PIERCE'S DISEASE RESEARCH EFFORTS
2000-2001 SUMMARY OF PROJECTS AND OBJECTIVES

Project Title:
A genetic map of *Vitis vinifera*: a foundation for improving the management of disease and flavor.

Principal Investigator:
Carole Meredith, Professor
Department of Viticulture and Enology
University of California, Davis,

Objectives of Proposed Research:

1) Develop a genetic map of *Vitis vinifera.*
2) Identify genetic components controlling fruit cluster structure.

Justification and Importance of Proposed Research:

Future technical advances in quality or production efficiency to enable California producers to compete in the global markers will likely take the form of new viticultural practices or genetically modified varieties. Although some improved viticultural practices may be developed empirically, the evolution of more significant improvements will depend on more detailed knowledge about key vine processes and how they are influenced by environmental and management factors. There is also a future for genetically modified varieties, but these are not likely to be new varieties, since the world wine market revolves around classic European varieties. They will instead probably be existing varieties into which highly specific directed genetic modifications have been introduced.

Project Title:
Genetic transformation to improve the Pierce's disease resistance of existing grape varieties

Principal Investigator:
Carole Meredith, Professor
Department of Viticulture and Enology
University of California, Davis

Objectives of Proposed Research:

1) Further improve a genetic transformation protocol in our laboratory to routinely produce transgenic vines of important grape varieties, particularly Chardonnay.
2) Introduce into an existing variety a gene encoding an antimicrobial compound shown to be effective against the causal agent of Pierce's disease.
3) Regenerate transgenic vines and determine whether they exhibit improved tolerance to Pierce's disease.

Justification and Importance of Proposed Research:

Pierce's disease is a serious threat to California viticulture. No cultural or chemical treatments have yet proven effective against it. Genetic transformation offers the possibility of introducing a specific new gene that will confer increased PD resistance to existing varieties.

Project Title:
Biological Control of Pierce's Disease with Non-pathogenic Strains of *Xylella fastidiosa*

Principal Investigator:
Donald A. Cooksey
Department of Plant Pathology, UCR

Objectives of Proposed Research:

1) Construct deletion mutations in putative virulence genes of *Xylella fastidiosa*.
2) Test mutant strains for virulence in grapevines.
3) Test mutant strains for biological control of pathogenic strains in grapevines.
4) Compare sequences of virulence genes between the Pierce's disease strain and the CVC strain.

Justification and Importance of Proposed Research:

Pierce's disease of grapevine, caused by *Xylella fastidiosa*, has been known in California for over 100 years (Gardner and Hewitt, 1974), but the recent arrival of a much more efficient vector, the glassy-winged sharpshooter, has greatly increased the threat of this pathogen to the grape industry (Blua et al., 1999). One general approach that is being considered to manage this situation is biological control of the bacterial pathogen. The CDFA list of research priorities included biological control of *X. fastidiosa* as a medium priority. The specific biological control approaches that were listed included the use of bacteriophages and antagonistic endophytic bacteria isolated from the xylem of grape. We have discussed these and other approaches with other UC researchers through the UC-DANR Workgroup on the Integrated Pest Management of Glassywinged Sharpshooters and the Diseases they Vector. Drs. Bruce Kirkpatrick and Ed Civerolo of UC Davis are investigating endophytic bacteria found in grape xylem, and Dr. Sandy Purcell has conducted research on bacteriophages. Another approach that the workgroup discussed and endorsed, was the possible use of a nonpathogenic strain of *X. fastidiosa* derived from a pathogenic Pierce's disease strain for competitive exclusion of the pathogen in grapevines. As discussed below, this concept has certain advantages over other biological control approaches and considerable precedent in bacterial, fungal, and viral systems, including the biological control of xylem-inhabiting bacterial pathogens. The CDFA list of research priorities also included the use of mutant strains of the Pierce's disease bacterium to identify bacterial genes that mediate plant pathogenicity, and the UC Taskforce on Pierce's disease further suggested that researchers accomplish this by taking advantage of the genome sequence data of the citrus variegated chlorosis strain of *X. fastidiosa*. This proposal will utilize the genome sequence data to address both the identification of pathogenicity genes and biological control of Pierce's disease.

