

**FINAL REPORT FOR CDFA AGREEMENT NUMBER 08-0448**  
**October 1, 2008 – June 30, 2012**

**I. Project title**

The Benefits and Costs of Alternative Policies for the Management of Pierce's Disease

**II. Principal investigator and cooperators**

*Principal Investigator*

Professor Julian M. Alston

Department of Agricultural and Resource Economics, University of California, Davis

*Co-operator(s)*

Professor M. Andrew Walker

Department of Viticulture and Enology, University of California, Davis

Dr. Matt Daugherty

Department of Entomology, University of California, Riverside

Dr. Barry Hill

California Department of Food and Agriculture

*Other(s)*

Ms. Kate Fuller, Graduate Research Assistant

Department of Agricultural and Resource Economics, University of California, Davis

Mr. Kabir Tumber, Junior Specialist

Department of Agricultural and Resource Economics, University of California, Davis

Professor James Sanchirico

Department of Environmental Science and Policy, University of California, Davis

Dr. Jonathan Kaplan

Department of Economics, California State University, Sacramento

### **III. List of objectives and description of activities conducted to accomplish each objective**

The overall objective of this project is to develop a detailed, practical, quantitative understanding of the economic consequences of Pierce's Disease (PD) and alternative management strategies. More specific objectives are to quantify the current and potential economic impacts of the disease, to estimate the potential economic payoff to investments in PD R&D, to evaluate alternative management strategies including alternative research investments, and to guide policy decisions, including research priorities. To pursue these objectives we developed an economic model of the California wine and wine-grape sector. The model is structured to allow us to simulate market outcomes under alternative scenarios for the prevalence of PD, and alternative technologies and policies for its management, and to assess the economic consequences of these alternatives for various stakeholder groups. The model is designed specifically with a view to using it to evaluate the likely expected benefits from investments in alternative R&D projects related to the management of PD.

Our project commenced formally on September 1, 2008. Kate Fuller was employed initially as a Graduate Research Assistant to work half-time on the project and later as a full-time postdoctoral researcher. Kate's doctoral dissertation work forms an element of the project. Jim Sanchirico, an expert bio-economic modeller, was added to the team of participants and he was actively involved in co-chairing Kate's dissertation committee with Julian Alston. Kate and Jim completed a model that can be used to examine insect-control decisions made by growers. Their model allows for vectors that are mobile across properties belonging to several growers with several different treatment options.

In early work we emphasized investment in developing our own knowledge and information resources. One important element of this was to develop a detailed data base on the economics of wine and wine grape production in California. We completed this data-gathering phase, and compiled this information into a report documenting by county and crush district for each important grape variety measures of bearing and non-bearing acres, yield, quantity produced (crush volume), price, and other such variables over the past 30 years. This information has been useful for other purposes as well as for parameterizing our model of the industry, which was our primary purpose for developing the data base. We are developing a spreadsheet program to make the data accessible to others who want to study the industry.

We also made some investment in learning both (1) about how to structure and use models of spatial-dynamic processes, such as the spread of vector-borne diseases, and how such models can be adapted and applied to the present context, and (2) about the biology and economics of the pest and disease problem, and the surrounding issues, through consulting with scientists and other industry experts and reviewing literature. We learned that the PD/GWSS problem is more difficult in some ways to model than we envisioned at the outset, and that we would have to revise our modelling strategy to deal with the difficulties of modelling PD/GWSS in California. Consequently, and with advice from our scientist collaborators, we opted to focus initially on studying the issues as they arise in the north coastal valleys where PD is endemic and spread by native sharpshooters. The fact that PD is a continuing phenomenon there enabled us to develop some economic data and insight into the problem, management strategies, and the costs of prevention, control, and eradication strategies.

