CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

A. G. Kawamura, Secretary

2007 Specialty Crop Block Grant Program (SCBGP)
Final Performance Report

Specialty Crop Agreement No. 12-25-G-0571

State of California
Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Specialty Crop Block Grant Program Contacts:

Kathy Alameda, Manager
Federal Funds Management Office
Email: kalameda@cdfa.ca.gov
Phone: (916) 651-9888
Fax: (916) 653-0206

Crystal G. Myers, SCBGP Manager
Federal Funds Management Office
Email: cgmyers@cdfa.ca.gov
Phone: (916) 651-1174
Fax: (916) 653-0206

The United States Department of Agriculture (USDA) awarded $1,304,956 of 2007 Specialty Crop Block Grant Program (SCBGP) funds to the California Department of Food and Agriculture (CDFA) for projects outlined below to enhance the competitiveness of California specialty crops. All projects have been completed. This report reflects the final results of those projects.

1. Buy California Marketing Agreement (BCMA) - Retail Education Project

Grant Funds Expended- BCMA was awarded $100,000. All funds have been expended. Over the life of the project, $70,000 of in-kind matching funds contributed toward the project results.

Project Summary- The "California Grown" program under the auspices of the Buy California Marketing Agreement (BCMA) plans to approach the retail grocery partners statewide, through their respective corporate offices, and present them with a set of user-friendly templates, via a web connection, with the intent to share the "California Grown" logo, and other generic marketing related materials, in selected retail outlets, in combination with in-house materials. BCMA is embarking on this project with the knowledge that there is a trend in the retail industry to not accept outside "point of sale" signage. It is believed that they can create a source for retailers that would integrate well into their existing formats.

The program would be an on-going, monthly web-based communication that would target the key buyers in the areas of produce, meat/foul, and wine and would be a resource for the pre-identified in-store retailer managers, reminding them that promoting California grown products is important to increased sales and consumer education. We are proposing the creation of multi-commodity, on-going monitoring and systems review of the project, which will take place in a planned, pre-determined statewide retailed-based environment.

BCMA would be offering the retail outlets the opportunity to once again integrate their materials with those of the established and successful campaign materials and signage used in the previous and on-going "California Grown" effort.

Approach- The final performance of this project includes: Implementation of the download center, lift kit and flash demonstration.

- The online download center is featured on the homepage of the California grown campaign website in a section titled "attention retailers." Retailers are encouraged to sign up for the download center to have access to the logo and other marketing materials to assist them in crafting in-store presence.
- Promotion of the "lift kit" is used to help retailers boost sales by using the CA GROWN logo on their in-store materials.
- The flash demonstration explains what is available in the download center and then features a shopper in a grocery store.

The download center and flash demonstration provide a consolidated location of resources that is easy for retailers to access. These have helped BCMA gain access to retail locations that would not accept preprinted point of sale materials.

Goals- The ultimate goal of this project was to reach out to retailers in the state and provide resources to enhance the competitiveness of California grown specialty crops with the use of the CA GROWN logo. Project goal was to have at least fifty (50) members (retail executives) register to access to the download center area of the website. That goal was reached in March 2009. The following were used to convey the campaign messages: custom promotions as well; in-store posters, recipe cards, grocery bags, sales flyers in food sections of newspapers.

Results/Conclusions- As a result of this project, 168 total users 58 of which are retailers, have registered and are using the download center today. The project has provided the "California Grown" campaign and the California agriculture industry a very valuable tool for promoting California grown specialty crops. Although the grant ended, BCMA will continue to promote and monitoring the site and download center.

Other uses of the new site/download center outside its original purpose have been discovered since the launch date. For instance, companies who license the CA GROWN logo for product packing and marketing materials now can access the online download center to obtain the logo. Previously licenses were sent to users on a disk containing the logos. In addition, the download center provides easy access for other stakeholder such as media, board members, agencies and other industry cooperators.

Additional Assessments- Please visit www.californiagrown.org to view the download center.

Project Contact:
Maile Shanahan-Geis, Executive Director
Buy California Marketing Agreement
1521 "I" Street
Sacramento, CA 95814
Email: Maile@californiagrown.org
Phone: (916) 446-1063

2. Central Coast Vineyard Team (CCVT)- Increasing Conservation Farming Practices

Grant Funds Expended- The CCVT was awarded $85,710. All funds have been expended. Grant funds did not cover the total project cost. Additional cost provided by CCVT and program participants.

Project Summary- This project addresses a critical need addressing both environmental and economic concerns. The project adheres to the concerns of USDA and CDFA, but is significantly unique as it brings many of those concerns together to directly benefit producers in both an environmental and economic capacity, and by providing consumers a tangible, meaningful and credible way to support sustainable farming with their shopping dollar. Often, projects involve researching particular practices which take into account agency's environmental and resource goals, but overlook the economic viability of the producer from a bottom line perspective. Some projects address the economic costs of a few sustainable vineyard practices, but fail to relate those costs to how a grower sells his/her grapes and what market rewards exist as a result of implementing sustainable vineyard practices. This project addresses the final elements necessary to create a self- sustaining certification and marketing program for sustainability produced wine grapes.

Approach- Over the course of this project, CCVT staff and cooperators developed a certification program that furthers the adoption of conversation practices through the market based incentives. The certification program was developed though a series of tasks. Tasks include conducting a pilot certification program to third party certify the sustainable wine growing practices of ten Central Coast vineyards, developing a report of findings and recommendations based on lessons learned during the pilot program, outreaching the results of the pilot program, developing a financial plan to create a sustainable program for long run, developing marketing materials to further outreach the program and certified vineyards, and to summarize the acreage and overall certification program.

The certification program provided a means for winegrape producers to have a third party auditor verify their practices in areas of environmental, social and economic vineyard management. The independent audit process provides a transparent process through which vineyards and wineries can authentically communicate with the trade and general consumers regarding their conservation practices. The following seven (7) tasks contributed to accomplishing the project goals.

- Task 1- Conduct a pilot certification program to certify ten (10) Central Cost vineyards as "Sustainably Grown."
- Task 2- Develop a report of findings and recommendations regarding certification program.
- Task 3- Outreach the results of the pilot program.
- Task 4- Develop a business plan for a creating, certifying and marketing entity to allow for continuance of program without grant assistance.
- Task 5- Develop marketing materials for "Sustainability Grown" wine grapes and wines.
- Task 6- Develop an acreage and participating evaluation report and project evaluation.
- Task 7- Develop and submit the Final Project Report.

Goals- The seven (7) tasks described above were achieved:

- Task 1 exceeded the expectations with fourteen Central Coast vineyards representing over 3,700 acres achieving third party certification in 2008. Task 1 was achieved as of May 15, 2009.
- Task 2 was achieved following the completion of task 1 (May 2009).
- Task 3 was achieved throughout the course of the Pilot Program and beyond. Outreach was conducted to the wine grape industry, general Ag, and consumers.

- Task 4 was completed with the assistance of Steve Hamilton, Professor of Economics, Cal Poly State University, San Luis Obispo. Project staff incorporated his professional expertise into the development of a fee structure that provides a long-term, self-sustaining program.
- Task 5 was achieved following the completion of pilot program.
- Task 6 was achieved within the completion of task 2. The pilot program exceeded expectations with fourteen (14) vineyards completing the program versus the ten (10) originally anticipated.

Results/Conclusions- CCVT anticipated that as a result of this project, fifty (50) buyers, distributors and wineries would source and market wines made with certification sustainably grown fruit. CCVT has achieved significant exposure to wineries, wine buyers, and distributors through press releases and articles in industry publications such as Wine and Vines and Wine Business Monthly. Currently twenty-four (24) wines are eligible to use the certification seal on the bottles. CCVT anticipates between 40 and 50 wines to be eligible to use the certification seal by the end of 2009.

Additionally, the pilot program resulted in over 3,700 acres achieving sustainable certification through implementation and documentation of practices as stated in the certification standards. The second year vineyard applicants total over 9,000 acres applying for sustainable certification. If all second year vineyard applicants achieve certification it will result in a 240% increase in use of the certification standards in January. Following the pilot certification program, task included the development of a report of findings, development of program procedure forms, licensing agreements and filing systems; development of program fees and scheduled of fee payments; development of marketing and outreach materials including a new website and accompanying blog; giving presentations and facilitating workshops training SIP certified hospitality, sales and marketing staff. Once vineyards received its certifications, staff began collecting applications for wineries to use the SIP Certified seal on wine bottled containing 85% or greater SIP Certified fruit.

The unusual developments that occurred during this project were the self assessment workshops conducted by CCVT for vineyards using the certification standards. Sixty-five (65) winegrape producers attended the workshops. CCVT found that regular self-assessments increase the adoption of conversation practices.

Additionally, during the course of the project, CCVT staff realized that the level of details and logistics required to complete the pilot certification program was greater than originally projected. Program staff learned multiple lessons during the course of the project, including:

- Certification program administration requires high level of detail and logistical planning
- Creating a measurable and verifiable set of standards results in a high level of documentation required by producers pursing certification
- Producers involved in the project pride themselves on their production practices and strive to improve over time.
- Program procedures must be written thoroughly and include a high level of detail and guidance.
- Certification fees must balance the program cost with the perceive value of certified vineyards and wineries.
- Outreach and education should focus on trade, press and industry professionals in the beginning. Consumers are also important, but will gain much from their knowledge through the acceptance of the program by trade and industry.
- Sustainability is one layer of quality product and the quality product should be the main focus of the market initiative.
- Sustainable certification is meaningful in the marketplace and will increase adoption of conservation practices.

Additional Assessments- The following table includes a complete list of publication. Copies of project materials, website and presentation samples can be provided upon request. Additional information can be found on CCVT website at: http://vineyardteam.org/

Project Events

Date	Event	Location	Attendance
11/7/07	Ag and the Environment	Asilomar	30
11/13/07	Wine & viticulture Class	Cal Poly, San Luis Obispo	30
4/30/08	Central Coast Wine Growers Association	Arroyo Grande	25
6/11/08	CERA Meeting	Templeton	12
8/21/08	Sonoma Vit Tech	Santa Rosa	25
9/22/08	Wine Financials Symposium	Napa	30
11/5/08	Livermore Valley Winegrape Association	Livermore	40
11/14/08	Sustainable Ag Expo	Monterey	360
11/20/08	American Vineyard Grape Expo	Paso Robles	100
12/2/08	Green Wine Summit	Santa Rosa	300
1/13, 14,20/09	Self-Assessment Workshops	Paso Robles, Los Olivos, Monterey	65
1/28/09	Wine & Viticulture Class	Cal Poly , SLO	30

Date	Event	Location	Attendance
2/14/09	PRWCA Pourings with Halter Ranch	Santa Monica and UCLA	700
3/3/09	EPA Presentation	Washington, DC	75
3/10/09	Livermore Grape Expo	Livermore	50
3/17/09	Celebrate Agriculture	Monterey	100
3/27/09	J& L Wine Distributors	Paso Robles	15
4/24/09	Trends in Environmental Law	Santa Barbara	60
5/11/09	Wineries of Santa Clara	Gilroy	25
5/12/09	Sustainability in the Tasting Room	Monterey	10

Project Publications

Date	Publication	Article Title	Circulation (est.)
7/29/08	Wines & Vines Online	Vineyard Sustainability Now Certified	30,000
8/1/08	American Vineyard	Pilot Program for Sustainable Vineyards	11,000
8/8/08	Capitol Press	Vineyards Court Certification	12,000
8/19/08	Public News Service – CA	Green Wine Anyone?	15,000
8/24/08	The Tribune	Vineyard Sustainability Now Certifiable	42,000
9/1/08	Wines & Vines	Sustainability Audits on the Central Coast	5,185
10/1/08	California Agriculture	Agro-Environmental Partnerships	16,000
10/23/08	New Times	Good Stewards of the Land	62,000
11/1/08	New Times	Enjoying Fine Wine Italian Style	62,000
11/1/08	Wine Business Monthly	Communicating Sustainability	7,056
11/6/08	California News	Sustainability: Buzzword or Business Booster?	10,000
12/1/08	Comstock's	Enviromarketing: Viticulture Searches for a Sustainable Bottom Line	20,000
1/1/09	Central Coast Magazine	SIP Program: Setting Standards for Sustainability	25,000
1/16/09	Paso Robles Press	Local Vintners Embrace Sustainable Concepts	3,000
1/29/09	New Times	Saucelito Canyon Ad	62,000
2/1/09	Wine Business Monthly	Good Stewards of the Land	7,056
4/1/09	The Mercury News	How Green are the Wineries?	263,000
4/5/09	The Tribune	How Three Local Wineries Go Green	42,000
5/1/09	The Tribune	What's New in 2009	42,000
5/2/09	San Luis Obispo Beautiful: Art & the Octagon Program	SIP the Good Life	1,000

Project Contact:
Kris O'Connor, Executive Director
835 12th Street, Suite 204
Paso Robles, CA 93446
Email: kris@vineyardteam.org
Phone: (805) 369-2288

3. *California School Nutrition Association (CSNA)- The Garden Bar Project*

Grant Funds Expended- The CSNA was awarded $100,000. $96,315.41 was expended. The remaining grant balance is $3,684.59. CDFA requested USDA approval to amend State Plan (amendment 1) to reallocate the remaining balance to Project 13, Center for International Trade Development, Fresno.

Project Summary- Schools without proper refrigerated equipment (salad bars) are limited in the options available to them for fruit and vegetable purchases, unless they are the more costly prepackaged fruit and vegetable items. Participants in the program were elementary schools that had no previous salad bar equipment and therefore, limited student access to specialty crops as part of their daily school meal program.

Approach- The garden bar project was able to fund promotional materials (on-campus and take-home), point of sale materials, the salad bar equipment and serving accessories necessary to implement a successful Garden Bar. The specialty crop grant was divided into "mini grants," allowing districts to submit a proposal that required a marketing plan describing how they would utilize the Garden Bar for maximum potential. A committee of members of the Board of Directors of the California School Nutrition Association reviewed proposals and awarded 33 elementary schools throughout the state.

Awarded districts and CSNA leadership held an initial meeting in Palm Springs at the CSNA annual conference to discuss their plans. Two districts that had successful salad bar and farm-to-school programs participated to lend their expertise.

In the implementation of the Garden Bard, all except two awarded districts surpassed the goals of the project. Late ordering of equipment by those two districts prevented CSNA from submitting data in this report. In addition, each district approached their program's implementation differently, however, common factors for the success of the program included adequate funding for food purchases, administrative and parent support, teacher support, nutrition staff and custodial support, adequate funding for kitchen staffing to prepare and serve the food as well as adequate time allowing children to go through the Garden Bar line and self- serve. The success of this project was a collaborative effort.

At the end of the Garden Bar project, School Nutrition Directors were surveyed to obtain the most productive efforts. Responses to the survey can be provided upon request.

Goals- The primary goal of this project was to increase the varieties of specialty crops served in awarded schools by 50%. Across all districts, 26 varieties of specialty crops were served prior to the Garden Bars and 59 varieties served with the added Garden Bars. Garden Bars also featured all types of fruit and vegetables, with the mix of fresh, dried, canned and frozen specialty crops + nuts.

A second goal was the hopes that valuable marketing information will be gained from grant recipients and shared with other school nutrition professionals for their own Garden Bar programs. Additionally, the CSNA goal was to improve the opinions of the school meal program among parents, students and school personnel through the implementation and promotion of a Garden Bar. The reaction from school personnel, parents and students were very positive. Prior to implementing the Garden Bars, CSNA had student assemblies where children learned about the importance of clean hand as our district was implementing "sanitation stations."

Results/Conclusions- The following are the results and conclusions of the Garden Bar: The purchases of specialty crops increased where a Garden Bar was available. The project resulted in an average increase of $1.55 per student, per month on specialty crops. The increase of children's consumption of fruits and vegetables can be accomplished by purchase of a Garden Bar. Varieties were increased by more than 100%

during this project. In addition, a dramatic increase in fruit and vegetables *varieties* can be achieved through the utilization of a Garden Bar and the ability for children to serve themselves.

Fun, colorful posters were also prominently displayed to attract children to the Garden Bar. The posters proved to be successful. Support from staff, custodians, principals and parents were critical to the execution and success of the Garden Bar program.

Internal barriers to success must be overcome to implement a Garden Bar. Objections to Garden Bar implementations came from teachers, custodial staff and some administrators. The main objections appeared to be: a) lack of adequate lunch time for children to go through a salad bar line b) concerns that children would not be sanitary at an open salad bar, and c) the Garden Bar would result in a mess that would be very difficult to clean.

The primary external barrier to success was funding. In State Fiscal Year 2008/09, cutbacks prohibited the timely implementation of some Garden Bars due to cost of food and cost of staffing. At least one district is at risk for discontinuation of their Garden Bars due to the cost of produce. Advocated for increased fruits and vegetables in school meals must also advocate for adequate funding for food and staffing. As a result, school districts that have placed a high priority on school nutrition programs tend to allocate funds for food purchases (such as Scotts Valley and Oakland USD fruit and vegetable expenditures are highest, due to a high district priority).

Additional Assessments- Many challenges were observed. The biggest challenge was to have staff certified to prep and handle food for a salad bar. CSNA used this opportunity to revise job requirements for the staff at each elementary school; it is now required for Child Nutrition Assistant II to have a food safety certification.

Providing Garden Bar equipment to schools is ineffective if funding is not available for adequate staff and food purchases. After spring 2009, some districts reported difficulty maintaining their Garden Bar program due to budget cuts resulting in decreased funding and staffing.

Additional delays were encountered for the following reasons: Personnel charges at school districts; longer timeframes than anticipated to train staff, students, and volunteers; longer timeframes than anticipated to order/receive equipment; loss of budgets resulting in staff cutbacks and lack of timely responses from some districts that are overburdened. Additional information such as parent surveys and/or photos can be made available upon request.

Project Contact:
Judy Hirigoyen, Executive Director
California Dried Fruit Coalition on behalf of:
California School Nutrition Association
210 N. Glenoaks Blvd, Suite C.
Burbank, CA 91502
Email: judyhirigoyen@yahoo.com
Phone: (916) 508-5146

4. CA Sustainable Winegrowing Alliance (CSWA)- CA Vineyards Climate Protection Initiative

Grant Funds Expended- The CSWA was awarded $100,000. All funds have been expended and enabled CSWA to successfully accomplish the objectives of the project. Although CSWA is reporting a total match of $107,580.83, more than the $100,000 indicated in its original proposal, this figure is very conservative due to matching requirements of other grants, and does not fully reflect the voluntary hours that were contributed by members of the Advisory Committee, in-kind contributions by Wine Institute and the California Association of Winegrape Growers, and staff and other contributions from UC Davis.

Project Summary – The enactment of the California Global Warming Solutions Act of 2006 (AB32), mandates that mitigation measures be adopted for compliance with a reduction in greenhouse gas (GHG) emissions to 1990 levels by 2020. Existing knowledge concerning vineyard emissions and mitigation is dispersed among numerous scientific journals, policy organizations and regulatory agencies and is challenging to access. The purpose of this project was to aggregate and adapt information on climate change mitigation measures to a user-accessible format in order to accelerate mitigation efforts in the shortest possible timeframe.

Approach- California Sustainable Winegrowing Alliance (CSWA), in collaboration with industry and academic partners, examined existing climate change knowledge and research pertaining to vineyard greenhouse gas (GHG) emissions and offsets in order to gain a fuller understanding of the sector's GHG footprint. Grant funding was used to produce and disseminate a comprehensive report and user-friendly handout that consolidates information on topics such as carbon sequestration by vines, and energy use, nitrogen management, and other vineyard farming practices. Information was shared with partner organizations and their respective wine, raisin and table grape memberships, and incorporated findings into a GHG footprint project that takes into account both winery and vineyard emissions and offsets. The report was also integrated into CSWA's outreach and education efforts through the Sustainable Winegrowing Program (SWP).

Goals- The project addresses three primary goals, all of which were advanced to varying degrees during the grant reporting period, as described below.

1. To develop a fuller understanding of California vineyards' GHG footprint and identify research gaps. The California vineyard GHG report and related educational handout provided the baseline for a fuller understanding of CA vineyards' GHG footprint and identified a number of research gaps. In addition, CSWA worked with Dr. William Salas of Applied Geosolutions to modify a greenhouse gas modeling tool – the DeNitrification-DeComposition (DNDC) – for CA winegrape systems. The model provides a better sense of the GHG flux in vineyards, and will eventually allow growers to better understand which practices can bolster carbon sequestration and reduce emissions.

2. *To disseminate the report and relevant information to grape growers and other specialty crop producers in order to reduce GHG emissions and increase the adoption of practices that provide climate protection.* CSWA disseminated information to partner organizations' memberships, incorporated vineyard information into the Wine Industry's GHG Accounting Tool, and extended the report and information gleaned from the project through the SWP and to other industry associations. CSWA converted the wine industry tool to a web-based platform, and will eventually incorporate the DNDC modeling work mentioned above once it is field trialed and fine tuned.

3. *To enhance the competitiveness of California wine, raisin and table grapes by enabling producers to meet potential long-term GHG compliance requirements.* Although this goal has a longer timeframe than the grant reporting period, we identified research needs, communicated and coordinated findings and outreach with other perennial crop sectors, and identified and secured funding for these research priorities. Although initially the information generated by use of the web-based GHG tool mentioned above is for educational purposes, once the associated DNDC model is developed and validated in the field, we hope this use of the

technology may be used for calculating potential offsets in a future carbon market, further enhancing the competitiveness of California grape growers. To this end, we are working with Applied Geosolutions, academic partners, National Grape & Wine Initiative, USDA ARS, and Environmental Defense, among others.

Results and Conclusion- *Production of a California vineyards' GHG footprint report* (Grower handout completed in May 2009; Report completed in September 2010). The advisory group representing partner organizations including table, raisin and winegrape organizations and representatives from UC Davis and Fresno State – met twice in person and several times via conference calls to define the scope of the report to enhance understanding of vineyards' GHG footprint and identify research gaps. The group also heard from key researchers on their respective projects at a July 2008 meeting.

Under the guidance of Dr. David Smart of UC Davis, Eli Carlisle, a post-doctoral scientist from UC Davis, and Matthew Summer, a private consultant with a firm that has worked on climate change issues for the agricultural sector in the policy arena, were hired to undertake a literature review. The literature review was conducted, and several drafts of the report were circulated for advisory group members' review and comment, as well as scientific peer review.