Project Title:
Epidemiology of Pierce's Disease in Southern California: Identifying Inoculum Sources and Transmission Pathways

Principal Investigator:
Donald A. Cooksey
Department of Plant Pathology, UCR

Objectives of Proposed Research:
1) Determine which plant species near vineyards harbor Xylella fastidiosa and serve as potential reservoirs of inoculum for the spread of Pierce's disease to grapes.
2) Analyze samples of glassywinged sharpshooter populations on grape and alternate hosts to detect the presence of Xylella fastidiosa, and identify the major sources of vectors that move the Pierce's disease pathogen into grapes.
3) Measure the ability of the glassywinged sharpshooter to acquire and transmit Xylella fastidiosa to and from grape, citrus, and other plant species identified as potential hosts and sources of inoculum for the spread of Pierce's disease.
4) Develop and optimize methods to screen large numbers of plant and insect samples for the presence of Pierce's Disease.

Justification and Importance of Proposed Research:

Previous studies on the epidemiology of Pierce's disease in Northern California have described systems dealing with different primary vector species and different alternate host plants than those that are found in the Southern California systems. Most studies of alternative hosts and sources of inoculum of Pierce's Disease in California have concentrated on plants in riparian habitats, since previous vectors were limited to those environments (Purcell and Saunders, 1999). However, in the Temecula area of Southern California, the habitats and plant hosts that surround the vineyards are much different than those found in Northern California. Understanding the role that other plant species in the Temecula area may play in spread of Pierce's disease of grapes could be critical to management decisions. Our study will expand on previous studies to include major native, introduced, and cultivated plant species near Temecula vineyards. In addition, our survey of plant materials to detect alternate hosts will employ much more sensitive methods of detection that methods previously used to conduct surveys to detect *Xylella fastidiosa* in plants in other areas of California.

In addition to dealing with different host plants, the feeding habits and host range of the primary vector of the pathogen in Southern California differ from other vector species previously associated with the pathogen in California. Studies with the insect vector species present in Northern California, suggests that the pathogen was primarily being spread by vectors moving into vineyards from outside habitats, rather than spreading from vine to vine (Purcell, 1981; Purcell and Saunders, 1999). But because the glassy-winged sharpshooter feeds much lower on the cane than other sharpshooters in California, late season infections introduced by the glassy-winged sharpshooter may survive the winter to cause chronic Pierce's disease. This may enable more vine-to-vine spread of Pierce's disease than has previously been the case.

<u>Project Title</u>: (continued)
Epidemiology of Pierce's Disease in Southern California: Identifying Inoculum Sources and Transmission Pathways

There is little information available on the relative ability of the glassywinged sharpshooter to acquire or transmit the Pierce's disease pathogen from vine to vine, or from alternate hosts to grape. For example, it is believed that inoculations of the pathogen into citrus could result in localized propagation, making citrus a possible source of inoculum for sharpshooters moving into grape. Presently, there is little information available on the ability of the glassywinged sharpshooter to acquire this pathogen from alternate hosts such as citrus, or even its ability to transmit the pathogen from grape to grape. Because in many cases the vineyards of the Temecula area are in close proximity to citrus groves, it is critical to know the relative inoculum pressure that citrus and other plant hosts may provide in that area.

Knowledge of the source of disease inoculum from vectors, whether from inside or outside the vineyard, will be critical to development of management strategies for disease control. Results of these studies, combined with data on seasonal fluctuations of sharpshooter populations, will allow us to estimate the time of year and the regions where pathogen pressure is the greatest, and management strategies can be adjusted appropriately.

