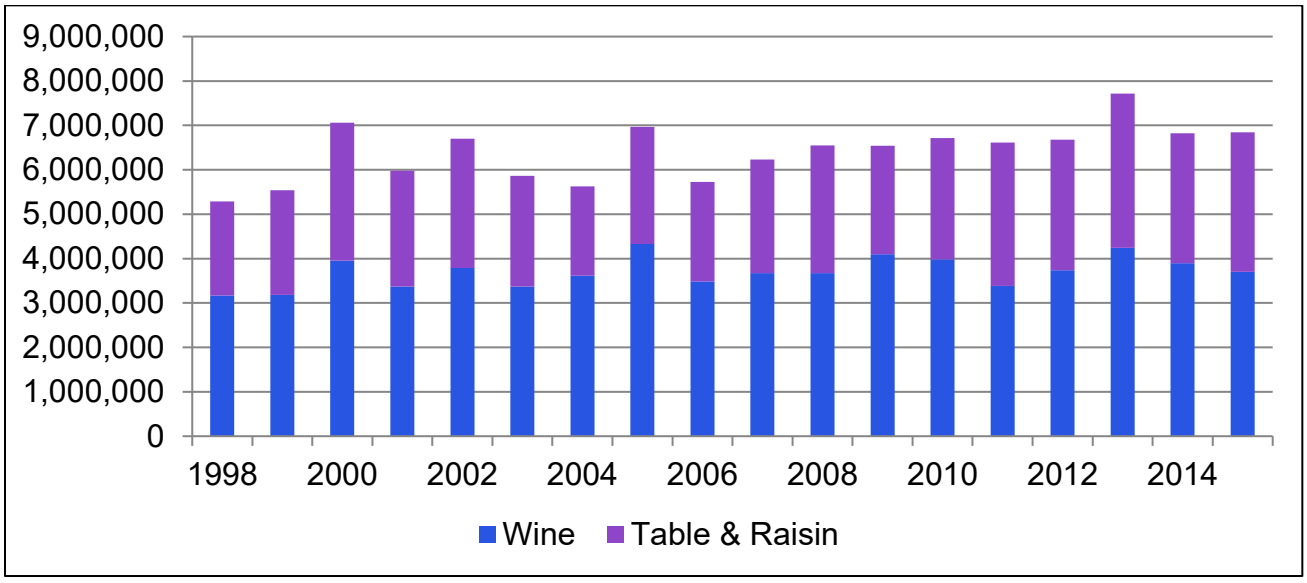
(a) Figures include total amount of funding appropriated, collected, or allocated in that fiscal year, regardless of what fiscal year the funds were actually spent in, and before overhead was taken out.

(b) Includes $3,451,974 of winegrape assessment funds that have been allocated for research and outreach on other winegrape pests and diseases besides PD/GWSS.

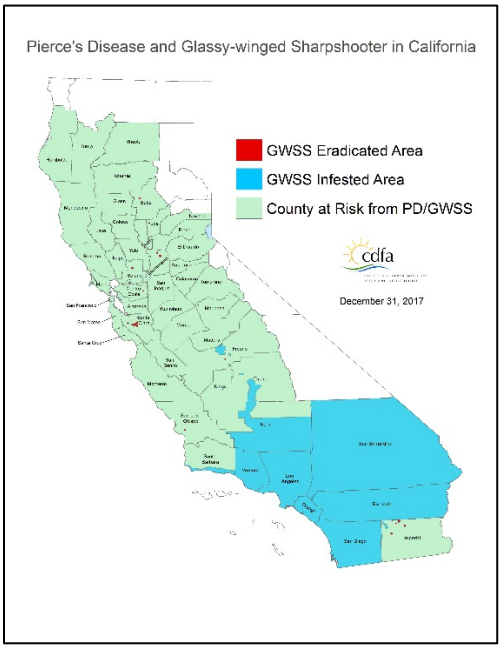
ADDITIONAL INFORMATION

1999 (before the Program): "Say goodbye to California wines."

