

**Report of the Pierce's Disease Research  
and  
Emergency Response Task Force**

**University of California  
Office of the President  
April 2000**

**The University of California prohibits discrimination against or harassment of any person on the basis of race, color, national origin, religion, sex, physical or mental disability, mental condition (cancer-related or genetic characteristics), ancestry, marital status, age, sexual orientation, citizenship, or status as a covered veteran (special disabled veteran, Vietnam-era veteran or any other veteran who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized).**

**University Policy is intended to be consistent with the provisions of applicable State and Federal laws.**

**Inquiries regarding the University's nondiscrimination policies may be directed to the Affirmative Action/Staff Personnel Services Director, University of California, Agriculture and Natural Resources, 1111 Franklin, 6<sup>th</sup> Floor, Oakland, CA 94607-5200 (510-987-0096)**

## **Executive Summary**

In early October 1999, University of California President Richard C. Atkinson established a task force of experts to help find solutions to Pierce's disease, an insect transmitted bacterium that threatens California's \$2.8 billion wine, table and raisin grape growing industry. More than 1,000 acres of vines in the North Coast premium winegrape growing regions have already been killed by the disease, with another 300 acres dead or dying in Riverside County. There is no known cure for Pierce's disease.

In establishing the UC Pierce's Disease Research and Emergency Response Task Force, President Atkinson said he was taking action to mobilize and focus the scientific, technical and information outreach expertise of the University to respond to this crisis. He asked the 12-member task force to:

- ! identify promising areas for research and to formulate a set of science-based research priorities for tackling the disease and its insect vectors;
- ! report on activities by UC scientists and farm advisors to extend PD-related technical assistance to vineyard operators; and
- ! identify other educational and information needs of user communities and strategies for speeding the flow of science-based information into the field.

### **Significant findings by the Task Force include:**

- ! Pierce's disease is not new – it has occurred periodically since the 1880s when it destroyed 40,000 acres of grapes in the Los Angeles Basin.
- ! The disease is caused by *Xylella fastidiosa*, a bacterium that clogs a plant's xylem and effectively shuts down its ability to take in water and nutrients.
- ! Premium winegrape regions on the North Coast are experiencing a Pierce's disease epidemic with over \$30 million in damage since 1994. The blue-green sharpshooter (BGSS) transmits the disease in this area.
- ! Over the past three years, a new outbreak has destroyed several hundred acres of vines in the Temecula Viticultural Area of Riverside County.
- ! The insect responsible for infecting Temecula grapevines is the glassy-winged sharpshooter (GWSS), an accidentally introduced exotic pest.
- ! GWSS is an especially aggressive flyer – which increases its ability to spread Pierce's disease over larger portions of vineyards than BGSS – and feeds and

breeds on a broad spectrum of host plants.

- ! If GWSS becomes established in the grape-growing regions of the state, more than 700,000 acres of wine, table and raisin grapes will be at risk.
- ! Besides Pierce's disease, GWSS can transmit strains of *X. fastidiosa* known to cause disease in almonds, citrus, stone fruits, alfalfa, oleander, and a host of other plants.
- ! Slowing the spread of GWSS should be a high priority both to minimize economic losses to agriculture and to "buy time" for scientists to work on solutions to Pierce's disease.
- ! Breeding resistance to the disease using genetic engineering and other biotechnology applications holds the greatest promise for eliminating Pierce's disease in grapes – the research investment must begin today, not 5 or 10 years from now.

**The Pierce's Disease Task Force makes the following recommendations to reduce the impact of Pierce's disease and its insect vectors on California agriculture, the nursery industry, natural habitats and urban landscapes.**

- ! **Immediate/Short-Term Research Priorities (Next 5 Years)** – Researchers should focus on vector control, disease control, and the epidemiology and physiology of the *X. fastidiosa* bacterium. Short term priorities include research into pest management strategies, barrier and trap crops, winter pruning, use of micronutrients and biological controls, and the movement of the bacterium in the plant xylem.
- ! **Long-Term Research Priorities (Next 5-10 Years)** – Initiate an integrated program to breed disease resistance in grapes using genetic engineering and DNA manipulation. The Task Force believes that moving genes resistant to the *X. fastidiosa* bacterium into wine, table and raisin grapes offers the only sure protection from Pierce's disease.
- ! **Statewide Monitoring and Tracking Program** – Support is needed for a coordinated, statewide monitoring, trapping and reporting program involving governmental agencies, the agriculture and nursery industries and UC. The objective is to locate populations of GWSS and BGSS, track the incidence and distribution of Pierce's disease and carry out emergency response programs to slow the spread of PD and its vectors.
- ! **Computerized Geobased Information System Database** – CDFA or UC should manage a GIS to store, display, manipulate and overlay information

collected by statewide monitoring and tracking programs. This data should be available to decision makers, growers and scientists.

- ! **Educational Outreach and Technical Assistance** – UC should take the lead in disseminating research findings and practical information on Pierce’s disease, its insect vectors and methods for reducing the spread of the bacterium by GWSS and BGSS; maintain a Pierce’s disease Web site; and develop and distribute printed materials, videos, CDs and other educational information on PD and its vectors.
- ! **Utilize *X. fastidiosa* Genome Mapping from Brazil** – UC scientists should access data from this just-completed genome mapping project on the strain of *X. fastidiosa* causing citrus variegated chlorosis.
- ! **Increased Funding for Research** – The Task Force recommends a minimum additional investment of \$2 million/year for short- and long-term research priorities identified in the report. Managing the disease and limiting its spread are the goals over the short term. Breeding of resistance to the bacterium in grapes using genetic engineering and DNA technologies is the long-term objective.
- ! **Increased Attention to Exotic Pest Invasions** – Resources should be available to expand research into the control and eradication of exotic pests, including building capacity in UC to respond quickly to new pest invasions. Such a program would complement exotic pest inspection, exclusion, eradication and control efforts of CDFA and USDA.
- ! **Expand Pool of Scientists Working on Pierce’s Disease** – Scientists from across UC, other universities and governmental organizations with expertise in Pierce’s disease, its insect vectors and other high priority research areas identified in this report should be encouraged to join in this important undertaking.
- ! **Establish Statewide Pierce’s Disease Coordinating Committee** – The Secretary for Food and Agriculture should establish a statewide committee to encourage timely sharing of information on the PD epidemic and to coordinate monitoring, trapping and emergency response efforts. The Secretary should designate a “PD czar” to oversee statewide efforts.

The Task Force also identified a critical need for a GWSS field identification guide and supported the preparation of a full-color brochure, *Glassy-Winged Sharpshooter: A Serious Threat to California Agriculture*. More than 70,000 copies have been distributed to workers in the agricultural, nursery and landscape industries by early 2000. A Spanish-language version will be available in March.

## Table of Contents

|   |            |
|---|------------|
| <b>Executive Summary</b> .....  | <b>iii</b> |
| <b>Introduction</b> .....   | <b>1</b>   |
| <b>Section I. Pierce’s Disease and Its Vectors</b> .....                    | <b>4</b>   |
| Blue-Green Sharpshooter .....   | 4          |
| Glassy-Winged Sharpshooter .....  | 6          |
| <b>Section II. Current Research on Pierce’s Disease and Vectors</b> .....   | <b>10</b>  |
| Funding Sources for PD Research .....                                       | 10         |
| Biology and Control of Insect Vectors .....                                 | 11         |
| Biology and Control of <i>Xylella fastidiosa</i> Bacterium .....            | 13         |
| Acquisition and Transmission of <i>X. fastidiosa</i> by Sharpshooters ..... | 14         |
| Plant Resistance to <i>X. fastidiosa</i> .....                              | 14         |
| <b>Section III. Educational and Technical Assistance from UC</b> .....      | <b>16</b>  |
| Educational Outreach/Information Dissemination to Users .....               | 16         |
| Glassy-Winged Sharpshooter Workgroup .....                                  | 19         |
| Membership on Advisory Boards .....   | 19         |
| <b>Section IV. Research Needs</b> .....                                     | <b>20</b>  |
| Monitoring and Database Management .....                                    | 21         |
| Control of Glassy-Winged and Blue-Green Sharpshooters .....                 | 22         |
| Control of Pierce’s Disease .....   | 23         |
| Plant Resistance to Pierce’s Disease .....                                  | 24         |

Movement, Multiplication and Pathology of *X. fastidiosa* ..... 24

Economic Analyses ..... 25

**Section V. Task Force Recommendations ..... 26**

**Appendices**

- Appendix I. List of Task Force Members and Press Release**
- Appendix II. Presentations and Publications by UC Academics**
- Appendix III. CDFA Glassy-Winged Sharpshooter/  
Pierce’s Disease Task Force Report (November 1999)**

## Introduction

In the summer of 1999, winegrape growers in Riverside County experienced the sudden die-back of grapevines in a number of vineyards in the Temecula Viticultural Area. By mid-August more than 300 acres of vines near Temecula were dead or dying and University of California scientists confirmed that Pierce's disease (PD) was the cause. In early October UC President Richard C. Atkinson established the Pierce's Disease Research and Emergency Response Task Force to mobilize the scientific, technical and information-outreach expertise of the University to find solutions to this serious problem.

Pierce's disease is caused by a bacterium (*Xylella fastidiosa*) that clogs a plant's xylem and effectively shuts down its ability to take in water and nutrients. The disease itself is not new to California. It was first recorded in the 1880s when it destroyed more than 40,000 acres of young grapevines in the Los Angeles basin. "Hot spots" of Pierce's disease also have persisted in the Napa Valley since the 1880s. There have been periodic epidemics over the last century where the disease has reached a higher incidence and become more widespread in the grape-growing regions of the state.

In the early 1990s winegrape growers in Napa and Sonoma counties again began reporting symptoms of Pierce's disease in their vineyards. The spread of PD into North Coast vineyards, while widespread, is mostly confined to vines planted along riparian (streambank) areas and near irrigated landscapes. The principal insect vector coming from these habitats is the blue-green sharpshooter (BGSS). Since 1994 more than 1,000 acres of PD-infected vines have been pulled and replanted, with an estimated cost to growers in excess of \$30 million.

The recent outbreak of Pierce's disease in the Temecula Valley, which has cost growers millions of dollars, is all the more troubling because the bacterium is transmitted by the glassy-winged sharpshooter, an exotic pest accidentally introduced into Southern California around 1989. Unlike the blue-green sharpshooter which is not a strong flyer, GWSS is an aggressive flyer – a trait which increases the spread of Pierce's disease over larger portions of vineyards.

There is growing concern that GWSS, now detected as far north as Santa Barbara County on the coast and Kern County inland, may spread Pierce's disease throughout the state's grape-growing regions. If this was to occur, production would be threatened on more than 700,000 acres of wine, raisin and table grapes valued at \$2.8 billion a year. There is no practical cure for Pierce's disease, with most vines dying within two years of being infected. Besides grapes, many other economically important commodities grown in California may be at risk from other strains of *X. fastidiosa*.

UC researchers, supported by the Viticulture Consortium Program, California

Competitive Grant Program for Research in Viticulture and Enology, American Vineyard Foundation and North Coast Pierce's Disease Task Force, have been studying ways to deflate the PD epidemic since the mid-1990s. Until recently the primary focus of these research efforts has been on the North Coast epidemic, with selective removal of riparian vegetation, introduction of new pest management strategies, winter pruning, and the application of micronutrients and antibiotics to vines showing the most promise for controlling BGSS and the *X. fastidiosa* bacterium.

As the magnitude of the problem in Riverside County became apparent, many organizations moved to provide funds to study the glassy-winged sharpshooter and its role in spreading PD. The UC-managed Viticulture Consortium approved funding in spring 1999 for research into GWSS population dynamics and the incidence of PD in Temecula vineyards. Local governments and industry raised another \$250,000 over the summer. In October Governor Davis signed AB 1232 (Chapter 627 of the Statutes of 1999) which provides \$2.25 million in state funds over the next three years to support Pierce's disease research. The urgency bill requires industry to contribute another \$750,000 for a total of \$3 million in new funds.

The California Department of Food and Agriculture (CDFA) and the University each appointed a task force to address the Pierce's disease crisis. The CDFA Glassy-Winged Sharpshooter/Pierce's Disease Task Force was established by Secretary for Food and Agriculture Bill Lyons, Jr., in September 1999. Members were from CDFA, the winegrape industry, universities (UC and CSU), county agricultural commissioners, and the U.S. Department of Agriculture (USDA).

The primary focus of the CDFA task force was on the glassy-winged sharpshooter and slowing the spread of Pierce's disease in Southern California. The task force members identified a series of research objectives and ranked them as high, medium or low priority. Their report was delivered to Secretary Lyons in November.

In announcing his appointment of the UC Pierce's Disease Research and Emergency Response Task Force in early October, Atkinson cited the economic losses to California's wine and grape industries from PD and the University's commitment to work with growers to control this threat to the state's agricultural economy.

He asked the Task Force members to:

- ! identify promising areas for research and to formulate a set of science-based research priorities for tackling the disease and its insect vectors;
- ! report on activities by UC scientists and farm advisors to extend PD-related technical assistance to vineyard operators; and

- ! identify other educational information needs of user communities and strategies for speeding the flow of science-based information into the field.

The 12-member task force, chaired by Vice President – Agriculture and Natural Resources W.R. “Reg” Gomes, included scientists from the Berkeley, Davis and Riverside campuses and county advisors from UC Cooperative Extension. Appendix I includes the October 6, 1999, press release announcing the Task Force and a roster of members.

The first meeting of the Task Force was in Oakland on October 15; the second at UC Berkeley on November 23. A subcommittee of the Task Force met at UC Riverside on October 29. During these meetings, information on the magnitude of the Pierce’s disease epidemic on the North Coast and in Southern California was reviewed. The Task Force members developed a detailed list of research needs and priorities, made decisions on the publication and distribution of a GWSS informational brochure, and developed a set of recommendations intended to increase the University’s research and educational outreach activities in response to the PD crisis in California.

The report that follows summarizes the findings and recommendations of the Task Force. It also provides background on the disease and the status of research and educational outreach efforts now under way in the University. The report is organized under five sections.

- ! Section I. Pierce’s Disease and Its Vectors
- ! Section II. Current Research on Pierce’s Disease and Vectors
- ! Section III. Educational and Technical Assistance from UC
- ! Section IV. Research Needs
- ! Section V. Task Force Recommendations

## Section I. Pierce's Disease and Its Vectors

### Background

Pierce's disease was first recorded in Orange County in the 1880s when it killed more than 40,000 acres of young grapevines in less than five years. Known then as "California vine disease," PD put a quick end to the expansion of winegrape production in the south part of the state.

