

**California Department of Food and Agriculture  
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## CALIFORNIA GROWN PROMOTION

*California Grown – Love California*

\$1,547,200

### **The Buy California Marketing Agreement**

The “Love California” campaign will educate and inform a targeted audience by demonstrating the process from growing to transporting specialty crops from start to finish, while educating the audience of the love and care that farmers and farmworkers put into producing specialty crops every step of the way. The campaign will continue to grow an online community of people who support California specialty crops and provide a consistent stream of content highlighting the wide variety and seasonality of specialty crops and farmers in the state of California through multiple social media sites. The project will create new video content in a “Snackable” format designed for various digital platforms, and launch a new influencer program entitled Choose California Grown, which will engage key online influencers and bloggers with a following of California shoppers. A new event program, “Meet California Grown” will simultaneously engage California shoppers at point of sale and through various digital platforms. The program will develop and distribute new weekly recipes, California specialty crop farmer, and in-season California specialty crop content. The program will execute point of sale promotions with retail partners in California featuring multiple California specialty crops.

*Sustainability Research, Education, and Promotion to Enhance U.S.*

*Winegrowers’ Competitiveness*

\$299,998

### **California Sustainable Winegrowing Alliance**

The U.S. winegrape growers and vintners face mounting pressure in a globally competitive marketplace with growing interest in sustainability. The project goal is to use sustainability research, education and promotion to enhance U.S. wine industry competitiveness and to increase adoption of sustainable practices to boost profitability, long-term viability, and marketability of winegrapes and wine. The California Sustainable Winegrowing Alliance (CSWA) and principal partner organizations from California (over 85 percent of U.S. wine production) and New York, Oregon, and Washington (totaling 90 percent U.S. wine production) will conduct consumer/trade research to gauge interest and understanding of sustainable winegrowing; training and education for growers, vintners, trade and consumers; and promotion of sustainably produced U.S. winegrapes and wine to trade and consumers. Project success will be evaluated by a five percent increase in sales and increase in adoption of best practices and related environmental and economic benefits.

*Buy Local Bok Choy*

\$50,000

### **Special Service for Groups, Inc./Asian Pacific Islander Forward Movement**

Special Service for Groups, Inc./Asian Pacific Islander Forward Movement (APIFM) proposes to increase the competitiveness of bok choy, a specialty crop in California, through increased access and awareness. APIFM will create, implement, and evaluate Buy Local Bok Choy, a

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comprehensive campaign aimed at supporting local farmers by engaging local community institutions such as restaurants, to source their bok choy needs from local Asian and Pacific Islander farmers. Success will be measured and evaluated by ensuring website and social media marketing strategies engage and sustain bok choy orders from at least two local Asian farmers. The Buy Local Bok Choy campaign's impact will further be assessed by measuring and analyzing any changes in bok choy sales between the local APIFM partner farmers and local community institutions throughout the campaign.

*"Outstanding in Their Field," a Promotional Campaign Tying California Farmers' Conservation Efforts to the CA Grown Brand* \$293,552

**California Exposition & State Fair**

"Outstanding in Their Field" addresses the need to create a greater connection between farmers and consumers by sharing farmers' diverse stories, conservation efforts, and more. This will be framed within a California grown exhibit showcased at three consecutive State Fairs (with more than 600,000 visitors annually). The goals are to both raise visitor awareness of the quality and increase the sales of California grown specialty crops by connecting farmers' stories to today's environmentally conscious consumer. The outcome of the project is a 7,000 square-foot exhibit (designed and built for transport) that includes product tasting, retail market space, and a social media campaign tying consumers to the California grown identity using the State Fair website (visited by 1.5 million yearly). Evaluation includes creating a retail sales benchmark in year one. A report of the exhibit and campaign metrics with stakeholder and staff reviews will be available for sharing.

*California Food for California Kids: Summer Meals Promotion in the Central Valley and Riverside County* \$290,405

**Center for Ecoliteracy**

Working with regional clusters of school districts that are part of the California Thursdays® Network in Riverside, San Joaquin, and Stanislaus counties, the Center for Ecoliteracy will conduct "Farm to Summer" capacity building and marketing campaigns to promote California grown fruits and vegetables in fresh, healthy summer meals. The program builds on a pilot 2016 Specialty Crop Block Grant-funded summer meal promotion by advancing the creative design and the most successful marketing strategies. The Central Valley and Riverside Summer Meals Promotion will feature three enhanced efforts, 1) menu-planning capacity building, 2) local grassroots outreach teams, and 3) public relations events featuring local growers – in addition to the advertising campaigns. The program is designed to increase procurement of specialty crops for summer meals, awareness of specialty crops in summer meals, and the consumption of fruits and vegetables at summer meal sites within the school districts.

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*Leveraging the California Grown Identity to Boost Sales of California*

*Olive Oil to Nationwide Retailers*

\$297,438

**California Olive Oil Council**

California produces 99.2 percent of the olive oil in the United States. Over the past five years, retail sales of olive oil in the United States grew by 22 percent while California olive oil sales rose by only 4.5 percent. The United States is buying more olive oil but sales of foreign oil still dominate over California olive oil sales. California needs to differentiate its oil to grow sales. The project seeks to accomplish this by leveraging the California grown identity and promoting olive oil to retailers nationwide (the largest olive oil sales market). The California Olive Oil Council (COOC) represents 90 percent of California olive oil growers and is the only entity that promotes on behalf of the entire industry. The project efforts will target high-value retailers and train growers to market themselves (90 percent of California olive oil growers have their own label). The goal is a sales increase of \$66.7 million directly benefiting growers. COOC will evaluate and measure the goal using IRI/SPINS sales data (the industry standard) and grower sales reports.

*Leveraging the California Grown Identity to Grow California Prune Sales*

*Among Generation X and Millennial Snack Consumers*

\$300,000

**Sunsweet Growers, Inc.**

With agricultural labor wages rising 13 percent from 2010-2015 and United States prune imports rising 67 percent just last year (U.S. Department of Agriculture, Foreign Agricultural Service) there is an industry need for marketing efforts that can drive higher returns to California prune growers. This is an industry priority, especially with California prune acreage projected to grow due to modest crop price upticks after long-term declines (California Dried Plum Board). Representing 65 percent of the prune sales in the United States and 244 California prune growers, Sunsweet seeks to share the value of California grown prunes with Generation X and Millennial snack consumers on behalf of all growers. This will be done via a public relations and digital advertising campaign leveraging a rise in value-added dried fruit and nut snacking by these consumers and new California prune snack products in the market. The goal is to boost consumption of California prunes to drive a 13.8 percent sales increase by 2020 while lower-value, unprocessed bulk prunes are shifted to higher, value-added uses. Success will be evaluated and measured by internal records and independent IRI sales data (the industry standard).

*California Backroads: Growing Markets for California Grown Wine on  
the Roads Less Traveled*

\$295,001

**Wine Institute**

There has been a 32 percent increase in wine imports in the United States since 2001. California wine sales in the United States have fallen 10 percent since 2004 (Gomberg) and long-term declines are predicted (Global Trade Information Services). Imports are now 35 percent of the market in the United States and are investing heavily to grow this share even more. California growers and vintners need to reverse this trend and prevent further import

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traction now to maintain viability. For this reason, expanding California Grown winegrape and wine sales is an industry priority. To accomplish growth in winegrape and wine sales, the Wine Institute, representing approximately 1,000 California wineries and 85 percent of wine production in the United States, seeks to launch a marketing campaign to create awareness and demand for lesser-known California wine regions (California Backroads). By sharing positive attributes of California grown winegrapes and wines (e.g., small family farms and high quality) through national marketing and promotional activities, the project will boost both winegrape and wine sales by 7 percent. Benefits will translate to all California growers and vintners. Success will be measured by annual crop reports and sales data.

*California Grown Figs FIT a Healthy and Active Lifestyle: A Robust Digital Marketing Campaign to Increase Demand for California Grown Figs \$296,800*

**California Fig Advisory Board**

Figs and fig products are gaining in popularity due to the fig's strong nutritional profile and portability. This is a prime opportunity for California fig farmers to ensure consumers are seeking out California grown figs. The California fig industry produces 100 percent of the figs sold commercially in the United States, while imports represent 60 percent of figs sold in the United States. In fact, the California fig industry has seen a 67 percent increase in fig imports since 2015. To raise awareness, stimulate consumption, and drive sales of California grown figs, the California fig industry must establish a robust presence online where today's consumer is actively seeking out health and nutrition information. Success will be measured through data collection on the farm gate value of figs and actual shipment sales.

*Zinfandel Stories: Preserving California's Legendary Vineyards \$259,141*

**Association of Zinfandel Advocates and Producers**

Economic forces are pressuring farmers to replant California's Zinfandel vineyards with varieties that are not uniquely Californian. By increasing the profitability of small-block Zinfandel farming through increasing demand for single vineyard designated wines, vineyard owners will be able to preserve historic plantings for future generations. This project will raise awareness of this issue by connecting consumers with farmers, winemakers, and vineyards via multiple touch points including innovative digital storytelling, media, consumer and trade events, and tours. Key influencers will visit vineyards and hear farmers' stories. Consumer and trade events will feature vineyard designated wines and winemakers, while digital storytelling will broadly expand the project's reach.