CSWA produced and printed 2,000 hard copies of a grower-friendly hand-out based on the report findings, "Vineyard Management Practices and Carbon Footprints," and sent it to partner organizations, posted it online, and distributed at a number of industry events (see below).

Following peer review, CSWA finalized and distributed the comprehensive report to partners and made it available in pdf format for unlimited distribution via the website and email distribution. Due to the research gaps and complex variables comprising a vineyard GHG footprint, CSWA worked with Dr. William Salas of Applied Geosolutions to adapt a greenhouse gas modeling tool for agricultural systems (DNDC) to winegrapes to better understand GHG fluxes in the vineyard (completed in September 2010).

Dissemination of the vineyard GHG report *(Began in fall 2008; on-going).*
The grower-friendly handout and additional resources were posted in Climate Protection Resources section on www.sustainablewinegrowing.org with a link from the homepage. On-line posting of climate protection resources was mentioned with a link in Wine Institute News Briefs member email/newsletter (1000+ members)

Information from project used to produce CAWG's "Emerging Cap-and-Trade Programs." Results of the project and/or key findings were presented at many industry events**,** reaching an estimated 1,089 attendees:
Napa Viticulture Fair, Napa (est. 150 attendees, Nov. 2008); CAWG Board of Directors Meeting, Buellton (est. 30 attendees, Nov. 2008); Central Coast Sustainable Ag Expo, Monterey (est. 150 attendees, Nov. 2008); Sustainable Grape Growing Workshop, Fresno (est. 41 attendees, Dec. 2008); Unified Wine & Grape; Symposium, Sacramento (400+ attendees, Jan. 2009); Grower Tailgate Meetings in Madera, Pixley and Ceres (101 attendees, March 2009); Climate Protection & Energy Efficiency Workshop, Sonoma (est. 50 attendees, July 2009); Climate Protection & Energy Efficiency Workshop, Paso Robles (est. 30 attendees, July 2010); Climate Protection & Energy Efficiency Workshop, Mendocino (est. 12 attendees, August 2010); Climate Protection & Energy Efficiency Workshop, Napa (est. 60 attendees, July 2010); Co-sponsored The Integrated Vineyard: What's in Your Toolbox?, which included a segment on soil building and carbon capture (est. 65 attendees, Nov. 2010); Staff and members of the advisory group have attended or participated in a number of climate change-related meetings and events since the start of the program including the following:
Participated in more than a dozen California Environmental Dialogue plenary sessions focused on climate change; Presented at the 17th Annual CA Water Policy Conference - "Climate Change: From Sizzle to Substance" - in Los Angeles (Nov. 2007); Attended "Climate Change and the Food Processing & Winery Industries: How to Comply with the AB 32 Regulations and Cope with the Coming Low-Carbon Business Environment" in Stockton (Jan. 2008, cosponsored by California League of Food Processors, Agricultural Council of California, Wine Institute, Manufacturers Council of the Central Valley, and Camp Dresser McKee

Inc.); Attended the II International Climate Change & Wine Conference in Barcelona (Feb. 2008); Attended AB32 Agricultural Working Group meeting in Sacramento (Feb. 2008); Presented at an informational hearing of the Assembly Ag Committee on sustainable agriculture and climate change-related topics (April 2008; Presented at the California Farm Bureau Federation's Air and Environmental Issues Committee in Sacramento (May 2008); Presented at Climate Change and Wine: Seminar for Wine Professionals at Gloria Ferrer Caves & Vineyards in Sonoma (July 31 2008); Presented at Green Acres, Blue Skies conference at UC Davis (June 2008); Co-sponsored and presented at the Green Acres, Blue Skies Conference at UC Davis (June 2009); Hosted a climate protection workshop, the first in a series of workshops co-sponsored by Pacific Gas & Electric Company (July 2009); Presented at the Eco winegrowing Symposium in Mendocino (August 2009); Presented at the CA Climate and Agriculture (CalCAN) Climate and Agriculture Summit at UC Davis (October 2009); Presented at a Farm Day co-sponsored by CalCAN, Certified CA Organic Farmers and the Community Alliance of Family Farms in Winters (April 2010); Met with an expanded group of UC Davis scientists and project partners to discuss the California Nitrogen Assessment and other GHG-related topics (March 2010).

Incorporation into industry-wide GHG footprint model*. (Completed initial phase in 9/2010; ongoing*
Wine Institute worked with international partners from Australia, New Zealand and South Africa to develop the International Wine Industry Greenhouse Gas Accounting Tool as a credible, free, easy-to-use protocol and calculator based on the World Resources Institute Protocol. This tool includes placeholders for emission factors which need to be refined based on the findings of the GHG vineyard report and further research. To date, three versions of the calculator have been released. Funding from this grant program was not used to fund the development of the tool, but is included in the matching funds. UC Davis scientists involved in the project reviewed the GHG Accounting Tool and provided extensive feedback on the GHG Accounting Tool based on findings in the literature review and draft report, and worked with Provisor, the contractor that developed the tool, CSWA staff and consultants, members of the advisory group, and outside experts to determine the best means for improving the vineyard aspects of the tool.

CSWA worked with Dr. William Salas of Applied Geosolutions to calibrate the DNDC for winegrapes, using data from UC scientists' work at several research stations throughout the state to give us a better sense of the GHG flux in vineyards.

Adaptation of the International Wine Industry Greenhouse Gas Accounting Tool to a web-based version was completed, beginning with emission factors with the highest level of confidence, but can later be adapted for vineyard emission factors which need to be refined based on the DNDC model and further research.
CSWA is now working on identifying five performance metrics to use to baseline and set improvement targets for the California wine industry, including GHG production, which will also be informed by this project.

Extension through CSWA and the SWP. (Completed 9/ 2010; On-going)
CSWA has reviewed the SWP criteria to determine which are related to climate change based on the report findings. By "tagging" all existing criteria related to climate change and creating new criteria where appropriate, participants will be able to measure how their operations are performing on these criteria compared to other vineyards in their region and statewide. The built-in metrics also enables CSWA to benchmark, target areas in need of improvement through educational workshops and materials, and to gauge progress over time.
The *California Wine Community 2009 Sustainability Report*, which measured improvement in 227 criteria from the Code of Sustainable Practices – including chapters relevant to climate change emissions and mitigation such as Energy Efficiency, Water Management, Soil Management, Integrated Pest Management, and Air Quality, was released in January 2010 and is publicly available online at www.sustainablewinegrowing.org

Web resources have been added to enable SWP participants to learn more about practices that reduce emissions and improve sequestration potential. Educational workshops on energy efficiency and water

management, as well as a new series on climate change, have been held in wine regions throughout the state, highlighting the link to winery and vineyard practices and GHG emissions, and ways to improve practices to reduce emissions and improve sequestration potential.

***Articles in trade journals*.** (Completed January 2010) In-depth articles about the GHG and vineyard report were published in *Practical Winery and Vineyard* in fall 2009 and in *American Vineyard Magazine* in January 2010. Inclusion in a scientific, peer-reviewed journal is still being pursued.
Related articles appeared in *Wines and Vines, the North Bay Business Journal, the Press Democrat, and Meininger's Wine Business International*.

***Serve as an example for other grape and perennial specialty crops*.** (Completed September 2010)
In addition to the eight (8) organizations associated with the Advisory Group members and organizations attending the presentations mentioned above, the Report has been shared with:

- National Grape & Wine Initiative (approximately 20 organizational members)
- Almond Board
- California Farm Bureau (multiple organizational members)
- Napa Valley Grape Growers
- Napa Valley Farm Bureau
- Sonoma County Winegrape Commission
- Lodi Winegrape Commission
- University of Giesenhiem in Germany
- INCAVI (Sustainable wine institute in Spain)

Through the Specialty Crop Research Initiative, Specialty Crop Block Grants and other funding programs, CSWA and other wine and grape industry organizations have become increasingly aware of the research needs and have jointly submitted proposals or provided letters of support for climate change-related proposals.

Additional Assessment - The final report and list of correlated SWP practices are attached. Please note, all other documentation including final Word version of the report, grower handout, media coverage, and other documents are available.

Project Contact:
Allison Jordan, Executive Director
CA Sustainable Winegrowing Alliance
425 Market Street, Suite 1000
San Francisco, CA 94105
Email: ajordan@wineinstitute.org
Phone: (415) 356-7535

5. USDA, Ag Research Services (ARS) previously indicated as CDFA - Exotic Fruit Flies

Grant Funds Expended- USDA, ARS was awarded $200,000. All funds have been expended.

Project Summary – Economically important fruit flies in the family Tephritidae are among the most serious agricultural pests throughout the world. Over 90% of the *Baclrocera* species respond to either methyl eugenol (ME) or cue-lure (C-L). Of the 73 Bactroccm and Dacus species that arc agricultural pests, 41 respond to C-L raspberry ketone, 22 to ME, and 10 to neither. Conventional fruit fly detection and control methods (i.e. male annihilation) rely heavily on liquid organophosphate insecticides. Overuse of these insecticides has been implicated with secondary pest out breaks, negative effects on beneficial insects, environmental contamination and adverse effects on human health. Most importantly, continued registration of many organophosphate insecticides for certain uses in the U.S. is in doubt. Detection traps used against accidental introductions of *Baclrocera* throughout the world rely heavily on ME/C·L and naled or Malathion. The eradication method of choice in California (CA) for many ME-responding *Bactrocera* species (i.e. oriental fruit fly, guava fruit fly, and peach fruit fly) is spot application of a mixture of Min-U-Gel, ME, and naled. Min-U-Gel and other thickened formulations when weathered in habitats with warm temperatures or high rainfall are not long-lived, often lasting less than 1-2 weeks. This type of male annihilation treatment method relies heavily on liquid Malathion or naled. Data from recent field trials in Hawaii with the insecticide spinosad in SPLAT (Specialized Pheromone and Lure Application Technology) formulations, suggest a promising substitute for Min-U-Gel-naled male annihilation formulations. In addition, SPLAT may be a longer lasting carrier. We tested these formulations with respect to efficacy and weathering in both Hawaii and California. These results will apply to most fruit flies responding to either C-L or ME.

Spinosad male annihilation treatments will reduce the need for organophosphate insecticides for fruit fly control in the U.S. Spinosad demonstrates lower mammalian and environmental toxicity with reduced risk to humans and wildlife than traditional insecticides. Spinosad treatments with GF-120 are presently allowed in organically certified orchards. Our studies will provide further efficacy data for novel sprayable products for fruit fly control. Once confirmatory data are obtained for fruit flies, SPLAT may provide convenient, longer lasting, and safer products for control of economically important exotic fruit flies that respond to either ME or C-L in CA and Florida (FL), where accidental introductions occur annually.

Approach – Goal 1) Determine the length of time Spinosad effectively kills fruit flies when deployed in male annihilation treatments in Hawaii and CA; whether the addition of UV light inhibitors will extend the effective period of the Spinosad. The overall fourfold research objectives of the spinosad male annihilation research were: 1) Bioassays of SPLAT-MAT Spinosad ME/C-L vs Min-U-Gel-ME naled weathered in Hawaii;
2) Bioassays of SPLAT -MAT Spinosad ME vs Min-U-Gel-ME naled weathered in CA;
3) Bioassays of SPLAT-MAT Spinosad C-L vs Min-U-Gel-C-L naled weathered in CA; and
4) Chemical degradation studies of SPLAT-MAT Spinosad ME/C-L and Min-U-Gel-ME/C-L naled.

Results of the SPLAT-MATTM Spinosad ME field trials in Hawaii **(objective 1)** were summarized and are described in detail in Vargas et al. (2008). Results of the CA weathering trials of SPLAT-MAT Spinosad ME vs Min-U-Gel naled **(objective 2)** were summarized and are described in detail in Vargas et al. (2009 b). Results of the CA weathering trials of SPLAT -MAT Spinosad C-L and SPLAT -Melo-Lure (M-L)(raspberry ketone formate) vs Min-U-Gel naled C-L in Hawaii and CA **(objective 3)** were summarized and are currently in press (Vargas et al. 20IOa). Briefly, spinosad products, when mixed with SPLAT and ME/C-L offer a reduced risk alternative for control ofME/C-L responding flies. Degradation studies **(objective 4)** of the two lures (ME and C-L) and insecticides are presently being summarized into regression models for development of use patterns. Pesticide degradation data (SPLAT spinosad vs Min-U-Gel naled) were incomplete and tests are currently being repeated in Riverside, CA in July 20 I 0 for further analysis by Dow AgroSciences using IR4 funds. These data are important to making a more informed decision on replacing naled with spinosad. Finally, based

on the above body of research, an invited review article on new ME/C-L technologies is being published in the journal "Vitamins and Hormones" in a special pheromones volume and is currently in press (Vargas et al 2010b).

Goal 2: Determine whether the trap catch of methyl eugenol and cuelure baited traps using Spinosad can be made equivalent to those using dibrom using either the current wick dispenser or a solid matrix dispenser. Initial trials with spinosad baited ME/C-L traps for male annihilation were conducted and published previously by Vargas et al. (2003). For purposes of the present objective and a request from Florida for tests of a safer detection trap ME and C-L traps to detect tephritid flies on the U.S. mainland were tested with and without spinosad under Hawaiian weather conditions against small populations of oriental fruit fly and melon fly respectively. In comparative tests, standard Jackson traps with naled outperformed traps without an insecticide. Addition of the reduced risk insecticide, spinosad, did not increase trap capture significantly compared to Jackson traps without an insecticide. Captures with the Hawaii fruit fly Area-Wide Pest Management (AWPM) trap with DDVP (2, 2-Diehorovinyl dimethyl phosphate) insecticidal strips, compared favorably with those for the Jackson trap with liquid naled (the FL standard). In subsequent tests, captures with solid Fanna Tech wafer dispensers with ME or C-L and DDVP placed inside Jackson and A WPM traps were equal to those for a Jackson trap with a liquid insecticide and lure mixture (Jackson trap with naled) currently used for detection of ME and C-L responding fruit flies in Florida. From a worker safety and convenience standpoint, Farma Tech ME and C-L wafers with DDVP would be more convenient and safer to handle than current liquid insecticide formulations (e.g. naled) used for detection programs in FL and CA (Vargas et al. 2009a). For more details, see Vargas et al. (2009a, 20 l0a). Finally, detection traps and male annihilation formulations with spinosad were also tested in French Polynesia against the C-L responding Queensland fruit fly and ME responding oriental fruit fly (Leblanc et al. 2010).

Goal 3. Determine if melo-Iure will enhance the effectiveness of cuelure for flies attracted to this cuelure analog. Melo-Iure plugs were sent to various collaborators in Australia and Reunion Island where C-L responding *Bactrocera* species are established. Tests of both C-L and melolure (M-L) at these locations confirmed that M-L can attract several related species of exotic fruit flies, many of which have been trapped in protein bait traps in CA and some of which have not yet been detected in CA. In tests conducted in Australia, there were a total of20 different species that responded to either M-L or C-L. There were 6 species that were attracted to M-L only. *B. neohumeralis* and *B. peninsu/aris* were more attracted to M-L compared to C-L. *B. neohumeralis* is a major pest in Queensland attacking similar hosts as *B. tryoni.* Tests conducted in Piton Hyacinthe, in the south of Reunion Island, (France) in the Indian Ocean showed that M-L was significantly more attractive to *D.demmerezi* compared to C-L. *D. demmerezi* is a pest of cucurbits also found in Madagascar and Mauritius.

Goal 4. Determine if new plant-derived extracts are more effective at attracting female fruit flies to traps than the current hydrolyzed-protein based lure. Tests were conducted on the borders of a papaya field with wild populations of melon flies. Three treatments: (300 mg cucumber plug, 100 mg cucumber plug and 300mI solulys protein bait) were compared in liquid multi-lure traps. Cucumber lures showed a bias toward female trap capture compared to male trap captures that increased with increased lure concentration. Both cucumber attractants captured at least twice as many flies compared to protein bait after the first week in the field (Fig. I). Similar data on the effectiveness of the cucumber-based lures were tested in Taiwan against melon flies. Cucumber lure captured significantly more melon flies compared to C-L, protein bait and control (Fig. 2). Further tests are continuing on improving the formulation and development of alternative dry trap designs.

Goal 5. Determine if it's possible to substitute Spinosad on a solid matrix for dibrom on a wick in fruit fly traps. Weathering tests of formulated lures were weathered under CA conditions at the CDFA site in Southern CA and sent back to Hawaii for evaluations.

Results after 8 weeks showed that the formulated ME products are as good as the lures placed on cotton wick (the CDFA standard) (Fig.3). ME matrix formulations containing spinosad, naled and ddvp were as good as ME on wicks containing naled (Fig 4.); however C-L matrix formulations did not perform as well as C-L on wicks containing naled (Fig. 5).

Goals – The goals for this project were: 1) Determine the length of time spinosad effectively kills fruit flies when deployed in male annihilation treatments in HI and CA; whether the addition of UV light inhibitors will extend the effective period of the spinosad. 2) Determine whether the trap catch of ME and C-L baited traps using spinosad can be made equivalent to those using Dibrom (naled) using either the current wick dispenser or a solid matrix dispenser. 3) Determine if melo-lure will enhance the effectiveness of cue-lure for flies attracted to this C-L analog 4) Determine if new plant-derived extracts are more effective at attracting female fruit flies to our traps than the current hydrolyzed-protein based lure. 5) Determine if we can substitute spinosad on a solid matrix for Dibrom on a wick in our fruit fly traps.

Results/Conclusion – Outcomes/goals 1-2: Results of SPLAT -MAT Spinosad ME/C-L weathering in CA and HI and bioassays over the last 3 yr were completed and summarized in peer-reviewed publications (Vargas et a12003, 2008, 2009b, 2010a, 2010c). Chemical degradation studies still need to be completed. In addition an invited review article on new ME/C-L technologies was accepted in the journal "Vitamins and Hormones" for a special pheromone volume (Vargas et aI20IOb). SPLAT research results were highlighted in the article. Most importantly, SPLAT -MA pM Spinosad ME was registered with US EPA for use in the United States. It was licensed in 2010 in Hawaii and CA for fruit fly control (Bret et al. 2010). Dow AgroSciences is planning a product launch for Hawaii and CA.

Outcomes/goals 3-5: Melolure has been shown to be a superior lure to C-L and its use in detection and control programs in CA should be recommended although it is not recommend inclusion of spinosad, but rather naled or DDVP in the a formulated matrix.

Outcomes/goal 4: The cucumber-based attractant for melon fly has also been shown to be superior to the protein bait currently used by CDFA trapping programs. The cucumber based lure are more specific for the C-L responding *Baclrocera.* Such lures would optimize detection, delimitation and eventually lead towards development of eradication technology against these Bactrocera-responding species.

Outcome/goal 5: Pre-formulated plugs containing ME, CL, Melolure or cucumber have inherent advantages to the current practice of placing the liquid material on a cotton wick. These include reduced chemical exposure as well as quicker deployment in the field. Spinosad does not appear to work well with C-L either in cotton wicks or in pre-formulated plugs. C-L plugs pre-formulated with either naled or DDVP while slightly less attractive than C-L on a wick are still attractive from the standpoint of reduced worker exposure to organophosphate insecticides. Due to low volatility C-L formulations will require further research to optimize the pre-formulated matrix.

Additional Assessment - Below includes some additional resources outlining accomplishments/highlights of this project.

1. Bret, B., L. E. Gome~ A. Mafra-Neto and R. I. Vargas. 2010. A little dab'll do ya: advances in fruit fly bait technology with SPLAT-MAT Spinosad ME. Pacific Branch Meeting, Boise, ID. April 12, 2010
2. Jang, E.B. 2010 Effectiveness of plastic matrix male lures and traps against *Bactrocera dorsalis* and *B. cllcllrhitae* in Hawaii. J. Appl. Entomol.
3. Leblanc, L., R. I. Vargas, B. Mackey and R. Putoa. 2010. Evaluation of cue-lure and methyl eugenol with solid lure and insecticide dispensers for monitoring and male annihilation in Tahiti. Proc. Hawaii. Entomol. Soc. (in review).

4. Siderhurs~ M. S. and E.B. Jang. 2010. Cucumber Volatile Blend Attractive to Female Melon Fly, *Bactrocera cucurhitae* Coquillett). J. Chern. Ecology
5. US-EPA label for SPLAT-MAT-Spinosad-ME.
6. Vargas, R. I., Miller, N. and Stark, J. D. 2003. Field trials of Spinosad as a replacement for naled, ddvp, and malathion in methyl eugenol and cue-lure bucket traps to attract and kill male oriental fruit flies and melon flies (Diptera: Tephritidae). Hawaii. J. Econ. Entomol. 96: 1780 - 1785.
7. Vargas, R. I., J. D. Stark, M. Hertlein, A. Mafra-Neto, R. Coler and J. Piiiero. 2008. Evaluation of SPLAT with spinosad and methyl eugenol or cue-lure for "attract-and-kill" of oriental and melon fruit flies (Diptera: Tephritidae) in Hawaii. J. Econ. Entomol. 101: 750-768.
8. Vargas, R. I., Stark, J. D., Burns, R. E., Mau, R. F. L., Cook, P. and Piiiero, J. C. 2009a. Captures in methyl eugenol and cuelure detection traps with and without insecticides and with a Farma Tech solid lure and insecticide dispenser. J. Econ. Entomol. 102: 552-557.
9. Vargas, R. I., J. C. Piiiero, R. F. L. Mau, J. D. Stark, M. Hertlein, A. Mafra-Neto, R. Coler and A. Getchell. 2009b. Attraction and mortality of oriental fruit flies (Diptera: Tephritidae) to SPLAT-MAT-methyl eugenol with spinosad. Entomol. Experiment. et applicata. 131: 286-293.
10. Vargas, R. I., Mau, R. F. L., Stark, J. D. and Piiiero, J. C. 2010a. Evaluation of methyl eugenol and cue-lure traps with solid lure and insecticide dispensers for monitoring and male annihilation in Hawaii. J. Econ. Entomol. 103: 409-415.
11. Vargas, R.I., J. C. Piiiero, E. B. Jang, R. F. L. Mau, J. D. Stark, L. Gomez, L. Stoltman, and Mafra-Neto, A. 2010b. Attraction and mortality of melon flies (Diptera: Tephritidae) to SPLAT-MAT-cue-Iure with spinosad. J. Econ. Entomol. (In Press).
12. Vargas, R. I., T. E. Shelly, J. C. Piiiero, and L. Leblanc. 20lOc. Recent advances in methyl eugenol and cue-lure technologies for fruit fly detection, monitoring and control. Vitamins and Hormones, Section: Pheromones, vol 83. (In Press).