Over the next century the disease, which is named for N.B. Pierce,<sup>1</sup> reappeared occasionally. The records show several cyclical outbreaks of PD prior to the last decade, the most significant occurring in the 1940s and costing growers more than \$10 million. While its symptoms were known, the cause of Pierce's disease remained a mystery.

About 25 years ago, scientists at UC Davis linked Pierce's disease to an unidentified bacterium. Their colleagues at UC Berkeley were able to culture the bacterium, *Xylella fastidiosa*, and Davis researchers found that it damaged grapevines by entering the plant's water-conducting tissues (xylem), multiplying rapidly, and eventually clogging its critical water and nutrient transport system.

UC researchers also discovered that the disease is spread by sharpshooters, an insect related to the common leafhopper. Sharpshooters feed by piercing the xylem of plants and sucking the sap. If the plant already carries *X. fastidiosa*, a sharpshooter can transmit the bacterium from diseased to healthy plants. Unlike phylloxera which causes a long, slow decline in production, a vine infected by *X. fastidiosa* and left untreated typically dies within a year or two. During this period, the vine produces no fruit.

Pierce's disease has reemerged recently as a vineyard problem in both Northern and Southern California winegrape growing regions. An outbreak of this lethal disease of grapes began in Napa and Sonoma counties in the 1990s and PD has since been found in Mendocino and Lake counties. The disease has cost North Coast growers an estimated \$33 million and required the removal and replanting of more than 1,000 acres of vines.

### Blue-Green Sharpshooter (*Graphocephala atropunctata*)

---

<sup>1</sup> Newton B. Pierce, special agent to the United States Secretary of Agriculture and California's first professionally trained plant pathologist, is credited with identifying the disease that was later to bear his name. Pierce was able to reject many of the prevailing explanations of what caused grape disease, but never was able to find the true cause. This is ironic because his academic specialty was bacterial pathogens. Pierce published his findings in 1892 as *California Vine Disease*, U.S. Dept. of Agriculture, Division of Vegetable Pathology, Bulletin No. 2.

The insect vector transmitting the *X. fastidiosa* bacterium on the North Coast is the blue-green sharpshooter, a leafhopper that overwinters in riparian vegetation. BGSS occurs along the entire Pacific Coast and in the foothills of the Sierra Nevada. BGSS is often found in irrigated ornamental landscapes planted in coastal urban and suburban communities. On the North Coast, PD manifests itself mostly in vines planted along or near riparian areas.

Adult blue-green sharpshooters are long-lived. There is usually only a single generation per year. A few adults may lay eggs a few weeks after they mature, resulting in a partial second generation, but most females require a period of cool temperatures to mature reproductively and do not lay eggs until the following spring. A high percentage of adults survive the winter, but not much is known of their behavior during this period.

Adult blue-green sharpshooters retain infectivity with *X. fastidiosa* for an indefinite period. Thus adults that acquire the bacterium during the autumn can introduce it into plants during the following spring. The spatial pattern of PD in North Coast vineyards reflects the spring dispersal pattern of BGSS adults. To reduce the spread of Pierce's disease near riparian areas, growers must limit the number of adult blue-green sharpshooters entering vineyards.

Although BGSS feeds on many plant species, it strongly prefers a more limited number of plants during the early spring. This period is critical to the spread of new infections of *X. fastidiosa* – infections that can result in chronic Pierce's disease in grapes. UC scientists recently discovered that selective removal of 5 to 6 of these preferred plant species in a typical riparian habitat can dramatically lower feeding and breeding activity by adult BGSS. Moreover, the replacement of preferred plants with a variety of native riparian perennials, along with other restoration measures, can improve the environmental quality of previously degraded riparian habitats where PD is a problem. Unfortunately, the current list of replacement plants includes species that may prove attractive to GWSS.

The University and its industry and federal government partners are sponsoring several long-term PD research projects on the North Coast through the Viticulture Consortium.<sup>2</sup> UC scientists are examining ways to manage and reduce the economic impacts from this epidemic, including research into riparian woodland management, new biological, cultural and chemical

---

<sup>2</sup>The Viticulture Consortium was established in 1996 and is funded by Congress through a special research grant to the USDA Cooperative State Research, Education, and Extension Service (CSREES). The University of California administers the grant program for viticulture research west of the Mississippi and Cornell University does the same for research east of the Mississippi. The UC-managed program is housed in the Division of Agriculture and Natural Resources. A Guidance Committee comprised of growers, processors, UC researchers, Cooperative Extension advisors and other university scientists sets research priorities and reviews research proposals. Pierce's disease has been a high priority in the western United States since the inception of the Viticulture Consortium program and more than \$300,000 in federal and private matching funds have been awarded for research in California.

controls for BGSS, effects of cold temperatures on PD, and breeding disease resistance into rootstocks.

### **Glassy-Winged Sharpshooter (*Homalodisca coagulata*)**

The most dramatic outbreak of Pierce's disease in recent memory was triggered by the appearance of the glassy-winged sharpshooter, an exotic pest accidentally introduced into California over a decade ago. GWSS probably entered Southern California as egg masses on plants brought in from the southeastern United States. First collected near Irvine in 1989, it was mistaken for the native smoke tree sharpshooter (*Homalodisca lacerta*) until positively identified in 1994.

GWSS is a serious threat to California vineyards because it travels longer distances than other sharpshooters and its larger mouthparts allow it to feed on older wood. This ability to feed on wood at the base of canes and on older stems appears to increase the rate of spread of *X. fastidiosa* from vine to vine. It also promotes systemic infection by placing the bacterium in closer proximity to the xylem. Traditionally, most summer infections of vines are made by vectors feeding on new growth near the tips of canes. The summer infections can usually be removed in the course of normal winter pruning in the vineyard, thereby minimizing vine-to-vine spread of the bacterium.

GWSS has been found in high numbers in citrus and avocado groves and on woody ornamentals. It has been recorded feeding on over 70 species of plants in 35 different plant families and is active throughout the year. GWSS probably can feed and reproduce on many other plant species that it has not yet encountered or where it has simply not been observed.

In the past three growing seasons, Pierce's disease has killed more than 300 acres of vineyards in the Temecula Valley and threatens the survival of Riverside County's viticulture and wine industries. To put this rapid spread into perspective, the outbreak of PD in Temecula was first detected in 1997. The following year the symptoms of the disease were visible in only a few localized areas. However, UC Riverside scientists sampling for the disease, found a PD incidence ranging from 25% to 97% in vineyards. By summer 1999 hundreds of acres of vines were dead and significant new acreage is expected to succumb to PD this growing season.

Based on current knowledge of the biology of GWSS, there is reason to believe that this insect pest may disperse northward into the major wine, table and raisin grape producing areas of the state. While the presence of GWSS would represent a serious threat to California viticulture, this disease vector also poses serious consequences for other commercial crops and nursery ornamentals.

GWSS is already thought to be responsible for much of the spread of oleander leaf scorch (OLS) in Southern California. This disease has killed a large number of the oleanders

planted as ornamental shrubs in parks, commercial and residential landscapes and in freeway medians. OLS is caused by a strain of *X. fastidiosa* distinctive from that affecting grapes and almonds, but it may yet prove capable of causing disease in other ornamental and commercial crops.

In addition, GWSS may spread diseases to localities where they are not yet a problem, as well as increasing the incidence of *X. fastidiosa*-caused diseases where they already occur. Some strains of the bacterium not yet in California may now spread rapidly if they are introduced into the state. This includes citrus variegated chlorosis (CVC), a serious disease of citrus that has killed more than 60 million orange trees in Brazil. Other strains of the *X. fastidiosa* bacterium are known to infect peaches, plums and forest trees in the southeastern United States.

### **GWSS may cause increased incidence and severity of PD in California**

UC scientists believe the glassy-winged sharpshooter has the potential to increase both the incidence and severity of Pierce's disease in California because it can:

- ! substantially increase the population of insect vectors transmitting *X. fastidiosa* to susceptible crops (numbers);
- ! cover longer distances in a shorter time than other sharpshooters (range and speed);
- ! utilize more breeding habitats and plant hosts than native PD vectors (opportunistic behavior); and
- ! transmit disease from vine-to-vine, resulting in an exponential, rather than linear, increase in PD incidence in vineyards (exponential spread).

**Increased numbers of vectors.** Until the appearance of GWSS, the blue-green sharpshooter was responsible for most occurrences of PD in grapevines. Although its range includes most of California, problems with BGSS are largely limited to vineyards planted adjacent to streams and rivers and near certain irrigated ornamental landscapes.

In the Central Valley, the principal vectors of *X. fastidiosa* are red-headed (*Carneiocephala fulgida*) and green (*Draeculacephala minerva*) sharpshooters. These grass-feeding sharpshooters do not find grapes an attractive host. Consequently, they have little measurable impact on grapevines other than creating occasional Pierce's disease "hot spots" in vines located near their breeding habitats (pastures, hay fields).

GWSS can expand its presence more rapidly than native sharpshooters by feeding on a

larger variety of plants and by reproducing in habitats that have not supported sharpshooter populations in the past. While not all viticultural areas will support high populations of GWSS, UC scientists believe the pest is capable of producing significant numbers in regions of the state with favorable habitats.

This could dramatically increase the incidence of Pierce's disease in raisin, table and wine grapes in the San Joaquin Valley where native sharpshooters are not much of a factor, and in coastal California where BGSS already is active. In addition, almond leaf scorch and other diseases caused by *X. fastidiosa* can be expected in locations where they have been rare or absent if GWSS becomes established.

**Increased dispersal rate.** Experience in the southeastern United States, and early results from California, indicate that GWSS is more opportunistic, active and aggressive than most sharpshooters. These behaviors have contributed already to a greater incidence of PD damage across vineyards in the Temecula area when compared to the limited "edge effect" spread pattern that is typical of the BGSS in North Coast vineyards. While the population dynamics and distribution patterns of the glassy-winged sharpshooter now can only be predicted, it appears to have the ability to disperse faster and travel farther than any of the native sharpshooters responsible for transmitting Pierce's disease.

**Different breeding habitats and crop host preferences.** GWSS is established on a wide variety of plants in Southern California. These include commercial crops (e.g., citrus, avocado and macadamia), ornamentals (e.g., eucalyptus, crape myrtle and ash), and natural vegetation, including oak, sycamore and sumac. Its ability to feed on dormant trees and vines during winter months is unprecedented for California sharpshooters and it likely can reproduce on an even wider variety of cultivated plants and natural vegetation than is currently documented.

Because GWSS is a "generalist" feeder, local populations are expected to progressively adapt to local conditions and to new host plants as the insect expands its range. The natural habitat of the glassy-winged sharpshooter is forest margins. It also is found on orchard crops such as citrus and plum. In coastal and foothill areas of California, riparian woodlands may prove to be suitable habitat.

This raises concerns about GWSS becoming established along the north and central coasts of the state where most of the winegrape production occurs near riparian areas. The San Joaquin and Sacramento valleys also support extensive areas of riparian vegetation. How GWSS will adapt to forest and riparian habitats is unknown, but research to find these answers should be a priority as this insect expands its range.

In addition to grapes, GWSS feeds readily on a variety of tree species in the southeastern United States, including stone fruits. Its ability to feed on peaches and plums, and

on oaks and other forest trees is well documented. Given this adaptability GWSS may be expected to feed on almonds, peaches, cherries, apricots and other stone fruits, as well as some native forest trees in California currently free of *X. fastidiosa*.

GWSS has already been observed in backyard peach and apricot trees in Southern California. If it expands its range into commercial orchards, the possibility of plum leaf scald and phony peach disease strains of *X. fastidiosa* being introduced to the state could increase, as would the probability that these diseases would prove difficult to control.

Citrus variegated chlorosis disease in oranges is caused by a strain of *X. fastidiosa* and was recently described as the world's most dangerous citrus disease. Brazil, with the largest citrus acreage in the world, lost an estimated 60 million trees when the bacterium spread across the country in less than a decade. The Brazilian government responded by providing over \$12 million to map the genome of *X. fastidiosa* responsible for CVC.

California citrus could also be at risk with the introduction of GWSS. Until recently the presence of sharpshooters in California's citrus groves was rare. With GWSS now established in Southern California and in the southern San Joaquin Valley, citrus variegated chlorosis could become a serious threat to the state's \$580 million orange crop. More than 200,000 acres of oranges would be in danger of contracting CVC if this *X. fastidiosa* strain is accidentally introduced into California. Thus far grapefruit and lemons, which are valued at \$200 million a year, do not appear to be susceptible.

**Feeding behavior and accelerated spread of Pierce's disease.** While the glassy-winged sharpshooter has already demonstrated high mobility and an ability to occupy a wide range of new habitats and host plants, UC scientists believe its feeding behavior may be the biggest factor responsible for increases in the spread and incidence of PD in California. GWSS displays very different behavioral traits than native sharpshooters.

Current research and observation show that most infections of *X. fastidiosa* are introduced into grapes during the late growing season (June–August) and often do not spread to older wood by autumn. Typically, most of the late-season infected tissues can be eliminated through winter pruning. Therefore, it is theorized that overwintering adults, having already acquired *X. fastidiosa* the previous season, are responsible for introducing systemic, or chronic, outbreaks of PD the following spring. These spring infections are more likely to spread throughout vines and not be eliminated by winter pruning.

Data from the Napa Valley, where BGSS is responsible for PD, support this theory. Studies show that *X. fastidiosa* does not reach sufficient numbers for uninfected blue-green sharpshooters to acquire the bacterium from new growth until late May or early June. Any systemic spread of *X. fastidiosa* into grapevines must have occurred from infected, overwintering adults feeding in the early growing season (March–May). This underscores the

importance of overwintering adults, already infected with *X. fastidiosa*, as the source of chronic cases of PD that result in the death of vines.

GWSS may alter this situation by introducing infections throughout the growing season at the older, woody base of canes and stems rather than in new growth. These basal infections would not be pruned out during the winter. If the glassy-winged sharpshooter's feeding habits result in summer inoculations of *X. fastidiosa* and the establishment of chronic infection, vine-to-vine spread could become an important new feature of PD in California. This could create an exponential rather than linear increase in the rate of spread and incidence of Pierce's disease through time. If true, explosive increases in the spread of PD by GWSS to other parts of the state where the insect becomes established can be expected.

## **Section II. Current Research on Pierce's Disease and Vectors**

University of California scientists, specialists and farm advisors have been investigating Pierce's disease in grapes periodically for at least 50 years.<sup>3</sup> Researchers from land-grant colleges and universities in states where PD is epidemic also have developed an extensive body of knowledge on the disease and GWSS over the years. Unfortunately for the current situation, sustained research in California on Pierce's disease and its vectors waned during the past few decades with the gradual decline of periodic epidemics of the disease in the state.