*California Specialty Crop Sales and Promotional Mission to Southeast Asia*

*\$299,241*

**Center for International Trade Development**

This project will expand opportunities for California specialty crop stakeholders through export promotions, media events, and trade and consumer educational opportunities throughout Southeast Asia. In partnership with CA GROWN, the Center for International Trade Development (CITD) will host activities highlighting specialty crops ensuring regional buyers

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understand the value of these high quality products. Targeted outreach activities will provide opportunities to develop new export sales via business-to-business meetings arranged by CITD on behalf of California specialty crop exporters. Promotions will include product sampling and chef demonstrations focused on using California specialty crops in local dishes. As media and consumer awareness promotions are established, export activities will build on the project's momentum with promotions in each target market. The project will conclude with an outbound trade mission serving 20 California specialty crop suppliers.

*California Grown Specialty Crop Trade Show*

*\$298,165*

**Center for International Trade Development**

This project will leverage existing Visit California and CA GROWN outreach by complimenting ongoing overseas promotional efforts to introduce specialty crop foods to a targeted audience of import decision makers. There will be three outbound missions centered around major trade shows in markets with high growth potential. Sessions will be established for specialty crop exporters to meet one-on-one with importers. This project will also execute a promotional campaign in target countries and take part in other international events to continue specialty crop food education and awareness. Specialty crop awareness will be promoted via social media in target markets throughout the project. It is anticipated that sales will increase from \$6 million to \$9 million (50 percent) as a result of marketing and/or promotional activities.

*California Grown Flowers Retail Promotion Campaign*

*\$176,730*

**California Cut Flower Commission**

Research reveals that 74 percent of consumers do not know where flowers come from; yet 58 percent of consumers would prefer to buy California grown flowers over imported flowers. Additionally, a study by the Institute of Grocery Distribution in 2015 found that consumers buy local because of the perception that products are fresher and to support local farmers. However, California cut flower farmers are losing market share to cheaper, imported flowers from Colombia, Ecuador, and Mexico. To better compete for market share and drive consumer preference, the California Cut Flower Commission seeks funding to conduct California Grown Flowers promotional campaigns with retailers operating in California. The project would emphasize June, which has recently been declared California Grown Flower Month by the state legislature. Funds would be used to develop retailer-specific promotional campaigns, including point-of-sale marketing materials and videos profiling California cut flower farmers.

*Creating Demand for California Dried Fruit in Schools*

*\$288,522*

**California Dried Fruit Coalition**

To meet the demands of school district guidelines as well as the picky palates of school-aged children, the California Dried Fruit Coalition (CDFC), a coalition of California's date, dried fig, dried plum, and raisin farmers, will embark on a research and development project to create a new concept featuring four of California's dried fruit products. This is the time to develop a new market and differentiate California grown dried fruits due to the impact of imports (nearly 40 percent) displacing current domestic market share. The new concept will also provide school-aged children with much needed nutrition. The CDFC will work with the California Polytechnic

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State University Food Science & Nutrition program to conduct multi-phase research to develop the new concept. The CDFC will also engage with school industry leaders to gather insights and share results to create demand for the new concept. Success will be measured through sales and farm gate values.

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## ENVIRONMENTAL STEWARDSHIP AND CONSERVATION

*Optimizing Access of Drip Irrigated, Organic Fresh-Market Tomatoes to Soil Nitrogen Through Grafting and Irrigation Management* \$213,338

**The Regents of the University of California, Davis**

Drip irrigation can improve water use efficiency, increasing the sustainability of farming in California. However, drip irrigation poses challenges for organic growers. The wetted soil volume is smaller than with other irrigation types, potentially limiting nitrogen mineralization from organic sources and reducing the zone of root nutrient uptake. Grafting is becoming popular for some vegetables and opens exciting possibilities to select rootstocks that are better able to explore the soil's nutrient pool. This research will examine spatial and temporal patterns of nutrient availability, crop uptake, and fruit quality under different irrigation schedules and drip tape configurations for grafted and non-grafted, organic fresh-market tomatoes. The project shall improve the sustainability of drip irrigation in organic systems by increasing nutrient use efficiency and decreasing the risk of nitrate leaching to the groundwater. The results will be transferable to other drip irrigated specialty crops.

*Searching the U.S. Department of Agriculture Fababean Germplasm for Genotypes With Enhanced Biological Nitrogen Fixation* \$288,353

**California State University, Chico Research Foundation**

Fababean (*Vicia faba*) has the highest biological nitrogen fixation (BNF) among annual legumes. To use the full potential of fababean as a cover crop, the U.S. Department of Agriculture fababean germplasm (consisting of about 400 lines from different parts of the world) will be searched for genotypes with superior BNF. The germplasm has been widely used in various breeding programs, but the BNF potential is unknown. A population of 50-60 genotypes from the germplasm will be established in a replicated field trial (about 360 plots). The population will be characterized for, 1) morphological traits, 2) biomass production, 3) BNF, 4) contribution to soil nitrogen, and 5) water use efficiency (using the <sup>13</sup>C and <sup>15</sup>N natural isotope abundance technique). The study will be the first to reveal the potential of this valuable resource as a cover crop. Promoting fababean (and other legumes) can reduce the need for nitrogen fertilizers and animal manures that are known to add to environmental pollution and greenhouse gas emission.

*High-Throughput Screening for Salt-Excluding Walnut and Pistachio Rootstocks* \$147,027

**The Regents of the University of California, Davis**

Increasing salinity is projected to reduce California agricultural production by billions of dollars annually by 2030. Walnut and pistachio orchards mature slowly and remain productive for decades implying that orchards planted today must anticipate salinity levels well beyond 2030.

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Most walnut and pistachio rootstocks are interspecific hybrids, but diversity for salinity tolerance within Juglans and Pistacia is not well understood. This project aims to, 1) optimize high-throughput hydroponic screens for salinity tolerance in walnut and pistachio rootstocks and 2) identify sources of salinity tolerance for breeding through screening of diverse germplasm. Success will be measured by comparing salinity tolerance between established, elite clonal rootstocks and newly discovered sources of tolerance.

*Strengthening the Climate Resilience of Central Coast Specialty Crops With Organic Amendments Using the COMET-Farm Tool* \$300,000

**University of California Cooperative Extension, Monterey County**

California state agencies are advocating for the use of soil amendments derived from organic materials to increase soil health and improve climate resilience. The application of these materials has shown to increase soil organic carbon content, reduce fertilizer loss, and improve nutrient use efficiency. The use of these amendments, such as compost, is a common practice within the Central Coast specialty crop industry. Yet, fundamental questions remain concerning soil carbon sequestration limits, nutrient availability, crop yield stability, and greenhouse gas emissions. Previous work has shown that the influence of a single compost application on soil nitrogen dynamics, such as nitrous oxide emissions under nitrogen fertilization, depends on soil texture. This project proposes lab, field, and greenhouse experiments to improve understanding of these materials and inform the nutrient management component of the Natural Resources Conservation Service COMET-Farm Tool, aiming to make it more relevant for Central Coast specialty crop producers.

*Improving Irrigation Scheduling for Almonds Using Variable Rate Micro-irrigation, Soil, and Plant Water Status Monitoring* \$299,138

**The Regents of the University of California, Davis**

The Sustainable Groundwater Management Act along with more frequent droughts will result in constrained water supplies for almond growers. Growers will need to cope with limited water by enhancing water use efficiency. The purpose of this study is to help growers produce more nut yield per unit of crop water use by adopting variable rate micro-irrigation (VRM). The project will develop a method for scheduling VRM based on integrated monitoring of the soil, plant, and evapotranspiration. Innovative technologies such as the cosmic-ray neutron probe, stem water potential (SWP) sensors, and remote sensing of evapotranspiration will be evaluated in this study. Outcomes of the study will include increasing the number of almond growers using VRM and the number of growers reporting increase in yield per unit of crop water use. The number of growers that have adopted precision irrigation technologies such as cosmic-ray neutron probes and SWP sensors will be monitored through surveys.

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*Developing Sustainable and Climate-Smart Vineyards Through Sheep  
Integration*

\$278,252

**The Regents of the University of California, Davis**

Sheep grazing in vineyards is gaining popularity among growers. It can provide multiple production benefits, while aiding in climate change adaptation and mitigation through gains in soil organic carbon (SOC). To date, there is no research on integrated sheep-vineyard systems (ISVS) in California and impact assessments are needed. This project seeks to understand how more ecologically intensive ISVS may be utilized to increase SOC and soil health, and provide multiple production co-benefits. The project proposes to setup trials at the Huichica Creek Agricultural Demonstration Vineyard across established long-term tillage and forage treatments to evaluate the effects of sheep grazing on, 1) SOC fluxes and soil health, 2) nutrient retention and availability, 3) yields and quality, and 4) labor, water, and energy inputs. This project will set a strong basis to develop novel best management practices. Results will be disseminated through stakeholder involvement in research and outreach activities.

*Effects of Composted Olive Pomace on Carbon Sequestration, Water  
Retention, and Soil Health in California Olive Groves*

\$231,041

**The Regents of the University of California, Davis**

Using compost made from olive pomace (olive meat, seed, and skin byproducts) restores soil organic matter, increases soil health, and reduces dependence on irrigation. While previous studies have demonstrated these beneficial effects of olive pomace compost, little is known about the effects on California soils. Now a major olive grower in the state is constructing a new composting facility where wet olive pomace will be mixed with locally available materials including almond harvest sweepings and greenwaste. This study will assess which compost blends and rates best increase soil organic matter, improve drought resilience, and promote soil health using a combination of field, greenhouse, and laboratory experiments. The project will develop scientific guidelines for using composted olive pomace in California and will extend these results through field days and educational outreach designed by The Regents of the University of California, Davis Olive Center, which provides growers with scientific information on best practices.

