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MARKET ENHANCEMENT

California Always in Season - Live California

\$1,673,035

Buy California Marketing Agreement

Building on the success of the 2014-2015 “California, Always in Season – Building Community” project, The Buy California Marketing Agreement (BCMA) and the California Travel and Tourism Commission (Visit California) will coordinate an integrated paid media program with Time Inc. The Time Inc. partnership leverages a full breadth of publications to achieve efficiency and reach for the California Grown program. After two strong years with Food & Wine as its featured partner, the program has evolved to include more publications and added a data driven digital media program that increases the reach and efficiency of the paid media program. The California, Always in Season - Live California campaign will continue to focus on the seasonality, diversity and uniqueness of California Grown specialty crop products and encouraging consumers to eat specialty crops grown in the state for a healthier mind and body, a healthier economy and a more enjoyable lifestyle. BCMA will continue to engage stakeholders and consumers to continue to build the CA GROWN community. CA GROWN is uniquely qualified to showcase more than 50 specialty crops on a seasonal basis throughout the year through marketing, public relations and advertising platforms.

Paso Robles Wine in the Lone Star State

\$312,712

Paso Robles Wine Country Alliance

There is opportunity to grow the Texas wine market, a strong market for California wine, by introducing consumers to the fruit-forward and unconventional blended wines of the Paso Robles region. With per capita consumption of wine in Texas less than half the United States average, the broad array of Paso Robles' crowd pleasing wines will help convert beer, spirits, and import wine drinkers to California wine, and encourage them to consume wine on more occasions. Paso brands currently in market report good success, but in order to truly make an impact in this high opportunity market a much larger presence is needed, one not afforded through Paso Robles Wine Country Alliance limited membership dues. Per E. & J. Gallo research, some consumers think the region is located in Mexico; outreach is needed. This program will hit consumers from multiple touch points: media, retail, restaurants, bars, events, and directly through advertising. If California does not address this market, import wine brands will capitalize on Texas' large volume and high growth potential.

Creating Demand for California Dried Fig Ingredients

\$139,736

California Fig Advisory Board

Imports of figs and fig products into the U.S. have steadily increased in recent years. In 2013-14, imports increased 241 percent from the base year of 2007-08 (3,625 tons/12,372 tons). The continued influx of imports has had a devastating effect on this U.S. specialty crop and threatens the economic viability of California fig growers, processors, suppliers, employees, and the surrounding communities. In 2013-14, imports of fig products into the U.S. increased 30 percent over the previous year. Although California produces 100 percent of U.S. grown

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dried figs sold commercially in the U.S., imports represent 60 percent of the U.S. consumption. Therefore, the California fig industry requests funding to execute a comprehensive ingredient development program to educate key target audiences about domestically grown and produced figs and fig ingredients in California.

Expanding California Thursdays - Promoting and Serving More California Specialty Crops

\$237,704

Center for Ecoliteracy

The Center for Ecoliteracy will create new marketing and educational resources featuring California specialty crops for the expansion of "California Thursdays." The program is a collaboration between the Center and participating school districts to serve more healthy, freshly-prepared California grown fruits and vegetables in school meals. The "California Thursdays" network currently includes 42 school districts that serve more than 250 million meals a year. Providing districts with new resources focused on specialty crops will build upon the program's demonstrable impacts. This project will expand the market for producers and increase opportunities for small and mid-sized growers. It will increase access to fresh fruits and vegetables for the underserved youth that school meal programs primarily serve. Teaching students where their fruits and vegetables come from will provide an appreciation of fresh California food that can last a lifetime.

Increasing Demand for Canned and Frozen Apricots by Tackling Misconceptions

\$346,339

Apricot Producers of California

The California apricot industry is struggling. Acreage is down 37 percent since 2004 per Apricot Producers of California records due largely to misconceptions about health benefits of processed apricots (canned/frozen), which are 68 percent of United States apricot sales. Research on peaches shows canned/frozen peaches have equal or better nutrient levels than fresh due to levels of carotenoids also found in apricots. The University of California, Davis study will verify the same is true of canned/frozen apricots. Marketing efforts will share this info publicly, targeting dietitians, foodservice buyers, and other sources of health info with the goal to increase demand for canned/frozen apricots. Expected outcomes are to raise apricot prices by three percent (measured by National Agricultural Statistics Service data; represents \$1.3 million in added annual returns to growers), stop the decline in acreage (measured by grower surveys), and influence foodservice buyers to use more canned/frozen apricots (tracked by foodservice contact follow-up). Due to the importance of apricots to the canned fruit industry, this project is supported by processors such as Seneca Foods and Del Monte.

Expanding Market Opportunities for California Prune Producers through Prune Ingredient Substitutes

\$450,000

Sunsweet Growers, Incorporated

California prune acreage has declined for years (California Department of Food and Agriculture and United States Department of Agriculture, National Agricultural Statistics

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Service) due to tough economics. Consumers increasingly demand “clean labels” on foods (familiar ingredients, no additives/preservatives) and food makers, foodservice operators, and restaurants are pushed to comply. A 2013 consumer study found 50 percent avoid processed foods with high sodium and high fructose corn syrup (Hartman Group). Prunes are a proven substitute for sodium, sugar, and artificial colors. The project capitalizes on this to increase returns to California prune growers. With marketing aimed at makers of sauces and seasonings, the project goal is to boost grower returns with a prune ingredient line (concentrate, powder, puree, and fiber), providing an outcome of significant economic benefit to the 277 California prune growers (70 percent of United States prune sales) who own Sunsweet Growers. As a cooperative, all earnings flow directly back to prune growers. This project is backed by California Dried Plum Board, representing all California prune growers.

Creating Demand for Lake County Winegrapes - Reaching Key Audiences to Increase Competitiveness \$302,523

Lake County Winegrape Commission

Lake County winegrape prices have fluctuated over the last 12 years, with an average price per ton just 9 percent higher than in 2002. A 2008 University of California Cooperative Extension cost study for Lake County estimated cultural costs per acre at approximately \$1,871. Increases in costs for inputs and labor have reduced this income, leaving growers with losses rather than profits. Creating demand will educate key audiences and promote the Lake County wine region through focused course materials, outreach events in key markets, and online course delivery. This will build on materials developed by the California Wine Institute. National advertising in key trade and consumer publications, social media, and web access will generate awareness and help drive demand for Lake County wines and winegrapes. The goal of this grant is an increase of \$50 average return per ton by 2016. This will result in \$1,650,600 return to growers, helping to ensure economic stability for Lake County winegrapes.

Forecast of Pistachio Crop Yield Using Predictive Machine Learning Modeling \$131,948

California State University, Fresno

Pistachio is a valuable crop in California with more than 300,000 acres of bearing and nonbearing trees worth about \$1.3 billion in annual revenue. Pistachio producers and related industries are demanding accurate and timely early season forecasts of crop yields for marketing purposes and export decisions. These forecasts are particularly important as pistachio is a strong alternate bearing crop with potentially large annual yield fluctuations. This proposal seeks to develop accurate and timely yield prediction models for major pistachio regions in California. The proposed project will predict pistachio crop yields using machine-learning capabilities. Bearing acres, crop yields, relevant weather variables, and agronomic conditions (e.g., chilling hours, pests) will be used to develop machine-learning models. The main goal of this modeling is to learn from historical crop yields, weather, and agronomic conditions to identify any patterns and to predict early season pistachio crop yield.