Project Contact:
Charles W. Myers
U.S. Department of Agriculture, Agriculture Research Services
800 Buchanan Street
Albany, CA 94710-1105
Email: Chuck.Myers@ars.usda.gov
Phone: (510) 559-5769

6. *Project Apis M. (PAM)- Improving Population Services: Evaluating Bee Health*

Grant Funds Expended- PAM was awarded $100,000. $93,727.77 was expended. The remaining grant balance was $6,272.23. All aspects of the project were completed, even though all grants funds were not utilized. CDFA requested USDA approval to amend State Plan (amendment 1) to reallocate the remaining balance to Project 13, Center for International Trade Development, Fresno.

Project Summary- PAM received a two-year grant in the amount of $100,000 to develop field level testing to assess health of honey bee colonies. Nationwide, $16 billion in agricultural crops require pollination. California utilizes three-quarters of the nation's honey bee hives to pollinate over $6 billion in California crops. As demand for bees increase, available colonies have been declining due to varroa mites, loss of natural forage, Colony Collapse Disorder (CCD), and many other factors. In the past 10 years, available commercial hives have decreased by one million colonies. Hence, hive rental costs for growers have escalated rapidly from $35/colony a few years ago to recent pricing for the 2009 pollination season of $165 - $185/colony.

This project has assisted beekeepers and growers to objectively evaluate bee health in order to make appropriate management adjustments to ensure adequate healthy hives for spring pollination. Field and laboratory assessments that analyze bees for disease and virus levels, pest levels and nutritional health indicators have been pursued. These tests assist California's pollinated crops receive healthy hives.

This project uniquely addressed pollination needs by virtue of PAM's ability to quickly respond to grower and beekeeper needs and responsibly delve into finding solutions. Additionally, this project has served to unite an industry divided by the differing political objectives of the three national bee organizations.

PAM's Board consists of representatives from these national bee organizations who now work together on common research objectives. Furthermore, PAM readily cooperates with other academic and research institutions including university programs and the USDA. Many state and all the national organizations, many universities, and USDA are all now well aware and supportive of the bee health project being undertaken by PAM. PAM has highlighted this project nationwide and has solicited input from the individuals, organizations, and institutions, all who have assisted in meeting the goals of the project. Outreach has included press releases, presentations made at state and national meetings, newsletter postings and website updates.

Approach- This project has facilitated undertaking the research necessary to better understand bee health and has resulted in the development of diagnostic laboratories and services to more objectively evaluate bee health. Pollination of California's Specialty Crops involves pollination services from beekeepers throughout the United States. Beekeeping is a migratory business, with beekeepers shipping bees to locations where bees can be held safely, can feed, and can generate income via pollination. Thus, a California crop pollinator may have bees in California part of a year, but will travel to the Northwest, the upper Midwest or as far away as Florida or Maine to feed his bees and pollinate crops. In order to canvas the needs of these beekeepers and then to reach them with information on bee health, bee research and diagnostic services, PAM, with the help of this grant, has networked widely to reach the California crop pollinating target audience.

These funds enabled PAM to initiate 12 studies in 3 years in 7 different states, committing over $400,000 to improved pollination services by honey bees. The project highlighted the simple fact that a beekeeper's primary challenge is simply keeping bees alive, and successful over-wintering of bees is key to the complete and efficient pollination of California crops.

Pollination services, especially California almond contracts, have become the primary income-producing activity for beekeepers (rather than honey production). Interviews conducted via this grant illuminated the following issues: Beekeepers do not have the tools they need to determine if a colony is healthy or not; Growers of pollinated crops have little information on bee supply and health; the main evaluation tool for

beekeepers and growers is frame counts (the number of frames with 75% bee coverage); the Feasibility Study proposed three methods for field testing of bees:

- Train Pest Control Advisors (PCA's)
- Develop easy-to-use field test kits
- Provide access to diagnostic laboratories (*option emerged as the best available option).*

Interviews and laboratory visits identified five important areas for bee health evaluations. 1) Pests (mainly varroa and tracheal mites); 2) Diseases (Nosema, Foulbrood Diseases), 3) Viruses (Sacbrood, IAPV, Iridescent Virus); 4) Nutrition (protein, lipids, vitellogenin, nutrition and increased longevity) and 5) Pesticide exposure.

Goals- The primary goal of the project was to develop a new program for field evaluation of honey bee health and nutrition status for commercially-managed honey bees used in the pollination of California Specialty Crops. The supporting goals for the project related to the specific goal for each of the two years of the project. Those specific goals were: for Year 1, to conduct a Feasibility Study; and for Year 2, to develop a Sampling and Evaluation Protocol for in-field evaluation of honey bees. Year 1 was successfully completed on-target with the Feasibility Study completed on-time and submitted in November, 2008. The Year 2 goal to establish available in-field evaluation of bees has been attained. New programs are now in place to effectively evaluate bees for mites, *Nosema*, viruses and pesticides

Results/Conclusions- The following outcomes were achieved and accomplished on the following dates:

- 22 individuals (5 different locations) interviewed for Feasibility Study (9/07-3/08). The original target was 4 locations and 20 interviews. 19 additional individuals interviewed for Feasibility Study (4/08-9/08). Included owners of two of the largest beekeeping operations plus 17 scientists.
- Brochure printed (9/07-3/08) and distributed (10/07-9/09). PAM website at www.projectapism.org was continually updated with analytical information (10/07-9/09). Website hits doubled upon project presentations at national meetings (Jan 09).
- Feasibility Study published (completed and provided to CDFA 11/08)
- Canvassed available laboratories for analytical services available to beekeepers (10/08-9/09)
- Conducted email survey using a standardized form for analytical services available for beekeepers (8/09-9/09)
- Project highlighted in various publications and meeting such as: 23 different state and national meetings (5 in '07, 8 in '08, and 7 through 9/09); 4 more state/national meetings scheduled through 12/09; 4 grower and other seminars (10/07-3/09)
- Project featured in: 3 e-newsletters and 6 trade newsletters or publications (9/07-3/08); 3 *Almond Facts* grower articles (PAM or Bee Box articles '08-'09); 10 PAM's e-newsletters (2/08-9/09); *thedailygreen.co, Catch the Buzz* and *Scientific Ag* e-newsletters (10/07-9/09), and *Central Valley Business Times* Interview (9/30/2009)

Additional Assessments- Beekeepers pollinating California Specialty Crops live and travel throughout the United States, depending on the time of year. During early spring, beekeepers live in California and are busy attending their hives and managing pollination contracts. Other times during the year they attend beekeeper events and meetings in their own hometown area or bee yard locations. Events/presentations where the CDFA project was highlighted and California-pollinating beekeepers were informed of diagnostic services available for their use included:

- Eastern Apicultural Society Meeting (09)
- Western Apicultural Society Meeting (07, 09)
- Oregon Beekeepers Assoc (07)
- Washington/Oregon Beekeepers Joint Mtg (08)

- Montana State Beekeepers Assoc (08 and Oct 09)
- Idaho Honey Producers (07, 08 and Nov 09)
- California State Beekeepers Association (07,08, and Nov 09)
- Colorado State Beekeepers Association (08)
- South East Georgia Beekeepers (09)
- Florida State Beekeepers (09)
- Almond Board of California (07, 08 and Dec 09)
- Apiary Inspectors of America (08, 09)
- American Honey Producers Association (08, 09)
- American Beekeeping Federation (08,09)
- Pacific Entomological Society (08)
- CDFA Board Meeting (March, 2009)

Beekeepers pollinating California Specialty Crops access various types of media. PAm, with the help of this grant, highlighted bee health research and diagnostic services in the following print and electronic publishing forums:

- PAm e-newsletter (distribution to over 200 beekeepers, representing about 70% of the nation's CA-pollinating commercial beekeepers)
- Blue Diamond Growers *Almond Facts* with distribution to all of California's 6,000 almond growers
  - *Catch the Buzz* e-newsletter with primary distribution of 3,000 readers and secondary distribution of another 10,000 (pass along)
  - *UC Apiaries* UC extension publication with circulation of about 500
  - *thedailygreen.com* website with circulation of 200,000
  - *American Bee Journal*, circulation of 13,000
  - *Bee Culture*, circulation also of about 13,000
- Attachments including press releases, articles, power point presentations, and photographs can be provided upon request.

Project Contact:
Christi Heintz.
1750 Dayton Road
Chico, CA 95928
Email: christih@cox.net
Phone: (520)834-2832

7. *University of California, Davis (UCD) - School Garden Project*

Grant Funds Expended - The UCD was awarded $99,950. $86,488 was expended. The remaining grant balance was $13,462. CDFA requested USDA approval to amend State Plan (amendment 2 and 3) to reallocate a portion ($8,504) of the remaining balance to Project 14, California Agriculture Export Council (amendment 2) and the remaining $4,958 (amendment 3) to fund a portion of the California Department of Food and Agriculture (CDFA) Public Outreach on California Invasive Species Project 15.

The total budget for Project 1 portion was $57,170, ***$26,670 from specialty crop*** grant funds and $10,370 as matching UC salaries and benefits, and $20,130 as in-kind contributions from the California Department of Education, Life Lab Science Program, California Integrated Waste Management Board, and California Foundation for Agriculture in the Classroom. The Specialty Crop Block Grant funds covered salary, benefits, travel and per diem for one Program Representative to work 22.5% time during FY 07-08 to deliver trainers' workshops; follow-up with new trainers; and develop content and language for videos. This also included a sub-award of $1 0,000 to Life Lab Science Program to fund their partnership in developing and delivering the CSYSG Train-the trainer workshops and the video project.

The total budget for Project 2 portion was $38,210, ***$27,810 from specialty crop funds*** and $10,400 as in-kind contributions from the CDE, UCCE Santa Cruz and Monterey Counties; UCCE Ventura County; UC Hansen Agricultural Trust and the UC Garden-Based Learning Workgroup. The Specialty Crop funds covered salary, benefits, travel and per diem for one Program Representative to work 27% time during FY 07-08 to develop middle school lessons and other materials for the web site, coordinate the video/photo production effort, coordinate interviews and maintain communication among project partners. $5,500 was allocated for a subcontractor for production and editing of the video. Funding for video contractor was not used and was re-budgeted to salary and benefits.

The total budget for Project 3 was $35,200, including ***$17,150 from specialty crop funds*** and $18,050 as in-kind contributions from the CDE, Life Lab Science Program, Western growers and California Foundation for agriculture in the classroom. The Specialty Crop funds covered salary and benefits for a Program Representative to work 8.3 % time during FY 07-08 to develop the CSGN research database; and a sub-award of $11,000 to Western Growers for web development work and teacher travel scholarships.

The total budget for Project 4 was approximately $48,180, which includes ***$27,920 from specialty crop funds***, $19,148 in matching UC salaries and benefits, and $2,050 in in-kind contributions from the California Department of Education. The funds from CDFA covered salary and benefits of a Graduate Student Researcher at 25% FTE for 15 months, and a Project Scientist at 4% FTE to supervise the project.

Project Summary- The UCD Agricultural Sustainability Institute was awarded $99,950 to increase awareness, knowledge and consumption of specialty crops by providing immediate support for California Instructional School Gardens in four distinct but highly interrelated project areas: Project 1) professional development and training for school gardens Project 2) curriculum and strategies for middle school gardens Project 3) networking and web-based communication through the California School Garden Network and Project 4) impact assessment of the California Instructional School Gardens (CIS G) Program. The California Legislature authorized $15 million in December of 2006 to fund gardens in public schools through the CISG Program. 3849 schools applied for and received CISG funding for school garden development between August, 2007 and June 2008. The work completed here provided necessary elements for the effective use of the state CISG awards that could not be provided for by CISG Program itself. All projects fulfilled stated goals and met expected measurable outcomes. This was a hugely collaborative effort involving several collaborating organizations and the generous contribution of in-kind services. The four projects are described individually

below. Any resources developed for this project, additional or detailed reports on accomplishments, and web-links to significant material on-line are listed with each project and have been sent to CDF A in electronic form and in hard copy where appropriate.

Approach – ***Project 1. Expanding Opportunities for Professional Development for School Gardens by Extending a Proven Workshop Model through Train-the-Trainers Events and Web site/ DVD Video.*** This first project expanded opportunities for professional development through workshops and a web-based video training, and thereby increased the number of personnel equipped to instruct school children in garden-based education. At the onset of this work, there was an immediate need for informed, coordinated teams of instructors and parent volunteers at schools receiving funds authorized by AB 1535 through the CISG Program. Teams needed to build and develop school gardens and quickly translate those garden sites into effective learning opportunities for children and youth. A new workshop model, "Creating and Sustaining Your School Garden" (CSYSG) had previously been developed, piloted, and offered collaboratively by UC Davis Children's Garden Program (CGP) and the Life Lab Science Program (LLSP) and had met with high enthusiasm and demand from school garden practitioners. This CSYSG workshop model was strongly supported by the California School Garden Network (CSGN) and was coordinated with "Gardens for Learning", a special book project of First Lady, Maria Shriver, which was developed in partnership with the California Departments of Food and Agriculture, Health Services, and Education. The CSYSG model served as the basis for the resources provided in Project 1.

Project 2. Enhancing Understanding of California's Specialty Crops by Extending Garden-based Education to Middle Schools. This project targeted the previously underserved middle school audience. It enhanced middle school students' understanding of California specialty crops by supporting development and use of instructional gardens for middle schools. A 2002 survey, conducted by the California Department of Education (CDE), showed that 89% of schools with schools gardens used them for academic instruction, yet 74% of respondents indicated that a lack of curriculum materials linked to California standards was a major barrier to using gardens at this level. A follow-up survey of middle/junior high schools in 2005 found that the major impediments were lack of A single subject curriculum for this age group. Project II was designed to develop web-based resources integrating garden-based learning and life-long healthy eating as well as promote school gardening lessons/activities for students in this important age group

Project 3.Statewide Networking and Communication for Instructional School Gardens-Support for the California School Garden Network (CSGN). In 2004, California's First Lady, Maria Shriver, saw the need for a coordinated statewide effort to create and sustain California school gardens as a means of enhancing academic achievement, improving youths' health, and supporting stewardship of California's rich agricultural heritage. The overall purpose of Project 3 is to provide statewide networking, communication and technical support for California's instructional school gardens.

Project 4. Impact Assessment of the California Instructional School Garden Program (CISGP) funded by Assembly Bill 1535 The purpose of this project was to evaluate the effectiveness of the California Instructional School Garden Program at assisting schools in implementing, maintaining, and sustaining a School Garden Program. Studies have shown that garden-based education programs encourage agricultural and ecol6gicalliteracy, environmental awareness, and opportunities for experiential education. Additional research provides evidence for the usefulness of gardens in elementary schools to enhance academic instruction in core subject areas such as science (65%), language arts (42%) and math (46%). Project 4 conducted a quantitative and qualitative assessment of the impacts of the new CISG to inform participating state agencies about the effectiveness and potential of a program such as this to promote successful instructional school gardens.

Goals- ***Project 1*** provided professional development to a wide audience of adults working in schools around the state in two ways. 1) Through train-the-trainers events that targeted "garden experts", individuals who could receive CSYSG training content and then subsequently offer the CSYSG trainings to school teams in their own regions. CGP and LLSP completed a total of 5 CSYSG train the- trainers' events during year 1 and year 2 of this project. 2) Through the creation, development and placement on the web of "Let's Get Growing: Gardening How-to for School Programs". This video resource is housed on the CSGN web site has helped meet the training needs of school personnel and volunteers who were unable to attend a live workshop due to distance or time constraints. It includes 10 unique segments on specific gardening topics such as planting, composting, irrigation, and educational theme gardens for it total of30 minutes of video.

Project 2 The objectives of Project II were 1) to research, document, and provide through the CSGN Web site, successful garden-based learning single subject lessons linked to the standards for middle school educators; 2) to research, create and make available through the Web site "Strategies, Best Practices and Lessons Learned for GBL at the Middle School Level"; and 3) to develop and upload to the Web site visual documentation through video or photo of successful middle school garden programs to promote the lessons and other materials.
Project 3 goal was to support the efforts of all proposal projects as well as CSGN's objectives by providing networking, communications; and technical support through the CSGN Web site: http://www.csgn.org and by facilitating quarterly meetings that promote statewide participation.

Project 4 The specific goals for the project were as follows: 1) To gather data about a) schools that applied tor and b) schools that did not apply for the California Instructional School Garden program; 2) To determine the goals set by districts that completed the California instructional School Garden program application process through a midterm evaluation; 3) To determine how schools applying for the California Instructional School Garden program utilized the funding they received; and 4) To gather information that can be formulated into effective models for sustaining school gardens for instructional purposes. *Methodologv:* Two survey tools were used to collect information to meet these goals: the School Site Information Form (SSIF)-a form all schools completed to apply for the CISGP grant, and the Garden Grant Follow-Up Survey (GGFS)--developed by the project team as a midterm survey for funded schools and the School Garden Awareness Survey, an applicant survey for both funded applicant schools and those that did not apply, but could have applied. Fourteen months after the release of CISGP grant funds, GGFS surveys were sent to 1,992 schools that applied to the program and 1,662 schools that did not apply. Responses from 861 of the schools that applied were received (43%) and 801 of the non-application schools were received (48%).

Results/Conclusion – ***Project 1 Measurable Outcomes/due dates***
"Creating and Sustaining Your School Garden" (CSYSG) Train-the-Trainer Workshops offered collaboratively by UCD Children's Garden Program (CGP) and the Life Lab Science Program (LLSP). Completed in September 2008. Results: A total of 135 participants representing 64 different organizations attended the five train-the-trainers' workshops provided by UC Davis CGP and LLSP in Year 1 and Year 2 of this project. Subsequently, at least 35 training sessions were offered in counties across California to a total of 664 participants representing a minimum of295 schools and child population of approximately 93,879. 1063 Gardens for Learning" books were distributed at CSYSG trainings throughout the state to teachers, master gardeners, and school garden coordinators.

Creating and Sustaining Your School Garden" (CSYSG) Train-the-Trainer materials were made available on the CSGN website in March 2008. Since then the materials have accessed on-line 1791 times in Year 2 and Year 3 of the project and 533 times since the beginning of2010.

"Let's Get Growing: Gardening How-to For School Programs" Video Clips Posted On-line. Completed in September 2008. The video clips have accessed on-line 171 times in Year 2, 1649 times in Year 3 of the project, and 543 times since the beginning of 2010.

Let's Get Growing" DVD duplicated and distributed in December 2009. 400/500 copies of the "Let's Get Growing" DVD have been distributed to date to staff or garden coordinators working at schools with gardens.

Project 2 Measurable Outcomes/due dates
UC Children's Garden Program, in collaboration with CDE, researched successful middle school instructional garden programs across California. Completed in March 2008. Eleven (11) schools were selected as model programs, with interviews conducted on-site during visits with teachers, garden coordinators and students. Program activities were captured through observations and photographs.

In collaboration with CSGN, UCD created middle school area as part of content for "California Instructional School Garden Program" web pages. Web page established in July 2009. Results: Increased number of middle school teachers signing on as members of CSGN. Since the start of the project, 1,466 people have joined CSGN, bringing the total number of members to 3,066. Since this page was created, it has seen 768 visitors, 413 in the first six months and 355 in the most recent three months. The interest in this content continues to grow.

Creation of the "Middle School Stories," case studies for each of the 11 successful middle school instructional garden programs. Story web pages include an overview of each school, descriptions of its garden program, and ways its program directly utilizes California specialty crops to link to academic subject matter and state standards. Examples of curricula, lessons and activities were scanned and converted to pdf documents for easy downloading. Profiles include sections on "Tips and Best Practices" and "Sustaining Garden Programs.". Completion: Middle school stories were posted to website beginning July 2009. This resulted in an increased number of middle school teachers* accessing the CSGN Web site to download middle school lessons:, From July 2009, when the first story was uploaded, until December 2009, 413 unique visits were made to the Middle School main page. In the 3 months since that time, with the majority of the stories accessible, an additional 355 visits have been made. On a per month basis, this represents a 71% increase in visits.

"Best Practices for California Middle School Instructional School Gardens" a summary reference document developed from the best strategies and materials gleaned from school site visits and made available on www.csgn.org. Includes links to downloadable curricular lessons. Completed March 2010
The Best Practices for California Middle School Instructional School Gardens was written up in a web-ready format and uploaded on www.csgn.org.

A photo montage and correlated stories were created from site visit photographs and information. Montage includes numerous photographs of middle school students working in their school gardens. Completed July 2009 through December 2009. Photographs can be accessed via the pages of each individual school site. Clicking on a photograph brings up a further series of photographs, the effect of which is a photo montage for that section. This technique is repeated throughout the pages and school profiles.

Proposed survey of teachers via the CSGN website to document response to the middle school materials was however, proposed survey has not been conducted.

Project 3 Measurable Outcomes/due dates
Created the "California Instructional School Garden Program" webpage within www.csgn.org
This contains information and updates on the CISG Program. It includes information on the program, where the funding went, which schools received funding, and links to help schools who were applying for or received the

grants. Completed: December 2007**.** On average, the number of unique visitors to the CSGN website has increased by 2560 visits per month between 2007 and 2009. Approximately, 2204 individuals have visited and downloaded the materials created within Projects 1 and 2. 1466 new CSGN members have joined since the start of this project, bringing the total to 3066.

Added keywords and metatags to all CSGN pages to optimize searches on Google and Yahoo search engines. Categorized all research articles have been categorized to be searchable by topic and keyword Completed: December 2007. When searching the term "school gardens" on Google, CSGN is the first site listed in the search results. In searching "California school gardens" on Yahoo, CSGN is the first result. Information is readily accessible to a broad audience.

Maintained a monthly e-newsletter through which UCD publicizing the activities and materials for all projects, i.e., CSYSG Train the Trainer classes, subsequent local CSYSG trainings, "Middle School Stories" and "Best Practices for Middle Schools" section, and Regional Chapters. , Completed: December 2009. Currently, the e-newsletter reaches 3066 people, and the number continues to increase each month.