To guide our efforts to understand the PD issues in different areas of the State, we conducted interviews with vineyard managers in the Napa Valley utilizing a process known as “participatory mapping,” in which managers were asked to sketch out PD incidence, controls, and associated costs onto aerial images of their vineyards. Taking this approach enabled us to develop a better understanding, which has helped us in designing approaches to study the more general problem, including the role of the GWSS.

Based on this work, Kate Fuller wrote two research essays (as required by the Ph.D. program in Agricultural and Resource Economics at UC Davis). These essays entailed a review of relevant literature as well as the development of the framework for a general economic model of vector-borne disease as applicable to PD. As well as providing useful reference documents for our project, they formed the basis for Kate’s oral qualifying examination and dissertation prospectus. Kate’s dissertation plan was defined to include elements related to the main objectives of the project, including work on the BGSS in northern California as well as work on the GWSS, ultimately providing a basis for evaluating payoffs to research.

On January 14, 2010 we held a meeting in Sacramento with key people to review the status of the project and guide future directions. The participants included Bob Wynn, Tom Esser, Judy Stewart-Leslie, Joe Morse, Dan Sumner (moderator), Beth Stone-Smith, Sandy Purcell, Andy Walker, and Barry Hill, as well as Kate Fuller and Julian Alston. In the course of that very productive discussion we clarified a range of issues and ideas. We resolved to begin work in Spring 2010 gathering information pertinent to modeling PD as spread by the GWSS, beginning in Temecula, and to continue consultation with other participants in the discussion, especially Barry Hill.

On May 13-14, 2010, Julian Alston and Kate Fuller traveled with Barry Hill to Riverside and Temecula to meet with a variety of individuals and discuss the disease and its main vector in that part of the state, and to visit vineyards and develop a better understanding of the issues on the ground. We visited several vineyards and held meetings with researchers at UC Riverside (Matt Daugherty and Frank Byrne), as well as consultants and growers (Ben Drake and Billy Bauers). In the course of these visits and discussions we learned about research efforts underway, as well as concerns held by some of the industry participants. This visit was very useful in helping us develop a clearer conception of the issues and as a preliminary step towards designing and conducting some more in-depth work on the problem of PD/GWSS in Temecula. In August, 2010, Julian and Kate made a follow-up trip to Riverside to meet with experts there: Matt Daugherty, Frank Byrne, Nick Toscano, and Thomas Perring.

On October 14-15, 2010 Julian Alston and Kate Fuller traveled to Bakersfield to meet with Beth Stone-Smith, Judy Zaninovitch (formerly Stewart-Leslie) and others, to discuss PD/GWSS as they affect that part of the state, to learn about the implementation of the control program in the southern San Joaquin Valley, and develop a better understanding of the issues.

In December 2010, Kate Fuller traveled to Temecula to conduct a series of interviews similar to those conducted in Napa. She interviewed nine growers and managers to get a better idea of the current situation there and how it varies for different types of growers: organic versus conventional, small-scale operations versus larger-scale ones, vineyards that are surrounded by

grassland as well as those that are adjacent to citrus groves. These interviews were helpful for understanding the problem in ways that were useful in subsequent modeling work. Additionally, Kate was able to meet with Matt Daugherty and Nick Toscano, and Matt accompanied her on several of the interviews.

On December 28, 2010, Julian Alston, Kabir Tumber, and Kate Fuller met with Greg Morris, Tom Esser, and Stacie Oswald to discuss PD-related costs borne by the nursery industry. This meeting was part of an effort to quantify the costs of PD borne by different entities throughout the State. This meeting helped to inform us on the different protocols the nursery industry must follow and the costs of doing so. On May 11, 2011, we met with David House of Village Nurseries to follow up on this meeting with someone with direct experience. On August 3, 2011, Kabir and Julian traveled to southern California to discuss nursery compliance issues and met with Robert Crudup, president of Valley Crest Tree Company, and Richard Sanchez, head foreman of Coiner Nursery, both recommended to us by David House. We were able to acquire data and knowledge that has allowed us to draw conclusions about how much the nursery industry spends annually on compliance with the PD Control Program.