Project Title:
Biological control of the glassy-winged sharpshooter, *Homalodisca coagulata*: An important vector of Pierce's Disease in grapes.

Principal Investigator:
Dr. Mark Hoddle
Deptment of Entomology
University of California, Riverside

Objectives of Proposed Research:

We propose the development of a biological control program for the reduction glassy-winged sharpshooter (GWSS) densities in California. To achieve the objective of reducing GWSS densities with natural enemies we will:

1) Develop mass rearing methodologies and test host plant suitability for production of GWSS and its egg parasitoids for early season augmentative releases in citrus and grapes.
2) Determine the viability of both parasitized and unparasitized eggs after various periods of long-term storage at four temperatures and two humidities.
3) Conduct preliminary field studies to determine the efficacy of augmentative releases of mass reared egg parasitoids against field populations of GWSS in citrus and grapes.
4) Conduct foreign exploration for other GWSS egg parasitoids in the pest's home range (SE USA and NE Mexico) for release and establishment in CA. We will monitor the establishment and impact of new parasitoid species we release.

Justification of Proposed Research:

Reducing densities of the first generation of GWSS may be possible with augmentative releases of egg parasitoids (e.g., *Gonatocerus ashmeadi*) if natural enemies can be efficiently mass reared. To investigate the efficacy of augmentative releases, mass rearing technology for egg parasitoids needs to be improved and this will involve screening host plants for suitability of mass propagation, maintenance indoors, and oviposition preference by GWSS and host plant searching preferences of selected egg parasitoids. Following rearing, it will be advantageous to determine if unparasitized and parasitized GWSS egg masses can be stored at low temperatures and how this affects GWSS and parasitoid viability. Long to medium term cool storage of GWSS and parasitoids will mitigate production shortages and colony losses, and help ensure adequate numbers of parasitoids will be ready for release when necessary. If Objectives (1) and (2) in the above Objectives section are met, a logical next step is to assess the efficacy of augmentative releases of egg parasitoids in citrus and grapes to determine if early season releases of natural enemies are a feasible control strategy (Objective 3). Foreign exploration (Objective 4) for additional natural enemies to enhance or supplant activity by the endemic parasitoid fauna may offer the possibility of early season suppression of GWSS. If an effective early season parasitoid can be found from foreign exploration efforts it could eliminate the need for early season augmentative releases of mass reared GWSS egg parasitoids thereby enhancing the economic competitiveness of this approach.

Project Title:

Seasonal Changes in the Glassy-Winged Sharpshooter's Age Structure, Abundance, Host Plant Use, and Dispersal Patterns

Principal Investigator:

Dr. Robert Luck
Dept. of Entomology
University of California, Riverside

Objectives of Proposed Research:

1) Develop and test florescent dust and immunoglobulin G markers and a trapping system that allows rapid assessment of marked versus non-marked dispersers entering or leaving vineyards from citrus, riparian or urban habitats. (Year 1)
2) With these markers, identify the host plants (species) from which the glassy-winged sharpshooters disperse to the grapevines in spring and early summer and from the grapevines to the overwintering host plants and habitats in late summer and early fall. (Year 2 & 3)
3) Identify the relative contribution of glassy-winged sharpshooters from each host plant type (e.g. citrus, various species in the riparian vegetation, ornamental plants). (Year 2 & 3)
4) Develop a sampling system to estimate the density of egg batches laid in leaves of host plants and the density and age specific survival of nymphs (citrus initially,) and various other hosts plants (as they are identified, e.g., riparian and ornamental plants) (Year 1)
5) Conduct an intensive trapping and sampling program in the Temecula and San Joaquin (Kern County) Valleys to identify the source (host plants) and density of the sharpshooter dispersers. (Year 2 & 3).