### **Funding Sources for PD Research**

Research into Pierce's disease again became a priority a decade ago with the re-emergence of the disease in Napa and Sonoma counties. The North Coast Pierce's Disease Task Force, a grower and winery supported working group, provides private funds for PD research as well as coordinating disease management and education for its members. The task force members are vineyard managers and researchers employed by wineries and growers. UC scientists and farm advisors serve as technical advisors.

Through 1998 the North Coast Pierce's Disease Task Force has contributed nearly \$200,000 for applied research, with the focus on improved management tactics. The American Vineyard Foundation (AVF), an industry-supported Section 501 (c) (3) non-profit, tax-exempt scientific and educational organization, matches these funds. There is close cooperation with the Viticulture Consortium in selecting projects. Of the nine PD projects funded by the task force, all but one have involved UC researchers.

The University of California and Cornell University manage the federally funded Viticulture Consortium Program. This USDA special grants research program has an annual budget of \$1 million, with UC and Cornell each receiving about \$500,000. Funds for the University of California administered program are awarded through an annual competitive process and are open to qualified scientists from throughout the western United States. Industry matches the funds through the AVF, has considerable input in setting research priorities and occupies seats on the peer review panel.

The UC Viticulture Consortium has identified Pierce's disease as a high priority. Since 1997 more than \$325,000 in funds have been allocated for Pierce's disease research, with

---

<sup>3</sup> The December 1946 issue of *California Agriculture* carried remarks by UC President Robert Gordon Sproul at the annual meeting of the California Farm Bureau Federation. Sproul said, "Some of these agricultural enigmas, like Pierce's disease of grapevines ... still baffle the scientists." He went on to report "Pierce's disease is not new; many years ago it ruined the vine industry of Orange County. Today, several departments of the University ... are bending every effort to see that it shall not destroy the important grape industry that has grown up in other parts of the state." (Santa Cruz, CA; October 30, 1946).

industry contributing \$180,000. During the past two years, four projects focusing on PD in North Coast vineyards and the BGSS vector were approved for funding. This year a project has been approved to study the impacts of GWSS on grapes in the Temecula area.

Funding for Pierce's disease research will increase significantly as a result of the approval of AB 1232. This CDFA-managed program will provide \$1 million a year in new funds for the next three years, with \$750,000/year from the State General Fund and another \$250,000/year from industry.

USDA allocated an additional \$100,000 to the University of California in late September 1999 for research on GWSS and BGSS. Because of the increased interest shown by Congress in the Pierce's disease epidemic in California and the threat from the glassy-winged sharpshooter, it is expected that additional funds for research will be appropriated in the FY 2000-01 federal budget.

Following is a "status report" on research conducted by UC investigators into Pierce's disease, the *Xylella fastidiosa* bacterium, and its insect vectors. The focus is on projects funded over the past five years. The summary covers (1) biology and control of insect vectors; (2) biology and control of *X. fastidiosa*; (3) acquisition and transmission of *X. fastidiosa* by sharpshooters; and (4) plant resistance to *X. fastidiosa*.

## **Biology and Control of Insect Vectors**

Studies aimed at developing methods to lower populations of blue-green and glassy-winged sharpshooters, and reduce the incidence and spread of Pierce's disease in grapes, are now under way at UC Riverside, UC Berkeley, and through the UC Integrated Pest Management (IPM) Project. The red-headed and green sharpshooters are also being studied, although there is little evidence to show that these grass-feeding insects are a threat to grapes in the Central Valley. Since Pierce's disease is spread by different insect vectors in Northern and Southern California grape-growing regions, the management approaches being investigated vary depending on the location.

**Management of riparian areas.** On the North Coast, the incidence of Pierce's disease is most severe in vineyards located adjacent to streams and irrigated ornamental landscapes on the valley floors and the edges of forest lands at higher elevations. Spring infections are believed to be critical in establishing chronic Pierce's disease in North Coast grapes and researchers are examining ways to discourage overwintering adult BGSS from entering vineyards. The insecticide dimethoate can be applied to riparian vegetation in Napa and Sonoma counties to control adult BGSS during the early growing season, but research conducted over the past four years by UC Berkeley entomologist Alexander Purcell has focused on developing more effective, nonchemical methods for reducing early spring populations in environmentally sensitive riparian areas.

This involves replacement of plant hosts preferred by BGSS with non preferred plants. The objective is to disrupt BGSS breeding. Early results are promising with activity reduced by 70% to 99% in the control sites as compared to untreated areas. What remains to be determined is if there is a similar reduction in the spread of PD to adjacent vineyards. Final guidelines for implementing riparian vegetation best management practices are now in the approval process. On a related note, research is under way on the North Coast to study the incidence of ornamentals as reservoirs for *X. fastidiosa*.

**Application of pesticides to control sharpshooters.** The use and effectiveness of pesticides in controlling sharpshooter populations and the spread of *X. fastidiosa* is being investigated in Northern and Southern California vineyards. UC Berkeley scientists are focusing on BGSS, while scientists from UC Riverside and the UC IPM area advisor in Ventura County are examining GWSS.

Tests of a soil-applied formulation of the insecticide imidacloprid (Admire®), registered in 1999 for use on grapes to control leafhoppers and mealybugs, are underway. This material is systemic in grapes and kills sharpshooters at approved application rates, although mortality typically requires at least several days on treated vines. In addition, a formulation of imidacloprid for foliar applications (Provado®) has been approved for use against grape leafhoppers and is effective against sharpshooters for two to three weeks after application.

More needs to be known about the effects of insecticides on vector movements and the transmission of *X. fastidiosa*. Still remaining are research trials to evaluate the effectiveness of these insecticides in reducing the incidence of PD. Large-scale test plots in vineyard conditions and at least three years of trials are needed.

**Physical barriers.** Insecticide-treated barrier crops planted on vineyard margins are being evaluated by UC Berkeley scientists as a technique to prevent BGSS from entering vineyards from riparian areas. Scientists at UC Riverside have plans to evaluate the use of large screen barriers (up to 8 m in height) in Temecula to disrupt the movement of GWSS from citrus orchards into vineyards.

**Natural enemies.** Although GWSS is a common insect in the southeast, it is much more abundant in citrus and some other plants in California. This suggests that natural enemies may play a role in lowering GWSS populations in its home regions. UC scientists have discovered several natural enemies of GWSS in Southern California and another in Mexico. These are parasitoid wasps that attack the eggs of GWSS.

Field studies in Riverside and Ventura counties have found that a tiny wasp, *Gonatocerus ashmeadi*, is particularly active and accounts for at least 95% of the observed GWSS parasitism. At least three other species, *G. morilli*, *G. incomptu* and *G. novifasciatu* account for the remaining 5% of egg parasitism. Most of the observed parasitism occurs during

summer and early fall months on egg masses of second generation GWSS. No effective parasite has been recovered that preys on the first generation GWSS egg masses laid in late winter and spring.

Research to develop more effective biological controls for the management of sharpshooters is critical, because nonchemical methods often are the only ones available for insect and vector control across the broad range of California's agricultural, urban, and natural ecosystems.

## **Biology and Control of *Xylella fastidiosa* Bacterium**

Efforts are under way in the laboratory and in the field to better understand the biology of the *X. fastidiosa* bacterium and to investigate and evaluate direct treatment and control methods for plants infected with the disease. Scientists from the Berkeley, Davis and Riverside campuses and Cooperative Extension county offices are evaluating novel methods, including the use of other bacterial species and bacteriophages (viruses that attack bacteria), for control of *X. fastidiosa* in host plants.

**Micronutrients and chemical therapies.** Although no chemicals are currently registered for therapy of PD, the broad-spectrum antibiotic tetracycline is being tested by private industry and the University of California. Another UC Davis project involves experiments to determine whether infection of grapevines by *X. fastidiosa* can be prevented by boosting levels of essential plant bacterial micronutrients such as zinc, iron, copper and molybdenum. Laboratory studies have established what concentrations are toxic to the bacterium and field trials are under way at UC Davis and in Temecula.

UC Davis scientists are also looking at different methods of introducing the nutrients into vines. These include foliar applications to leaves, tiny plastic screws inserted into vines, hand-held injection devices and irrigation drip lines. The strategy is to protect the plants against infection, rather than treat them after the fact.

UC scientists from Davis and Berkeley, in collaboration with colleagues from the University of Florida, are examining the effects of xylem chemistry on the spread of *X. fastidiosa*. Their objective is to modify the host plant chemistry to restrain the growth and colonization of the bacterium.

**Pruning.** Studies and field experience have shown that normal dormant season pruning of grapevines can eliminate many incipient infections of *X. fastidiosa*. Experiments are now in progress to test the effectiveness of severe pruning of chronically diseased vines to regenerate a healthy vine in the shortest time. Results to date are promising, but one downside is that production is lost during the regeneration of the vine. In addition, pruning does not appear to

decrease the chance of reinfection in grapes.

Interestingly, pruning is a major control method for citrus variegated chlorosis in Brazil. It also has been effective in controlling almond leaf scorch disease. For both CVC and almond leaf scorch, early identification of symptomatic branches is critical. Once the bacterium is widespread in a plant, pruning is not successful as a control for *X. fastidiosa*.

If adopted, expanded use of pruning for the control of *X. fastidiosa* in grapevines and other permanent crops is expected to be labor intensive. It also will place increased demands on growers for monitoring and field testing plants and result in additional costs. Researchers caution that these factors must be taken into account when making decisions to adopt severe pruning practices or pull and replace vines or trees.

### **Acquisition and Transmission of *X. fastidiosa* by Sharpshooters**

Scientists on the Berkeley campus are seeking to unlock the mechanisms that allow *X. fastidiosa* to adhere to solid substrates and identify where the bacterium attaches and detaches in a sharpshooter's foregut. This research is critical to an understanding of how insect vectors acquire and transmit the bacterium to host plants. Additional studies are under way at Berkeley to understand the behavior of *X. fastidiosa* in both systemic and non-systemic host plants. The movement of the bacterium within host plants is thought to hold the key to its ability to cause disease and to expand its presence in crops and natural plant communities.

Meanwhile, scientists at UC Riverside are evaluating how GWSS transmits another strain of *X. fastidiosa* to oleander with the intent of determining potential disease resistance properties in this ornamental plant. Another study at Riverside is focusing on the utilization of molecular techniques (e.g., polymerase chain reaction) for detecting *X. fastidiosa* in sharpshooters. The purpose of this project is to gather data on the relative proportion of GWSS populations that are infective with the bacterium and to identify sources of vector strains of *Xylella*.

### **Plant Resistance to *X. fastidiosa***

All cultivars of commercial grapes (*Vitis vinifera*) are susceptible to Pierce's disease. Field observations show that the degree of susceptibility can vary by cultivar. However, these differences are slight to nil for vines less than 3 years old. Unfortunately, the most resistant wine cultivars are among the least in demand commercially.

**Conventional plant breeding.** Many grape species grow where pressure from PD is high and where GWSS and other insect vectors are abundant. UC Davis plant geneticists have a long-term breeding program under way to identify the *X. fastidiosa* resistance genes in these

grape species. Progeny from crosses between resistant and susceptible parents and a second generation of crosses between resistant and susceptible selections have been developed in the laboratory.

These seedling grape populations may provide the individuals necessary to identify the DNA markers tightly linked with *X. fastidiosa* resistance and to begin locating and identifying resistance genes. If successful this research could greatly accelerate breeding efforts to incorporate *X. fastidiosa* resistance into cultivated wine and table grapes. It also may help to identify the resistance genes to *X. fastidiosa* in resistant wild species and allow the genes to be genetically engineered into cultivated grapes.

The breeding of PD resistant grapes has been under way for about 100 years in the southeastern United States and several PD resistant cultivars have been released from the University of Florida. While these cultivars have high resistance to PD, they lack the necessary fruit quality to compete with *V. vinifera* wine and table grapes.

**Genetic engineering.** A major effort to develop molecular genetic methods to analyze and manipulate *X. fastidiosa* is currently under way at UC Davis and other labs around the world. If successful, these methods may be used to identify specific genes that mediate *X. fastidiosa*'s plant pathogenicity and insect transmission characteristics, and produce marked *Xylella* strains that can be used in plant colonization studies.

For example, the bacterial genes required for systemic movement, pathogenicity, or conferring plant host specificity might be targeted with genes that can be introduced into plants. Identifying the genes that correspond to those of known function may allow for the identification of physiological properties of *X. fastidiosa* that would make the bacterium particularly vulnerable to chemotherapies still to be developed.

It is also possible to incorporate genes that limit or prevent PD in commercial grapes via genetic engineering. Genetic engineering of grapes has been limited to date, but many of the limitations have now been overcome. Genes have been identified that affect bacterial multiplication and movement and may function in grape against the *X. fastidiosa* bacterium.

It is also feasible that molecular genetic advances will allow *X. fastidiosa* resistance genes to be identified and incorporated into *V. vinifera* grapes without the negative fruit qualities associated with wild grape species and current PD resistant cultivars. Even with rapid progress being made in the areas of genetics and molecular methods, it is important to understand that plant breeding of *V. vinifera* grapes and other perennial crop plants resistant to *X. fastidiosa* will require years of sustained development and testing before the cultivars can be used commercially.

**Genome mapping.** Until now, *X. fastidiosa* has been a relatively little studied pathogen. However, the entire genome sequence of the strain of *X. fastidiosa* responsible for the citrus

variegated chlorosis epidemic in South America should be in the public domain and available to UC researchers by spring 2000. Funding for this mammoth undertaking was provided by the state government of São Paulo, Brazil. Researchers in the University should capitalize on this new information and utilize the results to better understand the genetic characteristics of the bacterium.

### **Section III. Educational and Technical Assistance from UC**

The University of California has classroom instruction, research and public service responsibilities under the California Master Plan for Higher Education. The public service component includes educational outreach and dissemination of science-based information and knowledge beyond campus walls. The Division of Agriculture and Natural Resources (ANR), as the University's largest multi campus research unit, has public service as an integral part of its mission "to serve California through the creation, development and application of knowledge in agricultural, natural and human resources."

The Division administers the Agricultural Experiment Station (AES), UC Cooperative Extension (UCCE), and the Natural Reserve System.<sup>4</sup> It brings together nearly 1,100 research scientists and educators on 3 campuses, 10 research and extension centers, over 60 Cooperative Extension county offices and 33 natural reserve sites to develop and deliver practical solutions for local problems. The University's response to the Pierce's disease epidemics facing North Coast and Temecula grape growers is an excellent example of how the Division mobilizes research and extension resources to identify, investigate and respond to critical problems facing the state.