*Carbohydrate Budget Analysis Tool for Improved Management of Nut Tree  
Orchards Threatened by Climate Change*

\$268,258

**The Regents of the University of California, Davis**

This project will develop a new tool called the "Carbohydrate Observatory" to enable specialty crop growers to adapt management practices to changes in climate (including loss of fog, swings in chill hours, and drought) based on the carbohydrate (CHO) status of crop trees. Using a citizen science approach, samples from growers and lab analysis will collectively build seasonal trends of the CHOs of major tree crops throughout California. Preliminary data suggests that chill portions, heat units, management practices, tree age, etc., are correlated with stored CHOs and may predict yield. Symptomatic tools currently in use (e.g., nutrient status, water stress) may have become inadequate to assess future impacts of climate

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change. Affordable access to CHO analysis for growers is an invaluable tool, especially for post-harvest management. This project aims to continue, over several seasons, to establish seasonal baselines from which growers can assess efficient management needs of crop trees.

*Evaluating Production Practices for Organic and Conventional Moringa  
Oleifera in California*

\$299,736

**University of California Cooperative Extension, Fresno County**

Moringa is a new crop for California that is drought tolerant, has a growing market as an emerging superfood, has potential for increased acreage of organic production, and could be grown on a larger scale as it becomes more widely known. This project seeks to determine recommendations for production practices for moringa in California. Field trials will evaluate several seed accessions under different fertilization and irrigation regimes, including organic soil amendments for growth and yield parameters and nutrient and antioxidant content. Frost protection methods will be evaluated for winter survival of established moringa plants so that moringa can be grown as a perennial in California. Pests occurring on moringa in the Central Valley will be documented and field trials will be conducted on management of selected pests. Recommendations on production practices will be made available to a statewide audience with the goal of increasing moringa production in California.

*Strategies to Augment Water Supply Through On-Farm Recharge on Pecans  
as a Key Element for Groundwater Sustainability Under the Sustainable  
Groundwater Management Act*

\$292,746

**Bachand & Associates**

Most of the San Joaquin Valley, which exports \$20 billion annually in specialty crops, is designated as critically overdrafted under the Sustainable Groundwater Management Act (SGMA). In some areas (e.g., Tulare), groundwater provides half the water used. Unless groundwater supply is augmented, SGMA will cut San Joaquin Valley specialty crop acreage. On-farm recharge (OFR) offers a flexible approach by enrolling farmlands to capture floodwater to recharge groundwater. Pecans, which are facultative upland species and native North American cultivars, are a unique nut crop able to tolerate saturated soils and flooding past dormancy and thus suited for flood zones. On pecan fields in commercial orchards, OFR practices and economics will be developed. Pecans as a SGMA compliance element will also be assessed in the context of regional SGMA planning. Potentially, expanding pecan acreage can be a SGMA compliance strategy. Notably OFR will also increase root zone moisture profiles, increasing drought resilience and irrigation efficiency.

*Development of Lettuce Cultivars With Improved Water and Nitrogen Use  
Efficiency and Environmental Impact Assessment*

\$295,420

**Cal Poly Pomona Foundation, Inc.**

Lettuce size and quality are attained during production when water and nitrogen are not limiting. Water is an increasingly unpredictable resource and climate models predict less water for California. Greenhouse gases (GHG) drive global warming, and atmospheric nitrous oxide,

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a long-lived and potent GHG, increasing dramatically since 1940; nitrogen-based fertilizers are, by far, the major anthropogenic source. Since lettuce cultivars were developed under non-limiting water and nitrogen, developing cultivars with improved nitrogen and water use efficiency will lower the environmental impact of growing the crop and help ensure sustainability in California. This project seeks to, 1) advance the genetic lines created with previous CDFA funding, 2) develop commercially-viable molecular markers linked to high leaf nitrogen, 3) implement selection based on photosynthetic rate per unit of leaf nitrogen, and 4) assess GHG emission of lettuce grown under limited nitrogen.

*Improving Date Palm Water Use Efficiency Through Updated Crop Water Use Information and Irrigation Practices* \$299,785

**University of California Cooperative Extension, Imperial County**

Efficient water management is a priority in the California Low Desert (LD) production area. The date palm is ideally suited for the LD region, and an accurate estimate of the crop's water use is essential for efficient irrigation practices and drought strategies. Growers have started to adopt micro-irrigation, but the lack of information on crop water use and the viability of micro-irrigation are the largest uncertainties facing date palm growers. This project intends to acquire and disseminate relevant information on crop water consumption and crop coefficients, to develop a user-friendly irrigation tool, and to assess the viability of micro-irrigation in LD date orchards. Extensive data collection will be conducted at four commercial, mature date palm orchards in the Coachella and Imperial Valleys using the combined cutting-edge ground- and remote-sensing technologies. An effective outreach program will be developed to disseminate the project findings to growers and stakeholders.

*Integrating Compost Into Conventional Processing Tomatoes to Improve Soil Health and Water Management* \$295,762

**The Regents of the University of California, Davis**

Processing tomatoes are one of California's top agricultural commodities. Yet practices commonly used by tomato growers can lower yields, detrimentally impact soil moisture and quality, or promote disease risk; limiting the long-term viability of this specialty crop in the state. Soil amendments and irrigation optimization are two resource management techniques with the potential for enhancing the sustainability of conventional tomato farming in California. This project will compare the costs and benefits of compost application and irrigation regimes that reduce water use in conventional tomato systems. The effects on fruit quality, yield, soil pathogen suppression, and soil health attributes will be assessed at the Russell Ranch Sustainable Agriculture Facility, a commercially run research farm in Davis, CA. Outputs will be shared with University of California Cooperative Extension advisors, growers, and the scientific community via on-farm workshops, field days, conference presentations, and online publications.

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*Recycling Nut and Other Organic Waste on Farms for Sustainable Nutrient Management and Nematode Control* \$299,551

**The Regents of the University of California, Davis**

In California, there are about 10,000 growers and 200 processors of almond and walnut, producing about 2.7 million tons of shells and hulls annually. This project aims at creating novel solid and liquid pest control and biofertilizer products from almond, walnut, and other organic wastes; using these products to suppress plant pathogens and pests, provide nutrients to tree crops, improve soil properties, sequester carbon, and reduce negative environmental impacts of chemicals. The solid product will be a mix of anaerobically digested organic waste (digestate) and nut shell biochar. The liquid product will be a concentrated digestate. The products will be experimentally tested on orchards for the benefits on plant growth, nematode suppression, and soil properties. A cost-benefit analysis will be performed to determine the technical and economic performances. Project success will be determined by the success of the experiment and the willingness of farmers to apply the new products.

*Developing a Hurdle Technology of Sequential Ozone and Infrared Treatment for Improved Safety and Quality of Dried Fruits* \$299,236

**U.S. Department of Agriculture, Agricultural Research Service**

California is a top producer of fruits in the world and continues to be the number one exporter in the United States. Sulfur dioxide (SO<sub>2</sub>) is widely used in the preparation of fruits for drying, to improve the product quality and safety. However, it is harmful to human health and the environment. The U.S. Food and Drug Administration and the Office of Environmental Health Hazard Assessment have removed SO<sub>2</sub> from the safe list of food additives causing health fears for consuming dried fruits and great concerns for fruit processors. This project's goal is to develop a hurdle technology using sequential ozone and infrared (IR) heating to replace SO<sub>2</sub> treatment and produce dried products with improved safety and quality and clean labeling. IR can also achieve partial drying with reduced drying time and energy usage. Project success will be evaluated by developing the new technology and producing dried fruits with high quality and safety and without health and environmental concerns.

*Selecting Insect Strains to Convert Specialty Crop Waste Into Value-Added Materials* \$179,784

**The Regents of the University of California, Davis**

Agricultural waste management is viewed by many as a challenge when it should be viewed as an opportunity. Moreover, this project will demonstrate how insect discovery and selective breeding can increase the sustainability of specialty crop waste management practices. The project will, 1) compare the performance of a range of insect species as bioconverters (the number of insects needed to convert times grams of specialty crop waste), 2) selectively breed high performance insect strains, and 3) characterize the potential for using insects reared on different organic agricultural wastes as animal feed additives. This project hinges on the use of existing facilities and preliminary data that supports the claim that insect strains can effectively convert specialty crop waste and generate value-added materials. As main project outcomes,

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the project will generate adapted insect strains and demonstrate environmental sustainability of alternatives to landfill disposal of targeted specialty crop wastes.

*Developing Best Management Practices for Tomato Growers to Use Compost by Understanding the Effects on Carbon and Nitrogen Dynamics*      \$297,210

**The Regents of the University of California, Davis**

Composts improve soil productivity by increasing water holding capacity, tilth, and microbial activity. With the implementation of California Assembly Bill 341, the availability of co-compost food and greenwaste (FWC) as a soil amendment to improve soil health will increase. Frequent use of FWC will improve nitrogen (N) availability, but little information is available to tomato growers about reassessing N inputs from using this compost. The project's goal is to improve N management planning and the financial performance of tomato growers by providing information to develop best management practices that use FWC. The project will investigate the benefits of FWC on tomato yield, soil carbon and N stocks, N use efficiency, GHG emissions, and estimate the economic value of FWC use in tomato systems. It is expected that the results of this project will develop best management practices for tomato growers using FWC. Findings will be reported to stakeholders through extension and outreach activities.