We have drafted a paper, documenting the various costs of the disease borne by various government bodies and industry groups under the existing program. This assessment of costs is of direct interest in its own right, as a measure of the importance of the pest and disease problem and the potential payoff from alternative policies or technological innovations. In addition, it helped us to define a benchmark for our model, which we have developed to assess the benefits from the PD Control Program and research projects funded by that entity.

In 2011 we completed the development of a model of the market for California winegrapes, which we can use to evaluate the impact of various policies related to PD/GWSS. More recently we have refined some details of the specification, the mathematical structure and solution procedure, and some parts of the parameterization. Since PD/GWSS also affects raisins and table grapes, along with citrus growers and the nursery industry, the analysis has to incorporate these effects as well, even though our primary focus is on impacts on the winegrape industry. To aid in this part of the project, and to accelerate progress on the work generally, we recruited two economists to the project team. Kabir Tumber, a recent M.S. graduate from the Department of Agricultural and Resource Economics at UC Davis, has been employed full-time to work on the project. Dr. Jonathan Kaplan from Sacramento State University was employed as a consultant, part-time, primarily to assist with some technical modeling aspects. In particular Dr. Kaplan helped with the construction of the dynamic systems simulation model of the market for California wine grapes that we used to model various PD/GWSS policy scenarios.

We fell about six months behind the original schedule, reflecting the combination of a delayed start (while we waited for funding to be approved), a slow beginning (as we learned that we had to revise our modeling strategy), and some further delays as we sought to identify suitable assistance in view of the revised strategy. However, having established a revised strategy in January 2010 together with a very good team appropriate to that strategy, we made excellent progress from then on. The project was due to end on June 30, 2011. We received approval for a 12-month no-cost extension to allow us to complete the work and make best use of the expertise of the team to draw useful insights and publish (and publicize) the results.

In November of 2011, we completed the development of an integrated three-region dynamic simulation model of the production and pricing of winegrapes in California. In February 2012, we extended this model to six regions, differentiated by winegrape production, prices, and PD pressure, using information from CDFA Crush Reports and consultation with experts including Andy Walker and Bruce Kirkpatrick. This model can be used to simulate 50-year forward projections of the production and prices of California winegrapes, by region, under various scenarios of pest and disease prevalence and policy, and the associated pattern of benefits and costs to growers and others. We presented initial simulation results at the annual workshop in December 2011.

In January of 2012, we solicited advice from relevant experts including farm advisors, academic and government researchers, grape growers, and pest control advisors, on current and potential PD incidence under a range of scenarios, for each of the six supply regions. Specifically, we asked what would happen in terms of PD incidence if the PD Control Program (PDCP) was ended. Using survey results, we spent the first quarter of 2012 conducting further simulations and analysis.

Kate's dissertation was filed on March 27, 2012. The dissertation includes chapters that detail an economic history of PD, the estimation of a model of the demand for California winegrapes, the details of simulation model, and the main results from our analysis, quantifying the economic impacts of PD in the market for California winegrapes. These results have been summarized in a paper that has been submitted to an academic journal for review for possible publication. Although the project is officially completed, we plan to conduct further simulations and continue to refine our parameters in order to gain insight about benefits of specific components of the program.

A final phase of the project is to evaluate the benefits from alternative research investments, reflected in the adoption of alternative technologies for managing the vectors, or the disease, or making vines resistant using conventional (marker-assisted) breeding or genetic engineering (transgenic) approaches. At the time of writing this report, that work is not complete but it is well underway. Scientists (including Andy Walker, Abhaya Dandekar, and Rick Roush, in particular) and others have been consulted for advice about the likely timing of different kinds of innovations (in terms of when they will become available and how quickly they will be adopted) and their effectiveness at mitigating losses from PD (whether spread by the GWSS or other vectors). Based on this advice we have developed parameterizations for the technological alternatives and conducted initial simulations. Work that remains to be done includes refining the analysis and distilling findings, and writing the results up into a paper for publication. This work should be completed by the end of September 2012.