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Improved Post-Storage Walnut Quality by Understanding Water Activity Relationships

\$229,194

The Regents of the University of California, Davis

Deterioration of walnut quality in storage results in lost revenue for the industry and reduces market access and market development. Water activity, the amount of free water in a sample available to support metabolic activity, is directly related to the rate of deterioration of a food; however, the walnut industry has not previously used water activity as a tool to optimize storage conditions. The objective is to determine the relationships between water activity and the rate of deterioration of walnuts from a variety of sources (variety and harvest maturity). Walnuts will be stored in-shell and as kernels at 41°, 59°, or 77°F in a factorial with 20 percent, 40 percent, or 60 percent relative humidity. The quality of the four main California varieties from two different harvest dates will be determined at harvest and during storage. After six and twelve months of storage, a trained taste panel will evaluate sensory parameters. Where differences in quality are observed, oil composition at harvest will be analyzed.

Promoting California Pistachios and Dried Plums (Prunes) as Ingredients in China

\$309,403

American Pistachio Growers

The American Pistachio Growers (APG) and the California Dried Plum Board (CDPB) propose hosting a series of culinary and baking seminars to promote pistachios and dried plums as ingredients to the hotel industry in China and Hong Kong. This series is a continuation of the "Bakery Seminars" conducted by APG and CDPB in Korea and Japan in 2014 and is based on their success. Specifically, this project will support six cooking seminars in the spring of 2016. These events will be hosted by the James Beard Foundation's recipient of Most Outstanding Chef in America, celebrity chef Nancy Silverton, and will target luxury hotels' executive chefs, pastry chefs, and, in addition, bakers from large industrial bakeries. Currently, pistachios and dried plums are not widely used as bakery ingredients by this sector. Through hosting seminars, APG and CDPB will create new demand among the trade, and maximize the potential of a rapidly growing hotel sector in this market.

Online Marketplace for Nursery Growers: Connecting Growers of Nursery Crops with Buyers in a Bilingual, Virtual Marketplace

\$267,963

California Association of Nurseries and Garden Centers

The project will create a web-based marketplace where growers of nursery crops can display their plants and plant inventory and where buyers can source product by plant type, water use, and environmental suitability. To meet the growing population of Hispanic growers and buyers, the marketplace will be in English and Spanish. In addition, the project will identify potentially invasive plants and provide substitution recommendations as recommended by the PlantRight program with which the California Association of Nurseries and Garden Centers has partnered. The display, plant education, and buyer/seller interaction necessary for nursery growers to successfully market a diverse range of plants once took place at large, regional trade shows. Many industries, including the nursery industry, no longer have the capacity to organize these

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large trade shows. As such, growers have struggled to reach buyers in an organized, systematic fashion resulting in diminished sales.

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SPECIALTY CROP ACCESS AND NUTRITION EDUCATION

*Promoting California Specialty Crops through Education and
Enrichment*

\$298,516

CDFA, Division of Inspection Services, Office of Farm to Fork

Many Californians suffer from diet-related diseases, often as a result of not consuming enough specialty crops. Efforts to increase the consumption of California specialty crops are a win-win: they support California specialty crop farmers while promoting a healthier diet for California consumers. This project aims to promote the consumption of California specialty crops through increased specialty crop nutrition education, inclusion in school meals, and specialty crop outreach.

*Farm-to-WIC Expansion Campaign: Increasing Redemption of WIC Produce
Checks at Farmers' Markets*

\$293,413

California WIC Association

California Women, Infants, and Children (WIC) Association, in partnership with 84 member local WIC agencies, community-based organizations, local Farmers' Markets, and the California Department of Public Health WIC Division will launch a targeted Farm-to-WIC Campaign designed to increase the number of certified farmers' markets and small farmers who are trained and authorized to accept WIC Fruit and Vegetable Checks (FVCs) for fresh fruits and vegetables. The proposal will promote higher utilization of FVCs at authorized farmers' markets and explore the feasibility of enrolling WIC families in local Community-Supported Agriculture schemes using their FVCs.

Effects of California Dried Plums on Bone and Cardiovascular Health \$63,840

The Regents of the University of California, Davis

The aging of the U.S. population presents a number of challenges, many of which can be addressed through nutritional approaches. Postmenopausal women are particularly at-risk for diseases including osteoporosis (an estimated 50 percent of women over the age of 50 will either suffer from or be at risk of bone loss by 2020) and cardiovascular disease, the number one killer of postmenopausal women. Fruits and vegetables contain polyphenols, which may reduce risk for a number of chronic diseases and promote health. Because more than 5,000 different polyphenols exist, more attention and understanding of the specific category of polyphenols, and their associated biological activities, will help differentiate the health promoting properties of different fruits and vegetables. Determining if dried plums (*Prunus domestica* L.) can help prevent bone loss and reduce cardiovascular disease risk would likely increase market demand nationally and worldwide, and improve the health of Californians.

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Lettuce Cultivars with Improved Salad Processing Efficiency \$418,774

USDA, Agricultural Research Service

Packaged salads are popular with consumers. Salad-cut lettuce can exhibit short shelf life, decaying within eight days after harvest and rendering the product unsaleable. Nutritional quality of lettuce can also decline post processing. Wasted product results in economic loss as new lettuce must be grown, processed, and shipped. New cultivars with longer shelf life will reduce waste and increase the distribution system's efficiency. This project will develop the resources needed to breed lettuce with longer shelf life and stable yield. The proposal will determine the shelf life and yield of 250 lettuce accessions over multiple field experiments. The proposal will also determine the relationship between shelf life and nutrition loss. DNA-based markers will be used to create a genetic fingerprint of each accession and to identify genes conferring superior performance. Seeds of improved breeding lines, new knowledge, and data will be released to the lettuce industry.

Linking Farms to Schools for Nutrition-Based Learning \$211,902

School Garden Network of Sonoma County

Farm to school programs are a gateway to introducing young children to healthy habits, tasting fresh produce, and connecting to California's agricultural heritage. This project addresses gaps in nutrition and specialty crop consumption in Sonoma County with a robust, countywide farm-to-school program including: 1) Harvest of the Month fruit and vegetable tastings; 2) Farm field trips; 3) School garden technical and financial assistance; 4) Garden nutrition classes; and 5) Specialty crop cooking and nutrition education workshops. The project is designed to increase specialty crop consumption in adults and children as well as generate revenue sources for California farmers. The education model of this project will increase awareness of how to purchase and prepare specialty crops for adult consumers and encourage youth to become informed eaters through exposure to new and familiar specialty crops.

Real Kids, Real Food Farm to School Program \$403,766

Sierra Harvest

Sierra Harvest inspires, educates, and connects Nevada County families to fresh, local, seasonal food. The project would enhance the competitiveness of California specialty crops by supporting Sierra Harvest's existing Farm to School program which would serve 92 percent of kindergarten through eighth grade schools in Nevada County by offering: field trips to specialty crop farms; tastings of seasonal, specialty crops for Harvest of the Month education; cooking classes and nutrition education using seasonal specialty crops; and garden stands to improve specialty crop access at school. In phase one, Sierra Harvest's Farm to School program, under the 2012 CDFA grant, has enjoyed tremendous growth and is proving that targeted nutrition education can improve preferences for specialty crops. During phase two, Sierra Harvest will increase promotion of partner farmers, enhance ways to connect the grower to consumers showcasing the benefits of specialty crops, and increase financial program contributions from participating schools for program sustainability.