Project Title:
Biological, Cultural, Genetic, and Chemical Control of Pierce's Disease

Principal Investigator:
Bruce Kirkpatrick, Project Coordinator for AVF PD Research Program
Department of Plant Pathology
University of California, Davis

Objectives of Proposed Research:

1) Understand how Xf moves, and the patterns of its movement, in systemic (grape, blackberry) and non-systemic (willow) plant hosts using microscopy.
2) Understand how temperature influences the movement and survival of Xf and the incidence and/or severity of PD.
3) Determine whether vegetation barriers between riparian areas and vineyards and/or insecticide-treated "trap crops" at the vineyard edge can reduce the incidence of PD.
4) Develop transformation / transposon mutagenesis systems for Xf using existing or novel bacterial transformation vectors. Use Xf mutants to identify bacterial genes that mediate plant pathogenicity, movement, or insect attachment.
5) Isolate and identify endophytic bacteria that systemically colonize grapevine. Develop methods to genetically transform grape endophytes to express anti-Xf peptides.

6a) Develop a genetic map to Xf resistance using *V. vinifera* X (*V. rupestris* X *M. rotundifolia*) seedling populations and AFLP (amplified fragment length polymorphism) markers, identify resistance markers, and identify potential resistance genes.

6b) Utilize DNA markers for resistance to rapidly introgress Xf resistance into several *V. vinifera* winegrapes and/or utilize genetic engineering procedures (when available) to move above identified Xf resistance genes into winegrapes.

7a) Determine the resistance of 10 grape genotypes to PD after mechanical inoculation and natural infection with Xf. Elucidate the xylem chemistry of these grape genotypes and statistically correlate both chemical profiles and specific molecular markers to PD resistance.

7b) Determine the resistance of common host plants (willow, resistant; blackberry, susceptible) to Xf and discern the relationship of specific chemical profiles to resistance. Utilize these techniques to examine resistance mechanisms of resistant seedlings identified in 6a.

7c) Validate the influence of chemical profiles and specific chemical markers on the growth and survival of *Xylella fastidiosa* by tests in in-vitro culture.

Justification of Proposed Research:

This joint project addresses the control of PD from the following perspectives: increase our understanding of the biology and ecology of Xf; develop trap crop strategies for control, deterrence or isolation of the vectors; investigate possible control strategies through application of micronutrients and antibiotics; develop Xf transformation systems to understand the infection and resistance process; develop molecular markers to Xf resistance and utilize such markers to genetically map resistance and to breed resistant cultivars; and examine the mechanisms of Xf resistance associated with xylem chemistry and biochemical responses to Xf.

Project Title:
Keys to Management of Glassy-winged Sharpshooter: Interactions Between Host Plants, Malnutrition and Natural Enemies

Principal Investigator:
Dr. Russell F. Mizell
Professor of Entomology and IPM Director
University of Florida

Objectives of Proposed Research

1) To determine the effects of host plant assemblages and host plant chemistry on distribution, performance and behavior of GWSS and its natural enemies.
2) To determine the relationship of host plant xylem chemistry, leaf epicuticular wax chemistry and leaf morphology on host selection, feeding and ovipositional behavior of GWSS and its parasites.
   a) assess host plant acceptance and subsequent feeding rate, host plant selection and acceptance for oviposition and the survival and performance of early and late instar nymphs as a function of host plant species
   b) quantify the impact of these plant variables on the behavior and parasitism rate of eggs by *Gonatocerus ashmeadi*.