#### **IV. Summary of major accomplishments and results for each objective**

As described above, we made progress generally as planned towards achieving the specified objectives, though on a delayed schedule. We developed data and other information, drafted papers on elements of the issues, built the elements for the simulation model, and used the model to perform an economic analysis of the disease and the CDFA PD Control Program. Kate Fuller met the requirements for her dissertation, which is one important output from the

project. Intermediate and final research outputs have been presented at several conferences and reports of the results have been published or are in process towards publication. Our results suggest that the PDCP yields significant benefits; over \$250 million per year compared to its \$50 million annual cost. Using the most conservative estimates (from the survey) of PD incidence if the PDCP was ended, the net benefit from the program is \$60 million per year.

## **V. Publications or reports resulting from the project**

Fuller, Kate B., and Alston, Julian M. 2012. "The Demand for California Winegrapes." *Journal of Wine Economics*. In press.

Alston, Julian M., Fuller, Kate B., Kaplan, Jonathan D., and Tumber, Kabir P. 2012. "The Economics of Pierce's Disease and Related Policies in the California Winegrape Industry." Working Paper. Robert Mondavi Institute, Center for Wine Economics, No. CWE- 1202

Tumber, Kabir P., Alston, Julian M., Fuller, Kate B., and Lapsley, James T. "The Costs of Pierce's Disease in the California Grape and Wine Industry." Working Paper. Davis, California: The University of California at Davis, 2012.

Fuller, Kate B. *The Economics of Pierce's Disease in the California Winegrape Industry*. Unpublished doctoral dissertation, Department of Agricultural and Resource Economics, University of California, Davis, March, 2012.

Fuller, Kate B. "Spatial Externalities and Vector-Borne Plant Diseases." Pierce's Disease and the Blue Green Sharpshooter in the Napa Valley." Paper prepared for presentation at the Agricultural and Applied Economics Annual Meeting, Pittsburgh, PA, July 2011. Available at <http://ageconsearch.umn.edu/handle/103865>.

Fuller, Kate B. "The Economics of Pierce's Disease Policies in California." Dissertation prospectus, as required by the Ph.D. program in Agricultural and Resource Economics at UC Davis. August, 2010.

Fuller, Kate B. "Optimal Management Strategies for Vector-Borne Agricultural Pests and Diseases: Theory and Application to Pierce's Disease of Wine Grapes in Northern California." Research essay, as required by the Ph.D. program in Agricultural and Resource Economics at UC Davis. July, 2009.

## **VI. Presentations on research**

Fuller, Kate B. "California Winegrape Demand: Results from Econometric and Synthetic Demand System Estimations." Presented at the Western Economics Association International Conference, San Francisco, California, June 29-July 3, 2012.

Fuller, Kate B. "The Demand for California Winegrapes: Results from a Regionally Specified, Flexible Form Demand System Estimation." Presented at the 2012 Western Agricultural Economics Association Annual Meeting, Park City, Utah, June 20-22, 2012.