#### **Educational Outreach/Information Dissemination to Users**

The accidental introduction of GWSS into California, and the possibility that this insect could substantially increase the incidence and spread of *X. fastidiosa* in commercially important crops and ornamentals, has accelerated the need to move sound, science-based knowledge on the disease and its vectors into the public domain. This is being facilitated by the Division's network of county-based Cooperative Extension advisors, whose primary role is educational outreach to the community, and by campus-based scientists and specialists who are leading research efforts. Together, they are delivering the latest information from the University to those who need it most.

To accomplish this, Division academics are employing an educational outreach and information dissemination strategy that includes farm visits and small group consultations; workshops and presentations to growers, pest control advisors, governmental agencies and scientific societies; publications, brochures and other print products; press releases and media contacts; and Web sites and other Internet-based tools.

---

<sup>4</sup>The Division of Agriculture and Natural Resources has been "taking the University to the people" for over a century. The Hatch Act of 1887 established a national system of agricultural experiment stations located at land-grant universities and colleges across America. The Smith-Lever Act of 1914 established the Agricultural Extension Service (now Cooperative Extension) to disseminate university research in agricultural sciences and home economics to farmers and rural families.

**On-farm visits, workshops and presentations to growers and others.** Since 1996, Division advisors and scientists have made hundreds of farm visits and conducted small group consultations with growers, farm managers, processors and pest control advisors. They have extended research-based information on the *X. fastidiosa* bacterium, the symptoms of Pierce's disease in vines and ways to control its spread, and life cycles and habitat preferences of BGSS and GWSS. They have provided information on the disease and its vectors to commodity groups, governmental agencies, elected officials, other scientists and the public through workshops, conferences, and presentations at legislative hearings and professional meetings.

Appendix II provides a summary of presentations for the period 1996 through 1999. In the first year the focus was on Pierce's disease in grapes on the North Coast and the spread of oleander leaf scorch in Southern California. More recently the discovery of GWSS as a transmission source of PD has taken on importance. The presenters include a cross-section of county-based advisors and campus-based researchers.<sup>5</sup>

As Pierce's disease becomes more widespread, workshops and field days will increase in importance as an effective way to disseminate research findings and other new information on PD to large audiences. Presentations are typically half-day or full-day, include reports from UC scientists and advisors on the latest research results and management strategies, and allow for question and the exchange of information.

In addition to meeting with grape growers in the coming year, the Task Force has identified a need to target wholesale and retail nursery operators with information on GWSS and its threat to agriculture. Nurseries could inadvertently spread *X. fastidiosa* to new areas of the state if plants are shipped with GWSS egg masses on the foliage.

**Publications, brochures and other print media products.** UC scientists and Cooperative Extension farm advisors also use a variety of print mediums to extend information on PD and its vectors to growers, regulators, elected officials, pest management professional and colleagues within the Division. Appendix II provides a sampling of articles published in refereed and peer-reviewed journals, newsletters, commodity/industry magazines and technical abstracts from 1975 through 1999.

Several years ago, the UCCE Integrated Pest Management area advisor for the North Coast published a 12-page booklet, *Pierce's Disease in the North Coast*. The illustrated guide identified symptoms of PD, how to treat infected vines, and described the role of BGSS

---

<sup>5</sup>Mike Henry, Peggy Mauk, Phil Phillips, Rhonda Smith, Lucia Varela and Ed Weber are county-based Cooperative Extension farm advisors; Heather Costa is a campus-based UCCE specialist; Bruce Kirkpatrick, Joe McBride, Alexander Purcell and Richard Redak are campus-based faculty with part-time AES research appointments; Matt Blua is a postdoctoral scientist; and James Bethke is a staff research associate.

in spreading the disease. A color flyer on Pierce's disease was also produced. These publications have been used by growers, farmworkers, pest control advisors and agricultural commissioners.

In 1996 the UC Cooperative Extension IPM area advisor in Southern California helped develop a diagnostic kit for oleander leaf scorch. Working with the firm AgGia, the area advisor contributed to the design of a commercial kit that is used to identify this strain of *X. fastidiosa*.

The Division recently published a GWSS identification guide commissioned by the Task Force. Task Force members identified a critical need for such a publication at its October 15, 1999, meeting. Less than two months later a full-color brochure was produced and distributed. Design, layout and content were coordinated with CDFA and the grape industry. A copy of the brochure – *Glassy-Winged Sharpshooter: A Serious Threat to California Agriculture* – may be found in the inside back cover of this report.

Fifty thousand copies were printed and shipped to UC Cooperative Extension advisors in mid-December 1999. These were distributed to commodity groups, county farm bureaus and individual growers. A second batch of 50,000 was printed in mid-January 2000. About 20,000 copies have been provided to CDFA for mass distribution to wholesale and retail nurseries throughout California.

**Press releases, media tip sheets and interviews.** Over the past decade, University scientists, specialists and farm advisors have reached radio, television and print media audiences with science-based information on Pierce's disease and its insect vectors. Division academics continue to be available to the media for interviews and story ideas. Contact information for UC academics with expertise on PD, the *X. fastidiosa* bacterium, and GWSS and BGSS can be accessed at <http://danr.ucop.edu/news/askuc/AskAg.htm>.

The Division issued a tip sheet on research on Pierce's disease under way in the University to accompany the press release announcing the UC Pierce's Disease Research and Emergency Response Task Force. This October 6, 1999, release featured 10 research projects and educational outreach efforts with descriptions and contact information. On October 25, 1999, the Division's semi-monthly radio feed featured a segment on the glassy-winged sharpshooter. This was distributed to more than 100 English-language radio stations. A December 17, 1999, press release announced the release and availability of the four-color GWSS brochure.

**On-line Web sites.** Several University of California Web sites feature news on PD and its vectors. The most comprehensive site is maintained by the UC Berkeley College of Natural Resources. The "*Xylella fastidiosa*" Web site provides an overview and introduction to Pierce's disease, control guidelines for the disease in California, information on diseases caused

by *X. fastidiosa* and its insect vectors, news tips, and links to academics throughout the world with expertise in Pierce's disease. This is highly recommended and also includes a link to the *X. fastidiosa* genome mapping project in Brazil. Access the web page at <http://nature.Berkeley.EDU/xylella/>.

Other sites are maintained by the Division of Agriculture and Natural Resources and the UC Cooperative Extension, Ventura County office. The Division Web site provides an online media packet and three news releases on GWSS and PD, a radio news feature with full audio, a PDF copy of the GWSS color brochure, and downloadable color images of the insect. Go to <http://danrcs.ucdavis.edu/Special/gwss/default.html>.

The UCCE Ventura County web site has a detailed description of GWSS, a partial list of host plants and photos of the insect and its egg masses on leaves. Go to <http://ucceventura.xlrn.ucsb.edu/IPM/IPMHome.htm>.

### **Glassy-Winged Sharpshooter Workgroup**

In October 1999 the Division approved funding for a statewide workgroup to promote collaborative planning and coordination of University research and extension activities related to GWSS. The *IPM of Glassy-Winged Sharpshooters and the Diseases They Vector* is one of more than 70 workgroups established by the ANR Program Council. These workgroups bring together AES scientists, UCCE specialists and advisors, and other partners to address emerging and continuing high priority issues important to California's agricultural, natural and human resources communities.

The GWSS workgroup met for the first time on January 10-11, 2000, at UC Riverside. Over 25 members were present including UC scientists, specialists and farm advisors, representatives from CDFG, and from the wine and grape industries. The two-day meeting included reports on GWSS/PD activity in Riverside, Santa Barbara and Ventura counties and the San Joaquin Valley; a review of CDFG GWSS/PD Task Force research priorities and draft recommendations from the UC Task Force; an update on regulatory and quarantine issues; and discussion and agreement on research and extension outreach objectives for the workgroup.

The GWSS workgroup also took the opportunity to discuss ways to better coordinate the review and selection of research proposals for Pierce's disease and the GWSS and BGSS competitive research programs funded by CDFG, the University, USDA and the grape industry. This collaboration and review is viewed as an important step in maximizing the value of research expenditures and reducing the possibility of duplicate funding of similar projects.

### **Membership on Advisory Boards**

In addition to educational outreach/information dissemination activities and the

formation of the GWSS workgroup, Division scientists and county-based advisors serve on program, research and technical advisory committees sponsored by governmental agencies, commodity groups and other industry organizations. Membership on these advisory groups provides another opportunity for UC academics to extend science-based information on Pierce's disease, the *X. fastidiosa* bacterium and the insect vectors that spread the disease.

## Section IV. Research Needs

As part of its charge, the Task Force identified a set of research priorities that show promise for slowing the spread of Pierce's disease in California vineyards and reducing the incidence of sharpshooters that transmit the disease. Of the insects transmitting *X. fastidiosa*, GWSS is the greatest threat. However, the Task Force also recognizes that the blue-green sharpshooter, which is responsible for the PD epidemic on the North Coast and has cost grape growers more than \$30 million, is of major concern.

In developing research priorities for Pierce's disease, the Task Force members consulted with experts in the university community, governmental agencies and the agricultural industry. The UC Task Force research priorities share much in common with the recommendations of the CDFA Glassy-Winged Sharpshooter/Pierce's Disease Task Force (see Appendix III). This consultation and collaboration is in keeping with the goal of increased information sharing among funding agencies. It also reflects the broad agreement within the scientific community, industry and governmental agencies on PD research needs and priorities.

The significant increase in funds available through AB 1232 presents a unique opportunity to accelerate research into Pierce's disease and its vectors. To maximize the value of new and existing research dollars, the Task Force recommends that competitive programs managed by UC, CDFA and industry share information on research priorities, proposals received and proposals funded.

While the Division of Agriculture and Natural Resources has expertise in many of the high-priority research areas discussed below, the Task Force recommends expanding the pool of scientists to include researchers from across the UC system, other universities and colleges in the United States and abroad and governmental agencies.

### **Six high-priority research areas identified by the Task Force are:**

- ! Monitoring and Database Management;
- ! Control of Glassy-Winged and Blue-Green Sharpshooters;
- ! Control of Pierce's Disease;
- ! Plant Resistance to Pierce's Disease;
- ! Movement, Multiplication and Pathology of *X. fastidiosa*; and
- ! Economic Analyses

It should be noted that the Task Force members are convinced that breeding resistance to the *X. fastidiosa* bacterium into plants will provide the only long-term protection for grapes and other commodities. This will require time, fiscal resources and the application of genetic engineering and other biotechnology techniques. More immediately, a combination of physical and plant barriers, biological controls, chemical compounds, micronutrients, winter pruning, grower education, and intensive monitoring and data collection efforts show promise in reducing the spread of Pierce's disease.

## **Monitoring and Database Management**

### **1. Data collection/monitoring**

- # Determine temporal and spatial distribution of GWSS and BGSS in California, including a quantitative assessment of their densities and host plant associations, current predators and parasitoids.
- # Document occurrence and severity of PD in grapes in Temecula and the incidence of *X. fastidiosa* strains in other host plants. Determine whether alternative hosts are affected/unaffected.
- # Monitor other areas of the state for GWSS; where identified, conduct intensive sampling of host plants to document incidence and effects of *X. fastidiosa* bacterium.

### **2. Computerized statewide database**

- # Enter information into computerized database for associations between cropping systems, presence of GWSS or BGSS, occurrence of *X. fastidiosa*, and release of biocontrol agents. Use data to predict where future infestations of Pierce's disease will occur by monitoring GWSS and BGSS populations.
- # Develop and field test geographic/geobased information system (GIS); provide funding, adequate staffing and other support to maintain and update a statewide database.

### **3. Sampling, screening and trapping**

- # Develop and optimize methods to screen large numbers of plant and insect samples for the presence of *X. fastidiosa* using sensitive assays (e.g., polymerase chain reaction).

- # Improve vector monitoring; develop alternative trapping methods.

## **Control of Glassy-Winged and Blue-Green Sharpshooters**

### **1. Biological control**

- # Develop mass-rearing methods for GWSS and its associated predators and parasites.
- # Conduct “foreign” exploration to discover and recover new parasitoids/predators of GWSS.
- # Carry out preliminary field inoculative and inundative release studies. Evaluate parasitoid longevity, reproduction, field persistence, dispersal, and impact on field populations of GWSS in citrus, grapes, other crops/ornamentals and in urban areas.

### **2. Chemical control**

- # Determine how imidacloprid and other compounds affect transmission of *X. fastidiosa* bacterium to grapevines by GWSS and BGSS (by time after plants are treated).
- # Screen insecticides for dosage mortality responses of GWSS and BGSS at various times after application and for effects of sub-lethal dosages (low as well as no mortality) on plant-to-plant movements, flight propensity/ability and transmission of PD.
- # Determine optimal deployment of imidacloprid on grapes and other GWSS/BGSS host plants to reduce overall vector pressure.
- # Screen and examine materials known to have antifeedant properties in insects.

### **3. Barrier and trap crops**

- # Determine efficacy of large screen (>5m) physical barriers to reduce GWSS immigration from citrus and other plants to grapes.

- # Determine efficacy of barrier trees to reduce migration of BGSS into vineyards from riparian areas.
- # Determine efficacy of utilizing trap crops to attract GWSS out of grapes or prevent GWSS and BGSS movement into grapes. Could be in combination with an insecticide treatment of trap crop.

#### 4. Repellants/Confusion methods

- # Test efficacy of products applied to grapevines to repel or discourage feeding by GWSS and BGSS.
- # Evaluate reflective films for potential disruption of GWSS and BGSS flight and landing patterns.

### Control of Pierce's Disease

#### 1. Chemotherapy

- # Test efficacy of plant micronutrients, e.g., zinc, copper, manganese and iron, as well as antibiotics for controlling PD; develop methods to introduce these materials into grapevine xylem tissues.
- # Determine whether bactericides can be used prophylactically to prevent infection of healthy grapevines.
- # Conduct fertilization trials including soil mineral balancing, soil microbial enhancement and foliar sprays.

#### 2. Biological control

- # Identify endophytic bacteria antagonistic to PD.
- # Identify xylem-inhabiting, nonpathogenic bacteria; test their potential for reducing populations/movement of *X. fastidiosa* in grapevines.
- # Discover bacteriophages (viruses that attack bacteria) of Pierce's disease and test their protective or curative potential in grapevines.
- # Identify polypeptides antagonistic to *Xylella fastidiosa*. Attempt to genetically engineer grapevines or endophytic bacteria to secrete anti-

*X. fastidiosa* polypeptides into grape xylem (see below).

### 3. Cultural practices

- # Evaluate efficacy of severe pruning to eliminate PD infections.