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Bring the Farmer to Your School: Farm to Family

\$433,439

Sustainable Economic Enterprises of Los Angeles

From 2002 to 2014, Sustainable Economic Enterprises of Los Angeles (SEE-LA) and the Los Angeles Unified School District (LAUSD) have partnered to conduct the Bring the Farmer to Your School program as funded by the California Department of Public Health and CDFA SCBGP. This program, the only one of its kind in all of Los Angeles County, brings local California farmers into Title I LAUSD classrooms to deliver engaging educational experiences about California agriculture and nutrition that students do not receive through standard curriculum. SEE-LA's proposed 2015 to 2017 program will serve 200 schools and 160,000 urban students from diverse cultural and economic backgrounds with hands-on workshops and farmer presentations. SEE-LA seeks 2015 CDFA SCBGP funding to expand the program to include parents and pre-kindergarten families to broaden and reinforce the importance of fruits and vegetables, and engage parents in nutrition education through Harvest of the Month and parent sessions.

Increasing Specialty Crop Consumption through Increased WIC Farmers' Market Nutrition Program Check Redemption

\$129,511

Pacific Coast Farmers' Market Association

In 2014, California Women, Infants, and Children (WIC) agencies distributed more than \$2.4 million in WIC Farmers' Market Nutrition Program (FMNP) checks that may only be spent on fruits, vegetables, or fresh herbs at certified farmers' markets, but only 68 percent were redeemed. The unredeemed checks represent more than \$775,000 of lost revenue for California specialty crop farmers. This project will increase the redemption rate of WIC FMNP checks in the Bay Area by partnering with WIC agencies to conduct check distribution at farmers' markets instead of at the WIC agency sites. Recognizing that many WIC recipients are not current farmers' market shoppers, the project will also provide WIC recipients with free classes to help them learn how and where to use the checks and how to increase their fruit and vegetable consumption on a budget.

Increasing Access to Specialty Crops in Fresno

\$193,496

National Hmong American Farmers, Inc.

The San Joaquin Valley produces many of the specialty crops consumed in the United States. Paradoxically, it also has some of the highest obesity and poverty rates in the state. In Fresno County alone, 113,000 people have difficulties accessing grocery stores. As a result, many residents cannot afford or do not have access to fresh fruits and vegetables. This project will improve the health of low-income communities in the San Joaquin Valley while supporting local specialty crop farmers. Targeting the numerous Southeast Asian farmers and residents of the county, this project will promote increased consumption of locally grown produce through: 1) holding weekly farm stands at schools; 2) connecting local farmers to procurement staff at school districts; 3) educating schoolchildren about locally grown fruits and vegetables; 4) training Southeast Asian farmers in farm to school marketing and safe handling and agricultural practices; and 5) conducting public education on specialty crops.

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San Joaquin County AgVenture

\$178,448

County of San Joaquin

AgVenture is a holistic agriculture and nutrition education program. It consists of eight field days (two field days in year one and three field days each in years two and three) held in the north, central, and south areas of San Joaquin County for third grade students and three Healthy Snack Program events for five fourth grade classes (one event each in years one, two, and three). More than 1,000 specialty crop farmers, producers, and volunteers donate their time and expertise to bring educational presentations and displays to educate more than 11,000 third grade students and their parents at field day events. The program teaches students about specialty crops, nutrition in relation to healthy living, and the importance of agriculture's role in the county's economy. At the Healthy Snack Program events, approximately 120 fourth grade students learn how to incorporate specialty crops into a creative and healthy snack.

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EQUIPPING CURRENT AND NEXT GENERATION SPECIALTY CROP FARMERS

*Development of Starter Cultures to Obtain Consistent, High Quality
Sicilian-style Olives*

\$215,264

The Regents of the University of California, Davis

California is the only producer of fermented "specialty" table olives in the U.S. The national and international market for this product offers strong growth potential to California table olive processors. However, there is currently a lack of methods available to processors to control the fermentations and this deficiency has resulted in an excess of \$10 million in product losses, limiting profitability for the sector as well as growth and investment for improvement of specialty table olive production. This project would create and implement a workforce training program to maintain the technical skills required to keep the Sicilian-style olives competitive, specifically to identify starter cultures to ensure that all personnel and farmers in the industry understand how to prevent spoilage events.

*Tools, Training, and Opportunities for Organic Specialty Seed
Producers*

\$298,075

Organic Seed Alliance

California has the largest organic specialty crop industry in the U.S. and there is a large unmet demand for seed produced in and for organic farms. California is the leading vegetable seed producing state, and organic seed producers have the potential to meet organic specialty crop needs. In 2015, a summit of California organic specialty seed professionals identified these objectives: 1) Instruction for organic specialty seed producers in seed quality and business; 2) Availability of specialized seed production tools; 3) Market demand for California organic seed; and 4) Information sharing between producers. This project will meet these objectives through instruction, tool sharing, marketing, and data sharing. More than 300 organic specialty seed producers will directly benefit from project activities, with a net benefit of more than \$400,000. More than 1,500 organic specialty crop producers nationwide will benefit from the increased quality, quantity, and diversity of seed as a result of this project.

Specialty Crop Internship Listing Website

\$66,041

CalAgJobs

With a shortage of qualified professionals to support specialty crop production and decreasing student enrollment in related fields, it is more important than ever to showcase the specialty crop internship opportunities to draw more people into this career path. This project will create a comprehensive listing of California specialty crop internships, free for industry to use and free for students to access. This will be a benefit to specialty crop producers who can more easily advertise for and recruit interns, and a benefit for the industry as a whole as it will be

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better able to attract people into internships and considering long term careers in specialty crops.

Grower Education For Farm Water Quality Practices

\$92,470

Sonoma County Agricultural Commissioner

This project will increase vineyard and orchard operators' abilities to comply with emerging regional storm water runoff regulations and improve stream habitats impacted by runoff. Many operators are unfamiliar with the principles of erosion control and water pollution prevention. It is critical that these growers have access to information sufficient to develop and implement the Water Quality Farm Plans that will be required by the water board regulations. The County will produce a Manual of Best Management Practices for Vineyards and Orchards (instructional manual). Seminars will be designed and facilitated to educate operators about practical strategies they can implement to minimize pollution runoff into streams. The instructional manual and seminar materials will be posted online for access by individual vineyard and orchard operators, as well as other local government or nonprofit organizations interested in hosting their own seminars for local operators.

Nut Safety School

\$200,979

AgSafe

California's nut industry experienced unprecedented growth in the past decade. Industry value was below \$1 billion 10 years ago, and today it has skyrocketed to \$6.5 billion. Production growth has led to an increase in employment needs and with more employees comes greater risk. The National Institute of Occupational Safety and Health reports that a majority of traumatic injuries and deaths in agriculture are caused by machinery and most notably involve tractors, a critical tool in nut production. This industry's rapid growth has created a need for the development of holistic occupational safety programs. AgSafe and project cooperators will address this deficiency by creating the Nut Safety School, a three-part training series in English and Spanish addressing critical worker safety issues during almond, walnut, pecan, and pistachio pruning, harvest, and year-round operations. In doing so, California nut growers will see improvements in worker safety and efficiency that includes fewer worker injuries.

*Improving Competitiveness of Small and Large California Blueberry Farms
through Grafting*

\$137,058

The Regents of the University of California, Davis

Blueberry production in California requires soil acidification to produce high yields, as blueberries are adapted to low pH soils. Acidification can be prohibitively expensive for small farmers and socially disadvantaged farmers. Previous research demonstrates that grafting of productive blueberry genotypes onto rootstocks of the high pH tolerant *Vaccinium arboreum* (*V. arboreum*) is a viable means of adapting blueberry to local soils. Grafted plants would eliminate the need for acidification. This could make blueberry production for local direct marketing possible for small farmers in underserved communities. It would also benefit large-scale producers by eliminating acidification costs and facilitating mechanized harvesting, since

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grafted varieties have a single trunk. This project would evaluate yields of grafted blueberry and investigate mechanisms limiting yield for blueberry in high pH soils, as well as train small farmers in a grafted blueberry production system designed for local marketing.