Justification and Importance of Proposed Research:

Leafhopper vectors of *Xylella fastidiosa* (including GWSS) behave very differently from most herbivorous insects. GWSS and other xylophagous leafhoppers have evolved many unusual adaptations such as host switching to maximize nutrient uptake, unprecedented assimilation efficiency of nutrients, and excretion of ammonia (Andersen et al. 1989, 1992, Brodbeck et al. 1993) that enable GWSS to feed exclusively on xylem fluid. The physiology and behavior of GWSS that make it an efficient vector also make it less amenable to conventional pest management approaches. Adult GWSS feed on hundreds of different host plants (Turner and Pollard 1959, Adlerz 1980, Mizell and French 1987) which they select for feeding by gustation (taste), and each taste event may lead to uptake or transmission of *X. fastidiosa*. GWSS is long lived, exceptionally mobile and fecund (up to 1000-1500 eggs). Natural seasonal fluctuations in plant xylem chemistry determine the seasonal use of host plants by GWSS adults (behavior and performance) (Andersen et al. 1989, 1992, Brodbeck et al. 1990, 1993, 1995, 1996, 1999). Due to the impact of plant nutrition on vector abundance, behavior and performance, it is imperative that any research on the distribution and behavior of GWSS and its natural enemies (and *X. fastidiosa)* be related to plant chemistry. Xylem chemistry can be affected and/or manipulated by environmental factors, culture and management practices (fertilizer, water, pruning, rootstock) and weather extremes.

The ideal scenario for GWSS population growth appears to be the close proximity of good GWSS ovipositional/developmental hosts with adult feeding hosts. For example, the population outbreak of GWSS in the Temecula region may be an excellent example of the consequences of the proximity of good ovipositional hosts (*Citrus*) to adult feeding hosts (*Vitis*). These two conflicting requirements for GWSS population growth (good adult feeding hosts and ovipositional/developmental hosts) make it imperative to study host species and assemblages of host plants for GWSS, as well as movement both within and between these plant assemblages.

Project Title: (continued)
Keys to Management of Glassy-winged Sharpshooter: Interactions Between Host Plants, Malnutrition and Natural Enemies

Since GWSS cannot be studied in un-colonized areas, we contend that the important experiments identifying critical GWSS behaviors can and should be performed in Florida. The hypothesis directing our research is strongly supported by a synthesis of current knowledge: host plant resistance (to vectors and *X. fastidiosa*) is the model that provides the best potential for successful future suppression of Pierce's disease. Practical management of GWSS (and other vectors) and *X. fastidiosa* will likely require a myriad of strategies and tactics. Host plant chemistry's role as the mediator of the great majority of these relationships will be used as the tool to identify important host plant species and their impact on critical GWSS behaviors, and then to manipulate them to suppress GWSS and the incidence of Pierce's disease. The direct application of the proposed research will enable science-based management decisions by growers and regulatory personnel as to the importance of each plant species to GWSS. Important plant species can be selected for planting, removal or manipulations (trap cropping).

Project Title:
Sharpshooter-associated bacteria that may inhibit Pierce's Disease

Principal Investigator:
John Peloquin
Dept. of Entomology
University of California, Riverside

Objectives of Proposed Research:

We will identify insect associated bacteria in GWSS and related insects in Southern California or other areas where the vector insects are endemic. We will then attempt to culture these bacteria. Those bacteria that can be cultured will identified. These will be evaluated further for the production of antibiotics inhibitory to *Xylella*, for potential hazards to plants, animals, humans and for their potential for genetic manipulation through techniques for genetic transformation. Those that can be genetically transformed will be investigated for their ability to express transgenes that produce substances that inhibit, attack, destroy, or prevent the transmission of *X. fastidiosa.* Concurrently, we will evaluate various peptide antibiotics and bacterial extracts for activity against *X. fastidiosa.* Those peptide antibiotics demonstrating effective inhibition of *X. fastidiosa* could be candidates for introduction and production in the GWSS-associated bacteria.

Justification and Importance of Proposed Research:

We will culture, identify, then select or genetically transform insect-associated bacteria, especially gut bacteria, from Glassy Wing Sharp Shooter to produce substances that inhibit or kill *Xylella fastidiosa*. We intend to use bacterial-plasmids derived from gram-negative bacteria and the novel *himar* transoposon/transposase-mediated system derived from the *mariner* insect transposon.