*Decision Support Tools for Spatiotemporal Integration of Citrus Virtual Orchard and Soil Sensing*      \$298,062

**The Regents of the University of California, Davis**

Increasing yield, improving fruit quality, and optimizing harvesting operations are the priorities of the citrus industry in California. These needs will be addressed by integrating high resolution soil mapping and time-lapse virtual orchard (VO, i.e., 3-dimensional maps of an orchard) in visible, near-infrared, and thermal bands. The main objectives of this research project are, 1) to integrate soil mapping and VO information to predict yield, fruit quality, and optimal ripening time, and 2) to create a user-friendly web platform for the management, analysis, and interpretation of the soil and crop data. Outreach activities will be geared towards educating growers, agricultural consultants, and scientist on the use of VO and geospatial soil-sensing technologies. Additionally, engaging, hands-on field workshops will be carried out for growers. Three orchards in the eastern San Joaquin Valley will be used as research sites over a two-growing-season time. Three varieties of citrus will be investigated.

*Crop Water Stress Index for Precision Irrigation Scheduling of Pistachio Trees*      \$288,650

**California State University, Fresno**

Pistachio is a major crop in California and a suitable candidate for deficit irrigation practices without sacrificing the crop yield and quality. Deficit irrigation, however, requires precision irrigation to avoid crop loss. Presently, precision irrigation is not common in pistachios where growers more commonly use weather-based irrigation scheduling with a single crop coefficient approach and/or soil water profile monitoring. Pistachios are almost entirely under micro-

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irrigation in California, thus a more suitable approach for irrigation scheduling is a dual crop coefficient approach due to frequent wetting versus a single crop coefficient. Further, pistachios have deep roots and soil water monitoring in the top few feet of soil may not indicate the true available water for crop use. This project will employ the crop water stress index to detect water stress and schedule irrigations. The success will be measured by water savings while maintaining crop yield and quality at the field level.

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## EQUIPPING CURRENT AND NEXT GENERATION SPECIALTY CROP FARMERS

*Watch Us Grow*

*\$50,000*

### **African American Farmers of California**

The Watch Us Grow project will provide a full “ground to table” experience for young people from underserved communities in Fresno County. Participants will plant and grow specialty crops through demonstration events on the African American Farmers of California (AAFC) 20-acre farm and smaller urban farms in Fresno County. Participants will also learn about the nutritional benefits of consuming the specialty crops that they helped grow through outreach events that include demonstrations and recipe development. Participants will develop an affinity for healthy specialty crops and an intent to consume more specialty crops. It is also expected that some participants will continue through the Watch Us Grow project and ultimately enter careers in specialty crop production. Project success will be measured by changes in knowledge of, and interest in consuming more, specialty crops as measured by surveys of Watch Us Grow Project participants.

*Train Next Generation Specialty Crop Stakeholders to Use Cost and Return Studies to Improve Farm Management Decision Making*

*\$263,587*

### **The Regents of the University of California, Davis**

The competitiveness of California specialty crop farmers is contingent on making the best use of farm management time and resources. The University of California Agricultural Issues Center conducts farm-level cost and return studies on individual agricultural crops produced in specific regions in California. In 2017, there were more than 1.4 million downloads of cost and return studies from the University of California Cost and Return website. This project has three goals. First, the project will develop 15 new cost and return studies for specific regionally-produced specialty crops in California. Second, the project will work with farm advisors around the state to produce and deliver educational materials demonstrating how specialty crop farmers can apply cost and return studies to make better farm-level economic decisions. Third the project will develop and deliver materials to help those in farm finance, insurance, bargaining, and marketing make better use of the farm cost and return studies in providing services to the specialty crop farm community.

*Reducing Uncertainty: Cover Crop Workshops, Outreach, and Education in Contra Costa Specialty Crop Farms*

*\$83,256*

### **Contra Costa Resource Conservation District**

The Contra Costa Resource Conservation District (RCD) will conduct a multi-faceted outreach and education campaign aimed at addressing the uncertainties and barriers to cover cropping, as a practice, faced by specialty crop growers in Contra Costa County. The project will start by surveying Contra Costa growers to collect an industry wide assessment of the awareness of

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and the perceived barriers to cover cropping. With that data, the Contra Costa RCD will design an outreach campaign including direct mailings, email digests, and social media as well as quarterly workshops and biannual site visits to specialty crop farms that have adopted the practice. These workshops and site visits will rotate around Eastern Contra Costa County where specialty crop farms are located. Through this outreach campaign, the Contra Costa RCD will work to increase the awareness of cover crops and address the barriers preventing adoption, encouraging specialty crop growers to adopt the practice for the benefit of their farms and the industry as a whole.

*Meeting the Demand for Specialty Crop Professionals Through Youth  
Engagement*

\$292,586

**Center for Land-Based Learning**

A study funded by the U.S. Department of Agriculture (2015) predicts that agriculture will have 57,900 new skilled jobs to fill each year and only 35,400 qualified graduates to fill them. More qualified graduates in agriculture are needed to meet industry demands. The Farming, Agriculture, and Resource Management for Sustainability Leadership Program provides high school students with a two-year program that includes hands-on experiences in agriculture. Students learn about specialty crop jobs while working alongside industry mentors during monthly field days that happen during the school year. Then, students can participate in job shadowing and internships. Upon completing the program, students have a better understanding of how the specialty crop industry produces, distributes, markets, and sells crops, and have a college and/or career path plan to get a job in the specialty crop industry. Project success is evaluated by a pre- and post-program survey, oral presentations to industry mentors, completion of a personal career plan, and the number of job shadowing and internship placements.

*Conservation Stewardship Training and Demonstration for Specialty Crop  
Growers: Investing in Your Farm*

\$112,458

**National Center for Appropriate Technology**

California specialty crop farmers face ongoing environmental and regulatory challenges: drought, flooding, increasingly irregular water supplies, new food safety regulations, and increased monitoring of fertilizer and water use. This project's goals are to train farmers on conservation practices which support and conserve the farm's resources, give technical assistance to farmers implementing these practices, and help farmers access conservation program funds. The technical assistance will focus on soil health practices, including enhanced water infiltration and storage and nutrient cycling and storage, to improve plant health and reduce input costs. The project's outcome will be more farmers implementing new conservation practices. Success will be measured by evaluating the number of farmers implementing new conservation practices, the amount of acreage of these practices, and the increased use of National Resource Conservation Service conservation practices.

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*Growing Organics Through Workforce Skills Development and New Farm*

*Incubation*

\$286,811

**Agriculture and Land-Based Training Association**

The Growing Organics (GO) project will raise California's competitiveness in the fast-growing organic specialty crop industry by building the production and management skills of the next generation of farmers and agricultural professionals. GO will provide intensive, land-based training on organic specialty crop production and farm business management to beginning farmers and young agricultural professionals, many of whom have a background as field laborers. GO will incubate 40 incubator farms on the Agriculture and Land-Based Training Association's 100-acre farm in Salinas Valley, providing affordable access to land, equipment, markets, and technical assistance. Another 60 individuals will gain workforce skills on-farm and be connected to agribusiness employers in the region. An additional 200 youth from community colleges, high schools, and non-profit programs will receive on-farm training in organic agriculture and guidance on potential career pathways through direct exposure to local agribusiness professionals and farmer-entrepreneurs.

*Food Safety Management Act and Food Safety Training for the Specialty*

*Crop Industry*

\$192,651

**College of the Sequoias**

The specialty crop industry can enhance competitiveness by ensuring compliance to the Food Safety Modernization Act (FSMA). This project will support California's Central Valley specialty crop industry with adoption of FSMA requirements and related food safety methodologies by providing affordable food safety training. The local specialty crop industry has difficulty attending food safety training as these trainings are offered in the larger cities and require out of town travel that is costly and disruptive to business operations. College of the Sequoias has experience delivering value-added, local, convenient, and affordable FSMA and food safety related training. The project's aim is to reach the local specialty crop industry including the workforce on farms, in packing houses, and in food processing plants. The project will measure success by the number of individuals completing the training and the increased level of food safety skills knowledge.

*Training to Support Winegrower Adoption of Best Management Practices to*

*Promote Positive Environmental, Social, and Economic Outcomes* \$234,889

**California Sustainable Winegrowing Alliance**

California winegrowers face many compliance challenges due to rapidly growing regulations (e.g., water quality, nitrates, air quality, and food safety). Technical training, tools, and resources are needed to help winegrowers adopt best management practices to more effectively comply with regulations and improve sustainability. The project's goals are to, 1) develop tools and resources to help winegrowers comply with regulations and increase best management practice adoption, 2) evaluate and communicate the effectiveness of specific best management practices, and 3) work with government and non-governmental organization partners to seek regulatory recognition, simplify the compliance process, and leverage

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resources. Activities and outcomes include 16 workshops and three webinars for 570 winegrowers, technical assistance for 90 winegrowers, and online tools (an environmental compliance training module, nitrogen reporting, etc.) and educational resources for more than 8000 winegrowers. The project's success will be evaluated by the number of individuals reached via education, outreach, and technical assistance and best management practice improvement.

*Supporting Small and Limited Resource Specialty Crop Growers to Adopt Efficient Irrigation and Nutrient Management Practices* \$221,813

**American Farmland Trust California**

Specialty crop growers continue to face pressures to adopt efficient irrigation and nutrient management practices (EINMP) while also encountering barriers to adoption. American Farmland Trust will organize and conduct nine workshops with farm tours per year for two years. These will target small and limited resource specialty crop growers and employees in the major growing regions of California. The workshops will focus on the most current information regarding the availability, performance, cost, and implementation requirements for EINMP and sources of technical and financial assistance. Workshop attendees will be surveyed to assess efficacy of the current support system in assisting them with EINMP adoption. Workshops will be conducted in partnership with Water Quality Coalitions, Resource Conservation Districts, University of California Cooperative Extensions, California State Universities, agricultural organizations, other non-profit organizations, crop consultants, and technology vendors.