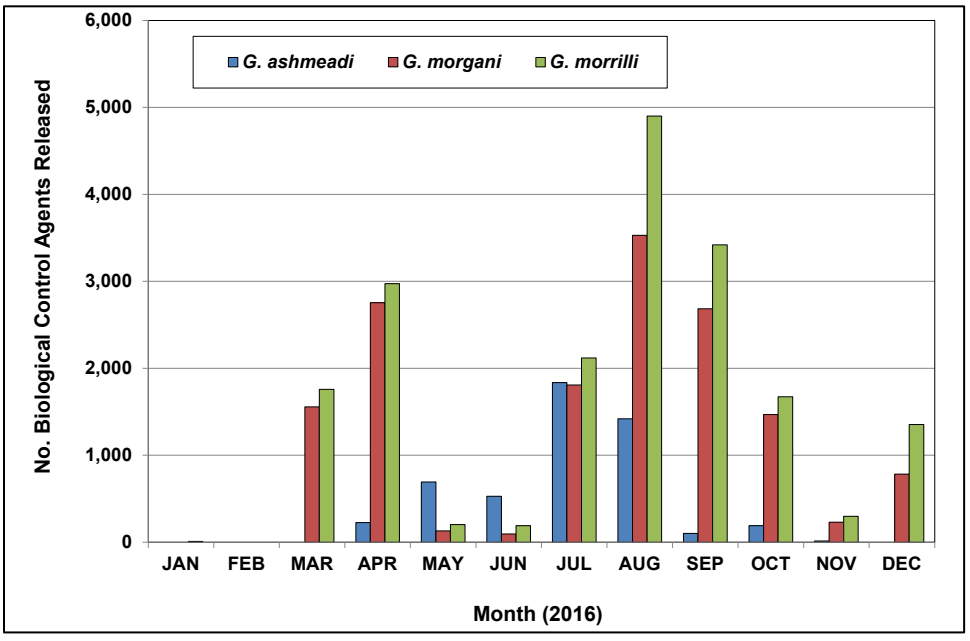
Grape Production in California (tons)



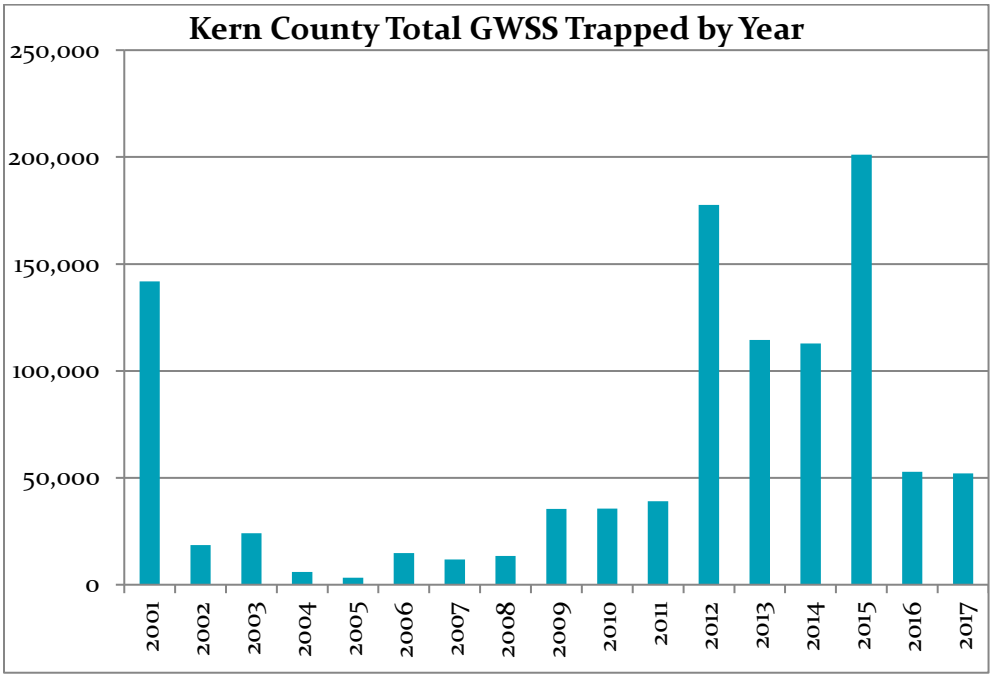
With the Program: California grape production continues to be strong.



The Program has successfully protected California from further spread of GWSS through regulatory, detection, and eradication efforts.



Number of GWSS biological control agents released per month in 2016.



Program challenge: GWSS resurgence because of pesticide resistance, refuges, weather, and other factors, bringing with it increased threat of Pierce's disease.