The Importance of Bees

\$65,900

Manteca Unified School District

Manteca Unified School District (MUSD) operates a 40 acre educational farm that produces specialty crops including almonds and seasonal vegetables. The farm is currently used to educate and train agricultural students. MUSD wants to expand this training to include apiculture. The beekeeping industry has experienced major setbacks lately with the Colony Collapse Disorder and the high populations of Varroa mites. Many beekeepers are aging and the next generation does not seem to consider beekeeping as a vocational opportunity. For this project, MUSD will hire 10 high school students and one college student for two years to train them in the practices of beekeeping, while also teaching them the importance of bees and their role in specialty crops. MUSD would buy and maintain enough beehives to pollenate the 22 acres of almonds that exist on the farm. The students would learn handling practices, honey harvesting practices, advocacy skills, and the industry would gain experienced workers.

Establishing Online Nuts and Tree Fruit Education Program to Train California Specialty Crops Growers

\$330,142

The Regents of the University of California, Davis

The proposal proposes the creation of a fruit production online educational training program to strengthen and extend programs currently available at the UC Fruit and Nut Research and Information Center (FNRIC). FNRIC will develop and deliver this online program. University of California, Davis (UC Davis) and UCANR personnel, cooperating with commodity board members and industry stakeholders, will actively supervise the online information resource development and performance. The objective is to train California's young and beginning farmers in sustainable fruit production on topics such as principles of tree biology, commodity production, fruit safety, technology tools, environmental conservation, fruit maturity, and harvesting techniques. This funding will support preparation and delivery of a series of interactive modules easily accessible mode to create a certificate training program online education. The program will be offered in English and Spanish.

Sacramento Valley Beginning Farmer Apprenticeship Program

\$437,468

Soil Born Farms

The Sacramento Valley Beginning Farmer Apprenticeship Program is an expansion of Soil Born Farms' Urban Farmer Training Program and a collaboration with the Center for Land-Based Learning's California Farm Academy. The program is designed to offer in-depth, multi-year education to beginning specialty crop growers in the Sacramento region to reverse the rate of new farmer attrition. Over the course of the project, 80 to 90 participants will receive on-farm experience, management, and decision-making skills through an accredited apprenticeship program; networking and technical assistance with agricultural professionals

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and farmers; and coursework, workshops, and field trips. The goal is to equip beginning farmers with sufficient training, work experience, and business management support to be successful at starting and sustaining their own specialty crop farms, or obtaining management positions with established farms. Program evaluation will be shared regionally to encourage replication.

Beginner Farmer Entrepreneurial Intensive

\$154,764

Ag Innovations Network

Ag Innovations Network's Entrepreneurial Intensive provides beginning and aspiring specialty crop farmers with the business skills needed to build a successful specialty crop agricultural operation. This two-day series, replicated in 10 counties, entails workshops ranging from bookkeeping to marketing, business plan creation to regulations, all taught by local farmers and agricultural advocates, together with experts from statewide organizations. Using Ag Innovations Network's preexisting network of "guilds" (local gatherings where farmers meet each month, of which Ag Innovations Network currently facilitates 10 throughout Northern California), the project will harness the expertise and available resources of local communities and effectively reach the target audience. These monthly guilds provide consistent peer support networks and opportunities for follow-up. Ag Innovations Network will then host a statewide career fair as part of an existing agricultural conference, offering further guidance to those exploring or pursuing a future in specialty crop agriculture.

Training the Next Generation of Leaders for the California Strawberry Industry

\$152,356

Cal Poly Corporation

The project will train the next generation of leaders for the California strawberry industry by developing an internship program for undergraduate students at Cal Poly San Luis Obispo (Cal Poly). The California strawberry industry is currently in a crisis. At a time when future farmers are in greatest demand, fewer young people are choosing farming as a career. Cal Poly is ideally positioned academically and geographically to train these future leaders. The College of Agriculture Food and Environmental Sciences is one of the largest in the country with approximately 3,900 students. The campus is centrally located in the strawberry production regions of California (30 miles from Santa Maria, 130 miles from Oxnard, and 145 miles from Watsonville). Cal Poly's Strawberry Sustainability Research & Education Center offers unique and unparalleled opportunities for students to collaborate and "learn by doing" within the industry.

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ENVIRONMENTAL STEWARDSHIP AND CONSERVATION

*Food Safe Integrated Nutrient Management of Organic Matter Amendments
in Almond*

\$292,349

The Regents of the University of California, Davis

Orchard soils in California may be depleted of organic matter, yet abundant, underutilized sources of organic matter amendments like manure and green waste are available. Addition of these materials show potential to limit nutrient leaching that threatens environmental quality, while still enhancing soil fertility. The Regents of the University of California, Davis' grower survey showed clear belief in the benefits of these materials, but use is limited by concerns for food safety and nutrient availability. This project aims to test how food safe use of organic matter amendments integrated with conventional fertilizer will impact tree nutrition and soil health by measuring tree growth, leaf nutrient status, soil nutrient cycling and soil carbon; verify food safe practices by screening for human pathogens on fruit at harvest; and monitor grower perceptions. This will be achieved with a mother-daughter participatory approach where research from one trial site in a randomized complete block design is replicated on smaller proximal trials.

*Water Stewardship and Drought Resilience in the Russian River
Watershed*

\$246,501

California Land Stewardship Institute

Winegrapes and pears are specialty crops grown in the Russian River watershed. Water supply for these crops is managed by individual growers. Conflict between water for farms and endangered salmon is the greatest problem for specialty crop growers. Since 2008, California Land Stewardship Institute has developed a comprehensive program with growers to reduce water demand and revise water systems and diversion methods to minimize conflicts with salmonids. This grant would fund training and technical assistance to growers to implement best management practices to reduce water demand for frost control, install stream flow gauges with growers to use in coordinating how water diversions within sub basins and identify infrastructure needs. This grant will increase water use efficiency and drought resilience and provide a long term solution to avoid environmental conflicts and allow specialty crop growers to stay in business. Without a comprehensive, science-based program, growers will not be able to use water to frost-protect crops.

*Improving Salinity Management Strategies for Almond Grown under
Micro-Irrigation*

\$429,590

The Regents of the University of California, Davis

Increased use of saline irrigation water poses a severe threat to almond and yet strategies for management of salinity are inadequate. Micro-irrigation is the predominant irrigation method in

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use and imposes unique challenges for salinity management. This project aims to develop salinity management strategies optimized for the principal micro-irrigated almond rootstocks and cultivars. Greenhouse and field experiments will be used to derive the biological parameters (uptake rates, root distribution, crop response) needed to make irrigation and salinity decisions. Representative evapotranspiration (ET) scenarios, soil types, salinity profile, irrigation strategies will then be selected for in-field validation. HYDRUS simulations will be performed to model ideal irrigation strategies under a variety of conditions and to develop grower accessible guidelines for salinity management, and to develop advanced irrigation design and scheduling practices that prevent excess salt accumulation and limit nitrate loss.