*Irrigation Training Program: Almond, Citrus, Grapes, Pistachio, and Walnut* \$229,506

**University of California Cooperative Extension, Imperial County**

The specific objective of this proposal is to initiate a statewide irrigation training program with a certificate of completion. The initial training emphasis will be on five major specialty crops (almonds, citrus, grapes [wine, table, and raisin], pistachios, and walnuts) with the primary focus on the Central Valley; additional training will also be done for table and wine grapes in other major production areas (Sierra Foothills, Central Coast, Temecula, and Coachella). The target audiences are irrigators, growers, and farm workers involved in all aspects related to irrigation and nutrient management. The main goal is improving irrigation efficiency with emphasis on enhancing fertilizer use efficiency and reducing off-farm movement of water, nutrients, and other chemicals. The proposed project is designed to address the increasing demand for practical training materials in irrigation and fertigation. Lastly, the proposed project will assist growers in getting "more crop per drop" and using fertilizers efficiently.

*San Diego Farmer's Round Table and Business Training Program* \$98,307

**Kitchen Table Consultants**

For San Diego County farmers, vegetable sales fell over \$28 million from 2015-2016. Farming costs have also swelled, with water costing up to 30 times as much as in the neighboring

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Imperial County. Given these and other factors, the need for business excellence is important to farm sustainability. To address this need, Kitchen Table Consultants will develop The Farmer's Roundtable and Business Training Program. This business improvement program will use mentor-led forums to educate farmers on best practices, new ideas, and financial comparisons to improve business performance and profitability for 20 San Diego specialty crop farmers. Topics include bookkeeping consistency, financial analysis, opportunity assessment, budgeting, sales planning, and marketing tactics and execution, in addition to outside one-on-one coaching. Success will be based on financial reviews of sales growth. Based on the program, five-year revenues for farmers are anticipated to increase by 75 percent (\$450,000).

*Ensuring Viability of California Specialty Crop Farms Through Food Safety and Produce Safety Rule Training* \$289,200

**Farm Employers Labor Service**

From 1998 – 2014, California suffered 2,305 foodborne illness outbreaks resulting in 52,440 illnesses, 3,215 hospitalizations, and 108 deaths (California Healthline). According to the Center for Disease Control, 46 percent of those foodborne illnesses have been traced to produce. Since education can help stop foodborne illness from occurring, the Food Safety Modernization Act's Produce Safety Rule now requires many California specialty crop growers be trained in foodborne illness prevention. However, education costs for compliance can be high – up to 4–6 percent of the average annual gross sales for smaller farms – and few trainings are available relative to the need. Through a new partnership the Farm Employers Labor Service, California Farm Bureau, and Safe Food Alliance seek to provide 20 low-cost trainings to ensure compliance with 2019/2020 requirements for small farms. The goal is to provide 1,000 growers with Produce Safety Alliance (PSA) training with success measured by the number of growers that become PSA-certified.

*Learn on Your Schedule: University of California Nursery and Floriculture Alliance Greenhouse and Nursery Grower Online Training* \$246,915

**The Regents of the University of California, Davis**

The University of California Nursery and Floriculture Alliance (UCNFA), a statewide outreach program of the University of California faculty and University of California Cooperative Extension specialists and advisors, serves the continuing educational needs of California's nursery and floriculture specialty crop producers. UCNFA proposes to create web-based, bilingual, informative training to implement practices needed to maintain the competitiveness of this specialty crop segment. Funding will support adding English and Spanish narration on presentations about greenhouse pests, diseases, basic horticulture, and water management topics. These presentations will be converted into videos for online educational materials. This project would provide the industry with a valuable resource that will benefit Spanish speaking growers with knowledge to implement environmentally responsible best management practices for the production of greenhouse and nursery crops.

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## SPECIALTY CROP ACCESS AND NUTRITION EDUCATION

*California Farm to School: Growing Healthy Hearts and Minds* \$293,334

### **California Office of Farm to Fork**

This project will increase awareness and consumption of California grown specialty crops among school children by supporting farm to school programs in California. This project supports the work of the California Farm to School Network (the Network) and the 2019 California Farm to School Conference (the Conference). Farm to School programs, which encompass everything from procurement to nutrition education to school gardens, are one of the most effective ways to put specialty crops on the plates of students and teach them to be life-long eaters of fruits and vegetables. The Network will provide ongoing support, technical assistance, and resources to farm to school practitioners throughout the state, including school food service professionals, teachers, parents, specialty crop farmers, and community organizations. The project will measure success through the activities of the Network generally and the Conference specifically. Network success will be evaluated through a process and outcome evaluation to determine the number of stakeholders reached, type of information disseminated, etc. as well as through targeted surveys to understand how the needs of members are being met. The Conference will be evaluated through numbers of attendees, evaluations of individual presentations/sessions, and an overall Conference evaluation submitted by all attendees.

*Farm Academy: Grapes – Vine to Table* \$48,743

### **PLANT Foundation**

The PLANT Foundation will develop a series of on-demand video courses and one live interactive virtual instructional course, focused on the grape industry. Both the on-demand video series and the live virtual session will, with science experiments or lessons using grapes as an example, educate students on the history and cultural influences of grapes, the process of raising and processing grapes for multiple uses (wine, table grapes, raisins, grape juice, grape seed oil, vinegars, etc.), the different varieties of grapes, the nutritional value of eating grapes and grape products, the methods to process grapes in the home kitchen (jams, jellies, preserves), and the career opportunities in the grape industry. The goals of this project are to increase the awareness, knowledge, and consumption of table grapes and to educate and prepare students for the many career possibilities in the grape industry. Project success will be evaluated based on the number of students accessing the on-demand video courses and live virtual session, pre- and post-surveys measuring the gain in knowledge about and intent to eat more grapes and grape products and careers in the grape industry, and a yearly set of student/parent interviews to assess the gain in knowledge about, intent to eat, and increase in consumption of grapes and grape products.

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*International GardenFood Workshop Series*

*\$50,000*

**Netiya**

Netiya will offer 12 International GardenFood workshops over the course of one year in an International Foods Garden in the San Fernando Valley. These workshops will cover water-wise cultivation of specialty crops; cultural history of crop cultivation throughout the world; preparation of a variety of ethnic foods; and instruction on how to create freshly prepared meals comprised mainly of specialty crops. The goal is for these workshops to bring together gardening, cooking, and health of body, mind, and spirit to foster wellness, self-care, and community care. Netiya will measure the success of the project by administering pre- and post-program surveys to all participants to collect data on how much their consumption of featured specialty crops increased one month after attending a Netiya workshop.

*Increasing California Specialty Crop Consumption through Summer Youth Internship and Youth Education Youth Program in Schools*

*\$48,674*

**Huerta Del Valle**

Huerta del Valle (HDV) will increase the consumption of California specialty crops in the Inland Valley service area – especially among low-income families – through a youth-led awareness campaign. Ten high school-aged youth will be selected for a paid summer intensive training internship at HDV’s training farm. Interns will be educated in areas of food, farming, environmental conservation, and nutrition. Each intern will be responsible for sharing their knowledge in the form of five presentations in the following school year to their peers. Presentations will focus on the how-to’s and why-to’s of consuming California specialty crops and will encourage large numbers of youth and their families living in the Inland Valley to begin consuming more California specialty crops. Special attention will be paid to specialty crop consumption on a limited budget and how to incorporate them into individual foodways. The program will be evaluated through quantitative and qualitative measures to gauge the attendance of the presentations and the effectiveness of the presentations on promoting the consumption of California specialty crops, especially those produced regionally. While tracking attendance will show how many learn from the program, HDV staff will also track participants’ consumption of California specialty crops as a result of the project.

*Introducing Specialty Crops to Students: Consumption, Cultivation, and Careers*

*\$287,174*

**Pacific Coast Farmers' Market Association**

This project introduces students to specialty crops to encourage lifelong consumption of California grown fruits and vegetables using three educational elements: consumption, cultivation, and careers. For the consumption element, elementary students will be encouraged to consume specialty crops through field trips to local farmers’ markets. Using a standards-based curriculum, students will meet farmers, learn about seasonal produce, and sample specialty crops. Handouts will reinforce educational messages. For the cultivation element, middle-schoolers will tour farmers’ markets to learn about seasonality, growing regions, and farming methods. These students will also visit local farms to learn directly from young farmers

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about farming practices. For the careers element, Mount Diablo High students (Title I), in addition to trips to farmers' markets and farms, will learn about career opportunities in California specialty crop industries such as science, management, and marketing careers in California farmers' markets, restaurants, hospitality, and food hubs.

*Bring the Farmers' Market to Your School*

*\$299,079*

**Sustainable Economic Enterprises of Los Angeles**

Sustainable Economic Enterprises of Los Angeles and the Los Angeles Unified School District (LAUSD) have partnered since 2002 to conduct the Bring the Farmer to Your School Program. This program, the only one of its kind in 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. It also incorporates a Harvest of the Month component, introducing specialty crops to younger students using interactive elements which have been demonstrated to be successful in students enjoying and choosing California specialty crops to which they are exposed. The project's proposed 2018-2020 program adds connections to farmers' markets through targeted farmers' market presentations and samplings at school sponsored events near local markets, to encourage families to purchase and prepare specialty crops. Two markets will pilot a monthly kid's cooking class, which will give children hands-on experience with preparation and consumption of fruits and vegetables.