Created web pages for each of the 5 Regional Chapters started during this grant period. Pages contain information specific to the CSGN Chapters, which are updated by Western Growers, but have content generated by the Chapters. Completed in December 2007. Regional Chapter pages have been viewed more than 4100 times since created.

Facilitated quarterly network-partner meetings that maintained professional involvement from a wide variety of government and non-profit organizations as well as classroom teacher involvement completed December 2009. As a result, maintained and involved teachers in CSGN meetings and board meetings. There were 10-12 teacher visits to in CSGN meetings during the project period. Teachers also maintained a voice in CSGN board meetings.

Project 4 Measurable Outcomes/due dates
Districts completed the *School Site Information Form* as part of the application process for the California Instructional School Garden Program. Completed in April 2007. 3,849 schools applied for the CISGP.

Data entry and management of for schools that did NOT apply for CISGP funding (from CDE principal database.) Completed: November, 2008 3,547 schools fit the non-applicant school criteria. Removal of schools with blocked and incorrect emails or no principal contact information. 1,662 non-applicant schools in the survey group.

Data entry and management of the *School Site Information Form* for schools that applied for CISGP funding. Completed: March, 2009 3,103 schools met initial screening criteria (site had to be part of district, provide a contact email, and have a unique contact person.) Removal of blocked and incorrect email addresses left 1,992 schools in the applicant survey pool.

Garden Grant Follow-up Survey (GGFS) sent to schools that completed the application process and the correlated *Application Survey* sent to a subset of schools that did not apply, with follow-up phone calls to non-respondents. Completed in February, 2009. 861 schools responded to the applicant survey (43%) and 801 schools responded to the non-applicant survey (48%). Some of applicant responses were missing critical information, so 749 (38% of pool) were used in analysis.

Data entry and analysis for both the *GGFS* and *Application Survey (completed August 2009).* Key findings were that schools were 3.7 times more likely to apply for CISGP if they had a garden coordinator, 3.1 times

more likely to apply with dedicated parent or community volunteers, but only 1.4 times more likely to apply if other funding sources were present. See full report for more key findings.
A manuscript detailing the findings from the project written and submitted to a peer reviewed journal so that the findings will be accessible to schools throughout the state. Completed December 2009. Manuscripts submitted to Journal of American Dietetic Association and Journal of Nutrition Education and Behavior, awaiting response.

All Projects 1-4 -Results and Conclusions: Outstanding progress was facilitated and achieved to support increased understanding of specialty crops through the development and use of California Instructional School Gardens. *(Project 1)* The CSYSG Train-the-Trainers model development and extensive offerings exceeded outcomes originally proposed and clearly indicate that success can be achieved when a topic of importance is correctly identified and appropriately addressed by collaborating experts and then subsequently turned over effectively to regional trainers across the state. *(Project 2)* Going directly to outstanding middle school programs to document their stories where educators are creating materials, developing strategies, and field testing all as they go, has resulted in a compelling and proven roadmap for those newly interested in addressing this challenging audience. *(Project 3)* The projects all depended upon the ongoing statewide coordinating efforts of the CSGN supported by Western Growers through the organization and facilitation of statewide meetings and development and maintenance of the powerful website that houses many of the developed resources and easily reaches educators. *(Project 4)* The follow up research on the state legislated CISG Program provided here is essential for the public and our leaders to understand how funds allocated for California Instructional School Gardens were used and why certain schools were more able to take advantage of those than others. In conclusion, resources were developed and made available, outcomes were met or exceeded, and funded programs were monitored in support of California's Instructional School Gardens.

Additional Assessment – The following materials are all available online at www.csgn.org. Hard copies can be provided upon request.
Project 1:
- Creating and Sustaining Your School Garden Train-the-Trainer materials
- "Let's Get Growing: Gardening How-to for School Programs," video training (DVD available upon request)
- Summaries of statistics for CSYSG and Train-the-Trainers workshops, detailing attendance and potential reach

Project 2:
- Summary of California Middle School Garden stories
- Best Practices for California Middle School Instructional School Gardens
- Middle School Garden Stories

Project 3:
- Search Optimization findings in Google and Yahoo
- Pages on www.csgn.org created for this project

Project 4:
- CISG Program Full Report

Project Contact:
Carol Hillhouse, Principal Investigator
University of California, Davis
Department of Plant Sciences
One Shields Avenue
Davis, CA 95616
Email: jchillhouse@ucdavis.edu
Phone: (530) 752-7033

8. *University of California, Davis (UCD) – Ecological Footprint of Walnuts*

Grant Funds Expended – UCD was awarded $99,968. $97,967.99 was expended. CDFA informed USDA, the remaining $2,000.01 was redirected to CDFA, Federal Funds Management Office to cover project management cost. CDFA discussed the redirection with USDA; however, the amount redirected was under the (20%) needed to obtain prior approval; therefore, no formal amendment was required.

Project Summary- The purpose of the project was to enhance the competitiveness of walnut growers in California by providing needed knowledge that will allow growers to make better informed decisions in the face of impending environmental concerns. This project addressed two important issues facing California walnut growers:

1. The potential impacts of climate change on walnut production.
2. The economic and environmental impact tradeoffs of various pest management strategies as a consequence of reducing impacts to water quality.

Climate Change: Abundant scientific evidence indicates that anthropogenic greenhouse gas emissions will lead to rising temperatures in the future. This prospect has induced many to consider the potential effects of a changing climate on everyday life. Climate can strongly influence crop production and pest management via its effects on the life cycles of crops, pests, and natural enemies. Flowering and fruit set of trees can suffer due to a reduction in needed winter chill. Temperature changes can potentially change pest pressure and geographic ranges. Compared to growers of annual crops, growers of perennial crops such as fruit and nut trees can be more hindered in their responses to environmental changes, given the long term investments required for their crops to bear fruit and the number of growing seasons necessary to show a profit on the initial investment. To assist these growers in remaining competitive in the face of climate changes, this project undertook a comprehensive analysis with the goal of increasing grower awareness of the long run impacts of climate change on production in order to facilitate reassessment of production methods and make timely adaptations to ensure both sustainable and competitive production under potential changed environmental conditions

Water Quality: In addition to climate change, there has also been a heightened awareness of environmental impacts of pest management on the environment. Pest management choices can have a profound impact on aquatic ecosystem health. Newer pest product formulations are often considered lower risk to aquatic species due to their mode of pest control action being highly selective to the targeted pest, with little effects on other species. However, for growers to be able to successfully employ these new products, the products must prove cost effective. While lower risk products often cost more than their conventional counterparts, their reduced probability of harming natural enemies can increase the likelihood of biological control of certain pests, and thus potentially offer a cost savings in some situations. The project therefore conducted an extensive analysis of currently practiced pest management strategies in order to discern which strategies would be the most likely to be cost effective while lowering impacts to surface water quality

Approach- Key activities of the project were collaboration, research, and outreach.

Collaboration: Collaboration included a wide network of stakeholders involved in walnut production and the issues of climate change, water quality, economics, and agronomy. By including a diverse range of experts, UCD was able to increase the usefulness of the project by fine-tuning the questions and research approaches to the most current identified needs/pressing issues.

Research: The research activity comprised the bulk of project, broken into two separate sub-projects focusing on climate change and water quality issues. The following sections will be discussed: collaborator roles in the research, tasks, favorable/unusual developments, and results/conclusions/recommendations:

Roles: Eike Luedeling was the primary researcher for the climate change portion, with strong support, data contribution, feedback, and discussion from the team including Minghua Zhang**,** Gail McGranahan , Joe Grant, Bruce Lampinen, Bob Beede, Patrick Brown, Bill Coates, Hal Crain, Carolyn Debuse, Evan Girvetz, Kitren Glozer, Janine Hasey, Kathy Kelley Anderson, Chuck Leslie, and Todd Rosenstock. Kimberly Steinmann was the primary researcher for the water quality portion, similarly assisted by Minghua Zhang**,** Joe Grant, Carolyn Pickel, David Ramos, Mark Cady, Bob Elliott, and John Steggall.

Tasks: The general overview of research activity tasks for both sub-projects included data gathering, model development, and interpretation of results. The climate change sub-project identified the Dynamic or Chill Portions model as a better approach for assessing chill requirements in walnuts through an extensive literature review and validation based on historic walnut phenology. Based on hourly and daily temperature records, winter chill was then modeled for two past temperature scenarios (1950 and 2000), and 18 future scenarios (average conditions during 2041–2060 and 2080–2099 under each of the B1, A1B and A2 IPCC greenhouse gas emissions scenarios, for the CSIRO-MK3, HadCM3 and MIROC climate models). For each scenario, 100 replications of the yearly temperature record were produced, using a stochastic weather generator. A novel climatic statistic, ‘‘safe winter chill’’, was then introduced and defined as the 10% quantile of the resulting chilling distributions. This metric can be interpreted as the amount of chilling that growers can safely expect under each scenario. In addition to winter chill, the project also analyzed potential effects of climate change on walnut pests. Using UC IPM degree day models (http://www.ipm.ucdavis.edu/MODELS/index.html) and IPCC greenhouse gas scenario climate change models, the project predicted changes in mean generation numbers for the codling moth (*Cydia pomonella* L.), navel orange worm (*Amyelois transitella* Walker), two-spotted spider mite (*Tetranychus urticae* Koch) and European red mite (*Panonychus ulmi* Koch).

The water quality sub-project conducted an integrated economic/environmental tradeoff analysis, reviewing 2,531 pest management strategies representing the practices of 891 growers on around 35,000 acres of walnuts in the counties of San Joaquin, Stanislaus, and Merced over the years 2002-2006. The environmental Impact Quotient (EIQ) model (Kovach et al., 2007) was used to estimate the likely risk to water quality. The water quality impact and cost of each pest management strategy was compared to that of a hypothetical alternative strategy composed of lower risk products considered by experts to be effective in controlling the same pests. The comparisons were run first under an assumption that the use of low risk products allows biological control to replace the need for miticide, and then under the assumption that a miticide would still be needed. The strategies whose costs did not increase upon lowering risk were then characterized in terms of their current pesticide use. This characterization allowed for identification of the traits of pest management strategies with the greatest likelihood of decreasing water quality impact with little economic consequence. A second analysis was then done to evaluate a key assumption of the tradeoff model: that the use of low risk products can decrease the need for miticides, possibly as a result of improved biological control. We analyzed California walnut grower data to determine if the number of mite treatments was reduced when pesticides harmful to mite natural enemies were avoided.

Favorable/unusual developments: The climate change sub-project initially planned to base the model solely on field collected data from 11 walnut orchards in the Central valley. However based on an extensive review of the literature concerning methodological advances, the scope of the winter chill analysis was able to be greatly expanded via an automation of the data processing using temperature records from 190CIMIS weather stations throughout California. This favorable development allowed for a much better estimate of winter chill dynamics throughout the entire state. In contrast, the results of a comprehensive data search involving literature review, expert consultation, government and other web sources lead to the conclusion that the initial scope of the economic tradeoff model was not viable, due to limited available information of sufficient quality at the time. Thus the initial model scope which included multiple environmental concerns and a translation of environmental impact into a societal cost metric was scaled back to a focus on surface water quality and a more accurate environmental impact unit-less metric.

Goals- The performance goals of the project were to provide important information to walnut growers and other interested stakeholders on economic, environmental, and climatic effects of agricultural and pest management practices in both the short run and the long run. The expected measurable outcomes defined in the initial proposal included the distribution of brochures presenting results in an easy to comprehend format and outreach to growers and other stakeholders via publications and meetings. It was estimated a minimum deliverable of 4 journal articles and 6 magazine/newsletter articles. Currently UCD published 6 peer reviewed journal articles, with one in progress, and over 50 articles, blogs, and summaries of the project work via a diverse range of organizations, including many local grower and commodity sites, environmental non-profits, scientific research based sites, as well as many high impact news sites with wide distributions such as the LA Times, the San Francisco Chronicle, and Fox News.
Similarly, the outreach has exceeded the minimum estimate of four meetings, with 9 presentations completed to a wide range of stakeholders.

Results/Conclusion – Results from the climate change sub-project fall into the following three categories: 'Identification of best model tool to estimate chilling needs, 'Prediction of future available chilling', and 'Prediction of future walnut pest generations'. The take home points are as follows:

- It is recommended that California walnut growers adopt the Dynamic Model of chill portions as their standard method for estimating winter chill. The commonly used Chilling Hours Model appears to overestimate the chilling decline as climate gets warmer. Chilling Hours and Chill Portions tools can be found at http://fruitsandnuts.ucdavis.edu/Weather_Services/Cummulative_Chilling_Models.htm. When using the Dynamic Model, the chilling requirement of most walnut cultivars appears to be around 60 to 70 Chill Portions.
- The study found that winter chill declined substantially for all emissions scenarios, with the potential growing area for many tree species or cultivars decreasing 50–75% by mid-21st century, and 90–100% by late century. The tree crop industry in California will likely need to develop agricultural adaptation measures (e.g. low-chill varieties and dormancy-breaking chemicals) to cope with these projected changes. For some crops, production might no longer be possible.
- In the Central Valley, the number of codling moth generations predicted for degree days accumulated between April 1 and October 1 rose from 2–4 in 1950 to 3–5 among all future scenarios. Generation numbers increased from 10–18 to 14–24 for two-spotted spider mite, from 9–14 to 14–20 for European red mite, and from 2–4 to up to 5 for navel orange worm. Overall pest pressure can thus be expected to increase substantially. More information on the impact of climate change on complex agro ecological food webs and on the response of pests to high temperatures is needed for improving the reliability of projections.

Results from the water quality sub-project fall into two main categories: 'Pest management strategies with least likelihood of economic tradeoffs to lowering water quality impacts', and 'Relationships between uses of pesticides known to be harmful to natural enemies and use of miticides'. The take home messages are as follows:

- 96% of the pest management strategies analyzed were candidates for reducing the impact on water quality. Replacement of current pesticides by alternative pest controls lowered probable impact, but resulted in an economic tradeoff in the form of higher costs for the majority of growers. If biological control could eliminate the need for miticides and aphicides, this tradeoff could be replaced by savings for nearly half of the sample analyzed. This cost savings would most likely be realized by growers who currently have low numbers of pests that are not candidates for biological control, and relatively high use of organophosphates and miticides. The results indicated that if these pest management strategies had been replaced by alternative strategies and biological control, then total organophosphate, pyrethroid, and miticide active ingredient use would have been reduced by an average of 4.5 lbs/acre per year, while simultaneously lowering the grower's pest management costs by an average of $52/acre, thus contributing to both economic and environmental long-run sustainability.

- There was a significant difference in use of miticides between sites with and without use of harmful pesticides, with the probability of miticide use being greater with use of a harmful pesticide. Fifty percent of the sites with at least one harmful pesticide application used miticides, compared to only 20% for sites without use of harmful pesticides. Sites with lower numbers of harmful applications had significantly fewer miticide treatments than those with higher numbers. Finally, the number of miticide treatments was reduced when growers refrained from using harmful pesticides early in the season. UCD concluded that while there is evidence that pesticide selection, application numbers and timing can assist in the implementation of biological control as an effective BMP, further research is greatly needed on the impacts of various pesticides on natural enemies

Outreach:

- Newsletter: Color 8 page newsletter, to be sent to approximately 3500 walnut growers in the counties of Butte, Colusa, Contra Costa, Fresno, Glenn, Kings, Lake, Madera, Merced, San Benito, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Tulare, Yolo and Yuba in October 2010
- Peer reviewed journals: 7 papers
- Presentations/workshops/outreach: 10
- Articles/Blogs/Online References: 50+

Additional Assessments-

Project Accomplishment	Beneficiary
Finding that the Dynamic Model is a better tool for growers to estimate winter chilling requirements	California Walnut Growers, Other Orchard Crop Growers
Understanding that chilling requirements may not be met in the future	Ultimately walnut and other orchard crop grower via spurring future research toward breeding of better suited cultivars, research toward management techniques to adjust for decreasing chill.
Understanding that pest generations will likely change and pest pressure may increase	Ultimately walnut and other orchard crop growers spurring research toward better understanding of life cycle dynamics/environment needs of pest and natural enemies.
Understanding of water quality impacts of commonly used walnut pesticides	California Walnut Growers, farm advisors, PCAs, policy makers
Understanding of role effective biological control can play in making low risk pest management affordable	Ultimately walnut and other orchard crop growers via spurring future research toward applied research focusing on the use of biological control to meet the needs of growers

The team conducting this project merged many groups of highly competent researchers and outreach experts together very successfully; therefore, were able to tap on all of our extensive project management skills to leverage data, expertise, and complementary projects to expand the initial scope and goals of the proposal. As often occurs, though, the iterative process of the research required modifications to specific aspects of the scope, such as the data limitations that were found to be significant in the area of determining societal costs of environmental impact. Overall, however, the diverse skill sets present at the collaboration table made it possible to meet these limitations early and modify approaches to meet the purpose of the project, as well as expand the scope in many areas.

Project Contact:
Minghua Zhang, Principal Investigator
University of California, Davis
One Shields Avenue
Davis, CA 95616
Email: mhzhang@ucdavis.edu
Phone: (530) 752-4953

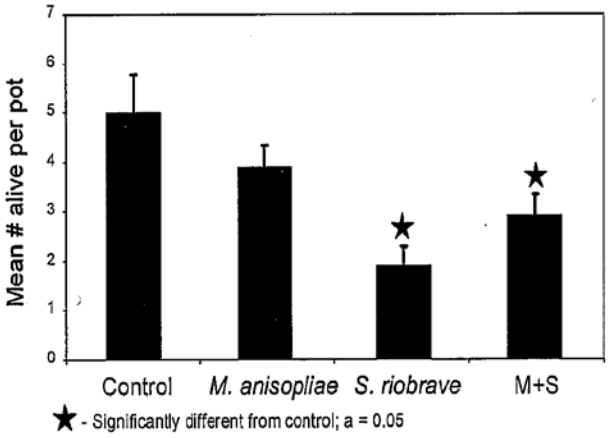
9. *University of California, Davis (UCD)- Control Tactics for Diaprepes Root Weevil*

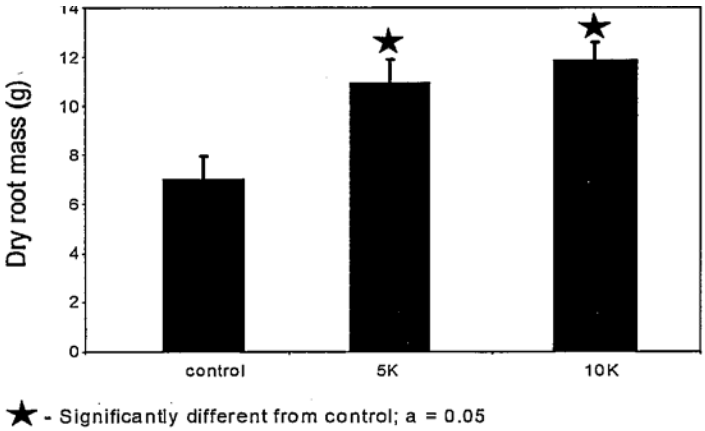
Grant Funds Expended – UCD was awarded $76,175. $75,959.85 was expended. The remaining $215.15 was redirected to CDFA, Federals Funds Management Office to cover project management cost. CDFA discussed the redirection with USDA; however, the amount redirected was under the (20%) needed to obtain prior approval; therefore, no formal amendment was required.

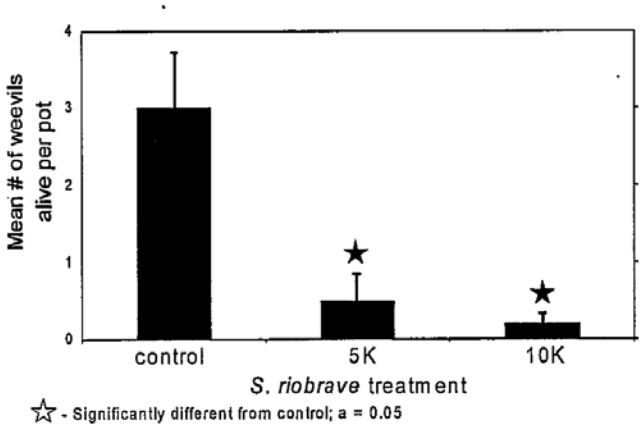
Project Summary – *Diaprepes abbreviatus* is a Caribbean weevil that invaded portions of San Diego, Orange, and Los Angeles Counties. This weevil is a serious pest in ornamental plant nurseries that are required by law to sell plants that are pest-free. Approximately 38% of all ornamental nursery production in California occurs in these three counties, and the production value was approximately $836,000,000 in 2005. As of May 1, 2007, three nurseries were within *Diaprepes* quarantine areas, and one nursery was positive for *Diaprepes.* Quarantined nurseries are required to apply a pyrethroid insecticide combined with one of two commercially available nematodes to meet cleanliness standards set forth by the State. Unfortunately, the recommended insecticide belongs to a class of insecticides currently under EPA review because of water run-off issues, and its use in the future may be eliminated or severely restricted. Therefore, new management programs for *Diaprepes* in ornamental plant nurseries are needed. We propose to investigate alternatives to pyrethroid insecticides, including conventional, organic, and biologically based products. The testing will be done in three stages and include laboratory and field testing. Successful management programs will be submitted to State regulators for approval. If accepted, the programs will be made available to nurserymen.

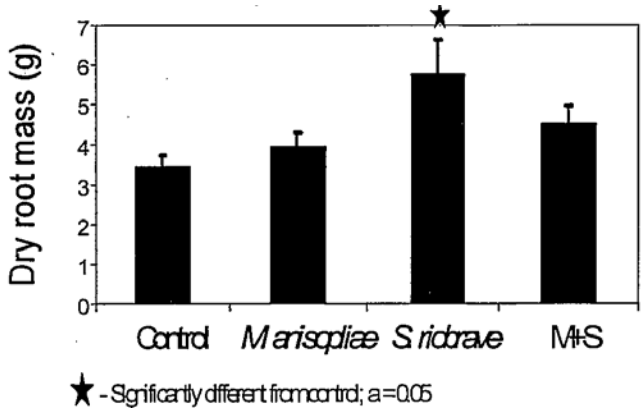
Approach-
A series of trials continues to test biological control agents against the citrus root weevil. These trials are mostly complete, and we are just conducting the final necessary trials to produce publication-quality data that are reliable enough for growers to trust. We have broken down the trials into three different classes: straight efficacy trials in nursery conditions, effects of components of potting mixes on entomopathogenic nematode efficacy against weevil larvae and the effects of substrate conditions on entomopathogenic nematode survival within nursery pots.