*Management Practices to Minimize Stormwater Pollution from Macrotunnel
Production Systems*

\$218,449

Ventura County Resource Conservation District

This project focuses on developing macrotunnel stormwater management practices, with raspberry as a model crop. Macrotunnel production systems contribute over \$1 billion to California's economy and is one of the state's fastest growing agricultural sectors. Raspberries, strawberries, and cut flowers are typically grown in these structures and the technique is rapidly expanding to other high-value crops. Despite their increased use, guidance to help macrotunnel growers choose management practices that limit agricultural pollutant loads in stormwater-induced runoff is sparse. This effort will evaluate the extent to which management practices commonly used for soil conservation and pollution prevention in open-field crops help macrotunnel growers reduce their environmental impacts. Practices will be assessed for pollution reduction, ease of use, and cost benefits. Additional benefits, including soil moisture retention and pest suppression, will be assessed on a practice-specific basis.

*Evaluation of Trade-Offs between Winter Cover Crop Production and Soil Water
Depletion in San Joaquin Valley Row Crop Fields and Orchards*

\$261,405

The Regents of the University of California, Davis

Maintaining competitiveness in California vegetable farms while simultaneously developing practices that address uncertainties of climate change is a major challenge that requires strategic improvements in how production systems operate. A means for improving the efficiency and productivity of cropping systems while also minimizing adverse environmental impacts is the use of cover crops to provide nitrogen, store carbon, and improve soil function. Current cover crop use in California is low due to concerns about opportunity costs involved with forgoing cash crop income, the cost additional water needed to grow a cover crop, and depletion of soil water by cover crops. Farmers currently lack science-based information related to cover crop management and water use. This project will determine the biomass potential for cover crops, changes in soil water storage under these cover crops compared to fallow, and data on the carbon and nitrogen capture potential of these mixes to inform farmers of the true tradeoffs associated with this practice.

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*Improving Water and Nitrogen Use Efficiency of Cool Season Vegetables:
Brussels Sprouts, Celery, High Density and Organic Crops* \$246,462

The Regents of the University of California, Davis

The vegetable production district of the Central Coast is an important production area that produces 90 percent of cool season vegetables in the summer. This region is water stressed due to the drought and newly enacted regulation of fertilizer nitrogen (N). Extensive evaluations have been conducted on water and nitrogen use of lettuce and broccoli to develop the web based decision support program, CropManage; it is increasingly being used by growers to improve irrigation and N management. Water and N requirements of other key vegetables is needed: celery, Brussels sprouts and high density leafy greens (baby lettuce and spring mix). In addition, CropManage provides N decision support on the quantity of N available from soil organic matter; better understanding of N sources other than from fertilizer is needed to assist organic as well as conventional growers in management decisions. This project will provide data to expand the utility of CropManage to other key crops.

High Elevation Vineyard Irrigation Model Beta Test \$96,523

Calaveras Winegrape Alliance

This project will perform follow-up beta testing of the 2012 Specialty Crop Block Grant Program High Elevation Vineyard Irrigation project's model protocol. Beta testing is necessary to ensure the model functions properly in real-world exposure. Alpha testing, completed under the 2012 project, substantiated the model's hypothesis that approximately 20 percent of water can be saved using the model. Per suggestions of previous growers, the cumbersome task of manually entering weather data has been replaced with a user friendly online program to perform these tasks automatically. The model's protocol, based on forecasted high temperatures, can now provide high elevation growers easy online access to get irrigation directives for their specific high elevation vineyard. Beta testing provides internal testing using select growers to analyze/modify data and should greatly improve best management practice effectiveness. High elevation expert Glenn McGourty, Viticulture and Plant Science Advisor, University of California Cooperative Extension Mendocino County, highly recommends beta testing before best management practice guidelines can be released to the general public.

*Updating Crop Water Use and Crop Coefficients of Mature Pistachio
Orchards in the San Joaquin Valley* \$384,609

The Regents of the University of California, Davis

Little information is available to growers on evapotranspiration (ET) by pistachio orchards grown under current irrigation practices and on salt-affected soils, where the canopy development, orchard's water use and production may be adversely affected by the high soil osmotic potential. This project will develop updated information on water use by mature pistachio orchards grown on non-salt-affected and salt-affected commercial soils under micro-irrigation. The Regents of the University of California, Davis will conduct field measurements of actual ET and crop coefficient (Kc) in four commercial pistachio orchards, and investigate impacts of increasing levels of soil-water salinity on canopy growth and crop ET. The expected

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outcomes are information of practical use by pistachio growers in making informed decisions on irrigation management and leaching practices, which could have a significant impact on pistachio production in the San Joaquin Valley. A hybrid method will also be developed combining ground and remote sensing measurements to estimate actual ET in orchards.

*Incentives to Reduce Greenhouse Gas Emissions and Nitrate Leaching
from Almond Orchards*

\$261,812

Almond Board of California

Over the last decade, California almond production has grown to nearly 900,000 acres. As one of California's top three crops (in acreage), almonds can play an important role in helping California meet its greenhouse gas reduction and water quality improvement goals. The Almond Board of California (ABC) has been leading efforts to understand the greenhouse gas and water quality impacts of different almond cultivation practices. The project would enhance this work by leveraging projects designed to reduce greenhouse gas emissions and nitrate leaching in California tree nut orchards. The proposed project would: 1) Quantify greenhouse gas emissions and water quality benefits from modified growing practices; 2) Carry out cost-benefit analyses for implementing such practices; 3) Participate in pilot projects with growers to determine opportunities and gather ground based costs of implementation; and 4) Build upon existing ABC-funded nitrogen budgeting tools to assist growers to make real-time management decisions.

*Sustainable Water Management Strategy for Specialty Crop Expansion
in the Sacramento Valley*

\$339,374

Sacramento Area Council of Governments

The emergence of new markets coupled with improved irrigation technologies will support new specialty crop acreage in the Sacramento Valley. Yet while new technologies can improve irrigation and financial performance, the switch from flood irrigation to drip systems that rely on groundwater also can affect ecosystem services of agricultural lands including groundwater recharge and habitat for salmon, waterfowl, shorebirds and raptors. The Sacramento region produces an annual agricultural output of over \$2 billion while also providing habitat for 50 percent of threatened and endangered species in California, yet recently regional groundwater storage has decreased by an estimated 1.6 million acre-feet. This project will examine scenarios that strategically locate flood irrigation to provide habitat and maintain adequate groundwater supplies for specialty crop production. The project will provide much-needed data, tools, practices and strategies that support specialty crop growers.

*Mineral Nutrient Requirements of Table Grape Cultivars in the San Joaquin
Valley and Effects of N Rates on Fruit Quality*

\$276,109

California Table Grape Commission

The proposed research will determine nitrogen needs and develop nitrogen and potassium budgets for major table grape cultivars. Prior studies on table grape nutrient requirements were conducted in the 1990s on Thompson Seedless table grapes, which are now grown only on

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9,637 out of 101,849 table grape acres. The newer varieties are more productive than Thompson Seedless and new vineyards are commonly drip-irrigated, and supported with larger trellises that differ from the typical table grape trellis used in the past, which increases total biomass production by the vines and may increase the demand for nitrogen and potassium. The overall goal is to determine nitrogen needs for the Crimson Seedless, Flame Seedless and Scarlet Royal varieties: optimum timing and rates for maximum nitrogen uptake and fertilizer use efficiency, to maximize yield and crop quality, while minimizing leaching. In addition, nitrogen and potassium budgets for three white table grape varieties, Shee gene 21, Princess and Autumn King, will also be developed.

Combined Denitrification and Blackberry Production in a Woodchip Bioreactor

\$82,044

Coastal San Luis Resource Conservation District

The Coastal San Luis Resource Conservation District has recently completed construction of a pump-and-treat woodchip bioreactor on farmland near Nipomo, California. This bioreactor has been planted with native blackberry plants which are currently thriving. This project will replace the existing native blackberries with several varieties of commercial blackberries. The project will also monitor water quality in the bioreactor and allow for quantification of nitrate reduction over two growing seasons. The goal is to compare fruit quality of blackberries grown in the bioreactor to traditional blackberries to determine if production on a woodchip bioreactor can produce a commercially viable crop. Blackberries are a valuable specialty crop on the central coast. Nitrate pollution from agricultural runoff is a significant problem. If this project succeeds, it would show a potential method for reducing nitrate pollution while keeping farmland productive.