*San Joaquin County AgVenture*

*\$192,639*

**County of San Joaquin**

AgVenture is a holistic agriculture and nutrition education program. It will consist of nine field days (three each year) held in the North, Central, and South areas of San Joaquin County for third-grade students, and three Healthy Dinner adult education classes (one each year) for adult chaperones who attend one AgVenture event. Each year, over 1,000 specialty crop farmers, producers, and volunteers donate their time and expertise to bring educational presentations and displays to educate over 10,000 third-grade students and their chaperones at AgVenture field day events. AgVenture teaches students about agriculture and consumption of specialty crops for improved nutrition and overall health. The Healthy Dinner program will serve 45 adults. It will reinforce the knowledge of specialty crops and their nutritional benefits gained from attendance at an AgVenture event and teach how to prepare a healthy meal with specialty crops.

*What's Growin' On?*

*\$49,879*

**California Foundation for Agriculture in the Classroom**

California Foundation for Agriculture in the Classroom will develop and distribute a free 16-page educational resource to 165,000 students (150,000 in English and 15,000 in Spanish) in grades 3-8, that contains lesson plans and hands-on activities about nutrition and specialty crops and is aligned to state education standards. The resource will be distributed at no cost to teachers, after school programs, the California State Fair, county based agricultural education programs, and educator conferences. Students and teachers alike will learn about specialty

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crops and healthy eating. Outcomes will be measured with pre- and post-surveys using a representative sample size of students. The surveys will test the number of students who gained knowledge about eating more specialty crops and the number who report an intention to eat more specialty crops.

*Ventura County Child Wellness Initiative*

\$218,684

**Students for Eco-Education and Agriculture (SEEAG)**

The goal of the Ventura County Child Wellness Initiative is to educate, inspire, and empower 10,000 children, including low-income or Title I students, to be their own healthy hero by eating more specialty crops. This expanded and enhanced program will teach children to embrace wellness. 1. Educate – Students for Eco-Education and Agriculture Nutrition Educators will visit schools during the day and after school in the Farm Fresh Mobile Classroom van. Students will learn about nutrients and health benefits of Ventura County specialty crops (e.g., berries, celery, citrus, tomatoes, avocados). A different crop will be highlighted each month. 2. Inspire - Students will learn to prepare a healthy after school snack using specialty crops. The Farm Fresh Mobile Classroom will encourage student movement activities. 3. Empower - Partner growers will donate fruits and vegetables that students take home to share with their family. Recipe cards and information about farmers' markets will support consumption at home.

*Protein-Quality Research Study of American Pistachios to Educate Consumers and Health Professionals*

\$246,158

**American Pistachio Growers**

This project is a research study that, with a positive outcome, will enable pistachios in the United States to use the Nutrient Claim, "A Good Source of Protein." This is a regulated claim that cannot currently be used without having this research. The U.S. Food and Drug Administration (FDA) requires the protein digestibility-corrected amino acid score along with the qualifying protein content per serving (which is already established) in order to calculate the percent daily value to make the "Good Source of Protein" claim. The study this grant would fund will determine the actual protein quality of pistachios, using a method that is accepted by the FDA and the World Health Organization. To be able to do so is important in an era when consumers are being urged by their governments to get more protein from plant sources for improved health. While it is currently believed pistachios are a "good source of protein," the study is needed in order to legally promote them as such.

*Promoting Alternatives to Citrus for Backyard and Community Gardeners in the Fight Against Asian Citrus Psyllid/Huanglongbing*

\$173,380

**University of California Cooperative Extension, Los Angeles County**

The health benefits of eating the recommended servings of fruits and vegetables include reductions in chronic diseases, however only 15 percent of Los Angeles County adults reported eating five or more servings a day. This project has two key goals. First, it will encourage Los Angeles County residents to eat more specialty crop fruit by increasing access through gardening. Second, the project ramps up efforts to engage residents in the fight

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against the Asian citrus psyllid (ACP) and the devastating disease it carries, huanglongbing (HLB), which threatens the citrus industry. At multilingual events, University of California Master Gardeners will share nutrition messages paired with tastings featuring specialty crop fruit. At the same time, participants will be introduced to the many alternatives to citrus for backyard orchards and learn strategies for managing existing citrus trees to reduce the risk of ACP/HLB. Outcomes, including increased consumption of specialty crop fruit, will be measured through a follow-up survey.

*Developing Pomegranate as a Specialty Crop for K-12 School Lunch Programs*

\$83,476

**The Regents of the University of California, Riverside**

The goal of this project is to enhance and expand pomegranate consumption in the United States by including pomegranates in pilot programs for student lunch programs in California. This research project has two objectives, 1) determine K-12 consumer acceptance of 'Wonderful' pomegranates in school lunches, and 2) determine consumer preferences for other cultivars in the U.S. Department of Agriculture, Agricultural Resource Service germplasm collection. Objective 1 will be met by conducting student and parent sensory panels in K-12 schools to determine preference for 'Wonderful' pomegranates versus conventional fruit (apples and citrus). Objective 2 will be met by conducting sensory panels including 'Wonderful' and other cultivars grown in different regions of California. Parents and siblings of schoolchildren will be included in these studies to determine if there is a link between parent-child or family preference for this California-grown specialty crop.

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## PLANT HEALTH AND PEST MANAGEMENT

*Proximal Remote Sensing of Plant Pathogenic Virus in Western Flower  
Thrips*

\$299,994

**The Regents of the University of California, Davis**

Specialty crop farmers need improved diagnostic tools to rapidly and cost effectively monitor risks posed by insects vectoring crop diseases, such as tomato spotted wilt virus (TSWV). Western flower thrips transmit TSWV to tomato crops in both California and Florida. Supported by preliminary data, the project seeks to demonstrate that proximal remote sensing can be used to detect TSWV in field sampled (dead and shipped in vials with ethanol) Western flower thrips. The main goals of this project are to determine if Western flower thrips, with and without TSWV, can be detected with a minimum of 80 percent accuracy; develop a reflectance-based diagnostic tool, which can be adopted and commercialized by diagnostic labs to improve monitoring and detection of TSWV for specialty crop farmers; and conduct presentations at stakeholder meetings. The research and diagnostic tool is highly relevant to a wide range of insects vectoring important specialty crop diseases including other thrips, leafhoppers, citrus and potato psyllids, and aphids.

*Identification of Baby Leaf Lettuce Varieties and Genes for Rapid and  
Uniform Growth, High Quality, and Disease Resistance*

\$282,367

**U.S. Department of Agriculture, Agricultural Research Service**

Spring mix is a popular type of packaged salad and baby leaf lettuce (BLL) is one of the main ingredients. BLL is a higher, value-added crop for growers than whole-head lettuce. As seeds for BLL are sown in very high density (7.4 million seeds per hectare), it is also profitable for seed companies. The industry prefers varieties with uniform, rapid early-growth and thick leaf textures. High planting density enhances occurrence of bacterial leaf spot (BLS), the disease that can make the crop unmarketable. This project will evaluate 450 lettuce accessions for growth rate, chlorophyll content, leaf thickness, and resistance to BLS. Chromosomal regions conferring desirable traits will be identified. The objectives of the project are to determine the best lettuce varieties for each trait and associated genes. The success of the project will be measured by the number of superior lettuce varieties identified, genetic regions discovered, publications, citations, and requests for seeds and information.

*Investigating and Improving Detection Methods for Spotted Wing Drosophila  
Insecticide Resistance in California*

\$298,414

**The Regents of the University of California, Davis**

Prior to the 2008 invasion of Spotted Wing Drosophila (SWD) in the United States, insect management for berry and cherry crops was amenable to integrated pest management. The key pest status of SWD has transformed management practices and growers now rely on frequent applications of insecticides to avoid crop loss. Although growers practice resistance management, the lack of alternative controls, especially for organic farms, and the short

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generation time of SWD suggest resistance development may be inevitable. SWD populations with tolerance to insecticides have recently been found in California berry crops. This timely project will investigate resistance mechanisms in these SWD populations by a combination of insecticide bioassays and high throughput DNA sequencing. The success of this project will be measured by the identification of mutations that confer resistance and the development of molecular tools to improve early detection of resistant SWD. This project will enable optimization of spray programs to minimize revenue loss.

*Finding Sources of Resistance to Armillaria Mellea Within the Pyrus*

*Germplasm Collection*

\$291,012

**The Regents of the University of California, Davis**

The objective of this project is to identify sources of resistance to Armillaria root disease caused by the fungus Armillaria mellea, within the genus Pyrus. Armillaria root disease is an issue of increasing concern for the California pear industry and needs to be addressed in a timely manner. Currently, no sources of resistance are known among the few pear rootstocks used commercially. This project proposes to evaluate a core collection of approximately 200 pear accessions from the U.S. Department of Agriculture, Agricultural Resource Service National Clonal Germplasm Repository in Corvallis, OR. An in vitro screening assay, previously shown effective for identifying resistant germplasm in grape, almond, and walnut (and now optimized for pear), will be used to evaluate the core collection. Moreover, the phenotypic data collected with the in vitro screening, and already available single nucleotide polymorphism-based genotypic data, will be used to attempt genome-wide association studies and identify the genetic locus(i) linked to resistance.

*Automating Citrus Disease Diagnostic Procedures Through Inline Instrument Engineering*

\$299,107

**The Regents of the University of California, Riverside**

Citrus diseases, such as Huanglongbing, tristeza stem-pitting, and leprosis, could devastate California's citrus. Citrus labs in California, such as the California Department of Food and Agriculture's Plant Pest Diagnostics Center, the Citrus Research Board's Jerry Dimitman Laboratory, the Central California Tristeza Eradication Association's Citrus Pest Detection Program, and The Regents of the University of California, Riverside's (UCR) Citrus Clonal Protection Program (CCPP), test thousands of samples every year to protect California's citrus. The CCPP and UCR's Technology Evolutionary Components Center have been developing inline instruments that incorporate citrus tissue processing, nucleic acid extraction, and an inline polymerase chain reaction thermocycler utilizing the Multifluidic Evolutionary Component system to increase lab diagnostic capacity. The evaluation criteria for project success will be, 1) validation of the inline instruments (i.e., sensitivity, specificity, and reproducibility) with "real life" samples and 2) measuring changes in throughput, cost, processing time, and the need for specialized labor and equipment. These instruments will also become model systems for diagnostics in other specialty crops.