- Fuller, Kate B. "Pierce's Disease and Related Policies in the California Winegrape Industry: Results from a Market Simulation Analysis." Presented at the 2012 Western Agricultural Economics Association Annual Meeting, Park City, Utah, June 20-22, 2012.
- Fuller, Kate B. "Alternative Measures for the Demand for Winegrapes in California." Presented at the 2012 American Association of Wine Economists Annual Meeting, Princeton University, Princeton NJ, June 7-10, 2012.
- Fuller, Kate B. "The Costs and Benefits of Pierce's Disease and Related Policy in the California Wine Industry: Results from a Market Simulation Analysis." Presented at the 2012 American Association of Wine Economics Annual Meeting, Princeton University, Princeton, NJ, June 7-10, 2012.
- Alston, Julian M. "The Benefits and Costs of Alternative Policies for the Management of Pierce's Disease." Presented at the 2011 Pierce's Disease Symposium, Sheraton Grand Sacramento Hotel, Sacramento, California, December 13-15, 2011.
- Fuller, Kate B. "Spatial Externalities and Vector-Borne Plant Diseases: Pierce's Disease and the Blue-Green Sharpshooter in the Napa Valley." Presented at the Western Economics Association International Annual Meeting, San Diego, California, June 28-July 3, 2011.
- Fuller, Kate B. "Spatial Externalities and Vector-Borne Plant Diseases: Pierce's Disease and Land Abandonment in the Napa Valley." Presented at the World Conference on Natural Resource Modelling, Ottawa, Canada, June 14-17, 2011.
- Alston, Julian M. "The Benefits and Costs of Alternative Policies for the Management of Pierce's Disease." Presented at the 2010 Pierce's Disease Symposium, Manchester Grand Hyatt Hotel, San Diego, California, December 15-17, 2010.
- Fuller, Kate B. "The Economics of Pierce's Disease Policies in California." Dissertation prospectus presentation, as required by the Ph.D. program in Agricultural and Resource Economics at UC Davis. University of California, Davis, August 2010.
- Fuller, Kate B., Sanchirico, James N., and Alston, Julian M. "The Benefits and Costs of Alternative Policies for the Management of Pierce's Disease." Poster presented at the 2010 American Agricultural Economics Association Annual Meeting, Sheraton Downtown Hotel, Denver, CO, July 25-27, 2010.
- Fuller, Kate B., Sanchirico, James N., and Alston, Julian M. "Optimal Management Strategies for Vector-Borne Agricultural Pests and Disease: Theory and Application to Pierce's Disease of Wine Grapes in Northern California." Presented at the 2010 American Association of Wine Economists Annual Meeting, University of California, Davis, June 25-27, 2010.

Alston, Julian M. “The Benefits and Costs of Alternative Policies for the Management of Pierce’s Disease.” Presented at the 2009 Pierce’s Disease Symposium, Doubletree Hotel, Sacramento, December 9-11, 2009.

Fuller, Kate B., Sanchirico, James N., and Alston, Julian M. “The Benefits and Costs of Alternative Policies for the Management of Pierce’s Disease: A Case Study of Pierce’s Disease and the Blue-Green Sharpshooter in the Napa Valley.” Poster presented at the 2009 Pierce’s Disease Symposium, Doubletree Hotel, Sacramento, December 9-11, 2009.

## **VII. Research relevance statement**

This project contributes to solving the PD/GWSS problem in California by providing detailed, practical, quantitative information about the economic consequences of Pierce’s Disease and alternative management strategies. More specifically the project provides quantitative information about (1) the current and potential economic impact of the disease, (2) the potential economic payoff to investments in PD R&D, and (3) the benefits and costs of alternative management strategies (including alternative research investments), which can be used to guide policy decisions, including research priorities.

## **VIII. Lay summary of project results**

We developed a detailed simulation model of the market for California winegrapes, using advice from PD experts such as farm advisors, grape growers, and researchers across the State, combined with economic theory and results from statistical analysis of historical data. We used this model to conduct policy simulations and analyses. Results from using the simulation model suggest that the CDFA Pierce’s Disease Control Program (PDCP) yields significant benefits. Taking into account the program’s \$50 million annual cost, we estimate that the program yields net benefits of more than \$200 million per year. Even using the most conservative (i.e., smallest) estimates of potential PD losses that would be borne if the PDCP were ended, we estimate a \$60 million annual net benefit to the program. Further analysis with the model will evaluate the benefits from alternative research-induced improvements in the methods for mitigating losses from PD, either by managing its vectors or managing the disease itself.

## **IX. Status of funds**

Funds for this project have all been spent.

## **X. Summary and status of intellectual property produced during this research project**

None to date.