Efficacy Trials
A series of trials tested 2 biological control agents; entomopathogenic nematodes and the entomopathogenic ungus *Metarhizium anisopliae.* Several trials have been completed and data have been collected and presented below, on both insect survivals (the two graphs on the left) and root mass of the plants (graphs on the right) in. the containers. In this set of experiments, UCD compared one entomopathogenic nematode formulation at two concentrations, one formulation of an entomopathogenic fungus and a treatment that combined the two. The data are represented below.



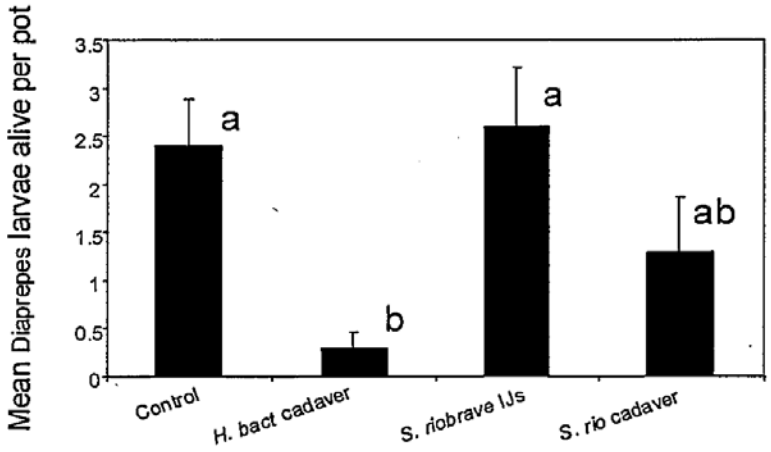






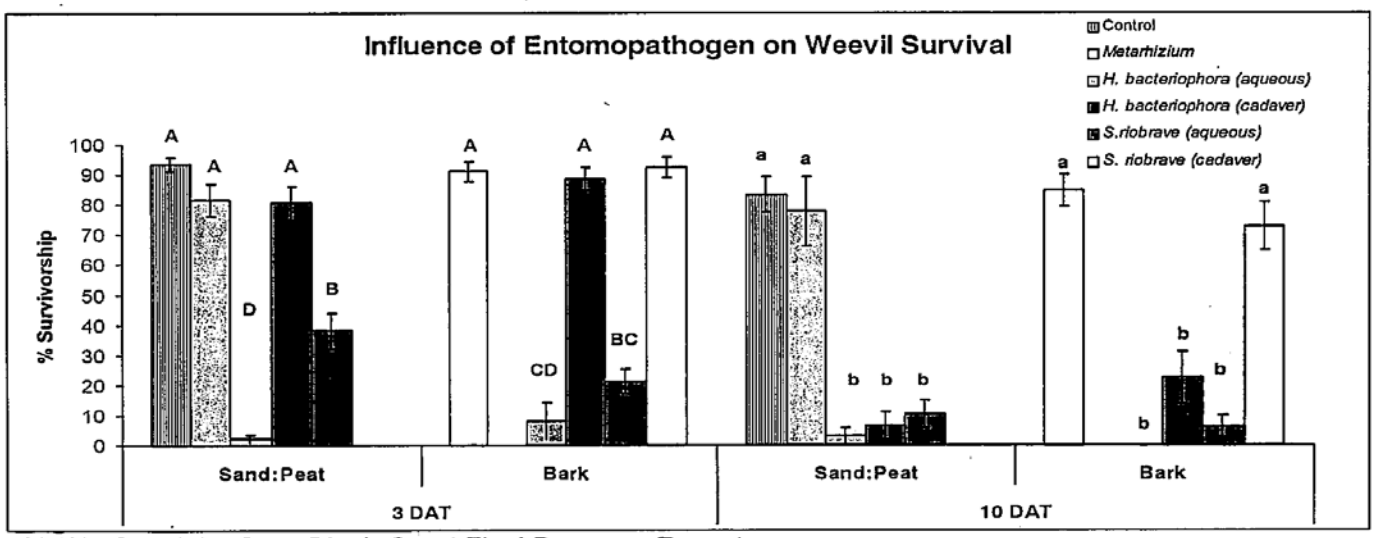
UCD also tested new formulations of entomopathogenic nematodes. The formulations are based on applying entomopathogenic nematodes while still inside the cadavers of their hosts, in this case *Tenebrio molitor.* This formulation has become commercially available, and is for sale by Southeastern Insectaries, Inc. In this trial, three treatments were compared with the control; 15,000 S. *riobrave* infective juveniles, two *T. molitor* cadavers infected with S. *riobrave* per pot and two *T. molitor* cadavers infected with *H. bacteriophora* per pot. After 8 weeks, surviving larvae were counted.

Survival of weevils is presented to the right. The best control was provided by the *T. molitor* cadavers infected with *H. bacteriophora.* This is especially interesting, because this species of nematode has proven not very effective when they are applied as infective juveniles in water. We are suspect of the S. riobrave adaver data because two of the pots had 5 larvae surviving which made the mean survival much higher. We suspect that some of these cadavers may not have been infected, thus no IJs were released into the pot. The cadaver application method is also proving effective from the aspect of residence time in the pots; when the pots are watered daily, IJs can be washed from the soil, but if the cadavers are producing IJs daily, then this problem is negated.



Effects of components of potting mixes on entomopathogenic nematode efficacy against weevil larvae
The efficacy of the EPNs against weevils under greenhouse conditions were evaluated using an alternate host, the black vine weevil, *Otiorhynchus sulcatus,* due to quarantine restrictions regarding Diaprepes. Weevil larvae were reared in our laboratory and evaluated at 6-8 weeks of age. Seven weevil larvae were placed in each pot containing green bean seedlings and allowed to feed for 3-4 days. Only the bark and the peats and potting mix were tested because of low persistence in the sawdust media. Treatments included *H. bacteriophora* and S. r*iobrave,* both applied as either drench or cadaver formulation and *Metarhizium anisopliae* (applied as soil drench). At 3 days after treatment (OAT) and again at 10 OAT, pots were destructively sampled and the number of surviving larvae was counted. Larvae were held for three additional days to allow nematode infection to become apparent. Larvae believed to be infected with EPNs were then dissected to confirm infection.
Data analysis: The number of infected/alive recovered weevils was corrected for control mortality using Abbott's calculation. This survivorship data was then arcsin transformed an analyzed with a nested ANOVA. Post-hoc tests were done with a Tukey's mean comparison. Data are presented as untransformed mean ± EM.

Results: indicate a significant interaction between entomopathogen and potting media type (3 OAT: $F_{g,158} = 65.18$, *P<0.0001;* 10 OAT: $F_{g,142} = 35.78$, *P<0.0001).* At 3 OAT, the aqueous drench application for both species had higher weevil mortality than either the untreated controls or the cadaver application in both potting media. . At 3 OAT there was a significant effect of media and treatment (df=3, *P=0.037)* with weevil mortality highest after infection with *H. bacteriophora* in the sand: peat media. However, both aqueous applications in both media types were significantly different than the other treatment/media combinations. By 10 OAT, the aqueous application of S. *riobrave* in bark media and the aqueous and cadaver formulation of *H. bacteriophora* in both bark and peats and media were all significantly different from the control and resulted in >80% weevil mortality. Entomopathogenic fungi, M. *anisopliae* caused minimal mortality of O. *sulcatus* as did the cadaver application of S. *riobrave.*



CDFA- Specialty Crop Block Grant Final Progress Report

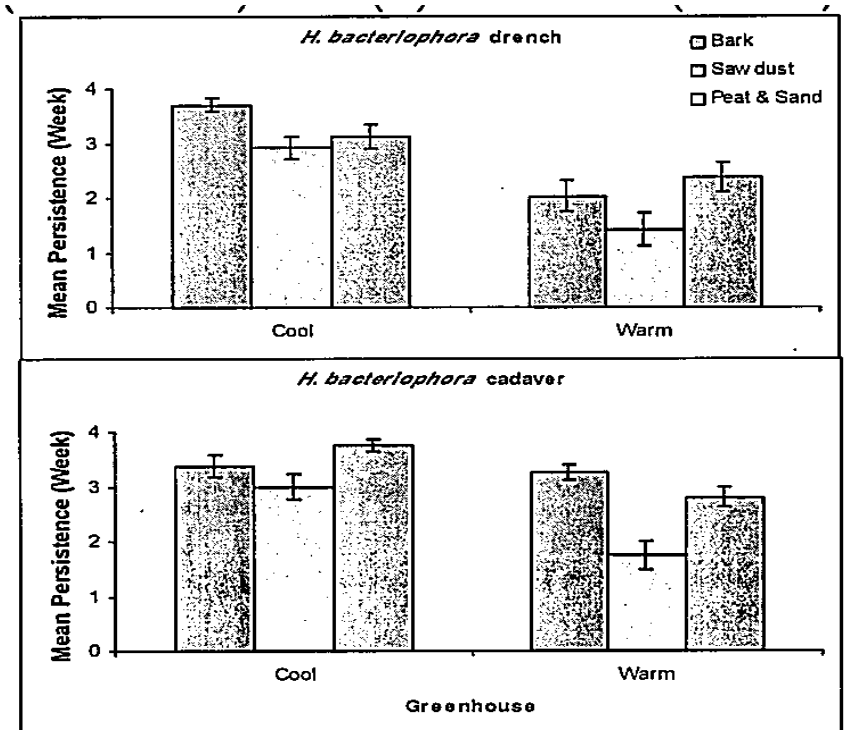
Effects of substrate conditions on entomopathogenic nematode survival within nursery pots The residence time of entomopathogens in the soilless media has been analyzed more thoroughly. Interesting differences appeared between entomopathogen species and soilless media, so work has been extended to look at the impacts of soilless media on foraging efficacy and behavior. We have conducted small trials comparing EPN application to efficacy in selected soilless media against weevil larvae.

Effect of Soil-less Mix and Watering Regime on Entomopathogen Persistence Time and Mortality of weevils:
The objective in this set of experiments is to optimize the retention of insect pathogens in potted nursery stock. We set out to test the residence time of 5 formulations of pathogens in 3 different potting media under 3 watering regimes (all treatments are described in the methods).

Persistence

Methods: *Tenebrio molitorwere* inoculated with 600 IJs of either S. *riobrave* or H. *bacteriophora* Oswego for the cadaver treatments. For the aqueous treatment, *Galleria* larvae were infected 10 days prior to treatment and IJs were collected with White traps. *Metarhizium* treatments were applied at recommended label rate as an aqueous solution. All aqueous treatments are applied as a soil drench in 50ml of dH_20. One gallon pots were filled with either (1) Bark (Monrovia) Mix (2) Sawdust (Hines) Mix (3) Peat: Sand (UC) Mix. All pots were watered thoroughly prior to treatment.

Pots were treated with one of the following treatments: a) *Heterorhabditis bacteriophora* Oswego aqueous solution [10,000 IJs] b) *Hb* cadaver [2 infected insects] c) *Steinernemariobrave* aqueous solution [10,000 IJs] d) *Sr* cadaver [2 infected insects] e) *Metarhizium anisopliae.* Pots were not watered the day after treatment. After treatment with entomopathogens, three watering regimes were evaluated: every day, every other day, no water for 3 days after treatment and then resume normal with DI water. Pots were placed in a complete randomized block design prior to treatment, with watering regime being the block factor. A total of 366 pots were tested per replicate, which breaks down into 120 per soil type and 72 pots per treatment.



At 7,21, 28, and 35 days after treatment, 2 soil cores (1" size) were taken from each pot for a total volume of 45ml. Soil was placed into a 50ml centrifuge tube and baited with two last instar *Galleria.* Baited samples were held for 7 days to establish infection. After the 7 day period, *Galleria* was evaluated for entomopathogens. For the EPN treatments, the *Galleria* larvae are dissected to confirm presence of infection. If either *Galleria* is positive for nematode infection, the sample was considered positive. The *Metarhizium* treatments were

evaluated for infection at 7 days by presence of conidia consistent with *Metarhizium.* When necessary, infections were verified by observing conidia under phase contrast microscope.

Results: Experimental results suggest that entomopathogens behave differently in various potting media types. Interestingly, there was no effect of watering regime on the entomopathogen treatments. The experiment was run in two greenhouses that averaged 68°F (cool) and 89°C (warm) and significant differences between the EPN treatments in each greenhouse occurred. Generally, persistence was decreased by week 4 in the warmer greenhouse. The EPN species *Heterorhabditis bacteriophora* (Oswego strain) and *Steinernema riobrave* were applied in both the aqueous and cadaver formulations. In the bark mix, persistence was highest for drench application of *H. bacteriophora* under cool conditions and cadaver formulation in the warmer environment. The peats and mix had the highest persistence of *H. bacteriophora* cadavers under cool conditions and drench application under warm conditions. For both application methods, persistence was low in the sawdust media. The EPN species *Steinernema riobrave* was also tested for persistence in the three potting media. In general, S. *riobrave* did not persist as long as *H. bacteriophora* and did not have high persistence in the cadaver formulation. At week 4, the peats and mix was best suited to drench application of S. *riobrave* under cool conditions. Under warm conditions, the bark mix supported greater persistence of the nematodes. The cadaver application of S. *riobrave* had extremely low persistence, with no positive samples at the end of the experiment, regardless of potting mix. This suggests that S. *riobrave* cannot reproduce efficiently inside the Tenebrio cadaver. For both EPN species the bark and peat sand mixes had higher persistence than the sawdust mix. The effect of potting media was not as strong for
Metarhizium anisopliae compared to the EPN treatments because it is a non-motile organism. Movement of M*etarhizium* through a pot is a result of either formation of hyphae or movement of spores through irrigation. Thus, *Metarhizium* persisted well throughout the four week trial in all media types, although it was highest in the sawdust media
The water potential was also measured as being completely saturated, after pots were watered until dripping and allowed to dry in the greenhouse for 24 hours.

Physical Characteristics of Soilless Media

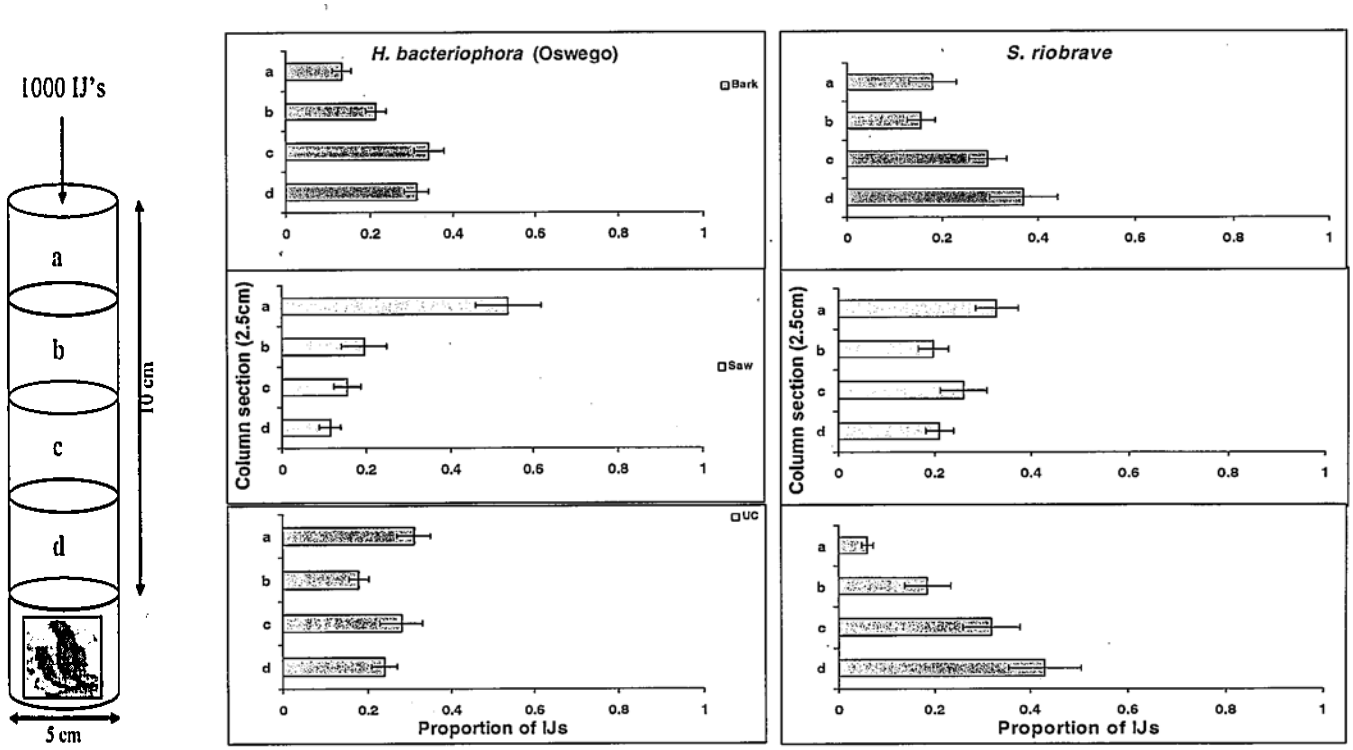
	pH (H_2O 1:5)	EC (H_2O 1:5) dS/m	N (Total)	C (Total)	Ash Content	OM
Bark	6.5	0.3	0.69	22.1	57.2	12.82
Sawdust	5.6	<0.1	0.06	27.6	41.3	15.98
Peat:Sand	8.0	<0.1	0.05	1.6	94.5	0.91

Particle Sizes of Soilless Media

Media Type	Very Fine ≥0.053 mm	Fine ≥0.106 mm	Medium ≥0.25 mm	Course ≥0.50 mm	Very Course ≥1.0 mm	Large Material ≥3.96 mm
Bark	5.89	10.81	9.96	10.88	15.78	32.25
Sawdust	0.91	5.91	14.68	23.14	35.83	6.31
Peat:Sand	3.53	13.04	25.48	27.28	14.36	2.12

Data analysis: Soilless media samples were sent to the UC Davis Analytical Laboratory for physical characteristics. Persistence time for each pot was determined as the number of positive samples over the four week period. Data were analyzed using the Kaplan-Meier survivorship statistic. Data are presented as mean ± SEM. Watering regime had no effect, so we group treatments by potting media tested.

Foraging Efficacy



Commercial Mixes. The results from the persistence trials indicate that the sawdust media is not a favorable environment for entomopathogenic nematodes.

Researcher were curious as to whether or not this was because the nematodes were washed out of the media, desiccated faster, changed their behavior, or could not forage efficiently. Researchers tested the last aspect to see if the nematodes were inhibited from foraging for a host. To stimulate foraging in the soil column, Researchers employed a 10cm PVC column that is divided up into four 2.Scm sections. Three *Galleria* larvae are situated at the bottom of the column to provide a host cue, beneath a fine mesh screen so that the nematodes cannot penetrate, and 1000 EPNs are added to the top section. After foraging for three days, the column is taken apart and nematodes extracted from each column. The theory behind this is that if the nematodes can forage normally in the potting media, they will at minimum be dispersed evenly through the different sections. If the nematodes cannot forage normally, they will remain concentrated in the top section.

The results of this experiment clarify and support the results from the persistence assay. For *H. bacteriophora,* the IJ's are found in significantly higher numbers in the lower two column sections (meaning they traveled the furthest) for the bark mix. They are evenly distributed throughout the peats and mix. However, for the sawdust mix, a significantly higher proportion of IJ's were found in the top 2.Scm of the column, indicating that the nematodes did not move efficiently through this media type. For S. *riobrave,* the IJ's also moved well in the bark mix as well as the peats and mix, with significantly higher numbers found in the lowest column section. An even distribution of IJ's was observed between all column sections for the sawdust mix, suggesting that they could "forage through the media, but at a slower rate than in the other media types. Species-specific differences between foraging behavior in each of the potting media types were apparent.

Data analysis: The proportion of IJ's found in each column section was arcsin transformed and analyzed with a one-way ANOVA. Post-hoc tests were done with a Tukey's mean comparison. Data are presented as untransformed mean ± SEM.

Individual Media Components: Based on the results above, we wanted to further investigate the role of each individual component in potting media. This will identify components that slow down nematode foraging or inhibit it altogether, to develop customizable potting media mixes, depending on 1) plant requirements and 2) biological control tactic. Using a modified method as above, we tested peat, cedar/pine bark, redwood sawdust (with and without bark), recycled plant materials (partially composted), vermiculite, perlite, and sand. Each component was evaluated alone and with either 25% or SO% sand (v/v). Materials were moistened from 20-S0%, or until it formed a “ball.” Sand was moistened to 10% (v/v). In this trial, nematodes were allowed to infect the G. *mellonella* host at the bottom of the column as a measure of viability following movement through the material. An attraction index was developed to calculate the average distance each nematode travelled in the 10cm column. The number of live nematodes in each section was counted and an "attraction" index was calculated which determined the average distance a nematode travelled per column:
((1.2S*a) + (3.7S*b) + (6.2S*c;:) + (8.7S*d))*N-1

Where the values a, b, etc. represent the number of nematodes in that particular section and the average distance in each section, and "N" is the total live nematodes per column. The distance travelled was analyzed using one-way analysis of variance (AN OVA), followed by Tukey's HSD for mean comparison. Data are presented as untransformed mean ± SEM.

Results: Entomopathogenic nematode, S. *riobrave* was evaluated for this study (tests of *H. bacteriophora* Oswego are ongoing). There is a significant effect on the distance S. *riobrave* travelled toward a host of the media and sand mixture (0, 25 or 50%) ($F_{21.160}$=18.67, *P<0.0001).* Nematodes travelled the furthest in 100% sand, the most suitable media for nematode foraging. Recycled plant material and peat moss (with or without sand) did not significantly differ from sand, as well as vermiculite mixed with sand. Individual components of cedar/pine bark, redwood sawdust (with and without bark) and perlite significantly reduced nematode foraging distance. Generally, addition of sand increased the foraging distance. These results support our previous results that redwood sawdust inhibits EPN survival (persistence) and foraging.