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*Hyperspectral Remote Sensing to Detect and Diagnose Arthropod Pests in  
Greenhouse Nursery Crops*

\$281,527

**The Regents of the University of California, Davis**

In this project, commercial nursery operations will be mimicked to demonstrate that hyperspectral remote sensing (HRS) can be used to detect and diagnose emerging arthropod infestations (Lygus, white flies, leafminers, Western flower thrips, and two-spotted spider mites) in Gerbera and Chrysanthemum. The project hypothesizes that different arthropod pests cause uniquely different reflectance responses in nursery crops, and this hypothesis is supported by preliminary data. This project addresses a priority for the nursery industry (automation) and provides the scientific foundation for integration of robotics and advanced HRS techniques into twenty-first century nursery operations. Specifically, integration of this technology will enable detection and diagnosis of emerging pest infestations much earlier than traditional monitoring methods (i.e., manual scouting for infestations and symptoms), allowing precise control efforts to be taken to help prevent severe pest outbreaks.

*New Detection Tools and Sustainable Control of Almond Canker  
Diseases*

\$252,796

**The Regents of the University of California, Davis**

Trunk and scaffold canker diseases are the major cause of tree death in almond orchards. These diseases reduce the yield and the lifespan of orchards. Canker diseases are caused by many unrelated pathogens that infect trees mainly through pruning-wounds, cracks, and shaker injuries. Field diagnosis is difficult as symptoms are similar among the various canker diseases. Laboratory tests are required to obtain accurate diagnosis and currently rely on tedious isolation methods. Control depends on the use of toxic chemicals with limited efficacy. The objectives of the proposed research are to develop new molecular detection tools for fast and reliable diagnosis of canker diseases and provide biological control solutions to growers to reduce reliance on chemicals and improve the sustainability of almond production. Project outcomes will be communicated through extension activities and success will be measured by surveying the number of growers adopting the new detection and control methods.

*Release of Generalist Parasitoids for Suppression of Spotted Wing  
Drosophila*

\$145,222

**U.S. Department of Agriculture, Agricultural Research Service**

Spotted wing drosophila (SWD), *Drosophila suzukii*, has rapidly become a devastating pest of soft-skinned fruits across the United States. Unlike other *Drosophila* species, SWD larvae feed on undamaged, otherwise marketable fruit. Zero tolerance for SWD-infested fruit in the marketplace has led to crop losses of up to 80 percent in the Western United States and \$718 million nationwide. Current management options for SWD rely almost entirely on insecticides, which are ineffective against SWD larvae within fruit. Prospective biological agents from the native range of SWD are currently in quarantine and show promise but do not yet have approval for release. There are several generalist parasitoids that attack SWD in California, and this project proposes to enhance SWD management programs by using natural enemies

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resident in California to suppress SWD populations in non-crop source habitats. Project success will be evaluated by measuring SWD levels and yields of marketable fruit after parasitoids are released.

*Molecular Detection and Quantification of Fusarium Oxysporum Vascular Wilt Pathogens* \$296,867

**U.S. Department of Agriculture, Agricultural Research Service**

Fusarium wilt is an important disease causing significant losses for a wide range of California specialty crops. Due to a lack of morphological differences among host-specific strains and molecular markers for accurate and rapid identification, it is difficult to identify taxa or determine inoculum levels in the soil prior to planting. Diagnosis from diseased plant material can also be complicated by colonization of the host by strains that are not pathogenic. Development of a molecular assay system that could rapidly identify and quantify these pathogens would allow growers to determine the risk of disease prior to planting, assess efficacy of control measures, and provide a rapid test for diagnosticians. A software pipeline has been developed for selection of unique sequences in the pathogen genome that can be used for diagnostic purposes, thereby providing a systematic approach for development of markers for a range of host specific strains impacting California specialty crops.

*Improved Management of Strawberry and Lettuce Soilborne Plant Pathogens Using Microbiome-Based Disease Prediction* \$299,944

**U.S. Department of Agriculture, Agricultural Research Service**

California is the number one producer of strawberries and lettuce in the United States. Soil fumigation has been indispensable for maintaining high quality and economic returns in strawberry production, and provides indirect benefits for lettuce production. Fumigation reduces the propagule density of soilborne plant pathogens, including *Verticillium dahliae*. The severity of soilborne diseases depends on propagule density, which steadily increases over time following fumigation. Knowing the propagule density is critical for the timing of fumigation, determination of application rates, and the choice of crop to plant. To make propagule density data more readily available, this project proposes using a machine-learning approach to develop a model that can accurately predict propagule density in the soil, based on quantitative characteristics of the soil microbiome. The project will be successful if propagule density can be accurately predicted from soil microbiome data.

*Biological Characterization of Sterile Navel Orangeworm With and Without Mating Disruption* \$284,220

**U.S. Department of Agriculture, Agricultural Research Service**

The navel orangeworm (NOW) is the key insect pest of almond and pistachio, and an important pest of walnut. These crops are planted on more than 1.5 million acres and are worth more than \$6 billion per year. The pistachio industry, in cooperation with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, has committed to a pilot program of at least three years examining the impact of sterile insect technique (SIT) as a

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component of NOW pest management. The research for this project, as an adjunct to the pilot project, will test methods for improving the competitiveness of sterile NOW, determine the impact of mating disruption on competitiveness of irradiated NOW, and compare the trapping radius of pheromone traps for males compared to traps attractive to females in the presence and absence of mating disruption. Deliverables include the documentation of optimal conditions for using SIT for NOW and improvement of existing monitoring techniques for NOW in the absence and in the presence of mating disruption.

*Novel Field-Based Diagnostic Strategies for Management of Powdery Mildew  
in California Specialty Crops* \$283,760

**U.S. Department of Agriculture, Agricultural Research Service**

In 2017, California producers lost yield and fruit quality due to uncontrolled disease epidemics related to fungicide resistance. This project will develop new tools to monitor the development and presence of fungicide resistance in pathogens that are responsible for specialty crop losses in California. It will build upon current, commercially available inoculum monitoring technologies for grape and expand them to other high-value crops such as strawberry and apple. The project will, 1) assess fungicide sensitivity and stability, and geographic distribution of isolates collected from table and wine grapes across two seasons, 2) validate molecular assays for monitoring resistance to quinone outside inhibitor and sterol 14a-demethylation inhibitor fungicides in *Erysiphe necator* and develop markers for other groups (e.g., quinoxifen), and 3) evaluate fungicide sensitivity and transferability of diagnostic assays in powdery mildew species on strawberry and apple.

*Testing the Safety and Efficacy of Imported Biocontrol Agents for  
Bagrada Bug* \$206,101

**U.S. Department of Agriculture, Agricultural Research Service**

Bagrada bug, *Bagrada hilaris*, was discovered in California in 2008 and has become a damaging pest to cole crops. The pest has rapidly spread from Southern California into the Central Valley and along the coast to Monterey Bay. Conventional pesticides are the primary means for controlling this pest leaving organic growers with few options. A long-term solution is the introduction of parasitoids specialized on this pest however, no parasitoids specialized on bagrada bug are known to occur in California. The project plans to test two bagrada bug parasitoids from Pakistan for safety and efficacy and to collect other parasitoids within the native range of bagrada bug in Africa. Project success will be measured by the number of novel parasitoids and non-target stinkbug species tested and the number of novel bagrada bug parasitoids discovered.

*Identifying Genetic Sources of Virus and Vector Resistance in Cucumis Melo  
for New Cultivar Development* \$283,335

**The Regents of the University of California, Riverside**

Cucurbit yellow stunting disorder virus (CYSDV) is a threat to melon production in California. Insecticides are not effective in controlling whitefly vectors or limiting CYSDV spread.

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Repeated crop failures have led to the elimination of the fall melon season in desert areas. Melon cultivars with resistance to CYSDV and whiteflies are necessary for restoration of fall melon profitability. The goals of this project are to, 1) develop rapid, laboratory-based virus and vector resistance phenotyping methods to accelerate breeding efforts, 2) use phenotyping methods to identify the genetic and molecular mechanisms of CYSDV and whitefly resistance in four melon accessions, and 3) produce resistant germplasm for crosses with elite melon cultivars. The project will present results at educational field days and industry meetings, and perform other outreach activities to provide the melon industry with information about newly developed germplasm and virus management using host-plant resistance.

*Time-Sensitive Methodology to Reduce the Risks of Alternaria Late Blight  
Resistance Build-Up in Pistachio Producing States* \$192,813

**The Regents of the University of California, Davis**

The Alternaria late blight (ALB), caused by *Alternaria alternata*, is a destructive pistachio disease and an annual concern for commercial growers in California and Arizona. Severe ALB disease is observed in about 20 percent of the 1,200 pistachio orchards of California, because of the conducive microclimatic conditions created by many cultural practices. ALB control relies on multiple fungicide applications where the efficacy of these products has been affected by the presence of molecular mutations associated with the pathogen's fungicide resistance. The project will develop a time-sensitive method to quantify the mutant populations during the latent state. The expected output is the ability to provide pesticide control advisers with early warnings about orchards under resistance risk and to allow the recommendation of the best fungicide combination to overcome the issue. Project success will be measured by comparing the decrease in ALB resistance within and between seasons along with final disease incidence.