## Plant Resistance to Pierce's Disease

### 1. Plant chemistry

- # Determine basis of resistance to *X. fastidiosa* by examining xylem chemistry in known resistant and susceptible species and cultivars of grape.
- # Determine *X. fastidiosa* interactions with host plants; nature of relationships between specific chemical profiles and resistance.
- # Establish whether apparent PD tolerance in select *V. vinifera* cultivars is real and whether xylem chemistry is responsible.

### 2. Grafting of rootstock

- # Establish if rootstocks and *Vitis* species have an effect on PD expression when *V. vinifera* grapes are grafted on top.

### 3. Genetic engineering/manipulation

- # Utilize known DNA sequences encoding antibacterial peptides to determine their effect against *X. fastidiosa*. Advance functional genes and strategies to engineering efforts on grape.
- # Develop a genetic map to *X. fastidiosa* resistance using available populations of susceptible X resistant individuals (e.g., *V. vinifera*, *X. V. rupestris*, *X. M. rotundifolia*) using AFLP DNA markers. The map will be used to identify markers to *X. fastidiosa* resistance and locate resistance genes.
- # Utilize DNA markers for *X. fastidiosa* resistance to rapidly introgress resistance into several *V. vinifera* wine and table grapes via marker-

assisted selection.

- # Utilize genetic engineering procedures to move grape *X. fastidiosa* resistance genes, when identified, into wine and table grapes.

## **Movement, Multiplication and Pathology of *X. fastidiosa***

### **1. Movement in plants**

- # Study xylem fluid composition and morphology; relate these parameters to the ability of *X. fastidiosa* to move within plants.
- # Determine how *X. fastidiosa* moves in systemic (e.g., grape, blackberry) and non systemic (e.g., willow) plant hosts.

### **2. Effects of temperature on *X. fastidiosa***

- # Determine the effects of temperature on growth and spread of PD in grapes and other key plants.

### **3. Pathology of *X. fastidiosa* and transmission of Pierce's disease**

- # Develop transformation/transposon mutagenesis systems for PD using existing or novel bacterial transformation vectors. Use PD mutants to identify bacterial genes that mediate pathogenicity, movement, or insect attachment in plants (take advantage of the Brazilian genome data).
- # Identify plant factors that influence transmission and inoculation efficiency of PD by GWSS on different host plants (link to priorities under Plant Resistance to PD).

## **Economic Analyses**

### **1. Microeconomics of PD**

- # Examine and document the economic factors related to incidence of PD damage to vines, costs to control, and expected output (loss in production) to provide growers with information on maintaining or replacing vines.

### **2. Macroeconomics of PD**

- # Examine and document long-range economic and other effects on the state, regions and counties from losing various segments of agriculture due to transmittal of *X. fastidiosa* strains to grapes and other crops by GWSS.

## Section V. Task Force Recommendations

The members of the UC Pierce's Disease Research and Emergency Response Task Force believe that the glassy-winged sharpshooter represents a serious threat to California agriculture, the state's nursery and landscape industries and to natural habitats. Of immediate concern is California's \$2.8 billion grape industry, with wine, table and raisin grapes being highly susceptible to Pierce's disease. California's multi-billion dollar wine industry also could be severely impacted by a statewide epidemic.

Glassy-winged and blue-green sharpshooters are responsible for transmitting *X. fastidiosa* to grapevines, but GWSS also can transmit strains of the bacterium to a broad range of commodities grown in California. These include almonds, oranges, peaches, nectarines, plums and alfalfa. Many ornamental, landscape and flowering plants produced by California's nursery industry also are susceptible to the disease. Fortunately, most of the strains of *X. fastidiosa* that infect other commodities and plants have not yet reached California.

The Task Force recommends the implementation of a statewide research, containment, pest management and educational outreach program to reduce or eliminate the spread of Pierce's disease and strains of the *X. fastidiosa* bacterium in California.

Over the next five years the emphasis should be on new monitoring and surveillance programs to track insect populations and the incidence of PD, improved pest management strategies for control and containment of insect vectors, better understanding of the movement and dynamics of *X. fastidiosa* in plants, development and field testing of novel chemical, biological and cultural controls for the bacterium, and delivery of educational information and technical assistance to growers.

Ultimately, the Task Force believes that breeding resistance to the *X. fastidiosa* bacterium into grapes, using genetic engineering and other new technologies, holds the greatest promise for reducing or eliminating Pierce's disease in California. Breeding disease resistance through genetic engineering also holds the key for keeping almond leaf scorch, citrus variegated chlorosis, phoney peach and other strains of *X. fastidiosa* out of commercial crops.

### **Recommendation 1: Short-Term Research Priorities (Next 5 Years)**

The Task Force recommends a coordinated research program to examine vector control, disease control, and the epidemiology and physical dynamics associated with the spread of *X. fastidiosa* in plants. This integrated approach is thought to have the highest potential for achieving reductions in the spread of Pierce's disease and minimizing economic losses for California viticulture over the next five years.

- **Vector control:** Reducing vector populations (numbers and distribution) is essential to managing the spread of Pierce's disease. High priority areas for investigation are biological and chemical controls, barrier and trap crops, habitat modification, and repellent and confusion methods. Particular attention should be placed on GWSS, but research into control of BGSS should also be aggressively pursued.
- **Disease control:** Currently, the spread of the *X. fastidiosa* bacterium in the vineyard is controlled primarily through winter pruning. Research into this cultural practice should continue. Two other high-priority research areas involve plant chemotherapy (high doses of micronutrients and prophylactic use of bactericides) and biological controls for the bacterium (endophytic bacteria, bacteriophages, etc.).
- **Epidemiology and physiology of *X. fastidiosa*:** Support for basic and applied research into the movement of *X. fastidiosa* in the xylem, differences in its spread in systemic and nonsystemic plant hosts, the effects of temperature on the growth and spread of PD, and the pathology and transmission of the disease is essential to developing more effective controls. This has great potential for discoveries leading to more effective management of Pierce's disease and contributing to the long-term objective of breeding disease resistance to the bacterium into grapes.

## **Recommendation 2. Long-Term Research Priorities (Next 10 Years)**

Members of the Task Force believe that disease resistance, over the long term, offers the only sure protection for grapes from the ravages of the *X. fastidiosa* bacterium. This will require substantial fiscal resources and the application of genetic engineering and other biotechnology techniques to insert disease-resistant genes into plants. There is insufficient time for conventional plant breeding practices, which could take 20 years or more to breed resistance into grapes.

The Task Force recommends funding for an integrated research program over the next decade that focuses on plant chemistry, grafting of rootstock, and finding and inserting disease-resistant genes into commercial grape varieties.

- **Plant chemistry:** Research to determine the basis for resistance to *X. fastidiosa* in known resistant species and cultivars of grapes.
- **Grafting of rootstock:** Studies to determine if rootstocks and *Vitis* species have an effect on PD expression when *V. vinifera* wine and table grapes are

grafted on top.

- **Genetic engineering and DNA manipulation:** Begin the lengthy process of examining known DNA sequences with encoded antibacterial peptides to determine their effect against *X. fastidiosa*, develop a genetic map to *X. fastidiosa* resistance using susceptible X resistant grapes, and utilize DNA markers for resistance to introgress this resistance into several *V. vinifera* wine and table grape varieties.

The goal is to move genes resistant to *X. fastidiosa* into wine and table grapes.

### **Recommendation 3. Statewide Monitoring and Tracking Program**

The Task Force recommends that state and federal governmental agencies, county agricultural commissioners, the agricultural and nursery industries and UC make every effort to slow the spread of glassy-winged sharpshooter beyond its current distribution in Southern California and the southern San Joaquin Valley. Slowing the expansion of GWSS (and BGSS) populations can reduce the economic impacts of PD on the grape industry, plus buy additional time for scientists to research and develop effective controls for insect vectors and the *X. fastidiosa* bacterium. The Task Force recommends:

- Implementation of a coordinated statewide monitoring, trapping and reporting program to locate populations of GWSS and BGSS and track the incidence and distribution of *X. fastidiosa*, especially in vineyards. Emphasis should be placed on identifying occurrences of GWSS. Information on location, population densities and feeding habits of GWSS and BGSS should be collected and entered into a statewide computerized database (see Recommendation 4).
- In addition to trapping and monitoring efforts now under way in CDFA, the Department should call on UC Cooperative Extension county advisors, county agricultural commissioners, private pest control advisors, growers, nursery operators, landscape professionals and field workers to assist in this statewide monitoring and reporting program. The system should be coordinated by a central office and have the capability to receive both electronically transmitted and paper reports.
- Identification guides and training videos on GWSS and BGSS should be developed as part of the monitoring program and available on the Internet or by mail. The Task Force has prepared and published a full-color brochure, *Glassy-Winged Sharpshooter: A Serious Threat to California Agriculture*. The brochure has been widely distributed and provides an excellent identification tool

for use in the field. A Spanish-language version of the brochure is now being prepared. The University plans to distribute this to growers, nursery operators and farm labor organizations in Spring 2000 for use by Spanish-speaking farm workers and growers.

#### **Recommendation 4. Computerized Geobased Information System**

Decision makers would benefit from having information on the disease and its insect vectors on a computerized geobased information system (GIS). Data could be compiled, overlaid and manipulated to track the locations and numbers of GWSS and BGSS, monitor and assess the incidence of *X. fastidiosa* outbreaks, and coordinate and assess progress of emergency response efforts.

CDFA or the University of California should take the lead in establishing a GIS accessible to commodity and grower organizations, researchers and farm advisors, county agricultural commissioners, governmental agency representatives and others with a need to monitor the spread of PD. Such a system will require funding for development, data input, and staffing.

#### **Recommendation 5. Educational Outreach and Technical Assistance**

The University, governmental agencies and the industry should continue to work closely to disseminate research findings and practical information on Pierce's disease, its insect vectors and methods for reducing the spread of the *X. fastidiosa* bacterium in vineyards. The Task Force recommends that the Division of Agriculture and Natural Resources take the following actions:

- **Continue to support the educational outreach and technical assistance activities of county-based advisors and campus-based scientists and specialists.** UC academics should have access to the latest research results on PD, information on methods for controlling the disease and its insect vectors, and training in the identification of GWSS, BGSS and the symptoms of PD. This information should be disseminated broadly to growers, nursery operators, governmental agencies and other users.
- **Create and maintain a Pierce's disease Web site** to serve as a centralized clearinghouse for research summaries, technical and practical information, training guides and other materials on PD from the University. Access to the Web site should be available to anyone.
- **Prepare printed materials, videos, CDs and other educational materials on Pierce's disease and its vectors.** These should be

developed in consultation with CDFA, agricultural organizations and the scientific community and widely distributed.

### **Recommendation 6. Utilize *X. fastidiosa* Genome Mapping from Brazil**

Scientists in the University of California should take full advantage of the genome mapping project just completed in Brazil on the strain of *X. fastidiosa* responsible for citrus variegated chlorosis. This highly technical information will be available to scientists worldwide in Spring 2000. Researchers familiar with the genome mapping project believe it will yield new information that can be directly applied to understanding the genetic makeup of other strains of *X. fastidiosa*, including the one responsible for Pierce's disease.

### **Recommendation 7. Need for Increased Funding**

The members of the Task Force believe there is a critical need to increase the funds available for research into reducing or eliminating Pierce's disease, its insect vectors, and other strains of *X. fastidiosa* that threaten California's agricultural and nursery industries. The Task Force finds that:

- Current funding, even with the infusion of \$1 million/year from AB 1232, is inadequate to support the comprehensive, multi year research program needed to halt the spread of Pierce's disease in the state.
- A minimum additional investment of \$2 million/year is required over the next decade to fund near-term research to slow and control the spread of the disease into grapes, and longer-term research to discover, select and breed resistance to *X. fastidiosa*.
- A concerted effort should be made by the University, CDFA, USDA, and the agricultural and nursery industries to secure additional research funds from public and private sources.
- Research funds should be awarded on a competitive basis. Funding agencies should utilize balanced advisory committees – with strong representation from both the scientific community and commodity groups – in developing research priorities, issuing calls for proposals, awarding research grants and reviewing annual progress reports.

Should other strains of the *X. fastidiosa* bacterium be introduced into California and be spread by GWSS to high value crops such as almonds, citrus and stone fruit, the additional annual investment in research could increase substantially.

### **Recommendation 8. Increased Attention to Exotic Pest Invasions**

The Task Force notes that GWSS is the latest in a long series of exotic pests to be introduced from other states and countries to California. Recent examples are Mediterranean and Mexican fruit flies, silverleaf and ash whiteflies, red imported fire ant, mitten crab, Africanized honey bee, Formosan subterranean termite and citrus leafminer. These pests have reached the state accidentally on plant materials, in heavy equipment and shipping containers, the bilge water of ships, and illegally in shipments of fresh fruits and vegetables sent from overseas to private individuals.

Despite intensified efforts by USDA, CDFA and the U.S. Postal Service, the introduction of exotic pests will continue to be a problem due to California's prominence as a major arrival/shipping point for interstate and international commerce. Millions of dollars are spent each year on inspection and exclusion programs to stop pests at their points of entry and for emergency eradication and control efforts once they have arrived. While these publicly-funded programs have yielded substantial benefits for Californians, what has been missing is a parallel investment in exotic pest research.

The Task Force recommends that the federal government and the State of California commit resources to substantially increase research into the control and management of exotic pests, including building capacity in the University of California to respond quickly to new invasions. The University's statewide Integrated Pest Management (IPM) project, or a new statewide center for exotic pest research, should be charged with overseeing an expanded research program in consultation with governmental agencies, commodity groups and other interested parties.

### **Recommendation 9. Expand Pool of Scientists Working on PD**

While the Division has expertise in many of the research areas discussed in this report, the Task Force recommends inviting scientists from across the UC system, other universities and colleges, and governmental agencies to join in this important undertaking. This action could significantly and rapidly increase the pool of scientists with expertise in Pierce's disease, GWSS and genetic engineering. Program managers responsible for awarding funds for PD research should make a concerted effort to attract a broad pool of scientists.

### **Recommendation 10. Establish Statewide PD Coordinating Committee**

The Task Force recommends that the Secretary for Food and Agriculture establish a

statewide committee to ensure the timely sharing of new information on the disease and its vectors and to facilitate research, monitoring, trapping, eradication and emergency response efforts. The committee should meet regularly and include representatives from CDFR, USDA, universities, county agricultural commissioners, the agricultural industry and other interested parties. The Task Force also recommends that the Secretary designate a “PD czar” with responsibility for coordinating the state’s response to this serious problem.