Media Salinity. In managed systems where irrigation and fertilization are common and frequent, soil salinity can pose significant problems for biological control agents. Soil salinity is so important to nematode movement because EPNs are obligate endoparasites of insects that move through the soil on the later film in the pore space between soil particles. IJs locate hosts through CO_2 and other host volatiles (feces and temperature), indirect cues from host feeding, electromagnetic fields and vibration. IJs have species-specific foraging strategies ranging from "cruiser" to "amushing." Cruiser nematodes move through the substrate to locate hosts and are efficient at controlling stationary larvae below-ground. Ambushing nematodes use a sit-and-wait strategy and can control insects that move on the substrate surface. Salinity is known to affect survival, movement capability and infectivity of EPNs.

Although survivorship and infectivity were generally unaffected by high salinity conditions, high levels of salinity inhibit S. *riobrave* foraging through soil. In our study, the foraging response of *H. indica* and S. *riobrave* were similar as both travelled significantly shorter distances through sand saturated with high levels of salt (30 and 50 dS/m). Under more saline conditions, movement towards a host cue (G. *mel/onel/a)* was inhibited for *H. indica* but not for S. *riobrave.* This response appears to be caused by disruption of orientation cues. In absence of a host cue, when individual nematodes were videotaped during short-term exposure to high EC levels (50 dS/m), velocity and distance decreased while meander of *H. indica* increased. This suggests that *H. indica* cannot move as quickly and moves mostly in a circular pattern (meander). The same result was not observed for S. *riobrave,* which indicates species-specific differences in the response to environmental cues. Differences

in response of S. *riobrave* in the foraging efficacy versus the behavioral bioassays suggests that in an applied setting (which the column bioassay mimics), foraging of S. *riobrave* is inhibited by high levels of salinity. This could be due in a large part to the longer exposure during the foraging efficacy bioassay. Integration of these nematode species into commercial applications is possible for control of solid welling pests such as *D. abbreviates;* however a good match between soil salinity and biological control agent is necessary and can be determined by soil testing prior to application.

Goals – The purpose of this project is to investigate methods of controlling *D. abbreviates* larvae in ornamental nursery stock that are consistent with regulatory needs (i.e., producing nursery stock that is free of pests) and with the needs of insecticide resistance management, air and water cleanliness standards, and sound business practices. Specific goals are outlined below.

Preventative Pest Management Program
1. Identify insecticidal products (conventional, biological and bio-based) that either alone or in combination will prevent neonate (first instar), and provide control for larvae up to the third instar from establishing in potted nursery plants.
2. Identify insecticidal products that will result in the death of adult weevils after feeding on treated foliage, and/or causes the adult weevils to avoid feeding on treated foliage.
Curative Pest Management Program
3. Identify the combination of insecticidal products that will eliminate large (6th - 8th instar) larvae from potted nursery plants.
Cultural Variables
4. Determine the effects of soil type and watering regimes on the successful combinations of insecticidal products found in Goals 1-3.

Results/ Conclusion- The results and conclusions are detailed above under the project approach section and illustrated in charts and graphs.

Additional Assessment- Presentations at Scientific Meetings: Spence, K.O., Lewis, E.E., Bethke, J. and Kaya, H.K. Potential for biocontrol *of Diaprepes abbreviates* larvae in nurseries in southern California. Presented to the 41 st Annual Meeting of the Society for Invertebrate Pathology and 9th International Conference on *Bacillus thuringiensis.* August 3-7, 2008

University of Warwick, Coventry, United Kingdom. Nielsen, A L., K. O. Spence, D. Bruck, E. E. Lewis. "Persistence and efficacy of entomopathogens in potting media" 2009. Soc. Invert. Path. Park City, UT.

Publications: Nielsen, AL., K.O. Spence and E.E. Lewis. 2008. Efficacy patterns of biopesticides used in potting media. Biopesticides International. 4: 87-102.

Two manuscripts are in preparation for submission: Nielsen, A, Spence, K.O. and Lewis, E.E. Effect of soil salinity on entomopathogenic nematode survivorship and behavior. For submission to Biological Control.

Nielsen, A., Spence, K.O., Bruck, D. and Lewis, E.E. Designing potting media to enhance persistence of entomopathogens for biological control of root pests. For submission to the Journal of Invertebrate Pathology

Project Contact:
David Ricci, Principle Investigator
University of California, Davis
One Shields Avenue
Davis, CA 95616
Email: fdricci@ucdavis.edu
Phone: (530) 747-3917

10. University of CA, Davis (UCD)- *Detection/ Management of Tomato Yellow Leaf Curl Virus (TYLCV)*

Grant Funds Expended – UCD was awarded $80,412. $39,802.47 was expended. The remaining grant balance was $40,609.53. CDFA notified USDA, AMS about the remaining grant funds (amendment 3) and reallocated a portion of the funds ($25,042) to Project 15, Public Outreach on California Invasive Species" and $14,845 to Project 16, CDFA's Australia Trade Mission. The remaining $722.53 was redirected to CDFA, Federal Funds Management Office to cover project management cost.

Project Summary – The whitefly-transmitted geminivirus, *Tomato yellow leaf curl virus* (TYLCV), causes a damaging disease in tomatoes. Once found only in the Old World, TLCV has now spread into the New World and is causing losses in tomato production. In March 2007, the virus was detected in Brawley, California. Since TYLCV is not seed-transmitted, it is believed that the virus was introduced via virus-carrying whiteflies. TYLCV causes yellow leaf curl disease in processing and fresh market tomatoes, causing severely stunted plants, upcurled leaves with interveinal yellowing, premature flower drop, and severely reduced or no fruit set. In fields with plans infected at an early stage of plant growth, complete yield loss can occur. The virus is spread by the sweet potato whitefly (*Bemisia tabaci* biotype B), which can remain viruliferous throughout its entire lifecycle. Since the virus can be acquired and transmitted by whiteflies quickly, the whitefly vector can rapidly spread the virus over broad geographical areas. Fortunately, the virus is not seed-transmitted nor can it be spread by physical contact. Long-distance spread is primarily through movement of infected plants (e.g., tomato transplants) or virus-carrying whiteflies moved in association with plants.

Tomato growers and processors will need to know how to manage this disease in California, if it does become established, in order to prevent widespread crop losses. Research can provide the information needed to develop effective control and management strategies. Current unknowns include the geographic range of the whitefly vector, the extent of TYLCV spread in California, identities of reservoir host species (weeds and crops) for the virus, and whether currently available commercial tomato varieties with TLCV resistance may be suitable for California production.

Approach – The project proposed to establish and conduct a monitoring program for TYLCV and for the insect vector, *Bemisia tabaci*, in the three counties that are near Imperial County and are likely to experience secondary disease outbreaks. The project monitored representative tomato fields for potential outbreaks of TYLCV by conducting visual surveys. Monitoring was performed in cooperation with local farm advisors. Representative fields were surveyed according to a standard procedure in which five locations were examined (the four corners and center of the field) and, at each location, plants in 5 thirty foot rows (10 paces) are visually examined for TYLC-like symptoms. These surveys were done at monthly intervals beginning May through September; and, an "off season" survey was conducted in January.

During the surveys, samples were collected from any plants showing TYLCV-like symptoms and DNA extracts prepared from leaves of those plants using a modified Deallporta method. These DNA extracts were used in PCR tests with a degenerate primer pair that would allow for detection of any whitefly-transmitted geminivirus and a TYLCV-specific primer pair. If a sample was found to be positive for the virus based on either one of the PCR tests, then the DNA sequence of this PCR-amplified DNA fragment was determined to confirm the nature of the virus infecting those samples. This allowed the ongoing efforts to survey for TYLCV in Imperial County and facilitate rapid detection of any secondary outbreaks of the disease in Southern California.

The aim of the field trials was to assess the adaption of reportedly TYLCV-resistant tomato varieties to the hot day/warm night temperatures and low humidity typical of the major tomato growing regions of the California Central Valley, to determine which varieties may be suitable for use by California tomato growers. The plan was to conduct field trials in summer of 2008 to determine which varieties were potentially most adapted to California production. The most promising varieties from 2008 were to be evaluated again in summer of 2009

to verify results of 2008; each variety was also to be tested for TYLCV resistance. The results were to be used to determine which varieties may be most suitable to recommend to California tomato growers.

The project would assay tomatoes and potential TYLCV reservoir hosts for susceptibility to the virus using a vector-independent inoculation method, referred to as agroinaculation. The work would be done in two parts: 1) evaluation of tomato varieties, and 2) evaluation of potential reservoir hosts. The varieties to be tested include some of the processing and fresh varieties that are currently being grown in California. Varieties that show TYLCV resistance can be considered for possible use by growers in California if TYLCV becomes established. The project would also assay the relative susceptibility of potential reservoir hosts, including other crops and weeds, as permitted. As reservoir hosts often do not show obvious disease symptoms, all plants were tested for TYLCV infection by the PCR assay with the TYLCV primers. These results would help establish which plants have the potential to serve as TYLCV reservoirs, thereby potentially serving as a bridge for the virus in the absence of tomato plants.

Goals- The project was initiated in January 2008, with the start of the new tomato season. The four goals of this project were:

Goal 1: Monitor presence of TYLCV in tomato fields and greenhouse-grown tomatoes in Southern California and Southern Central Valley in collaboration with UC Cooperative Extension advisors and tomato growers.

Goal 2: Monitor for the presence of the whitefly vector of TYLCV, *Bemisia tabaci* biotype B, In the Southern Central Valley to determine locations of the northern-most field populations, and whether adult insects are carrying TYLCV.

Goal 3: Conduct field trials with TYLCV-resistant tomato varieties developed for other countries/production areas to determine adaption to California growing conditions.

Goal 4: Screen selected tomato varieties for response (susceptibility or resistance) to the isolate of TYLCV introduced into California, in growth chambers using a vector-independent inoculation method. Using the same inoculation method, evaluate potential reservoir host species for TYLCV (e.g., weeds and other crop plants) for susceptibility to this isolate of TYLCV

Results/Conclusion- ***Results (Goal 1):*** TYLCV surveys were conducted in tomato fields and homeowner gardens in 2008 and 2009 in the Imperial Valley in collaboration with UC Cooperative Extension and the Imperial Valley county Agricultural Commissioners' Office. In both years, TYLCV was detected in tomatoes from home gardens. In 2008, TYLCV symptoms were observed in 2 of three commercial fields (survey conducted 25-26 June) and infection was confirmed with the PCR test and DNA sequencing results. The incidence was high in both fields (>50%). In addition, TYLCV infection was also found in a late-planted tomato field in Riverside County and in a single plant in a late-planted fresh market field in Merced County.

In 2009, surveys were conducted in the Imperial Valley early (April 16-18) and later (June 17) and in the season. In the early season survey we also inspected tomato transplants at a local retail store and a transplant operation, and observed no evidence of TYLCV infection and very few whiteflies. We then surveyed three commercial tomato fields. Whitefly populations were low in these fields. A single plant with TYLCV symptoms was found in one of these fields, and TYLCV infection was confirmed in this plant. No TYLCV symptoms were observed in the other two fields. A survey was then conducted in Riverside County of a sizeable fresh market planting along the Salton Sea. Few or no whiteflies were observed and no obvious TYLCV

In 2009, researchers developed a rapid test for differentiating *Bemisia* and *Trialeurodes* whiteflies based on a PCR and a random amplified polymorphic DNA marker. (H16). In preliminary tests with known adult *Bemisia* and *Trialeurodes* whiteflies, this test allowed for the differentiation of adults of these two genera of whiteflies.

In 2009, surveys, as well as those by our collaborators, of tomato production in Colusa, Fresno, Kings, Merced, and Yolo Counties did not reveal whiteflies associated with the 2009 tomato crops. However, late season samples of whiteflies from Fresno County (colonizing melons and cotton) and Merced County (colonizing melons) were determined to be *Bemisia*, based on morphological analysis of the pupae and symptoms were seen. In the late season survey, samples with TYLCV-like symptoms were collected from 3 fields. The incidence of these symptoms was relatively low. However, TYLCV infection was confirmed in samples from 2 of the 3 fields. A third survey was conducted in March 2010 and two tomato plants from a field in Niland were found to be infected with TYLCV.

Extensive surveys of commercial tomato fields in Colusa, Fresno, Kings, Merced, and Yolo Counties conducted as part of a tomato spotted wilt project funded by the CTRI did not reveal TYLCV-like symptoms. Our collaborators in San Diego and Kern County also reported no TYLCV-symptoms in commercial tomato fields.

Results (Goal 2) UCD Surveys, and those by our collaborators, of tomato production in Colusa, Fresno, Kings, Merced, and Yolo Counties in 2008 did not reveal whitefly populations associated with the crop. Late season samples of whiteflies from Fresno County (colonizing melons) and Yolo County (colonizing wild sunflower) were identified as the greenhouse whitefly (*Trialeurodes vaporariorum*).

Whitefly, weed and non-tomato plants were collected in June 2008 in the Imperial Valley and all tested negative for TYLCV infection. *Bemisia* whiteflies and weeds were again collected in November 2008 from various location and sources in the Imperial Valley. TYLCV was detected in 2 of 6 samples of whiteflies and these were collected from cabbage and Wright's ground cherry. In addition, TYLCV was detected in samples taken from the weeds Malva and Wright's ground cherry.

results of the PCR test. On the other hand, a late season population of whiteflies colonizing wild sunflowers in Yolo County was determined to be *Trialeurodes*.

Results (Goal 3): *Background:* The currently available TYLCV-resistant tomato varieties are primarily adapted and developed for production areas in the Middle East, Northern Africa, and Europe. These varieties have not been tested under field conditions in the California Central Valley, which typically experiences high daytime and warm night temperatures, high light intensities and low humidity. Tomato varieties developed for other production environments may not perform well and may not produce high fruit yields under California field conditions. It is unknown which of the currently available TYLCV-resistant varieties may be adapted and suitable for California growers to use in their production fields. Genetic control of TYLCV with resistant varieties is the most economically and environmentally desirable control method for this and many other diseases.
Aim: The aim of the field trials for Goal 3 was to assess the adaptation of reportedly TYLCV-resistant tomato varieties to the hot day/ warm night temperatures and low humidity typical of the major tomato growing regions of the California Central Valley, to determine which varieties may be suitable for use by California tomato growers. The plan was for Dr. St. Clair to conduct field trials in summer of 2008 to determine which varieties were potentially most adapted to California production. The most promising varieties from 2008 were to be evaluated again in summer of 2009 to verify results of 2008; each variety was also to be tested for TYLCV

resistance. The results were to be used to determine which varieties may be most suitable to recommend to California tomato growers.

Methods: Variety trials to assess agricultural adaptation of diverse tomato varieties with differing maturities require a longer time period over the growing season for a thorough evaluation of agriculturally important horticultural traits than is feasible in a grower's field with a scheduled one-time destructive harvest. Therefore, variety adaptation trials are typically conducted at University of California (UC) experimental field stations that can provide the necessary longer time periods under production conditions suitable and typical for the crop.

Dr. St. Clair selected the UC Westside field station, which is located in the southern Central Valley west of Fresno where warm nights/ hot days and low humidity are typical in this major tomato production area of California. Dr. St. Clair requested field space at the UC Westside field station for summer of 2008, but the request was denied due to a drought, which caused a severely limited surface irrigation water allocation to the station. In 2009, Dr. St. Clair again requested field space, and space was granted, so field plans were made and set in motion. However, only a short time later, the 2009 allocation of surface irrigation water (high quality, low/no salt) was set to zero for Westside and surrounding areas due to the continued California drought. The available well water at Westside was too high in salts for establishment of tomato seedlings and transplants. The station could not guarantee sufficient quantities of high quality water for the tomato seedlings to become established (4-6 weeks post-transplanting), which would place the trial at high risk for crop failure.

*Results Summary***:** As a consequence of the continued drought, the field trials could not be conducted in either year (2008, 2009) due to a lack of sufficient high quality surface irrigation water at UC Westside field station.

Results (Goal 4) Screen selected tomato varieties for susceptibility or resistance to the isolate of TYLCV introduced into California, in growth chambers using a vector-independent inoculation method. Using the same inoculation method, evaluate potential reservoir host species for TYLCV (e.g., weeds and other crop plants) for susceptibility to this isolate of TYLCV.

An agroinoculation system was developed with the California isolate of TYLCV (an isolate of TYLCV-Israel). It was shown to be functional by inoculating susceptible tomato plants and *Nicotiana benthamiana*. We then obtained seed of 10 of the most commonly planted processing tomato varieties in California. These were then inoculated with TYLCV using the agroinoculation method. All 10 were highly susceptible to TYLCV (had the highest disease rating of 4). A susceptible control (cv. Glamour) was highly susceptible (rating of 4), whereas a known resistant variety (cv. Gempride) was resistant (rating of 0).

Overall, the project (goal 1) was able to effectively monitor the spread of TYLCV in Southern California in 2008–2009. Through surveys, TYLCV was detected in homeowner gardens and commercial tomato fields in the Imperial Valley of California in 2008 and 2009. In 2008, TYLCV symptoms were observed in 2 of 3 commercial fields and infection was confirmed with the PCR test and DNA sequencing results. The incidence was high in both fields (>50%). In addition, TYLCV infection was also found in a late-planted tomato field in Riverside County and in a single plant in a late-planted fresh market field in Merced County. A third survey was conducted and two tomato plants from a field in Niland were found to be infected with TYLCV. These results indicate that TYLCV is established in the Imperial Valley, but not at levels sufficient to have high populations of virus-carrying whiteflies. Surveys of processing tomatoes in Fresno and Merced County failed to reveal TYLCV-infected plants, except for a single fresh market tomato plant from a late-planted field in Merced

Goal 2- Rapid tests to detect TYLCV in weeds and whiteflies were developed and applied to show that the virus could be detected in whiteflies from Imperial County and in weeds. This indicates that the virus is persisting in certain weeds, especially those in the Solanaceae family. A rapid and quick test to differentiate *Trialeurodes* and *Bemisia* whiteflies was developed and helped show that *Bemisia* whiteflies are able to move north into some of the major tomato growing areas of California. This increases the chances that TYLCV could spread within tomato crops or into weed hosts if introduced with tomato transplants or whiteflies.

Goal 3- could not be completed. The UC Westside field station, which is located in the southern Central Valley west of Fresno where warm nights/hot days and low humidity are typical in this major tomato production area of California was selected for field trials. However, the surface irrigation water was set to zero for Westside and surrounding areas due to the continued California drought. The available well water at Westside was too high in salts for establishment of tomato seedlings and transplants. The station could not guarantee sufficient quantities of high quality water for tomato seedlings to become established (4-6 weeks post-transplanting), which would place the trial at high risk for crop failure. As a consequence, the field trials could not be conducted due to lack of sufficient high quality surface irrigation water at UC Westside field station, resulting in Goal 3 not be accomplished.

Goal 4- A vector-independent means (agroinoculation) was developed for screening tomatoes for their response to the California isolate of TYLCV. Not unexpectedly, it was shown that the major processing tomato varieties grown in California were susceptible to the virus and that different varieties show different types of symptoms and that this was age-dependent.

This project worked in coordination with the Ag Commissioners, CDFA, and UCCE personnel to identify TYLCV outbreaks in commercial tomato fields in the Imperial Valley and to have these fields destroyed.

By giving numerous talks and presentations, growers have been provided a clear idea of the symptoms caused by the virus and the relative threat provided by the virus to tomato production in California. In addition, samples from growers and homeowners are routinely tested for TYLCV. Finally, tools are in place to facilitate breeding efforts for incorporating TYLCV resistance into tomato varieties for California.

Additional Assessment- Goals 1, 2 and 4: Tools are in place for the rapid and specific detection of TYLCV and its whitefly vector. These tools were effectively used to show that the virus is not moving beyond Imperial and Riverside Counties, suggesting that either the climatic conditions of northern counties are not favorable and that the virus is not moving with plant materials (e.g., tomato transplants). By giving numerous talks and presentations, Dr. Gilbertson has provided growers a clear idea of the symptoms caused by the virus and the relative threat provided by the virus to tomato production in California. In addition, samples from growers and homeowners are routinely tested for TYLCV. Finally, tools are also in place to facilitate breeding efforts for incorporating TYLCV resistance into tomato varieties for California

Numerous presentations were made to growers groups, CTRI and the CLFP on the status of TYLCV in California. A flyer produced on TYLCV was made available to growers and others concerned about the virus. In part through the efforts of this project, we have a good understanding of the present situation with this potentially damaging virus in California and this has been very beneficial to the tomato growers in the state of California.

Project Contact:
Dina St. Clair, Principle Investigator
University of California, Davis
One Shields Avenue
Davis, CA 95616
Email: dastclair@ucdavis.edu
Phone: (530) 752-3915

11. University of California, Davis (UCD)- Natural Product Herbicides

Grant Funds Expended – UCD was awarded $96,949. $96,934.37 was expended. The remaining $14.63 was redirected to Project 13, Center for International Trade Development, Fresno.

Project Summary- Weed management is viewed as a major challenge in conventional, transitional, and organic cropping systems. Control of weeds in agriculture costs the U.S. economy more than $15 billion annually, more that the cost of controlling insects and diseases combined. Weed control in specialty cropping systems is especially expensive due to a limited number of available herbicides, the high cost of hand labor, and the rising fuel costs associated with cultivation and tillage. Surveys of organic growers and studies of organic farms indicate that weeds are a major production problem, and that fear of uncontrolled weeds is frequently a factor inhibiting the adoption of organic practices.

Despite interest in organic methods, little research is directed toward organic weed management using natural product herbicides. A systematic evaluation of these herbicides has not been conducted. Development of effective and economical natural product herbicides has the potential to both improve soil and environmental quality in organic and specialty cropping systems, and to reduce expenses for farmers. In addition, by helping to overcome a major obstacle to the adoption of organic production practices, increased options for natural product weed control may improve overall environmental quality indirectly by decreasing overall use of other pesticides.

Approach- A wide range of natural product herbicides, including Vinegar, C-Cide, Green Match, Green Match EX, Matran, Raps, Racer, and Weed Zap were tested in the greenhouse (GH) on both junglerice (*Echinochloa colonum*) and yellow mustard (*Brassica* sp.). Products were applied at different concentrations (depending on product label and previous results), spray volumes (35 and 70 GPA), and with and without different organic surfactants (Natural Wet, NuFilm P, NuFilm 17, Humex, Mix Well, Bio-link, and Monterrey Organic Adhesive). GH trials were ongoing throughout the two years of the study, and were used to guide decisions regarding treatments used in field trials.