Development of Lettuce Cultivars with Increased Water and Nitrogen Uptake

\$416,343

Cal Poly Pomona Foundation, Inc.

Lettuce has a shallow root system that limits the amount of water and nitrogen uptake. Water is an increasingly critical and unpredictable resource and nitrogen fertilizers are known contributors to groundwater contamination and greenhouse gases. Developing cultivars with improved nitrogen and water uptake will reduce resource consumption, minimize environmental impact and enhance sustainability of lettuce production. To accomplish this goal, lettuce cultivars and accessions will be screened to: 1) Identify lines with the greatest root biomass, length and growth rates; 2) Identify lines with the greatest nitrogen uptake; and 3) Develop new F2 populations to determine the genetics of root biomass, water and nitrogen uptake. Superior genotypes identified in screens will be crossed with commercial cultivars that are typically shallow-rooted and have low nitrogen use efficiency. Determining the genetics of root growth and nitrogen uptake will facilitate successful breeding with this germplasm.

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*Real-Time Irrigation Metrics for Improved Water Use Efficiency in Orchards
and Vineyards*

\$295,623

The Regents of the University of California, Davis

California confronts an unprecedented drought of epic proportions and specialty crop growers need tools to allow them to use water more conservatively. The proposed project will address this issue by using normalized difference vegetation index (NDVI) provided by Skybox Imaging Inc. for near real-time sensing metrics to adjust irrigation amounts. This project will incorporate site-specific geospatial analytics (e.g., NDVI) ultimately deliverable in a smartphone application. NDVI will be ground verified for canopy area by destructive harvest and laser scans gathered with mobile lidar using unmanned aerial vehicles (UAVs). The result of this project will be an integrated platform combining interpretation of soil water reservoir (University of California Davis Soil Survey), canopy demand function (NDVI) and evapotranspiration demand (ET_c, California Irrigation Management Information System (CIMIS)). The proposed project leverages data from wine grape, almond, and pistachio sites intensively monitored for ET_c (micrometeorological method) soil water and yields.

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PLANT HEALTH AND PEST MANAGEMENT

*Demonstrating the Economic and Environmental Benefits of Hot-water
Pest Eradication*

\$401,836

**The Regents of the University of California, San Diego County Cooperative
Extension**

Hot water treatment of plant material for the elimination of endemic and invasive pests is not a new concept, and it is widely used in Hawaii. Although plants treated in this manner in Hawaii meet phytosanitary requirements in California, hot water treatment of ornamental plants is not practiced in California. The preferred methods for eradication of arriving invasives or nursery cleanliness standards are pesticide applications or plant destruction, which pose undue economic burden on the producer. Potentially, pesticide applications can pose an unnecessary impact on the environment depending on the magnitude of the eradication effort for some pests. This project is collaborative between local and state regulatory agencies, universities, and cooperating growers. It will build on the research conducted in Hawaii and other universities across the U.S., and the goal is to demonstrate that this method can be employed in California in lieu of pesticide applications and plant destruction.

*Development of Molecular Markers for Selection of Lettuce Genotypes with
Resistance to Verticillium Race 1*

\$442,160

USDA, Agricultural Research Service

Lettuce is a valuable California crop worth over \$1.4 billion annually. Production and profits are reduced when lettuce is infected with Verticillium wilt, the disease caused by the soilborne fungus *Verticillium dahliae*. Verticillium wilt has devastating impacts on crops. Plants are often symptomless until they are near market maturity, when the disease develops quickly and often results in complete yield loss in affected fields. The best long-term control of the disease is based on host resistance. Development of resistant cultivars is most desirable, but the progress in breeding is hindered by very slow and labor intensive field-based testing. To make the breeding process more rapid and economically efficient, the proposal will develop molecular markers that can be used to identify the genotypes with Vr1, the dominant gene for resistance to Verticillium wilt race 1. In addition, the proposal will analyze Vr1 resistance homologs in resistant and susceptible accessions and study their relationship.

Testing Efficacy of Anthraquinone as a Vole Repellent in Citrus

\$90,882

The Regents of the University of California, Davis

Recent USDA estimates of vertebrate pest damage to California's specialty crops suggest that approximately 30 percent of California's total citrus acreage (oranges and lemons) is damaged and expected yield loss per damaged acre is 1.0 percent and 3.5 percent for oranges and lemons, respectively (Gebhardt et al. 2011). More recent feedback from California's citrus representatives suggests that California voles cause damage by girdling the bark of citrus trees. Indeed, voles are among the six vertebrate pests most frequently implicated with

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depredation of California's agricultural crops as well as a species for which the development of efficacious control methods is currently needed (Baldwin et al. 2013, 2014). These losses have motivated the use of several damage management techniques, including non-lethal chemical repellents. Therefore, the project objectives are to identify the effective concentration and evaluate the efficacy of an anthraquinone-based repellent for mitigating girdling of citrus by voles.

Development of a Rapid Real Time Polymerase Chain Reaction (qPCR) Assay to Detect Nematode Pests of Pistachio, Walnut, and Almond \$220,083

The Regents of the University of California, Davis

Nematodes reduce vigor and yield in tree nuts, causing 15 to 20 percent damage on average, but sometimes as much as 50 percent. Developing a real time polymerase chain reaction (qPCR) diagnostic tool will enable rapid, accurate assessment of nematode species identities and population densities so that more field samples can be processed quickly with less expense. Field tests of this tool will demonstrate its efficacy in comparison to traditional microscopic methods. Nematode population thresholds associated with crop damage will also be assessed in cooperative extension field trials. The diagnostic tool and proper sampling strategies will be presented to growers, pest control advisors, and cooperative extension personnel through demonstration days, a hands-on workshop, and publications. By improving growers' capacity to detect pests such as root knot and lesion and ring nematode in tree crops, better pre- and post-plant management decisions can be made.

New Lettuce Cultivars with Resistance to Lettuce Drop \$334,418

The Regents of the University of California, Davis

Lettuce drop is a destructive disease causing annual losses to California's lettuce crop. Complete control is not achieved through current production practices. UC Davis and the USDA in Salinas, California have identified high level resistance in the cultivar Eruption, which could reduce losses by about 50 percent if its resistance genes are bred into new cultivars. This project will develop lettuce with resistance from Eruption and determine their adaptation to winter and summer production in California. It will determine the genetics of resistance in a population of recombinant inbred lines (RILs) derived from a cross with Eruption. This information is needed to efficiently breed resistance into new romaine, leaf, and iceberg cultivars. Breeding lines, RILs, data, and information will be publicly released for seed companies to use in the development of their own breeding lines and commercialization of new cultivars. The proposal will monitor adoption of these resources to determine project success.

Adopting High-Throughput Multiple Citrus Pathogens Detection System at Citrus Grower's Pest Detection Program \$448,898

Central California Tristeza Eradication Agency

The grower-funded Central California Tristeza Eradication Agency (CCTEA) has served San Joaquin Valley citrus growers for over 50 years, detecting and suppressing the citrus tristeza

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virus (CTV) in commercial groves. Recent technological advances have provided the means to distinguish between mild and severe CTV strains and to detect multiple pathogens in a single test. Now operating as the Citrus Pest Detection Program and responding to the expressed desire of citrus growers for broader service, the CCTEA is positioned to expand its diagnostic capabilities. By acquiring the necessary equipment, the agency can implement high-throughput nucleic acid extraction and multiplex detection of various pathogens in a single reaction. Threats such as Huanglongbing, severe CTV isolates, citrus stubborn, and other exotic pathogens can be addressed for the greater protection of California's citrus industry.