## Appendix I.

### PIERCE'S DISEASE RESEARCH AND EMERGENCY RESPONSE TASK FORCE

Dr. W. R. Gomes, Chair  
Vice President - Agriculture and Natural  
Resources  
University of California, Systemwide

Dr. Donald A. Cooksey  
Professor of Plant Pathology  
University of California, Riverside

Dr. Donald L. Dahlsten  
Professor of Insect Biology  
University of California, Berkeley

Dr. Bruce Kirkpatrick  
Professor of Plant Pathology  
University of California, Davis

Dr. Joe R. McBride  
Professor of Forest Science  
University of California, Berkeley

Dr. Joseph G. Morse  
Professor of Entomology; Program Leader,  
Agriculture and Natural Resources  
University of California, Riverside

Dr. Phil A. Phillips  
IPM Area Advisor  
University of California  
Cooperative Extension Ventura County

Dr. Alexander H. Purcell  
Professor of Entomology  
University of California, Berkeley

Dr. Richard A. Redak  
Associate Professor of Entomology  
University of California, Riverside

Dr. Neal K. Van Alfen  
Dean, College of Agriculture and Environmental  
Sciences  
University of California, Davis

Dr. M. Andrew Walker  
Associate Professor of Viticulture and Enology  
University of California, Davis

Mr. Edward Weber  
Viticulture Farm Advisor  
University of California  
Cooperative Extension, Napa County

#### Ex-Officio Members

Mr. Larry Bezark  
Senior Environmental Research Scientist  
Division of Biological Control  
California Department of Food and Agriculture

Dr. Edwin L. Civerolo  
Research Leader  
USDA, ARS, Pacific West Area  
University of California, Davis

Mr. Patrick Gleeson  
Executive Director  
American Vineyard Foundation

#### STAFF

Dr. Robert K. Webster  
Professor of Plant Pathology  
University of California  
Davis, CA 95616  
rkwebster@ucdavis.edu  
530/752-0316

Mr. Steven P. Nation  
Director, Governmental and External Relations  
Agriculture and Natural Resources  
University of California  
1111 Franklin Street, 6th Floor  
Oakland, CA 94607-5200  
steve.nation@ucop.edu  
510/987-0036

FOR IMMEDIATE RELEASE

October 6, 1999

Steve Nation (510) 987-0036

steve.nation@ucop.edu

### **UC NAMES TASK FORCE TO ADDRESS PIERCE'S DISEASE PROBLEMS IN STATE**

OAKLAND President Richard C. Atkinson announced today (October 6) the appointment of a task force to mobilize and focus the scientific, technical and information outreach expertise of the University of California to help growers combat Pierce's disease of grapevines.

"Pierce's disease has cost the California wine and grape industries millions of dollars in lost revenues since it began destroying grapevines in Napa and Sonoma counties several years ago," said Atkinson. "We are committed to working with the agricultural community to control this threat to a vital sector of the state's economy."

The UC Pierce's Disease Research and Emergency Response Task Force, chaired by Vice President - Agriculture and Natural Resources W. R. "Reg" Gomes, will develop a science-based strategy and set of research priorities to guide the university's short- and long-term studies for managing Pierce's disease. The task force also will report on efforts by UC to extend technical assistance to vineyard owners in winegrape growing regions where the disease is a problem.

Pierce's disease is caused by *Xylella fastidiosa*, a bacterium that kills grapevines by blocking their water transport tissue. Unlike Phylloxera which causes a long, slow decline in production, a vine infected with Pierce's disease usually dies within two years and produces no crop. *X. fastidiosa* is spread by insects known as sharpshooters.

UC scientists are engaged in research projects in Napa, Sonoma, Mendocino and Lake counties to control the blue-green sharpshooter, a leafhopper that transmits *X. fastidiosa* to vineyards near streams and riparian areas. They also are conducting studies to breed resistance to Pierce's disease in grapes. These projects are jointly funded with the American Vineyard Foundation.

"The stakes have increased significantly with the discovery in Temecula (Riverside County) of the glassy-winged sharpshooter, a highly mobile insect which threatens to spread Pierce's disease to vineyards across California," said Gomes. "If the glassy-winged and blue-green sharpshooters remain unchecked, Pierce's disease could mean significant economic losses for the state's wine, table and raisin grape growers, as well as citrus, almonds and ornamentals, which serve as hosts for the glassy-winged sharpshooter."

The California Legislature has proposed a state appropriation of \$750,000 per year for the next three years, with a \$250,000 a year match from industry, to fund Pierce's disease research. The California Department of Food and Agriculture (CDFA) recently established the Glassy-Winged Sharpshooter/Pierce's Disease Task Force to advise the secretary of Food and Agriculture on research needs and ways to control this sharpshooter.

"We will be working closely with CDFA and California's growers to develop a research agenda that focuses on control and management of the glassy-winged and blue-green sharpshooters and the Pierce's disease which they spread," said Gomes. "Eventually, we hope to produce resistance to Pierce's disease in grapes using genetic technologies."

The UC task force will provide information and advice to CDFA on research priorities by early November 1999, and a final report to Atkinson by January 1, 2000. Representatives from CDFA, the American Vineyard Foundation, the U.S. Department of Agriculture and the California Legislature will be invited to participate in UC task force meetings.

In addition to Gomes, UC task force members are:

- Donald Cooksey, Department of Plant Pathology, UC Riverside
- Donald Dahlsten, Center for Biological Control, UC Berkeley
- Bruce Kirkpatrick, Department of Plant Pathology, UC Davis
- Joe McBride, Division of Forest Science, UC Berkeley
- Joseph Morse, Department of Entomology, UC Riverside
- Phil Phillips, area IPM advisor, UC Cooperative Extension, San Luis Obispo, Santa Barbara and Ventura counties
- Alexander Purcell, Division of Insect Biology, UC Berkeley
- Richard Redak, Department of Entomology, UC Riverside
- Neal Van Alfen, dean of College of Agricultural and Environmental Sciences, UC Davis
- W. Andrew Walker, Department of Viticulture and Enology, UC Davis
- Edward Weber, viticulture advisor, UC Cooperative Extension Napa County

Robert Webster, Department of Plant Pathology at UC Davis and statewide project director for the UC Viticulture Consortium Research Program and UC California Competitive Grant Program for Research on Viticulture and Enology, will staff the task force.

###

For a tip sheet on Pierce's disease research and technical assistance projects involving task force members and other UC scientists please go to: <http://danr.ucop.edu/news/>.



## **Appendix II. Presentations and Publications by UC Academics**

### **A. Presentations to Growers, Pest Control Advisors, Other Agencies, Public, or Scientific Societies**

#### **1996**

Costa, H.S., Oleander leaf scorch research-group meeting, November 6, 1996, Moreno Valley, CA.

Henry, M., Oleander leaf scorch tours of Coachella Valley & Orange Co. to view infestation of Sharpshooters and incidence of OLS. Oleander Leaf Scorch Symposium, April 14, 1996, Univ. of California, Riverside, CA.

Phillips, P.A., "*H. coagulata* on citrus, potential problems", Oleander Leaf Scorch Symposium, April 14, 1996, Univ. of California, Riverside, CA.

Phillips, P.A., "GWSS, *H. coagulata*, biology and existing parasite complex," Citrus Research Board Meeting, August 22, 1996, Univ. of California, Riverside, CA.

Purcell, A. and Kirkpatrick, B., "Pierce's disease of grapevines," Napa Valley Vineyard Technical Group, February 7, 1996, Napa, CA.

Smith, R., "Pierce's disease control" Sonoma County Viticulture Technical Group monthly meeting topic, February, 1996, Santa Rosa, CA.

Weber, E., Purcell, A., and Varela, L., "Pierce's Disease Workshop and Field Tour," Napa Valley Vineyard Technical Group, May 22, 1996.

Wilen, C., "Oleander leaf scorch: Coming your way." International Society of Arboriculture Regional meeting, March 29, 1996, San Diego, CA.

Wilen, C., "Bacterial scorch of oleander," American Phytopathological Society, Pacific Div., June 1, 1996, Fresno, CA.

#### **1997**

Blua, M.J., Redak, R.A., and Bethke, J.A. Oleander leaf scorch: biology and research directions at the University of California. California Department of Transportation, 1997, Santa Ana, CA.

Costa, H.S., Oleander leaf scorch research-group meetings, February 27, 1997, Moreno Valley, CA.

Costa, H.S., Oleander leaf scorch research-group meetings, May 21, 1997, Moreno Valley, CA.

Costa, H.S., Southern Region Environmental Horticulture Coordinating and Training Meeting. Topics included discussion on oleander leaf scorch. November 13, 1997, Botanic Gardens, Univ. of

California, Riverside, CA.

Henry, M., Farm Advisor training presentation on oleander leaf scorch and sharpshooter, March 1997, PAPA Santa Ana, CA.

Phillips, P.A., "GWSS research and update," Citrus Research Board Meeting, March 27, 1997, Univ. of California, Riverside, CA.

Phillips, P.A., "GWSS: A new pest in Ventura County landscapes," UCCE Landscape Entomology symposium, June 18, 1997, Oak View, CA.

Phillips, P.A., "GWSS, *H. coagulata*, biology and existing natural enemies," Citrus Research Board Meeting, September 18, 1997, Visalia, CA.

Phillips, P.A., "Update on GWSS," Pesticide applicator meeting, December 4, 1997, Ventura, CA.

Redak, R.A., Bethke, J.A., and Blua, M.J. 1997. "Control of glassy-winged sharpshooters on oleander under greenhouse conditions," August 4, 1997, Valent, Fortune Biotech, and Gowan.

Smith, R., "Pierce's disease control," Simi Winery Growers, April 1997, Healdsburg, CA.

Smith, R., "Pierce's disease control," Calif. Assoc. of Family Farms' Lighthouse Farm Network, May 1997, Santa Rosa, CA.

Smith, R., "Pierce's disease control," Pesticide Applicator's Professional Association, August 1997, Petaluma, CA

Smith, R., "Pierce's disease control," California North Coast Grape Growers, November 1997, Healdsburg, CA.

Smith, R., Purcell, A., Varela, L., and McBride, J., "Epidemiology, transmission, movement of vector from riparian habitat, bacterium's fate in plants, control strategies," seminar. With scopes: vector ID exercise. In field: disease ID of spring symptoms in vines, insect vector collection (sweep net); ID of BGSS feeding and breeding riparian plant hosts, Growers, PCA's, April 2, 1997, Sonoma County, CA.

Smith, R., Purcell, A., and Varela, L., Epidemiology, vector lifecycle, control strategies. With scopes: vector ID exercise. In field: disease ID of summer vine symptoms, ID of BGSS feeding and breeding riparian plant hosts, Growers, PCA's, June 12, 1997, Sonoma County, CA.

Smith, R., Purcell, A., Varela, L., and Kirkpatrick, B., Seminar: epidemiology, field trial inoculation results update, lab detection techniques, Growers, PCA's, September 16, 1997, Sonoma County, CA.

Smith, R. and Varela, L., "Recognizing and categorizing fall PD symptoms to determine chronic PD

infections,” Growers, PCA’s, September 23, 1997

Weber, E., Purcell, A., and Varela, L., “Pierce’s Disease Workshop & Field Trip – epidemiology, vector identification, spring symptom identification,” Growers, PCA’s, April 8, 1997, Napa County, CA.

Weber, E., Purcell, A., Varela, L., and McBride, J., “Pierce’s Disease Workshop & Field Trip – epidemiology, diagnostic techniques, riparian ecology, vector identification,” Growers, PCA’s, June 11, 1997, Napa County, CA.

Weber, E., Purcell, A., Varela, L., and Kirkpatrick, B., “Pierce’s Disease Workshop & Field Trip – diagnostic techniques, summer symptom identification, mapping techniques,” Growers, PCA’s, September 30, 1997, Napa County, CA.

Weber, E., “Pierce’s Disease Update”, Napa Valley Vineyard Technical Group, December 3, 1997, Napa, CA.

Wilen, C., “Update on oleander leaf scorch,” PAPA meeting, January 16, 1997, Escondido, CA.

Wilen, C., “Bacterial scorch of oleander.” UC Landscape Workgroup, September 30, 1997, Davis, CA.

## **1998**

Bianchi, M., “Pierce’s Disease,” Presentation to growers, March 16, 1998, Arroyo Grande, CA.

Bianchi, M., “Pierce’s Disease,” Presentation to Paso Robles Vintners and Growers Association, April, 1998, Paso Robles, CA.

Bethke, J.A., Redak, R.A., and Blua, M.J., “Managing the glassy-winged sharpshooter to control the spread of oleander leaf scorch using selected pesticides”, Joint Annual Meeting of the Entomological Society of America and the American Phytopathological Society, 1998.

Bethke, J.A., Blua, M.J., and Redak, R.A., “Potential management of oleander leaf scorch using selected pesticides to control the glassy winged sharpshooter (Homoptera: Cicadellidae): a laboratory study,” Annual meeting of the California Association of Nurserymen, 1998, Poster presentation.

Blua, M.J., Redak, R.A., and Bethke, J.A., “Development of a management strategy for Pierce’s disease spread by *Homalodisca coagulata* in Southern California,” Annual Meeting of the Entomological Society of America, 1998.

Blua, M.J., Redak, R.A., and Bethke, J.A., “Population dynamics of *Homalodisca* sp., vectors of *Xylella fastidiosa*, in Southern California,” Joint Annual Meeting of the Entomological Society of America and the American Phytopathological Society, 1998, Poster presentation.

Blua, M., Redak, R.A., and Costa, H.S., "Controlling the spread of *Xylella fastidiosa*, the causal agent of oleander leaf scorch, by disrupting vector acquisition and transmission," Presentation to California Department of Transportation, April 22, 1998, Sacramento, CA.

Blua, M.J., Redak, R.A., and Bethke, J.A., "Sharpshooters bring new problems to California ornamentals", Annual meeting of the California Association of Nurserymen, 1998. Poster presentation.

Blua, M.J. and Redak, R.A., "Investigating the spread of Pierce's disease in the Temecula Valley of southern California", 1998, Temecula Valley Wine Grape Growers Association.

Blua, M.J., Redak, R.A., and Bethke, J.A., "Oleander leaf scorch: biology and research directions at the University of California", 1998, California Department of Transportation, Sacramento, CA.

Blua, M. and Costa, H.S., Updates on oleander leaf scorch research projects: vector biology and management. Landscape Management Research Conference and Field Day, September 16, 1998, Riverside, CA.

Costa, H.S., Landscape Horticulture Workgroup Meeting. Topics included discussion on OLS. April 29, 1998, San Diego, CA.

Costa H.S., Blua M.J., and Redak R.A., "Transmission of oleander leaf scorch disease by sharpshooters," Joint Annual Meeting Entomological Society of America, and American Phytopathological Society, November 10, 1998, Las Vegas, NV.