Project Title:
Developing an Integrated Pest Management Solution for Pierce's Disease Spread By the Glassy Winged Sharpshooters in Temecula, California

Principal Investigator:
Richard A. Redak
Dept. of Entomology
University of California, Riverside

Objectives of Proposed Research:

The objectives of the research presented here fall along five major lines of inquiry, each of which is an integral component to an integrated pest management approach. Each line of research will provide critical information to manage the tools available to successfully control the GWSS and limit the spread of PD in grapevines.

1) POPULATION MONITORING: Determine the distribution and relative abundance of

   A. The glassy winged sharpshooter within and among the major cropping systems in the Temecula Valley.
   B. The sharpshooter egg parasitoids, (*Gonatocerus sp.),* within and among the major cropping systems of the Temecula Valley.
   C. The temporal and spatial occurrence of the Pierce's disease bacterium in the Temecula Valley in wild and cultivated hosts and in the GWSS.

2) BIOLOGICAL CONTROL: Evaluate sharpshooter egg parasitoids (*Gonatocerus ashmeadi* and other species as they become available) as a biological control agents to reduce and limit populations of glassy winged sharpshooter in citrus and grape cropping systems in Southern California.

   A. Determine the oviposition rate for the sharpshooter on a variety of host plants in a greenhouse.
   B. Develop rearing methodologies for GWSS egg parasitoids, including determining the viability of both parasitized and unparasitized eggs after periods of long-term storage under refrigeration (required for mass rearing of parasitoids).
   C. Construct a degree day model for development of both sharpshooters and parasitoids (required for mass rearing and release of parasitoids, also will allow predictions of periods of high and low population densities).
   D. Conduct preliminary field release studies and evaluate parasitoid longevity, reproduction, field persistence, dispersal, and impact on field populations of sharpshooter in both citrus and grapes.
   E. Conduct exploration for other parasitoids in the GWSS's native range (southeastern U.S. to south Texas and northern Mexico).

Project Title: (continued)
Developing an Integrated Pest Management Solution for Pierce's Disease Spread By the Glassy Winged Sharpshooters in Temecula, California

3) USE OF INSECTICIDES TO CONTROL SHARPSHOOTERS AND LIMIT SPREAD OF DISEASE: Continue research evaluating pesticides to deter sharpshooters from feeding and/or rapidly kill them such that disease spread is decreased.

    A. Determine the degree to which neonicotinoids (e.g. imidacloprid) affect transmission of the PD organism to grapevine by pathogen-carrying sharpshooters through time after plants are treated.

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

    C. Determine the impact of neonicotinoids in citrus on GWSS.

4) BARRIERS: Develop a physical control technique for reducing movement of sharpshooters from citrus to vineyards.

    A. Determine the efficacy of large screen barriers to reduce sharpshooter immigration to grapes from citrus

5) CHEMOTHERAPY: Develop a means of "curing" grapevines infected with the PD bacterium, or preventing the establishment of *X. fasditiosa* in grapevines.

    A. Determine the lowest concentrations of various agricultural formulations of zinc, manganese, copper and iron which inhibit the growth of Xf in vitro.

    B. Determine the highest concentration of these materials that can be injected or applied to the soil or foliage without causing irreversible phytotoxicity.

    C. Determine what the resulting concentrations of these materials are in xylem sap collected from four widely used grape rootstocks grafted with Chardonnay scions.

Project Title:
Sequence of Xylella Fastidiosa Strain Causing Pierce's Disease of California Grapevine

Principal Investigator:
Andrew Simpson
Cordinator of the Organization for Nucleotide Sequencing and Analysis (ONSA)
Sao Paulo, Brazil

The AVF, USDA/ARS and the CDFA will be co-funding this project in Brazil. The project will cost $500,000. The Brazilians will be allocating $250,000 towards this project and the US Breakdown is as follows: $125,000 from the USDA/ARS, $62,500 from the CDFA and $62,500 from the AVF (wine and grape industry).