Development of Nematodes within the Genus Phasmarhabditis as Biocontrol Agents of Snails and Slugs in Californian Nurseries \$435,824

The Regents of the University of California, Riverside

Snails and slugs are among the most damaging pests of California's specialty crops, but current controls are impractical for large areas and toxic to many non-target organisms. There is hence a real need for more effective and safe strategies. The Regents of the University of California, Riverside has recently discovered *Phasmarhabditis hermaphrodita* for the first time in the U.S., and this nematode, in combination with its bacterial associate, is used as a successful biocontrol of gastropod pests in Europe. Furthermore, the Regents of the University of California, Riverside survey results demonstrate that more than 80 percent of stakeholders in the Californian nursery industry would use biocontrol. This project therefore aims to determine the distribution of *Phasmarhabditis* spp. in California, assess their host range, assess the efficacy of candidate species in field trials, and deliver a safe agent for widespread use in Californian nurseries and other relevant specialty crops. Key public outreach initiatives will include an enhanced project website, a stakeholder workshop, and publications.

Development of an Effective Attractant for Control of Leaf-footed Plant Bug in Pomegranate, Pistachio, and Almond \$114,672

USDA, Agricultural Research Service

In 2014, California pomegranate growers reported a large increase in leaf-footed plant bugs (LFPB). LFPB inflict serious damage to pomegranate, almond, and pistachio, and vector pathogenic microbes into pomegranate resulting in internal decay of otherwise intact fruit. Increases of LFPB are also a concern to tree nut growers, given that LFPB can migrate to tree nuts at a time when nuts are vulnerable. Anecdotal evidence from growers suggests that LFPB are attracted to pomegranates that have begun to split. This project will formulate a blend of pomegranate-based volatiles and use the blend as an effective control or monitoring of LFPB in pomegranate and tree nut orchards. An effective lure of LFPB would decrease damage to pomegranates and alleviate LFPB migration into other valuable specialty crops. California pomegranates have an annual value of \$120 million. California tree nuts have an annual value of \$5 billion. There is currently no sustainable tool available to growers for control or monitoring of LFPB.

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Develop Effective Fumigation Methods to Control Parasitic Nematodes in Orchard Soil for Successful Replanting \$442,028

USDA, Agricultural Research Service

Many perennial crops (stone fruits, nuts, and grapes) in California rely heavily on pre-plant soil fumigation to control plant parasitic nematodes and establish healthy and productive orchards. The current fumigation method at 18-inch-injection depth is unable to deliver fumigants 1,3-dichloropropene and chloropicrin to soil depths below three feet that has led to high nematode survival and poor tree establishment. Stringent environmental regulations also demand low emissions. Deep injection, carbonation, and low permeability tarp, such as totally impermeable film or combinations of these techniques, can facilitate fumigant movement to the deep soil while reducing emissions. This project will determine how these techniques can be utilized in broadcast, strip, or spot applications to improve fumigant movement in soil profile. Data on soil nematode control, fumigant movement, and tree growth will be collected and used to draw conclusions on more effective fumigation methods.

Improving Strawberry Gray Mold Management through Identification of Ineffective Sprays \$89,894

Cal Poly Corporation

Gray mold caused by *Botrytis cinerea* is the most important disease affecting strawberry fruit in the field and postharvest. Management of the disease relies heavily on the use of fungicides applied at weekly intervals during the harvest season (five to six months). *Botrytis* is notorious for developing resistance to fungicides, rendering them ineffective. Resistance is assumed to be well managed because several fungicides are used in rotation or mixtures during the season. However, resistance to several active ingredients has been documented in the eastern U.S. and some evidence of resistance was found in California. This project will comprehensively survey the California strawberry industry for resistance to all major active ingredients registered for use against strawberry gray mold in California. The project will use well established techniques and provide growers with information that ultimately will lead to avoidance of ineffective sprays and improved disease management.

Developing a More Sustainable Pest Management Program for Southeast Asian Farmers \$307,609

The Regents of the University of California, Fresno County Cooperative Extension

Since the 1980s, there has been a rapid expansion of Southeast Asian small farms in California, corresponding to an increasing Hmong population residence and farms in the San Joaquin Valley. These farms often have a rich diversity of specialty crops (e.g., Chinese bittermelon, lemongrass, long beans, mustard greens, Thai pepper, Chinese squash). The crops are grown in complex polycultures, mixing traditional farming practices with some modern techniques. Currently, insect pests are a primary concern because there is no integrated pest management program (IPM) developed for these farms, and a common response to insects is to hand spray crops with broad spectrum insecticides. This project will

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develop sustainable and safe IPM programs by identifying insect pests and their natural enemies throughout the season, developing sampling programs, and identifying control options for key insect pests. Throughout the project, information will be extended to the Southeast Asian farm community.

*Determining the Effects of Limited and Poor Quality Irrigation Water on Weed
Composition and Control in California Tree Nut Crops* \$148,902

The Regents of the University of California, Davis

Weed control in orchards is necessary to reduce weed competition that threatens new transplants, increase irrigation efficiency, and ensure that fruits and nuts can be harvested effectively and economically. Despite the adoption of water-saving irrigation systems (i.e. micro-sprinklers, drip tape), water availability, especially under drought conditions, is a significant concern of orchardists in California. Consequently, growers are relying, heavily, on groundwater of potentially poor quality to maintain production. This project will describe how changes in water volume, salt contamination, and pH are affecting weed community composition and herbicide performance. Weed control programs designed for water-limited systems will help growers maximize their water use efficiency and limit the application of unnecessary pesticides. Although the ongoing drought in California has highlighted these concerns, water quantity will continue to affect orchard weed control long after this drought ends.

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FOOD SAFETY

Identification of Novel Indicator Organisms to Determine the Risks of Fecal Contamination of Irrigation Waters

\$234,921

Center for Produce Safety

The Center for Produce Safety will partner with the University of Arizona to identify appropriate indicator organisms in irrigation water. The methods used to detect *Escherichia coli* were developed for drinking water and are known to produce high levels of false-positive and false-negative results when used for irrigation waters. Therefore, growers are required to make decisions about water quality/safety based on inaccurate tests. The project goal is to identify microorganisms for use as novel indicators of the presence of pathogens (not just fecal contamination) in irrigation waters to allow the produce industry to make more accurate risk-based assessments to determine when it is safe to irrigate crops. The objectives include examining irrigation water to determine the levels of fecal indicator and pathogenic bacterial/viral species by existing cultural and/or molecular methods; determining the composition (presence and relative abundance) of bacterial, protozoan, and fungal communities found in irrigation water; and identifying groups or specific species whose presence correlate well (presence/absence and relative abundance) with the occurrence of foodborne pathogens in irrigation waters. The use of more meaningful indicator species will provide growers with more accurate information to optimize their irrigation practices to minimize the risk of contamination of produce by foodborne pathogens.