Costa, H.S., Southern Region Environmental Horticulture Meeting. Topics included discussion on OLS November 18, 1998, Riverside, CA.

Phillips, P.A., "GWSS: A new vector of PD in California," 8th Annual Research workshop on grape pest management, November 24, 1998, Kearney Ag. Center, Parlier, CA.

Phillips, P.A., "GWSS: Update and Outlook," Citrus Research Board Growers seminar, August 12, 1998, Santa Paula, CA.

Phillips, P.A., "GWSS Biology and what it means to California Citrus," California Agricultural Production Consultants Association meeting, September 9, 1998, Ventura, CA.

Phillips, P.A., "GWSS Biology and existing natural enemies," Progress Report, Citrus Research Board, September 16, 1998, University of California, Riverside, CA.

Phillips, P.A., "GWSS: A potential disaster in the making for California Citrus," Poster session, California Agricultural Production Consultants Association Annual Conference, October 18, 1998, Anaheim, CA.

Phillips, P.A., "GWSS: A potential disaster in the making of California Citrus," Poster session,

Entomological Society of America Meeting, November 10, 1998, Las Vegas, NV.

Purcell, A., "Pierce's disease of grapevines: ecology and control," U.C. Bodega Marine Laboratory, July 16, 1998, Bodega Bay, CA.

Purcell, A., "Pierce's disease research" to U.C. Regents and President, September 30, 1998, Napa Valley Field Trip.

Purcell, A., "Pierce's disease update," Viticultural Conference, November 6, 1998, Mendocino Jr. College, Ukiah, CA..

Purcell, A., "Almond leaf scorch epidemiology", 26th Annual Almond Industry Conference, December 3, 1998, Modesto, CA.

Smith, R., "Pierce's disease control," 1998 Sonoma County Grape Day, February 1998, Santa Rosa, CA.

Smith, R., "Pierce's disease control," California North Coast Grape Growers, February 1998, Healdsburg, CA.

Smith, R., "Pierce's disease control," Temecula Valley Wine Grape Day, March 1998 Temecula, CA.

Smith, R., "Pierce's disease control," West County Alternative to Toxics, November 1998, Santa Rosa, CA.

Smith, R., Purcell, A., Botti, F., "Pierce's Disease – Fighting the battle, working with regulators," Unified Wine & Grape Symposium, January 21, 1998, Sacramento, CA.

Smith, R., Purcell, A., Varela, L., and McBride, J., "Epidemiology; disease transmission, bacterium's fate; vector movement from riparian areas; vector monitoring; disease management; riparian woodland ecology and resource values; In Field: riparian plant ID, species structure and composition; spring PD symptoms in vine; sticky trap monitoring," April 6, 1998.

Smith, R. and Varela, L., "Recognizing and categorizing fall PD symptoms to determine chronic PD infections," Growers, PCA's, August 20, 1998.

Walker, A., "Advances and new challenges in managing phylloxera, fanleaf and Pierce's disease," Napa Valley Viticultural Fair, November 10, 1998, Napa, CA.

## **1999**

Bethke, J.A., Redak, R.A., and Blua, M.J., "Control of glassy-winged sharpshooters on oleander under greenhouse conditions," Bayer, Valent, Rhone Poulenc, Novartis, October 14, 1999.

Blua, M.J. and Redak, R.A., "Update on the status of PD and the glassy-winged sharpshooter in Temecula," North Coast Pierce's Disease Task Force, November 9, 1999, Temecula, CA.

Blua, M.J. and Redak, R.A., "Glassy-winged sharpshooter and Pierce's disease in Temecula," California Association of Pest Control Advisors, November 17, 1999, San Diego, CA.

Blua, M.J., Redak, R.A., and Morse, J.G., "Developing bio-control for the glassy-winged sharpshooter," Citrus Research Board, 1999.

Blua, M.J. and Redak, R.A., "Glassy-winged sharpshooter and Pierce's disease in Temecula," Citrus Research Board, 1999, Santa Paula.

Blua, M.J., "Glassy-winged sharpshooter and Pierce's disease in Temecula," California Rare Fruit Grower's Inc, 1999

Blua, M.J., Phillips, P.A., and Redak, R.A., "Impact of the glassy-winged sharpshooter on Pierce's disease spread in California and new approaches to disease management," California Table Grape Commission and Raisin Marketing Board, 1999, Visalia, CA.

Blua, M.J. and Redak, R.A., "The status of PD and the glassy-winged sharpshooter in Temecula," North Coast Pierce's Disease Task Force, 1999.

Blua, M.J., Redak, R.A., Costa, H., and Bethke, J.A., "Controlling the spread of *Xylella fastidiosa*, the causal agent of oleander leaf scorch, by disrupting vector acquisition and transmission," California Department of Transportation, 1999, Sacramento, CA.

Blua, M.J. and Redak, R.A., "Status of the glassy-winged sharpshooter and Pierce's disease in Temecula," UCR Citizens University Committee, 1999, Riverside, CA.

Blua, M.J., "Pierce's disease: new vector and new worries for California growers," California Association of Pest Control Advisors, 1999, Santa Paula, CA.

Mauk, P., Luncheon meeting with area grape and citrus growers to discuss control options for GWSS and Pierce's disease. September 8, 1999, Temecula, CA.

Mauk, P., Two field calls to Callaway Vineyards to discuss Pierce's disease and GWSS in citrus, May 17, and July 16, 1999.

Phillips, P.A., "GWSS: A recent pest to California agriculture," poster, UC-DANR Statewide conference, February 9, 1999, Sacramento, CA.

Phillips, P.A., "GWSS research and update," Citrus Research Board, Project Report, March 9, 1999, Univ. of California, Riverside, CA.

Phillips, P.A., "Biology and control of GWSS, a vector of Pierce's disease," March 26, 1999,

Temecula Valley growers meeting, Temecula, CA.

Phillips, P.A., "GWSS research update," Entomology Assoc. of Southern California, June 1, 1999, Arcadia, CA.

Phillips, P.A., "GWSS research update," Citrus growers meeting, August 18, 1999, Santa Paula, CA.

Phillips, P.A., "GWSS: Biology and management," Citrus growers meeting, September 9, 1999, Temecula, CA.

Phillips, P.A., "GWSS: a potential threat to Citrus," Fall grower meeting, September 29, 1999, Visalia, CA.

Purcell, A., "Pierce's disease research update," Sonoma County Vineyard Technical Group, January 21, 1999, Santa Rosa, CA.

Purcell, A., "Pierce's disease update," Hot Topics Conference, Feb. 23, 1999, Napa, CA.

Purcell, A., "Pierce's disease and riparian habitat conservation," Habitat Conservation and Vineyard Management Forum, Napa, Feb. 25, 1999.

Purcell, A., "Pierce's disease," South Coast Grape Day, Temecula, March 26, 1999.

Redak, R.A., "The GWSS and Pierce's disease situation in California," Agricultural Committee of the State Assembly, October 12, 1999 Univ. of California, Riverside, Riverside, CA.

Redak, R.A., "The GWSS and Pierce's Disease situation in California in Wine Caucus," October 25, 1999, United States House of Representatives, Washington, D.C.

Redak, R.A., "The GWSS and Pierce's Disease update," November 11, 1999, Chancellors Advisory Committee, Univ. of California, Riverside, Riverside, CA

Smith, R., Purcell, A., Varela, L., McBride J.R., "Epidemiology; bacterium's fate in plants; role of riparian plants, impact of riparian vegetation management on fisheries; resource management criteria," Federal, State and local resource agencies, May 9, 1997.

Varela, L., "GWSS," PCA Update class, 1999, Santa Rosa Junior College

Walker, A., Anderson, P., Geitner, R., Johnson, D., Kirkpatrick, B., Mochizuki, M., Opatz, P., Purcell, A., Vail, M., and Weber, E., Seminar: "Managing Pierce's disease," American Society for Enology and Viticulture Annual Meeting, July 2, 1999, Reno, NV.

Weber, E. and Hirschfeld, D., "Hands-on pest management: Identifying Pierce's disease and other disorders," Foothill Grape Day, August 13, 1999, Plymouth, CA.

Wilén, C., "Update on oleander leaf scorch," Cal Poly SLO IPM Seminar, June 14, 1999, San Luis Obispo, CA.

## **B. PUBLICATIONS**

Blua, M.J., P.A. Phillips, and Redak, R.A. 1999. A new sharpshooter threatens both crops and ornamentals. *California Agriculture* 53(2): 22-25.

Feil, H., W.S. Feil, and A.H. Purcell. 1999. Effects of temperature on monitoring the flight activity of the blue-green sharpshooter, *Graphocephala atropunctata* (Hemiptera: Cicadellidae). *J. Econ. Entomol.* (in press).

Fishleder, A. and M.A. Walker. Evaluating grape rootstocks and species for resistance to Pierce's disease bacteria. 50th Annual Meeting, American Society for Enology and Viticulture, Reno, NV, Technical Abstracts, p. 39.

Grebus, M.E., J.M. Henry, J.E. Hartin and C.A. Wilén. 1996. Bacterial Scorch of Oleander. *Turf Tales Magazine*, Winter issue (distributed to nurserymen, golf course, and other landscape managers).

Grebus, M.E., J. M. Henry, J.E. Hartin and C.A. Wilén. 1996. Bacterial leaf scorch of oleander: a new disease in southern California. *Phytopathology* 86: S110 (abstract).

Grebus, M.E., J.M. Henry, J.E. Hartin, and C.A. Wilén. 1997. Bacterial scorch of oleander: A summary for landscape professionals (distributed to landscape professionals).

Krivanek, A.F. and M.A. Walker. *Vitis x Muscadinia* hybrids - promising parents for the genetic analysis of Pierce's disease resistance. 50th Annual Meeting, American Society for Enology and Viticulture, Reno, NV, Technical Abstracts, p. 46.

Phillips, P.A. 1997. Sharpshooter targets lemons. *The Voyager Newsletter*. 10(2): 2.

Phillips, P.A. 1998. The GWSS - a new pest for Southern California CAPA, *Advisor*, May/June: 12-13.

Phillips, P.A. 1998. The glassy-winged sharpshooter: a potential future threat to California citrus. *Citrograph* 83(12): 10-12.

Phillips, P.A. 1999. Sharpshooter - A new pest in California. *California Grower* 23(2): 12-14.

Phillips, P.A. 1999. Vineyards and almond orchards threatened: The GWSS is a serious new vector threatening to increase disease pressure in California's grape and almond industries. *Western Fruit Grower* 119(10): 18F-18H.

Phillips, P.A. 1999. GWSS - A serious new Pierce's disease vector in California vineyards. *Grape*

Grower 31(1): 16,18,19,34.

Purcell, A.H. 1975. Role of the blue-green sharpshooter, *Hordnia circellata*, in the epidemiology of Pierce's disease of grapevines. Environ. Entomol. 4: 745-752.

Purcell, A.H. and A.H. Finlay. 1979. Evidence for noncirculative transmission of Pierce's disease of grape and dwarf of alfalfa. Phytopathology 36: 117-128.

Purcell, A.H. and S.R. Saunders. 1998. Fate of a Pierce's disease strain of *Xylella fastidiosa* in riparian woodland plants in northern California. Proceedings of 7th Intl. Cong. of Plant Pathol., Edinburgh, U.K., August 9-16, 1998, p. 2.3.1 (abstract).

Purcell, A.H. 1998. Almond leaf scorch epidemiology. Proc. 26th Annual Almond Industry Conference, Modesto, CA, December 2-3, 1998.

Purcell, A.H. and S.R. Saunders. 1999. Glassy-winged sharpshooters expected to increase plant disease. California Agriculture 53 (2) 26-27.

Purcell, A.H., S.R. Saunders, E. Norberg, and J.R. McBride. 1999. Reductions of Pierce's disease vector activity by management of riparian woodlands. Phytopathology 89: S62 (abstract).

Purcell, A.H. and S.R. Saunders. 1999. Fate of Pierce's disease strains of *Xylella fastidiosa* in common riparian plants in California. Plant Disease 83: 825-830.

Purcell A.H., S.R. Saunders, M. Hendson, M. Grebus and M. Henry. 1999. Causal role of *Xylella fastidiosa* in oleander leaf scorch disease. Phytopathology 89: 53-58.

Redak, R.A., J.A. Bethke and M.J. Blua. 1997. Control of glassywinged sharpshooters on oleander under greenhouse conditions, spring, 1997. Arthropod Management Tests 23.

Smart, C.D., M. Hendson, M.R. Guilhabert, S.R. Saunders, G. Frieberthausen, A. Purcell, and B.C. Kirkpatrick. 1998. Seasonal detection of *Xylella fastidiosa* in grapevines with culture, ELISA and PCR. Phytopathology 88 Suppl.: S83 (abstract).

Smith, R. UC Cooperative Extension Sonoma County Viticulture Newsletter, March 1996. Begin to Monitor for Blue-green Sharpshooters Now.

Smith, R. UC Cooperative Extension Sonoma County Viticulture Newsletter, August 1999. Managing Riparian Vegetation to Control Pierce's disease.

Varela, L., Pierce's Disease in the North Coast (12 pp).

Varela, L., Smith, R. and Clark, J.K., Color flier "Pierce's Disease in the North Coast" (1 pp).

Weber, E., "Vineyard Views" Newsletters including PD topics, May 1995, October 1997, and May

## **Appendix III : CDFA Glassy-Winged Sharpshooter/Pierce's Disease Report**

1998.

Wilén, C. 1996 - present, Electronic newsletter for UC academics and others working with oleander leaf scorch to facilitate communication.

Triapitsyn, S. and P.A. Phillips. 1996. A note on the egg parasitoid of the GWSS in California. *Citrograph* 81(9): 10.

Triapitsyn, S.V., R.F. Mizell III, J.L. Bossart and C.E. Carlton. 1998. Egg parasitoids of *Homalodisca coagulata* (Homoptera: Cicadellidae). *Flor. Entomol.* 81: 241-243.

### **C. DIAGNOSTIC KIT DEVELOPED**

Wilén, C. 1996. Worked with a company (AgGia) to develop a commercial diagnostic kit for *X. fastidiosa* and determined that the kit was effective for diagnosing the oleander strain of the disease.

### **Report for Secretary Lyons from the California Department of Food and Agriculture Glassy-Winged Sharpshooter/Pierce's Disease Task Force**

#### **Research Categories and Objectives for Glassy-Winged Sharpshooter/Pierce's Disease**

The California Department of Food and Agriculture Glassy-Winged Sharpshooter/Pierce's Disease Task Force has met twice and we have focused our efforts towards the development of a list of research priorities to address the disease and insect problem.