The first field trial associated with this project began in December 2007 and ended in March 2008. Twenty-three treatments were applied at two locations at the same vineyard in Napa, CA. These treatments were visually evaluated for phytotoxicity 5 and 15 days after treatment. Large weeds were not controlled by this first treatment and thus a second application was made with the same treatments on the same plots. These plots were then again evaluated visually for phytotoxicity 5 and 15 days after treatment, and for overall control 30 days after treatment.

The second field trial was conducted in processing tomatoes at the UC Davis Vegetable Crops Experimental Fields from May through August 2008. Fifteen treatments were applied and weeds were visually evaluated for phytotoxicity 1, 3, 5, and 15 days after treatment. As in the first field trial, a second treatment (June 16) was applied approximately three weeks after the first (May 23). However, in this trial while the initial treatment was applied to each of two beds, the follow-up treatment was applied to only one bed so that a better comparison could be made between a single and a double treatment. In addition to phytotoxicity ratings, yield data was collected from each plot at harvest, with separate weights recorded for red, rotten, and green tomatoes. For the purposes of this categorization, “rotten” included tomatoes with sun damage.

The final field trial associated with this project was conducted in romaine lettuce, also at the UC Davis Vegetable Crops Experimental Fields. This trial began in September 2008 and ended in November 2008. Eighteen treatments were applied on each of two beds per plot on October 3 and then repeated on a single bed on October 20, including a new product recently developed by Marrone Organics. Due to recent developments in the greenhouse, this trial focused primarily on the impact of different concentrations of surfactant, rather than spray volume or concentration of active ingredient. In addition, both a weedy and a hand-weeded control were included in the plot plan, where previous trials only included a weedy control.

Weeds in this trial were evaluated for phytotoxicity 3, 5, and 15 days after each treatment, but yield data was not collected due to a weak lettuce stand and extensive rabbit damage.

Goals- The goal of this project is to evaluate natural product herbicides to assess weed control as affected by product, concentration, spray volume, surfactant, weed type (grass or broadleaf) and weed species. The information generated in these studies on efficacy and ideal application conditions for each organic herbicide have been and will continue to be made available to extension agents, pest control advisors and growers through extension presentations, journal articles, the UC Weed Research and Information Center (WRIC) website, and through the UC Integrated Pest Management (IPM) guidelines. This information should support the expansion of environmentally friendly weed management options in specialty crop systems, making production in California both more sustainable and more competitive, and will benefit both organic and conventional growers.

Results/Conclusions- Measurable outcomes and due dates are as followed:
Greenhouse Trials: The primary model used in analyzing Greenhouse data was E = T C S A, where E=efficacy, T= target species (mustard or jungle rice), C=concentration (5,10,15,20%), S=spray volume, and A=surfactant concentration. (measured either as percent phytotoxicity or as sample dry weight divided by the mean dry weight of control plants), GreenMatch EX, Racer, Matran and Raps were the most effective herbicides in GH trials. Vinegar and C-Cide were the least effective. Later formulations of C-Cide showed increased efficacy, but due to its high viscosity and the resulting difficulty in effective application, these results were inconsistent. Mustard was significantly easier to control than jungle rice, with target species showing up as a statistically significant variable at the alpha=0.05 level for all herbicides. Concentration was also significant for all herbicides, although in several cases the lowest concentrations actually produced slightly higher dry weights than the controls, and 15% and 20% treatments were statistically equivalent for several products (acetic acid, Racer, RAPS, and GreenMatch EX). Spray volume was a significant predictive variable for all herbicides except vinegar (spray volume *was* significant in mustard treatments, but not jungle rice) and Matran.

The addition of surfactants generally improved weed control, regardless of the herbicide or surfactant used. Early GH experiments showed NuFilm (P & 17) and Natural Wet to be the most effective of the natural product surfactants we tested, and these were used in treatments for the duration of the study. Natural Wet was used as the primary surfactant in the GH, although its performance was statistically equivalent to the NuFilm products and they were both used in field trials. Surfactant concentration was shown to be statistically significant for all herbicides except acetic acid. Of the three primary levels tested (0%, 0.2%, 1.0%), treatments with 0.2% added surfactant produced the lowest dry weights (highest efficacy scores). Toward the end of the GH trials, reduced surfactant rates (as low as 0.05% and .0.025%) showed some improvements in treatment performance, but inadequate data was collected to make general statements about the effectiveness of these low level treatments across herbicides.

Additional Assessments- GreenMatch EX, Racer, Matran and Raps were the most effective herbicides in GH trials. Vinegar and C-Cide were the least effective in controlling weeds in GH trials. Mustard was much easier to control than junglerice in GH studies. The addition of surfactants generally improved weed control, regardless of the herbicide or surfactant. Higher surfactant concentrations initially appeared to give improved control, particularly with Natural Wet, NuFilm P, and NuFilm 17. Thus, in GH trials, increasing concentration or spray volume improved control of mustard and junglerice, increased concentration of surfactant also improved control, and does not seem dependent on product used.

Project Contact:
W. Thomas Lanini
University of California, Davis
One Shields Avenue
Davis, CA 95616
Email: wtlanini@ucdavis.edu
Phone: (530) 752-4476

12. *University of CA, Davis (UCD)- Developing of a Global Positioning System (GPS) Plant Mapping/ Weed Control System*

Grant Funds Expended- UCD was awarded $94,485. All funds were expended. Funds were used to provide support for a graduate student research, a mechnician, development engineers, and other UC Davis research staff for their contributions to the project. The remaining funds were utilized to purchase the construction materials, and research supplies needed to develop and test the automatic weed control system. UCD provided in-kind matching contributions consisting of 1 month FTE each for faculty researchers Slaughter and Upadhyaya, and the researchers were provided with access to an RTK GPS base station, an RTK GPS rover system, and a tractor. The value of these UCD in-kind contributions was estimated at $73,058. In-kind technical support was also generously provided to the project by SWEMEC in Woodland, CA and Solex in Dixon, CA.

Project Summary- Weed control is a very important issue for Californian farmers producing vegetable crops. In Californian vegetable crop production, even low numbers of weeds can reduce marketable yield and have a detrimental impact on the competiveness of Californian vegetable crop producers. Weed control is even more important in organic vegetable crop production. Traditional manual methods of weed control, which are labor intensive, such as hand hoeing may not be sustainable in the long term. With 75% of the organic farmers relying solely on hand weeding (in additional to all the conventional farmers also using hand weeding), the industry is dependent on the availability of workers willing to undertake such work. A number of recent articles have reported on the current difficulties that Californian farmers are having in obtaining manual labor form farming.
In addition to labor problems, conventional farming practices often depend upon the use of herbicides for weed control. However, chemical herbicides are not completely effective at eliminating weeds and are subject to increasing regulation due to concerns about their environmental impact. In addition to environmental concerns about herbicide use, the long-term sustainability of herbicide-based weed control is uncertain due to problems with herbicide resistance and the high cost of developing new herbicides.

Clearly there is a need for new and innovative methods of weed control in order to reduce the dependence of California specialty crop farmers on manual labor sources, to reduce the introduction of chemical herbicides into the environment, and to increase the competiveness of California specialty crop farmers.
In this project UCD address the need by developing an automated system of mechanical weed control based upon global position system (GPS) technology that will substantially reduce the need for hand hoeing.

Approach- Traditional manual methods of weed control, which are labor intensive, such as hand hoeing may not be sustainable in the long term. Hand weeding is a tedious, menial task that is often conducted in an uncomfortable environment. Farm laborers who find alternative employment in construction, retail or other industrial sectors are unlikely to return to farm labor jobs. With 75% of the organic farmers relying solely on hand weeding (in additional to all the conventional farmers), the industry is dependent on the availability of workers willing to undertake such work. Further, the task requires large numbers of individuals for a fairly short period of time, exacerbating the problem. A number of articles (e.g. Barbassa, 2007) have reported on the current difficulties that California farmers are having in obtaining manual labor farming.

Further, manual weeding is expensive. For example, cotton, while not a specialty crop, is a heavy user of hand hoeing and can provide comparison data. Chandler and Cooke (1992) reported that in–row hand hoeing is over 5 times more expensive than between row cultivation of cotton.
In addition to labor problems, conventional farming practices often depend upon the use of herbicides for weed control. Pesticides are used by farmers to improve productivity and to remain competitive in the world market. However, the long term sustainability of herbicide-based weed control is uncertain due to problems with

herbicide resistance and the high cost of developing new herbicides. Historically, there is a low adoption rate of methods to reduce herbicide resistance which may be due to farmers' focus on optimizing short-term economic returns (Beckie, 2006), or their inability to assess the risk of resistance development (Rotteveel et al. 1997) or unrealistic expectation that new herbicide technology will continually be forthcoming (Llewellyn et al. 2002). Thus, herbicides should not be viewed as a sustainable resource. With the cost of bringing a new herbicide to market in the US at $150 to $180 million in 2005 (Beckie, 2006) the development of new herbicides is not guaranteed.

Goals- The goal of this project was to produce an innovative weed control system, based upon global positioning system (GPS) technology, for transplanted vegetable crops grown in California. The technology developed is suited for both organic and conventional vegetable crops grown in California. A traditional transplanter, typically that of currently used to plant Californian vegetable crops, was modified by adding a computerized data logger, sensors and an RTK GPS rover system. This system is capable of determining GPS coordinate (latitude and longitude) of each crop plant for use in map creation. The GPS crop plant location database, collected at planting, is then used later in the growing season for controlling a pair of mechanical weed knives. As the cultivation sled is pulled along the crop row by the tractor, an embedded controller uses the current GPS location of the sled to control the placement of the weed knives, carefully positioning them between crop plants to kills weeds within the crop row. The system is capable of eliminating the need for a large portion of hand hoeing in the row between crop plants in Californian specialty crop production systems.

This study demonstrated the feasibility of using a real-time kinematic (RKK) GPS to automatically map the location of transplanted row crops and then to utilize that map to automatically control a set of mechanical weed knives to provide to provide in-row weed control. The two deliverable outcomes from this project were 1) the development of a GPS crop plant mapping vegetable crop transplanter, and 2) the development of a global information system (GIS) crop plant controlled in-row weed control system. The effort for outcome #1 occurred primarily in 2008 while the effort for outcome #2 was initiated in 2008 with completion occurring in 2009.

In the first year of the project (2008), a positive-placement vegetable crop transplanter was retrofitted with an RTK-GPS receiver, plant, inclination, and odometry sensors. An on-board real-time data logger was interfaced to the GPS and plant sensors and used for recording planting events and latitude and longitude in the field during planting. Sensing the location where each plant was placed in the soil was accomplished by using an absolute shaft encoder mounted on the planting wheel of the transplanter. This system proved to be more robust and accurate than using an infrared light beam sensor to detect the stem location of each plant immediately after planting, which was also evaluated in 2008. Overall, the GPS transplant mapping system was capable of automatically producing a one-inch-level accuracy crop plant map suitable for use in precision plant care tasks such as in-row weed control.

After the GPS transplanter was developed and continuing into the second year of the project (2009), the automatic weed control system was developed. For this task, a ruggedized, real-time, embedded control system was interfaced to the GPS system and to a custom designed set of two mechanical weed knives. The prototype weed knife system is shown in figure 1. Weed cutting blades (shown in red in fig. 1) were attached to steel arms (shown in yellow in fig. 1) that were hinged at the top to allow the weed cutting blades to slide into the center of the row when the arms were pivoted about the hinge. Pneumatic cylinders (shown in black in fig. 1) were mounted at the "elbow" of each arm and provided the power needed to propel the knife blades through the soil at a high speed.

Knives closing #1

Knives closed #2

Knives closed #3

Knives closed #4

Knives opening #5

Knives opening #6

Knives open #7

Knives open #8

Knives closing #9

Knives closed #10

Knives closed #11

Knives opening #12

Figure1. Photographic sequence showing the operation of the UC Davis automatic in-row mechanical weed knife system. Photo #1 shows the weed knives closing after passing a tomato plant. Photos #2 through #4 show the weed knives closed, killing weeds in the row between the tomato plants. Photos #5 & #6 shows the weed knives opening as they approach the next tomato plant. Photos #7 & #8 show the weed knives open as

they pass the tomato plant. Photo #9 shows the weed knives closing, #10 & #11 shows them closed killing weeds. Photo #12 shows the weed knives opening again to pass by the next tomato plant.

In operation, the GIS crop plant map developed at planting is stored in the memory of the embedded controller. Several weeks after planting, during the normal cultivation period, the automatic weed knife system is pulled through the field by the tractor. In real-time, the embedded controller monitors the GPS location of the knife blades; when the knife blades are located between crop plants, the blades are held in the center of the row, as shown in figure 1 a, killing weeds in the row. The knives are placed in the "open" position, shown in figure 1 b, by the controller when they get close to a crop plant. After the knives pass the crop plant, the controller brings the blades back to the center of the row to continue to remove weeds between crop plants. The performance of the automatic weed knife system was validated in field trials on the UC Davis campus farm. Automatic knife positioning performance was consistent with RTK-GPS level accuracy (nominally a 1 inch standard error in position location).

(a)

(b)

Results/Conclusion- Planting trials were conducted on the UC Davis campus farm to assess the accuracy of the GPS crop plant mapping system. Field test results showed that the mean error between the crop plant map locations calculated from the planting data and the surveyed locations used as "ground truth" after planting was 0.8 inches, with 95% of the predicted plant locations being within 2 inches of their actual locations.

Mapping errors in the direction of travel were greater than mapping errors transverse to the travel direction indicating that some improvement in plant map accuracy might be obtained by characterization of dynamic planting effects on final plant location. This portion of the research demonstrated that it is feasible to instrument a positive-placement row-crop transplanter with sensors to simultaneously monitor the placement of each transplant into the soil, the roll and pitch inclination of the transplanter, transplanter odometry, and transplanter geoposition from a RTK GPS.

In agreement with the observations of N0rremark et al. (2003), and as expected for the 10-foot GPS antenna height, a significant increase in performance was obtained when raw GPS measurements were corrected for transplanter inclination. The error in the uncorrected travel direction location value was dominated by inclination variations and showed the greatest improvement (greater than 50% error

reduction) when corrected for inclination. The use of an inclination sensor allowed the GPS antenna to be mounted at a height selected to maximize the potential for access to high quality satellite geometries and to minimize the potential for GPS multipath error due to the tractor. The travel direction mapping errors for our system were similar in magnitude to those observed by N0rremark et al. (2007) under conditions where the seed was released with a non-zero horizontal velocity and only slightly higher than the error when horizontal seed velocity was zero. The mean total error in plant map accuracy was 2 cm, which was superior to the results (3 to 3.8 cm) obtained by Ehsani et al. (2004) in RTK GPS mapping of direct seeded corn.

Weeding trials were conducted on the UC Davis campus farm to assess the accuracy of the GPS automatic weed control system. Field test results showed that a mean distance of 2.4 inches between the crop plant and the leading edge of the knife blade at the time of knife opening could be achieved with a similar mean distance between the plant and the trailing edge of the knife at closing. The standard deviation of the distance between knife and crop plant at opening and closing was 0.8 inches. These results are in line with the expected performance given the current level of accuracy of RTK GPS technology and demonstrate the feasibility of automatic in-row mechanical weed control using GPS

In conclusion, this study successfully developed an automatic, one inch-level precision transplant mapping and in-row weed control system for Californian vegetable crops. The system utilized RTK GPS location and planting wheel sensors to produce highly accurate GIS maps of crop plant location. A ruggedized, real-time, embedded controller was developed that could automatically control a pair of weed knives to provide in-row weed control based upon the GIS maps. The system is suited for use in both organic and conventional vegetable crop production systems and shows excellent potential to help Californian farmers reduce their weed control costs and decrease their reliance on chemical herbicides.

Additional Assessment- Publications, and cited references listed below.

***Publication*:** Sun, H., D.C: Slaughter, M. Perez Ruiz, C. Gliever, S.K. Upadhyaya, R. S·mith. In Press. RTK GPS mapping of transplanted row crops. Computers and Electronics in Agriculture.

Invited Presentation: Slaughter, D.C. *Automated Weed Control Technology using RTK-GPS:* a *Prototype* Presented at the South Sacramento Valley Processing Tomato Production Meeting, Woodland Community & Senior Center, 8-Jan-09.

Cited references:

Barbassa J. 2007. Farm labor shortage may leave crops to rot in field. Statesman Journal. April 27,2007. www.statesmanjournal.comlapps/pbcs.dll/article? AI 0=/20070427 /BUSI NESS/704270314/1040

Beckie, H.J. 2006. Herbicide-Resistant Weeds: Management Tactics and Practices. Weed Technology. Volume 20:793-814

Chandler, J.M. and F.T. Cooke. 1992. Economics of cotton losses caused by weeds. In: Weeds of cotton: characterization and control. C.G. McWhorter and J.R. Abernathy, Eds. The Cotton Foundation, Memphis, TN. pp. 85-116.

Ehsani, M.R., S. K. Upadhyaya, M. L. Mattson. 2004. Seed location mapping using RTK GPS. Trans. ASAE 47(3): 909-914.

Llewellyn, R. S., R. K. Lindner, O. J, Pannell, and S. B. Powles. 2002. Resistance and the herbicide resource: perceptions of Western Australian grain growers. Crop Prot. 21:1067-1075.

N0rremark, M., Griepentrog, H.W., Nielsen, H., Blackmore, B.S. 2003. A method for high accuracy geo-referencing of data from field operations. In: Stafford, J.V., Werner, A. (Eds.), Proc. 4th European Conf. on Precision Agriculture. Berlin, Germany.

N0rremark, M., S0gaard, H.T., Griepentrog, H.W., Nielsen, H. 2007. Instrumentation and method for high accuracy georeferencing of sugar beet plants. Computers and Electronic;s in Agriculture, 56, 130-146. Rotteveel, T.J.W., J.W.F.M. de Goeij, and A. F. van Gemerden. 1997. Towards the construction of a resistance risk evaluation scheme. Pestic. Sci. 51: 407-411.

Project Contact:
Dr. David Slaughter
University of California, Davis
One Shields Avenue
Davis, CA 95616
Email: dslaughter@ucdavis.edu
Phone: (530) 752-5553

13. Center for International Trade Development, Fresno (CITD) Statewide Ag Market Development

Grant Funds Expended – The Center for International Trade Development (CITD), Fresno was awarded $10,000 based on the reverted funds from Project 3 and Project 6. All grant funds were expended.

Project Summary – The Fresno Center for International Trade Development (CITD), in conjunction with the California Department of Food and Agriculture (CDFA), qualitatively evaluated which export services significantly increase exports for California specialty crop growers. A series of roundtable discussions with California's *food/* agricultural product exporters were held on June 3, 2010 and June 10, 2010, and the CITD/CDFA used input from these discussions to tailor current export services and implement new programs that will assist specialty crop growers in doubling their exports.

The outcome of these sessions had far-reaching consequences in formulating a coordinated "export strategy" for the future. This project answered such essential questions as: What are top export priorities for companies? What barriers are exporters faced with and how can the CITD/CDFA help alleviate these problems? Should there be more foreign buying teams coming to California? Should there be government programs to assist in financing, transportation, or marketing your products overseas? How about locating foreign buyer or determining their credit-worthiness? How to determine the market requirements for your product?

A need exists for this project so the CITD/CDFA can assist the State in developing a coordinated export strategy to meet the President's National Export Initiative of doubling exports in the next 5 years.

Approach- A series of roundtable discussions were held to determine the needs of California specialty crop growers. This information based on surveys and discussions is significant to identify new programs or opportunities to help increase exports. Questions regarding the barriers that exporters face were asked and activities that could alleviate these problems were discussed to recognize unmet needs for export support. The CITD/CDFA sought to utilize suggestions from a representative sample of small and medium sized specialty crop companies about the gaps and hurdles that exist in international trade programs/activities benefitting specialty crop growers. Furthermore, the CITD/CDFA aimed to understand how the State of California could most effectively design and develop specific services to address those gaps.

Goals- The goals of the roundtable discussions are to identify the value of export services and determine issues specialty crop growers face while exporting. Obtaining this information will provide the CITD/CDFA data for a
new coordinated California export strategy, by:

- Identifying which export services are most valuable in helping to increase exports;
- Identifying unmet needs for export support;
- Indentifying new programs or opportunities to help increase exports;
- Testing new business models for provision of CDFA / CITD services

Approximately 28 specialty crop companies with 32 exporters participated in roundtable discussions across the state. Two discussion groups were held in June with agricultural companies to discuss the value of export services. Each discussion was split into two sessions, one in the morning and another in the afternoon for experienced and new exporters, respectively. The first group located in San Francisco was catered to exporters in the Northern region of California. A total of 15 companies attended the San Francisco session with 17 exporters: 10 experienced exporters and 7 new exporters. Joseph Mcintyre from Ag Innovations was the facilitator for this session.

The second group was held in Fresno at the CITD office for exporters in the Central Valley Region. A total of 13 companies participated with 15 exporters: 9 experienced exporters and 6 new exporters. The facilitator for this session was Khatchig Jingirian.

An additional 22 surveys were returned from list of exporters asking for their top export markets and priorities in exporting. These exporters also listed barriers they had faced and discussed the type of services the CITD provides that are useful. A list of top markets based on all the roundtable discussions is listed in the additional assessment.

During each discussion, each participant was asked the same set of questions:

- What are your current export needs and priorities?
- How are you using public export support services?
- *How* can CDFA/ CITD best support you?

Results/Conclusions- The most noted barriers that experienced exporters reported can be sorted into 3 categories: business development/sales and marketing, financing and logistics. Many exporters reported concerns with the rules and regulations of importing countries and documentation. Identifying which documents are needed for a transaction and which agency to account to provided a significant barrier for the exporters. Market information and country briefs are also not current or easily available for exporters making it difficult for them to understand the requirements of each importing country. Another significant issue is branding of California products. More promotion of California, fresh, high quality products needs to be done to enable more exporting of these products. Financing presented another fundamental barrier for exporters as they are faced with tough foreign competition in regards to pricing. The currency advantage for other countries cuts into the profit for California farmers. These exporters find it challenging to finance their operations without U.S government funding and support. Logistics also affect these exporters as California has many tariffs and regulations leading to unaffordable freight charges.