Control of Cross-Contamination During Field-Pack and Retail Handling of Cantaloupe

\$217,066

Center for Produce Safety

The Center for Produce Safety will partner with Virginia Polytechnic Institute and State University to better define cross-contamination points for melons during handling. Following recent melon-associated foodborne outbreaks, California cantaloupe growers voluntarily developed and implemented commodity specific food safety guidelines for the safe handling of cantaloupes and other netted melons. Although this document details best food safety practices to reduce the risk of contamination during production, packing, and distribution, science-based metrics describing transfer coefficients for pathogen contamination onto melons during field-packing operations are needed. Cross-contamination was highlighted by the Food and Drug Administration as a critical factor contributing to recent cantaloupe outbreaks. To date, no published literature evaluating the cross-contamination potential of whole melons has been established under typical field-packing conditions. Furthermore, there is a lack of data on handling practices related to cross-contamination risks for melons in the retail distribution supply chain, as well as guidance on the safe and uniform handling of melons throughout the retail environment. Through this project, potential cross-contamination points likely to increase risk will be identified and intervention strategies targeted to reduce the occurrence of pathogen transfer events during the handling of melons at harvest and retail will be developed.

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Evaluation of Sanitizing Treatments for Sizer Carriers in Stone Fruit Packinghouses

\$99,158

Center for Produce Safety

The Center for Produce Safety will partner with California State University, Fresno, to evaluate and improve sanitizing treatments for sizer carriers used in stone fruit packinghouses. Fruit sizer carriers are small rollers or holders for conveying washed fruit individually through optical sorters and automatic labelers for sizing, labeling, and packing. The aims of this one-year research project are to describe the potential for sizer carriers to harbor pathogens and allow for their growth under different environmental conditions and also to define a set of sanitizers and application methods that represent the greatest promise for evaluation at the commercial level. Environmental sampling will be performed in active commercial peach and nectarine packinghouses to determine natural microbial loads on the fruit-contact surfaces of sizer carriers. Subsequently, laboratory inoculation studies will be performed to determine the growth potential of selected foodborne pathogens on sizer carriers under various humidity and temperature conditions. Also, the potential of clean-in-place (CIP) sanitization will be evaluated by applying no-rinse sanitizers (steam and aerosol antimicrobial chemicals) to the sizer carriers. Results from this study potentially will be applicable to diverse fresh fruit packinghouses for preventing pathogen cross-contamination in produce packing operations. Findings and recommendations will be reported and disseminated through industry meetings and technical publications.

Microbial Food Safety Risks of Reusing Tail Water for Leafy Green Production

\$162,695

Center for Produce Safety

The Center for Produce Safety will partner with the University of California, Cooperative Extension, to determine whether tail water can be used for leafy green production without increasing microbial food safety risks to consumers. The use of sprinklers and furrow irrigation results in significant volumes of run-off or tail water. Although the use of drip lines reduces irrigation run-off, overhead sprinklers are needed for germinating and establishing crops, and for watering high-density leafy greens. Additionally, a significant number of acres of lettuce and other vegetables are irrigated by furrow after crop establishment. Many California Central Coast ranches have infrastructure for reusing tail water for irrigating crops, including sediment basins, reservoirs, and pumping systems. Currently, growers are reluctant to irrigate crops with tail water due to a lack of information on microbial food safety risks. This project will monitor, characterize and quantify microbial populations in run-off water from Central Coast vegetable fields, evaluate the risk of using this water source for leafy green crop production by quantifying survival of microorganisms during reuse applications and evaluate economically-feasible methods to treat tail water that would minimize microbial food safety risks for various reuse applications (e.g., pre-irrigation, dust control, irrigation).

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Comparative Genomics Analysis and Physiological Assessment of the Avirulent Salmonella Surrogate Relevant to Produce Safety \$110,494

Center for Produce Safety

The Center for Produce Safety will partner with the University of Florida to assess the genetic and physiological differences among Salmonella strains relevant to produce safety. Coliforms and generic Escherichia coli are poor predictors of behavior of human pathogens (such as Salmonella, pathogenic E. coli and Listeria) in the crop production environment. Accurate models of Salmonella behavior in the production environment must be built based on experiments conducted with Salmonella, and not based on data from distantly related surrogates like generic E. coli. This requires availability and careful characterization of “disarmed” strains of Salmonella that could be used for on-site research. This study will develop robust tools for modeling the behavior of these outbreak strains in the pre- and post-harvest production environment. The purpose of this project is to carry out comparative genomic and physiological characterization of the outbreak strains under production conditions and to compare them with a nonvirulent strain of Salmonella developed by the research team to be suitable for on-site studies as an indicator organism. Two key hypotheses of this study are aimed at understanding why only a dozen out over 2,500 Salmonella strains are associated with produce-linked illness outbreaks.

Methods for the Detection of Diverse Parasites on Packaged Salads Based on (viable) Oocysts \$223,907

Center for Produce Safety

The Center for Produce Safety will partner with the University of California, Davis to develop a novel test to detect parasites on leafy greens. This project will involve an approach to manage and monitor produce safety to reduce the risk of foodborne illness from consumption of packaged salads: detecting human parasites on the surfaces of leafy greens in a rapid, accurate, and affordable manner. A novel test will simultaneously detect four key parasites that can be associated with produce-borne disease. Applying the newly validated tests in parallel with previously established methods for testing packaged salads will provide a realistic evaluation for how suitable the developed assays are for routine screening by the produce industry. Additional methods will determine the viability of the parasites detected, and whether they are likely to cause disease to consumers of the produce.

Validating a Physically Heat-Treated Process for Poultry Litter in Industry Settings Using the Avirulent Salmonella Surrogates or Indicator

Microorganisms

\$193,921

Center for Produce Safety

The Center for Produce Safety will partner with Clemson University on process validation of poultry litter heat treatments. Poultry litter is an excellent source of nutrients for the growth of agricultural crops. To reduce the microbiological risks associated with the use of raw poultry litter as a soil amendment or organic fertilizer, heat treatment is recommended to reduce or eliminate potential pathogenic microorganisms. The thermal resistance of Salmonella in

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chicken litter is increased significantly when cells are adapted to desiccation or when aged chicken litter with low moisture content is heat treated. By increasing the moisture level in chicken litter or applying a two-step heat treatment (wet heat followed by dry heat), Salmonella can be inactivated more rapidly. Preliminary results indicate a good correlation in thermal inactivation rates between desiccation-adapted Salmonella and indigenous enterococci in chicken litter, suggesting enterococci as a potential indicator for heat process validation. This study will collaborate with two large poultry litter processors to validate their heat-treatment processes in industrial settings by using Salmonella surrogate and indicator microorganisms. Results from this research will provide some valid guidelines and tools for the fertilizer industry to produce Salmonella-free heat-treated poultry litter, thereby ensuring safe production of fresh produce.

Pathogen Physiological State Has a Greater Effect on Outcomes of Challenge and Validation Studies Than Strain Diversity \$274,750

Center for Produce Safety

The Center for Produce Safety will partner with Cornell University to develop and characterize a produce-specific pathogen strain collection. Effective control of foodborne disease-causing microbes (“pathogens”) requires science-based validation of interventions and control strategies. For example, it is important to show that a given antimicrobial treatment can reduce bacterial numbers with certain target efficiency, regardless of the specific genetic type of organism and regardless of the conditions under which an organism was grown prior to treatment. This is important as it has been shown that Salmonella exposed to a dry environment can be greater than 100 times more resistant to some treatment (for example, heat) than Salmonella grown in the presence of high levels of water. This project will assemble a collection of diverse microbes that are appropriate for validation of pathogen interventions in the produce industry, and will evaluate these organisms to determine whether and how exposure to different environmental conditions will affect the ability of these organisms to survive stressful conditions and control strategies. The resulting data, along with the bacterial collection developed as part of this project, will facilitate more reliable identification of effective control strategies that can reduce the risk of foodborne illnesses and pathogen contamination.