The following is a series of categories containing research objectives. Each objective was rigorously analyzed. The Task Force members concluded that all of the information that would be developed by pursuing these categories and objectives is important. Therefore, the order of the categories does not necessarily indicate their priority. Within each category of research, the high priority objectives that are expected to yield results in the short-term (one to two years) are listed first. Long-term results are expected to take three to five years to achieve. The Glassy-Winged Sharpshooter is referred to as GWSS and Pierce's Disease as PD.

While all of the objectives in the list compiled by the Task Force are sound and will address the Pierce's Disease and sharpshooter problem, additional objectives may be brought forward when research proposals are submitted for funding. Any new objective will need to be fully scrutinized to be certain that we have considered the full range of possible solutions to this important problem.

### **Appendix III : CDFA Glassy-Winged Sharpshooter/Pierce's Disease Report**

In addition to the research objectives, short-term goals recommended by the Temecula Winegrape Growers Association include: immediate approval for Section 18 registration for the soil-applied insecticide Admire (imidacloprid) on citrus, and obtaining additional funding for purchase and application of Admire which would prevent additional spread of PD in Temecula.

Respectfully submitted by,

Larry G. Bezark, Chairman  
Glassy-Winged Sharpshooter/Pierce's Disease Task Force  
November 1, 1999

**Glassy-Winged Sharpshooter/Pierces Disease Task Force Members**

|   |   |
|---|---|
| <p><b><u>Larry G. Bezark, Chair</u></b><br/>         California Department of Food and Agriculture<br/>         Plant Health and Pest Prevention Services<br/>         Integrated Pest Control Program<br/>         1220 N Street, Room A-357<br/>         Sacramento, CA 95814<br/>         (916) 654-0768 FAX: (916) 653-2403<br/> <a href="mailto:lbezark@cdfa.ca.gov">lbezark@cdfa.ca.gov</a></p> | <p><b><u>Vincent Petrucci</u></b><br/>         Fresno State University<br/>         Viticulture &amp; Enology Research Center<br/>         Professor of Emeritus<br/>         5604 N. Flora<br/>         Fresno, CA 93710<br/>         (559) 439-4215 FAX: (559) 431-8215 Home<br/>         (559) 278-2089 FAX: (559) 278-4795 Office<br/>         (559) 278- 2414 Personal Phone</p> |
| <p><b><u>Dr. Conrad Krass</u></b><br/>         California Department of Food and Agriculture<br/>         Plant Health and Pest Prevention Services<br/>         1220 N Street, Room A-316<br/>         Sacramento, CA 95814<br/>         (916) 654-1009 FAX: (916) 654-1018<br/> <a href="mailto:ckrass@cdfa.ca.gov">ckrass@cdfa.ca.gov</a></p>  | <p><b><u>Dr. Michael Oraze</u></b><br/>         National Biological Control Institute<br/>         USDA, APHIS, PPQ, CPHST<br/>         4700 River Road Unit %<br/>         Riverdale, MD 20737-1229<br/>         (301) 734-4329 FAX: (301) 734-7823<br/> <a href="mailto:Michael.J.Oraze@usda.gov">Michael.J.Oraze@usda.gov</a></p>  |
| <p><b><u>Ray Gill</u></b><br/>         California Department of Food and Agriculture<br/>         Plant Health and Pest Prevention Services<br/>         Plant Pest Diagnostics Branch<br/>         3294 Meadowview, CA 95832<br/>         (916) 262-1155 FAX: (916) 262-2059<br/> <a href="mailto:rgill@cdfa.ca.gov">rgill@cdfa.ca.gov</a></p>   | <p><b><u>Ben Drake</u></b><br/>         Drake Enterprises<br/>         Post Office Box 890009<br/>         Temecula, CA 92589<br/>         (909) 676-8188 FAX: (909) 699-8647<br/>         (909) 522-9339 Mobil</p>   |
| <p><b><u>Dr. Bruce Kirkpatrick</u></b><br/>         Department of Plant Pathology<br/>         One Shields Avenue<br/>         Davis, CA 95616<br/>         (530) 752-2831 FAX: (530) 752-5674<br/> <a href="mailto:bckirkpatrick@ucdavis.edu">bckirkpatrick@ucdavis.edu</a></p>  | <p><b><u>Craig C. Weaver</u></b><br/>         Callaway Vineyards<br/>         32720 Rancho California Road<br/>         Post Office Box 9014<br/>         Temecula, CA 92589<br/>         (909) 676-4001 FAX: (909) 676-5209</p>  |
| <p><b><u>** Dr. Alexander H. Purcell</u></b><br/>         Division of Insect Biology<br/>         201 Wellman<br/>         Berkeley, CA 94720-3112<br/>         (510) 642-7285 FAX: (510) 642-7428<br/> <a href="mailto:purcell@nature.berkeley.edu">purcell@nature.berkeley.edu</a></p>  | <p><b><u>James O. Wallace</u></b><br/>         Riverside County Agricultural Commissioner<br/>         Post Office Box 1089<br/>         Riverside, CA 92502<br/>         (909) 955-3045 FAX: (909) 955-3012<br/> <a href="mailto:riversag@cdfa.ca.gov">riversag@cdfa.ca.gov</a></p>  |
| <p><b><u>Dr. Richard Redak</u></b><br/>         Department of Entomology<br/>         University of California<br/>         Riverside, CA 92521<br/>         (909) 787-7250 FAX: (909) 787-3086<br/> <a href="mailto:richard.redak@ucr.acf.edu">richard.redak@ucr.acf.edu</a></p>   | <p><b><u>** Patrick Gleeson</u></b><br/>         American Vineyard Foundation<br/>         Post Office Box 414<br/>         Oakville, CA 94562<br/>         (707) 967-9307 FAX: (909) 967-9948<br/> <a href="mailto:AVF@Napanet.net">AVF@Napanet.net</a></p>  |
| <p><b><u>Andrew Johnson</u></b><br/>         Beringer Wine Estates<br/>         Post Office Box 111<br/>         St. Helena, CA 94574<br/>         (707) 963-2969 FAX: (707) 963-8251<br/>         Shop: (707) 944-2014 Mobil: (707) 483-6806<br/> <a href="mailto:johnsond@bwecorp.com">johnsond@bwecorp.com</a></p>   | <p><b><u>David Whitmer</u></b><br/>         Napa County Agricultural Commissioner<br/>         1710 Sosol Avenue #3<br/>         Napa, CA 94559-1315<br/>         (707) 253-4357 FAX: (707) 253-4881<br/> <a href="mailto:dwhitmer@co.napa.ca.us">dwhitmer@co.napa.ca.us</a></p>  |

\*\* Member of North Coast Pierce's Disease Task Force

## **MONITORING AND DATABASE MANAGEMENT**

### **High Priority - Short-Term Results**

Determine the temporal and spatial distribution, and relative abundance of the GWSS.

Determine the distribution and relative abundance of the GWSS egg parasitoid, *Gonatocerus ashmeadi*.

Develop and optimize methods to screen large numbers of plant and insect samples for the presence of PD using sensitive assays (such as polymerase chain reactions).

### **High Priority - Short-to Long-Term Results**

Determine the occurrence and severity of PD in new 'hot spots' in grapes including the Temecula Valley of Southern California.

Compile and incorporate statewide geographic information system (GIS) information to accurately represent the distribution of GWSS and PD; determine areas that could become affected by both the disease and vector.

### **Medium Priority - Short-to Long-Term Results**

Improve vector monitoring methods; develop alternative trapping methods.

## **BIOLOGY AND ECOLOGY OF THE ORGANISMS**

### **High Priority - Short-to Long-Term Results**

Characterize the dispersal and movement abilities of GWSS.

### **High Priority - Long-Term Results**

Determine the seasonal patterns of host plant use and host plant preferences of GWSS.

### **Medium Priority - Short-to Long-Term Results**

Characterize the dispersal and movement abilities of potential egg parasitoids.

### **Low Priority - Short-Term Results**

Determine a phenological degree day model for development of GWSS.

Determine a phenological degree day model for development of parasitoids.

### **Low Priority - Long-Term Results**

Synthesize current GWSS nutritional information into a practical protocol for screening host plants for their acceptability to obviate the need for plant chemistry analyses.

Determine the relationship of host plant xylem chemistry, leaf surface chemistry and morphology on host selection, feeding, and oviposition of GWSS. Assess: 1) host plant acceptance and subsequent feeding rate; 2) host selection and acceptance for oviposition; and 3) survival and performance of the nymph as a function of host plant species.

## **BIOLOGICAL CONTROL OF GWSS**

### **High Priority - Short-to Long-Term Results**

Determine the viability of both parasitized and unparasitized eggs after various periods of long-term storage various temperatures and humidities.

Develop rearing methodologies for the mass rearing and release of wasp parasitoids for the biological control of GWSS.

Conduct exploration for other parasitoids.

Determine the oviposition rate for the GWSS on a variety of host plants (required for egg parasitoid mass rearing).

### **Medium Priority - Short-to Long-Term Results**

Conduct preliminary field inoculative and inundative release studies and evaluate parasitoid longevity, reproduction, field persistence, dispersal, and impact on field populations of the GWSS in both citrus and grapes.

### **Low Priority - Short-Term Results**

Survey, identify, culture and evaluate the *Hirsutella/Entomophthora* spp. pathogens attacking adult leafhoppers in Florida and elsewhere.

### **Low Priority - Long-Term Results**

Determine the relationships of leafhopper egg density, host plant xylem chemistry, leaf chemistry and leaf morphology to the behavior and biology of the GWSS egg parasite, *Gonatocerus ashmeadi* and other parasite species as they become available.

## **USE OF PESTICIDES TO CONTROL GWSS AND LIMIT SPREAD OF DISEASE**

### **High Priority - Short-Term Results**

Determine the degree to which imidacloprid affects transmission of the PD organism to grapevine by pathogen-carrying GWSS through time after plants are treated.

Determine the optimal deployment of imidacloprid on grapevines to reduce vector pressure and disrupt transmission of the PD organism.

Screen insecticides to determine dosage-mortality responses of GWSS on grape at various times after application.

Screen insecticides to determine effects of sublethal dosages (low as well as no mortality) on plant to plant movements (avoidance), flight propensity/ability, and transmission of PD

Examine materials known to have antifeedant properties in insects. Continue working on new foliar applied insecticides and chemical repellents that disrupt the feeding habits of the GWSS and Blue-Green Sharpshooters.

## **BARRIERS AND TRAP CROPS**

### **High Priority - Long-Term Results**

Determine the efficacy of utilizing trap crops to attract GWSS out of grapes and/or citrus and thus prevent GWSS movement into grape and/or citrus fields.

### **Low Priority - Short-Term Results**

Determine the efficacy of utilizing insecticide-treated trap/barrier crops to attract GWSS out of grapes and/or citrus and thus reducing GWSS movement into grape and/or citrus fields (Including vine netting).

Determine the efficacy of large screen barrier traps to reduce GWSS immigration to grapes from citrus.

### **Low Priority - Short-to Long-Term results**

Identify plant species with resistance to PD and to use these plant species to reduce GWSS infectivity in areas currently colonized or in danger of being colonized by GWSS.

## **CHEMOTHERAPY FOR PD IN GRAPE USING ANTIBIOTICS AND OTHER TREATMENTS**

### **High Priority - Short-Term Results**

Study conductive tissue and track movement of PD.

Test efficacy of plant micronutrients, such as zinc, copper, manganese and iron, as well as antibiotics for controlling PD, and develop methods to introduce these materials into grapevine xylem tissues.

### **High Priority - Long-Term Results**

Determine whether bactericides can be used prophylactically to prevent infection of healthy grapevines.

### **Low Priority - Short-Term Results**

Conduct fertilization trials including soil mineral balancing, soil microbial enhancement and foliar sprays.

## **BIOLOGICAL CONTROL OF PD**

### **Medium Priority - Short-to Long-Term Results**

Discover bacteriophages of PD and test their protective or curative potential in grape.

### **Medium Priority - Long-Term Results**

Identify endophytic bacteria that are antagonistic to PD - identify xylem inhabiting, nonpathogenic bacteria, and test their potential for reducing populations or movement of PD.

Genetically-engineer endophytic bacteria to deliver polypeptides that are inhibitory to PD.

## **EPIDEMIOLOGY OF PD**

### **High Priority - Short-Term Results**

Determine incidence of PD strains in alternative host plants other than grape in Temecula

### **High Priority - Long-Term Results**

Epidemiology of PD in Temecula - Does vine to vine transmission occur?

Determine spatial patterns of PD spread in vineyards; determine the effect of date of inoculation on disease persistence in Southern California conditions; determine the effect of GWSS inoculation as a function of feeding sites within the vine (i.e., can winter inoculations of dormant canes or basal portions of green canes result in persistent infections?); and analyze infectivity patterns in GWSS: how they are affected by habitat and season.

### **Medium Priority - Short-to Long-Term Results**

Determine the effects of temperature on growth and spread of PD in grape and other key plants.

### **Medium Priority - Long-Term Results**

Determine the plant factors influencing transmission and inoculation efficiency of PD by GWSS on different host plants.

### **Low to Medium Priority - Short-Term Results**

Study the relationship of rootstocks and their ability to slow the spread of PD on the grafted scion wood.

## **MOVEMENT/SPREAD/MONITORING METHODS AND PATHOLOGY OF PD IN PLANTS**

### **High Priority - Long-Term Results**

Understand how PD moves in systemic (grape, blackberry) and non-systemic (willow) plant hosts using microscopy.

### **Medium Priority - Long-Term Results**

Develop transformation/transposon mutagenesis systems for PD using existing or novel bacterial transformation vectors. Use PD mutants to identify bacterial genes that mediate plant pathogenicity, movement, or insect attachment.

## CULTIVARS OF GRAPE RESISTANT TO PIERCE'S DISEASE

### High Priority - Long-Term Results

Develop a genetic map to PD resistance using *Vitis vinifera* X (*V. rupestris* X *M. rotundifolia*) seedling populations and Amplification Fragment Length Polymorphism (AFLP).

Utilize DNA markers for resistance to rapidly introgress PD resistance into several *V. vinifera* wine grapes.

Determine the resistance of 10 grape genotypes (10 scions grafted on two rootstocks) to PD after mechanical inoculation and natural infection with PD.

Determine the resistance of common host plants (willow, resistant; blackberry, susceptible) to PD and how the bacterium responds to specific profiles of xylem chemistry.

## **ECONOMIC ANALYSIS**

### **Medium Priority - Short Term Results**

Conduct a micro-economic analysis of PD damage, to allow growers to assess the economics of replacing diseased vines.

Conduct a macro-economic analysis of long-range effects of losing various segments of crops and the effect of damage in the region.