The top barriers that new exporters face are financing, inexperience and market knowledge. Since these exporters are new to the world of selling abroad, they have limited experience and knowledge about the exporting process and often do not know how to start. These exporters do not have enough knowledge about markets overseas, regulations and documentation required for exporting. New exporters lack contacts abroad or translation services and multilingual representatives that would help these exporters establish long lasting business connections. Financing is another core issue because the small size of these companies hinders their ability to obtain loans for attending trade shows and building their businesses. These exporters also do not know how to market their products properly in foreign markets.

Participants gave recommendations to the CITD/CDFA on specific services they could offer to help them with their exporting needs. The experienced exporters wanted a single export compliance portal that shows all documentation required to export to each country. Country briefs and a database of importers would also help these exporters to understand markets abroad. If each exporter knew key resource people in each country, the exporting process would be more efficient. The exporters thought the trade missions were beneficial but would like it if the buyers were matched to the exporters. Sales could be dramatically improved if the buyers could be pre-qualified and specific buyers that exporters want to network with could be contacted. Branding and awareness of California products is also needed to promote the freshness and high quality of produce that is grown in California. If the CITD/CDFA could inform foreign buyers and bring them to California to see the farms and the warehouses, a deeper connection to these products could be made leading to sales. Some exporters were not aware of all the services that the CITD/CDFA offers. These specialty crop growers want a website that could be organized in a way that shows all services that are provided by these organizations, leading to a single resource to answer all their questions. Financing is a big concern for these specialty crop growers as freight costs are high and phytosanitary certificates are expensive. It is also difficult to get loans as many of

these companies have to show collateral and sign off many checklists. The CITD/CDFA could offer exporters financial advice on obtaining aid and stand as a representative, for specialty crop growers, to the government when discussing trade issues. Some exporters wanted a local food trade show in the Central region of California since this is where most of the crops are grown. This food show would enable many buyers to see the land where these crops are grown and would also help build relationships between growers and buyers.

New exporters offered input on specific services the CITD/CDFA can provide to help alleviate the problems they face in trying to export. New exporters find it challenging to find buyers and sellers to conduct sales. The new exporters wanted qualified leads at trade missions or other events so they could establish better contacts and develop relationships with buyers. New exporters would also like consulting on documentation and developing market plans. If the CITD/CDFA could provide a seminar to show a complete export cycle, these new exporters could participate in a mock transaction and fully understand the logistics involved. The exporters would also like commodity specific research as well as cultural information on other countries. By obtaining this market research, exporters can better promote their products and follow the rules and regulations of countries properly. These specialty crop growers would also like more promotion of California products as this enables more export transactions. If the CITD/CDFA could also provide pricing information on commodities it would allow new exporters to price their product properly and gain a competitive edge when selling abroad

Based on the sample of exporters who participated in the focus gr.oup, several areas of opportunity for the Center and for California's trade programs emerged:

1. Development of an up-to-date on-line trade portal that contained information and links to relevant trade information. Exporters indicated a willingness to pay for such a service (a price of $500 per year was suggested by on participant). Whether or not such a service could be developed profitably would depend on both the subscription price and the number of subscribers, since the information developed for: such a portal would have national application, it is possible that the Center could expand its audience beyond California for such a product. Including countries in order of their significance for trade could stage the portal's development costs. It is clear from all the exporters that a key barrier to trade is accurate information - the collection of which is not free. Experienced exporters hire this experience and rely on a group of traders Who have knowledge of intricacies of trade, but even there exporters report the need for more and better information. This suggests that this information is potentially more valuable than participant's reported willingness to pay.
2. Other information service-like offerings may be useful and potentially revenue-positive for the Center, including creation of a database of information on importers and detailed country briefs. The thirst for knowledge about key markets (China, Mexico, Latin America, and Asia) suggests a potential for training or seminars by market aimed at both new and experienced exporters. Face-to-face or seminars by market cost-effective for the Center if they can be designed to promote both content delivery from experts and peer exchanges.
3. There are significant differences in the needs and ability to pay for CITD services between experienced and new exporters. New exporters, who often would benefit most from the training, technical assistance, and matchmaking functions of the Center, reported limited resources to pay for such services at anything close to market rates. Larger exporters appeared to long for the days when California was able to do more on the marketing side, but seemed realistic in accepting the need for some fee-based services. This suggests a staggered offering for the Center, which would offer relatively inexpensive "Getting Started" programs and progressively more expensive information services and consulting.
4. Participants report the highest value service of CITD (through WUSATA) to be connecting qualified importers and exporters. This has traditionally been done through the trade mission. These missions where highly recognized and utilized by participants. Focusing on improving the quality of the delegates on inbound missions was a consistent theme. This may require better coordination between trade program sponsors. Additionally, positioning missions to create brand preference for California programs through tours

of growing regions and processing centers that demonstrate the high quality of California goods was suggested. Participants did not directly discuss the value of the trade mission format itself, but the discussion of barriers and needs suggests that it is the contacts and not the mission form that tare most valued. This may offer opportunities for the Center to develop creative ways to "match make" that are less costly than the mission format.

5. The top markets exporters are currently in and want to expand in as well are China, Mexico, and Canada. The CITD/CDFA can use this information to plan future trade shows and better match buyers and exporters.

In conclusion, the services of the CITD/CDFA appeared to be valued by the participants, there also appears to be some opportunity to increase the cost sharing of their services with CITD/CDFA clients. This will likely need to be phased in over time to gain acceptance. New program offerings are also possible, particularly in information services at both the expert process and country intelligence level. The challenge for the CITD/CDFA will be to fund the development of their efforts, establish their value in the minds of clients, and then maintain them cost-effectively.

Overall the series of roundtable discussions were successful in determining the needs of specialty crop growers and suggestions that were made during the roundtable discussions can now be used by the CITO/COFA to tailor current export services and implement new programs that will assist specialty crop growers in doubling their exports.

Additional Assessments- Additional information can be found on the CITD website http://fresno.citd.org/

Project Contact:
Candy Hansen-Gage
Center for International Trade Development
State Center Community College District
390 West Fir Avenue, Building B # 303
Clovis, CA 93611
Email: candy.hansen-gage@sccd.edu
Phone: (559) 324-6401

14. California Ag Export Council (CAEC). Agricultural Trade Roundtable

Grant Funds Expended – CAEC was awarded $8.504. All funds were expended. CDFA requested USDA approval to amend State Plan (amendment 2) to reallocate a portion of Project 7 reverted funds to CAEC.

The total cost of the 2010 California Agricultural Trade Roundtable was approximately $13,400, with $8,504 in Specialty Crop Block Grant Program (SCBGP) Funds, and the remaining $4,900 paid by CAEC. In addition, individual participants covered their own travel and lodging costs estimated at approximately $3,000 in participant lodging expenses, and another $2,500 in travel (ie. airfare or mileage) costs. Thus, the estimated total of all costs for the Roundtable was approximately $19,000 of which only $8,504, or 44%, was funded through the SCBGP.

Project Summary- California produces a wide and diverse range of crops - which when totaled represent the largest agricultural production in the US, but when viewed individually (such as tree fruit production, tablegrape production, etc.), represent but a small portion of total US agriculture. Although this diversity is an integral aspect of California agriculture, it also cripples us when it comes to national attention on international trade issues that affect agriculture. For when weighed against the trade issues confronting large mid-western crops such as corn or soybeans, the trade issues confronting a "minor specialty crop" - such as pomegranates, or figs, or dates - are minor when viewed ·on a national level.

The purpose of the California Agricultural Trade Roundtable is to convene representatives from a wide "swath" of California specialty crop organizations, to discuss common trade issues and to arrive at a list of important trade issues that impact a large number of CA specialty crops - and to convey these to Federal officials and trade negotiators as "high priority" items for California agriculture.

Approach – The concept and details of the California Agricultural Trade Roundtable had been discussed numerous times between representatives from the California Agricultural Export Council and the CDFA. Representatives from the various California specialty crop industries, which had a "stake" in international trade issues, had been previously queried on their interest level in participating in this activity. In addition, Federal representatives - primarily from the USDA Foreign Agricultural Service, the USDA-Animal & Plant Health Inspection Service, and the US Trade Representative Office - had been previously contacted about their interest in attending and participating in the Roundtable.

Therefore, the actual logistics of assembling a group of California specialty crop commodity representatives, along with Federal officials, to discuss trade issues, was eased by the extensive "prep work" accomplished well in advance of the actual event. However, there were still numerous details to attend to - such as setting the actual dates, securing a suitable venue, making arrangements for the meals & refreshments, refining the agenda, securing suitable speakers.

In order to keep the group focused, and also to keep it to a size that promoted open communication (as opposed to a "lecture" situation where the attendees merely listen to a speaker rather than engage in mutual conversation), we determined the ideal size of the group to be 30 participants. In order to achieve this number, we invited over 50 people representatives from California commodity boards, trade associations, and private companies - all known to have had extensive experience in the trade issues that affect their particular specialty crop product. Invitations / Announcement was effected through e-mail contact, and through the website:. www.agroundtable.info. Owing to a wide number of reasons, over half of the invitees were unable to attend - and in the end, the total participation was 28 people (see attached file "attendee list.pdf'). The group was composed of: 18 Industry representatives, 4 Federal officials, and 6 from the State (4 from CDFA, and 2 from the State Community College).

The date for the Roundtable was set for April 29 & April 30, 2010. Although the Roundtable agenda represented only a single full day, the agenda was split between two days, beginning at 11:30 am on Thursday, and concluding at noon the following day. There were multiple reasons for this seemingly "odd" schedule: 1) by commencing at 11:30 am, participants can spend the first half of the day traveling to the venue, and the next day, can return in the afternoon, and 2) by incorporating an overnight period, it allows some "down time" to reflect on the important issues - and bring them up on the second day. (See attached file "AgRound Table.doc").

The Roundtable was held at The Sanctuary Beach Resort in Marina, CA Oust north of Monterey); a small hotel set into the dunes of Monterey Bay, but conveniently located adjacent to Highway 1, and within minutes of the Monterey airport. The actual meetings took place in the Kula Ranch restaurant backroom, on the premises of The Sanctuary. The first day was occupied primarily with presentations by the various Government representatives - both State and Federal. In addition, the industry attendees all introduced themselves, and described the important trade issues facing their products. The second day was primarily consumed in a facilitated discussion - which resulted in all participants identifying common issues facing them in great detail. See attachment "CA Ag Roundtable.ppt" for results of facilitated session.

As a follow-up activity to the Roundtable, we conducted a survey of the participants to determine their feelings on the value of participation. Although the results of this survey are still in "draft" form, the responses to date indicate that 100% of the participants gained value from the event, and would participate again in the future, if the opportunity arises.

Goals- *"The goal* of *the "Agricultural Trade Roundtable" is to prioritize international trade issues, provide* a *briefing on agricultural trade ,barriers; and conduct an overview* of *current international marketing practices* to *enhance the competitiveness* of *California's specialty crop industry."*

All of the proposed goals of the Roundtable were met, and described in this report and attachments.

Results/Conclusion-
Due Dates: All Outcomes were achieved during the Roundtable, held April 29 & 30, 2010.

- More than 30 agricultural entities will participate in a two-day forum on international trade issues affecting the specialty crop industry.

CITD fell short of the goal here, in that only 28 entities participated. This was due to a wide variety of reasons, including conflicting schedules, out of town, on vacation, etc. For future such events, a date earlier in the year may avoid some (but not all) of these conflicts.

- Identification of up to five (5) priority trade barriers that need to be addressed by California's specialty crop industry

As a result of the Roundtable, seven (7) priority trade issues were identified. Of these, the four (4) highest priority issues were "explored" by the group, with regard to possible "action items" to meet and overcome those issues. A total of 21 "action items" were identified and associated with the individual trade issues. The Four high priority issues identified were:

1 .Trade Agreements: with 2 associated "Action Items"
2. Market Access (Tariffs): with 7 associated "Action Items"
3. TASC (Technical Assistance for Specialty Crops: we 5 associated "Action Items"
4. China: with 7 associated "Action Items"

Three other priority items were identified, but we ran out of time to develop the "Action Items" for:
5. Sanitary & Phytosanitary/ Technical Barriers to Trade / Maximum Residue Levels
6. Intellectual Property Rights
7. Mexican Trucking

- Identification of a common marketing objectives/ activities for joint promotion within foreign markets

As a result of the Roundtable, participants agreed to further meetings, either in person or via conference call, to gain familiarity with, and to better refine concepts for "common marketing activities". One key item, of strong interest to most participants, was the concept of jointly marketing "California Agricultural Products" along with "California Tourism" in foreign markets.

- Recommendation on the statewide international marketing activities/ services conducted by the community colleges.

After a presentation by Candy Hansen-Gage, Director for the Fresno City College Center for International Trade Development, group discussion followed to 'brainstorm" how the community colleges could work together with the commodity boards to increase exports of California Specialty Crops. One recommendation was to coordinate Foreign Buyer groups that come to California, and for which the community colleges arrange the schedules, meetings with California suppliers, etc. The participants all agreed that closer coordination would result in bigger value, both for the Foreign Buyers, and for increased sales of California specialty crops.

Additional Assessment- The California Agricultural Trade Roundtable is a valuable learning experience for all participants - whether government officials attending, or the industry representatives. The Roundtable offers a "two-way" conversation on trade issues facing California, and not only give industry participants the opportunity to relay these issues to the government officials who can have an impact on solving the issues, but also gives the industry an opportunity to hear of new developments that may affect them.

The key California issues, which were identified at the Roundtable (and which are specifically identified in "Deliverables" earlier in this report), will be provided not only to the industry participants, but also to both Federal and State Government entities so as to have a good "snapshot" of what is currently of importance to California ago With widespread knowledge and recognition of the key issues, we hope for a speedier resolution.

The Ag Trade Roundtable should be held annually, not only to maintain a current list of the key issues, but also to keep both industry and Government representatives fully apprised of current conditions and issues facing California specialty crops.

See the website “agroundtable.info" for details on the event. A list of attendees, power point presentation and photos will be made available upon request.

Project Contact:
Fredrick Klose, Executive Director
California Agricultural Export Council
916 L Street, C-409
Sacramento, CA 95814
Email: fklose@caec.net
Phone: (916) 863-0311

15. California Department of Food & Agriculture (CDFA). Public Outreach Invasive Species

Grant Funds Expended – CDFA's Public Affairs Office was awarded $30,000. All funds were expended. CDFA requested USDA approval to amend State Plan (amendment 3) to reallocate the remaining balance of Project 7 ($4,958) and Project 10 ($25,042) to fund this Public Outreach Invasive Species project.

Project Summary- This project aimed to increase public awareness of the impact/threat of invasive 'species on specialty crop production. Specifically, this project addressed the lack of awareness among the public on invasive species. By developing the invasive species awareness resources, CDFA is enhancing the ability to detect and limit the introduction of invasive species within the state. Residents who are more aware of the threat of invasive species are more likely to report suspicious pests and understand the impact of bringing uninspected plant material into the state.

This project was timely because invasive species pose a significant threat to California's specialty crop industry especially in recent years with the detection of serious pests such as the European Grapevine Moth, Asian Citrus Psyllid, European Gypsy Moth, the Light Brown Apple Moth, and multiple fruit fly species to name a few. By educating the public through outreach materials, CDFA is increasing awareness of the need to report suspicious pests so we can detect and respond early on to infestations that could devastate the specialty crop industry and its competitiveness. It's imperative that we encourage and support an environment free of invasive pests.

Approach- Grant funds were used to increase the level of public awareness on the impact of invasive species on specialty crops by producing the following outreach materials:

- Invasive Species Booklet that includes highlights and information from the list of invasive plants, vertebrates, arthropods, invertebrates, and diseases created by the California Invasive Species Advisory Council.
- An Invasive Species Poster that highlights what Californians can do about invasive species including highlights of pests from each of the invasive groups listed in the above bullet.
- The brochure and poster were designed and created by Jay Van Rein, Office of Public Affairs. Content was contributed by our project partner, the CA Invasive Species Advisory Council. Other members of CDFA staff also contributed to the review of content.
- A thirty-second public service announcement (PSA) that focuses on the damage caused by invasive species on fruits and vegetables. The PSA highlights the "Don't Pack a Pest" message.
- A 13-minute video highlighting the impacts of invasive species in California. The video includes commentary from various members of the CA Invasive Species Advisory Council.
- The videos were produced and directed by Adrian Woodfork, Office of Public Affairs. We contracted with Peppers.TV for the camera work and editing.

Goals-

- The Invasive Species Booklet and Poster were printed and distributed to various stakeholders and were also posted to the Invasive Species Council of California (ISCC) www.iscc.ca.gov website. 10,000 booklets and 5,000 posters were produced.
- The booklet and poster were mailed out to the following stakeholders for their own distribution: 56 Boards and Commissions, 56 Agricultural Commissioners, all five Secretaries who serve as Invasive Species Council of California Board Members, and all 24 Invasive Species Advisory Committee Members. The materials are also distributed at meetings attended by the CDFA Executive Office and Plant Health and Pest Prevention. Services leaders

- The thirty second PSA was submitted to the three main network affiliates, KCTV, KCRA, and KOVR. These networks have an audience exposure of over 1.4 million households in the Sacramento, Stockton and Modesto region. The PSA is to run 3 to 15 times a month on a filler basis and will continue for a year and then be revisited.
- Following the political and Christmas season, we will initiate a statewide PSA campaign beginning January 2011 to reach audiences all across California.
- The PSA is complete and posted to the CDFA website. The 11 minute Invasive Species video was unveiled at the Invasive Species Council of California meeting on August 19, 2010. The video will be uploaded to the CDFA and ISCC website immediately following the meeting.

Results/Conclusion- A majority of the agricultural industry in California will benefit from this project's accomplishments. As indicated, a supply of brochures, posters, and videos have been sent to all the advisory boards and commissions, the California Agricultural Commissioners, and all the ISCC members for distribution to their constituents throughout California. These materials are also available on the CDFA and ISCC websites.

With the increased exposure to invasive species outreach, it is our goal that members of the public will start reaching out to their agricultural commissioners, CDFA, etc. With suspected finds which in turn allow us to respond quickly and save the state's specialty crop industry millions in lost revenues due to the introduction of an invasive species.

All results have been positive to date, with good feedback from the beneficiaries who have already received the outreach materials. There is nothing that we would have done differently. This project produced a beneficial outreach tool that will be used for years to come to enhance the long-term competitiveness of the specialty crop industry

Additional Assessment – Please visit CDFAs website www.cdfa.ca.gov for additional information. Copies of brochures, poster and videos can be provided upon request.

Project Contact:
David Pegos, Deputy Secretary of Communications/ External Affairs
California Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814
Email: dpegos@cdfa.ca.gov
Phone: (916) 654-0462

16. California Department of Food & Agriculture (CDFA). Australia Trade Mission

Grant Funds Expended – CDFA was awarded $14,845. All funds were expended. CDFA notified USDA, about the remaining balance from Project 10 (amendment 4) used to fund the Australia Trade Mission.

Project Summary- CDFA organized a specialty crop trade mission to Australia to raise awareness and educate California farmers, agricultural, and water officials on the impact of long-term drought on specialty crop viability and competitiveness. The purpose of this project was to increase the level of awareness among California's specialty crops industry on the impact of long term drought upon production, marketing, and farm viability. This project was timely and important because California is entering its fourth consecutive year of drought and the current on-farm challenges of farmers can be compared to their Australian counterparts who are experiencing a decade long drought.

Approach- The week long trade mission consisted of visits/tours of the Australia's Murray-Darling Basin, the agricultural center of Australia and the region that has been the hardest hit by the decade long drought. Working in coordination with the U.S. Embassy Office of Agricultural Affairs, the Australian Trade Commission and the Australian National Farmers' Federation a comprehensive trade mission program is being developed. Participants toured South Australia. Desalination plants were created in cities such as Sydney, Perth, and Brisbane and were built in efficient and timely manners.

Visiting the month of July allowed California participants the opportunity to see innovations in water catchment/storage, how water is factored into planting decisions, as well as be informed on permanent crop irrigation needs (such as wine grape irrigation requirements in July to further reduce soil salinity). Visiting a variety of desalination plants, conducting interviews, and attending presentations, A.G. Kawamura has been able to gain additional insight and understand the political, economic, and social implication of desalinations. Moreover, Australia's published, long-term vision has notable similarities to California's Ag Vision.

Goals- The Trade mission was successful in that participants (policy makers) were able to see first-hand and received information showcasing innovative farming techniques and irrigation efficiencies that may aid California in these drought ridden times if implemented at the correct location and for specialty crops most in need. However, before direct action can take place, key farm leaders, specialty crop officials, and agricultural stakeholders had to be educated on the impacts to specialty crops.

Results/Conclusion – Two specialty crop and agricultural representatives traveled to Australia to meet with Australian farmers, tour irrigation projects, and see first-hand how irrigators are responding with application technology to the critical challenges of reduced rainfall/reductions in irrigation water availability for specialty crops. The Trade mission results were presented in two public forums.

- Public seminar to specialty crop stakeholders (20) by way of the State Board of Food and Agriculture public meeting, July 28, 2010. Attendees included California Department of Water Resources, Agriculture Commissioners, and industry trade groups.
- Public meeting at the World Affairs Council meeting on August 9, 2010. The world affairs presented a panel roundtable discussion on what participants observed, learned, and their insights on Australia's response to the long term drought. Discussion topic included lessons for California, which is in its fourth year of drought. The panel consisted of participant in the study tour, A.G. Kawamura, Secretary of CDFA, Wendy Martin, Executive Project Manager and Statewide Drought Coordinator, California Department of Water Resources and Grame Barty, Regional Director of the Americans for Australia Trade Office.

The goal of the project was to increase the level of awareness of farmers' and agricultural stakeholders on the impact of long-term drought on California specialty crops competiveness and viability. This was successfully achieved through the informative meeting on July 28, 2010 to the State Board, Agriculture Commissioners, and industry groups about the trip. Further success will occur when members of the State Board use their newly acquired knowledge to use innovation water saving techniques that increase California specialty crop production and efficiency.

Additional Assessment - Please visit CDFA Website at http://www.cdfa.ca.gov/agvision/ for information on the key strategies for California agriculture, Adopt a Policy of Conserving Agricultural Land and Water Resources listed as one of the key strategies, which derived from the Australia Trade Mission. Materials/ Agenda's and presentations can be made available. Presentations and dialogue from both public meetings are available if requested.

Project Contact:
Joshua Eddy, Public Information Officer
California Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814
Email: jeddy@cdfa.ca.gov
Phone: (916) 654-0462