Key Points

1) To date, there is little know about the genetic make-up of the grape strain of Xylella fastidiosa (XF) and this project will virtually identify every gene involved in XF.

2) Once the genome sequence is complete, the resulting data will help all PD researchers to focus and refine their efforts on ways to manage or eliminate PD in our vineyards.

3) Up until now on the genomics side of the PD equation, researchers have been taking broad strokes with their programs hoping to hit something of interest. The sequence will serve as a solid target that is well defined.

4) The sequence would essentially tell us exactly the nature of the organism that is infecting the vines and its relationship to the citrus strain (CVC) – knowledge of fundamental and immediate importance.

5) We all know that this is not solely a winegrape problem and other commodity groups (citrus, almonds, etc.) should pursue this program for the strains impacting their crops.

6) In cooperating with the Brazilians on the program, we are all maximizing our research funds and expertise. Because they have the infrastructure already in place, we do not have to start from square one. The turn around time is incredible – six months to complete the sequence.

7) Although this program is not the silver bullet for the cure of PD in the near future, it is the type of research that will cut many years off the research timeline for a cure.

8) UC and other researchers are very interested in seeing this project funded because the data will be crucial for all programs moving forward.

Project Title:
Economic Impact of Pierce's Disease on the California Wine Grape Industry

Principal Investigator:
Jerome Siebert
Department of Agricultural and Resource Economics
University of California, Berkeley

Background:
Pierce's Disease, which is not new to California, currently threatens to wreak widespread damage to the California grape industry. The primary cause for concern is the introduction of an exotic pest (the Glassy Winged Sharpshooter) accidentally introduced into Southern California which has caused widespread and significant damage to the industry there. The major concern about this new pest, which transmits the disease, is that it is an aggressive flyer – a trait which increases the spread of the disease over larger portion of vineyards. There is growing concern that this new pest, now detected as far north as Santa Barbara County on the Coast and Kern County inland may spread the disease over larger portions of California's vineyards. There is no practical cure for Pierce's Disease with most vines dying within two years of being infected. The purpose of this study is to evaluate the increased costs of producers dealing with the consequences of this disease and the further impact on the economies of the state and wine grape growing regions.

Proposal Objectives:
1) The first phase of the study will be a micro economic study using a basic cost comparison model. This model will compare the costs of vineyards and yields without Pierce's Disease to those with Pierce's Disease. This model will estimate both increased costs of controlling the Glassy Winged Sharpshooter through the use of pesticides and changed cultural practices and subsequent replanting of vineyards once the disease has resulted in the death of the vine. An estimate of loss in revenues and increased costs will be made on a statewide basis and for the wine grape growing regions of California. A second phase will involve a macro economic estimate of the impact of Eutypa on the state and regional economies using an input – output model. The macro economic model will take into account not only impacts on the economy from additional costs on the wine grape industry, but additional impacts from related industries such as tourism.
2) Assumptions will be made on the degree of prevalence of the disease in the California wine industry with scenarios of progression in the various wine grape growing regions.
3) Estimates will be made on a regional basis using California Agricultural Statistics Service (CASS) reports on acreage and varieties by counties.
4) Existing UC Farm Advisor Cost Studies will be used to estimate the cultural, pest management, and replanting costs.
5) Data will be drawn from two studies financed by the California Wine Industry – "Economic Impact of California Wine" by the firm Motto, Kryla, and Fisher LLP; and "Grape Trends", also by the same firm.
6) A limited survey will be made of UC researchers, specialists, and farm advisors and selected industry personnel to determine appropriate assumptions and cost parameter limitations.
7) Estimates of the impact on the general California economy and employment will be made using an existing input – output model and database.
8) A preliminary estimate will be available by May 31, 2000, with updates and discussions with industry leaders provided through 2000.
9) Time frame from start to completion will be 180 days.