*Navel Orangeworm Sterile Insect Technique Pilot Project* \$50,143

**California Department of Food and Agriculture**

A California Department of Food and Agriculture (CDFA) permanent staff member will train a CDFA seasonal staff person to conduct the activities necessary to support the release of sterile navel orangeworm (NOW) during this pilot project. The CDFA seasonal staff person will transport sterile NOW moths from the Bakersfield Airport to the CDFA field office in Shafter, CA four times per week. The sterile NOW moths will be stored on-site in coolers. The seasonal staff person will load aerial release machines on the airplane or the ground release truck at the CDFA field office in Shafter, CA four times per week. The CDFA permanent staff member will conduct quality control on the NOW sterile moth shipments. This will include 48 hour mortality tests, box temperatures, and F1 progeny assessments. The CDFA permanent staff member will prepare quality control reports and reports on daily trap numbers of sterile NOW.

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## FIXED AMOUNT AWARDS: MEETING THE STANDARDS FOR THE U.S. FOOD AND DRUG ADMINISTRATION'S FOOD SAFETY MODERNIZATION ACT (FMSA)

*Food Safety Compliance Training for Specialty Crop Producers*      \$132,399  
**Training Institute, Fresno City College**

The Training Institute, an entity of State Center Community College District, will leverage 18 years of experience in delivering agricultural-based education. This project will address the priority of assisting California's specialty crop growers, farmers, producers, and manufacturers in adopting the standards and requirements of the Food Safety Modernization Act (FSMA), or risk product recall, and/or other financial repercussions. The target region encompasses the eight counties of Central California's San Joaquin Valley. The project estimates that 420 specialty crop growers and workers will satisfy the FSMA safety requirements and gain knowledge of the FSMA compliance by engaging in, 1) Produce Safety Alliance certified training for growers and key personnel, 2) a train-the-trainer program for farms doing worker produce-safety training inhouse, and/or 3) produce safety training for farms not offering worker training. Project participants will be surveyed at the end of each activity to measure knowledge gains.

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## FOOD SAFETY

*Identifying Competitive Exclusion Microorganisms Against Listeria Monocytogenes From Biological Soil Amendments by Metagenomic, Metatranscriptomic, and Culturing Approaches* \$48,523

### **The Center for Produce Safety with Clemson University**

The Center for Produce Safety will partner with Clemson University to identify competitive exclusion microorganisms against *Listeria monocytogenes* from compost. Compost has been used as a biological soil amendment in agricultural practices for centuries, as it provides readily available nutrients for plant growth and improves soil properties. Owing to the richness of the microbial community, compost can also mediate suppression of plant diseases and human pathogens. The goal of this proof-of-concept project is to utilize powerful high-throughput sequencing approaches to understand microbial composition and functions at the microbial community level in a variety of composts (dairy waste and poultry waste based), and to identify competitive exclusion (CE) microbial species with antagonistic activities against *L. monocytogenes*, followed by isolation of the CE microorganisms using culturing methods. Findings from this project will reveal the diversity of indigenous microflora in compost samples, and identify and isolate potential CE microorganisms for future studies on the biological control of *L. monocytogenes* in various ecosystems.

*Simulation Analysis of In-Field Produce Sampling for Risk-Based Sampling Plan Development* \$268,172

### **The Center for Produce Safety with University of Illinois**

The Center for Produce Safety will partner with the University of Illinois at Urbana-Champaign to develop and validate a produce-field simulation model to evaluate sampling plans. Effective preharvest, field-level produce sampling is challenging because current practices typically yield few positive samples, with fields rarely re-testing positive. The goal of this project is to provide data and simulation tools that will help growers, 1) develop improved sampling plans for in-field produce, 2) customize those plans for their individual fields, and 3) quantify the performance and costs of the new plans to make the business case for their implementation – all to better identify and manage preharvest food safety risks. The research team will simulate fields in four regions of the United States, contaminated by fecal deposits, irrigation water, or low-level soil bacteria. The team also will simulate convenience, generic, and risk-based sampling plans. Results will be used to communicate to growers the number and location of samples needed to achieve a known power to detect contamination. These simulations will be validated against academic literature, industry partner data, and field trials of controlled contamination of spinach. Success of this project will be measured by, 1) the production of produce field simulations and the interface for testing sampling plans via computer simulation, 2) a list of sampling strategies with known power to detect point-source, systematic, or sporadic contamination, 3) an assessment of the relative merits of pre-harvest and finished-product testing, and 4) at least two peer-reviewed, open-access publications.

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*Towards a Decision-Support Tool for Identifying and Mitigating On-Farm  
Risks to Food Safety*

\$316,358

**The Center for Produce Safety with University of California, Davis**

The Center for Produce Safety will partner with the University of California, Davis, to develop decision-support tools for produce growers to minimize risks. Growers continue to lack the ability to predict when their crops are at highest food-safety risk as well as effective strategies to manage those risks. While evidence is accumulating regarding the efficacy of many practices, results are often not made available to growers in a useable way. The first goal of this project is to synthesize existing literature to develop data-driven, pre-harvest, decision-support tools to help growers predict and mitigate risks associated with foodborne pathogens. A publicly accessible, web-based decision-support tool will be created to aid farmers in making more educated management decisions by helping them predict the risk associated with specific farming practices and surrounding landscape features. The second goal is to explore novel methods for suppressing foodborne pathogens—specifically, this project will evaluate how soil amendments and farm management affect the ability of feces-feeding soil bacteria to suppress pathogens (*Escherichia coli* and *Listeria*). Results may be used in future work to assess the efficacy of culturing suppressive bacteria as an on-farm pathogen-suppression strategy. Growers, industry, and conservation organizations have expressed strong interest in making informed decisions about on-farm practices to improve produce safety without comprising environmental health. By combining literature syntheses with lab and field experiments, this project will provide growers with both new strategies for mitigating pathogen prevalence and an effective tool to assist in navigating decisions regarding the food safety/conservation “stale-mate.”

*Illuminating the Role of Whole Genome Sequencing in Produce  
Safety*

\$90,644

**The Center for Produce Safety with University of Arizona**

The Center for Produce Safety will partner with the University of Arizona to improve the use of whole genome sequencing (WGS) as a tool to investigate foodborne outbreaks. As WGS continues to be developed as an investigative tool, it needs to be refined to maximize its potential and thus reach the ultimate goal of speeding up investigations. The goal of this project is to determine the mutation rates of *Salmonella*, *Listeria*, and *Escherichia coli* O157:H7 during long-term persistence in agricultural soil and irrigation water maintained under different geographical conditions. Understanding these mutational rates will help improve the development of the Food and Drug Administration’s GenomeTrakr for regional identification during an outbreak investigation. Furthermore, data from this project will assist the produce industry in developing WGS for internal source tracking to identify resident versus transient pathogens, sources of contamination for either, and better understand the breakdowns or gaps in prevention methods, thus improving produce safety by closing these gaps.

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*Development of a Model to Predict the Impact of Sediments on Microbial  
Irrigation Water Quality*

\$156,344

**The Center for Produce Safety with University of Arizona**

The Center for Produce Safety will partner with the University of Arizona to determine how sediment, pathogens, and flow properties affect irrigation water quality in canal systems. Sediments at the bottom of waterways can serve as reservoirs for enteric pathogenic bacteria; however, little is known about the impact of sediment resuspension on microbial water quality in constructed irrigation canals. This project will determine the impact of sediment-associated indicators (e.g., sediment size, flow velocity) and pathogens (i.e., *Escherichia coli*, *Listeria monocytogenes*, and enteric viruses) on the quality of irrigation water in constructed canal systems. A series of laboratory experiments will be conducted in a hydraulic flume to identify flow and sediment conditions that would result in the resuspension of sediment-bound bacteria/viruses in irrigation channels, and to quantify the impact of resuspension of different levels of bacteria/viruses in overlaying water. This information can be used to identify potential hotspots of accumulation of microbes in the canals, which could aid sampling programs for microbial water quality and inform corrective actions. Project results will be used to develop guidelines for growers and producers for risk assessment and sampling strategies to minimize the occurrence of pathogenic bacteria and viruses in irrigation water in canal systems.

*Preventive Sanitation Measures for Listeria Monocytogenes Biofilms in  
Critical Postharvest Sites*

\$115,774

**The Center for Produce Safety with Clemson University**

The Center for Produce Safety will partner with Clemson University to develop preventative sanitation measures against *Listeria monocytogenes* (Lm) biofilms in stone fruit packinghouses. The project will investigate critical packinghouse microenvironments where bacteria can reside and serve as reservoirs. These critical areas will be identified directly in stone fruit packinghouses in California, in collaboration with plant management, through topographical measurements and environmental swabbing, and then will be recreated as fabricated surfaces for laboratory testing regarding the potential for biofilm formation. Engineered surfaces will be inoculated with Lm (in pure culture and in co-cultures with microorganisms isolated from the packinghouses) and allowed to form biofilms in flow-through enclosures within a bioreactor system. The biofilms will be treated with sanitizers commonly used in the stone fruit packing industry, and optimal conditions will be determined regarding sanitizer concentration and contact time. The team also will test whether the sanitizer treatments selected for this study meet or exceed Environmental Protection Agency requirements for hard surfaces found in the packinghouses other than stainless steel. Results from this study will provide improved pathogen control in addition to basic good agricultural practices, thereby helping the stone fruit industry to produce safer produce for human consumption.

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*Listeria Monocytogenes Growth Potential, Kinetics, and Factors Affecting its Persistence on a Broad Range of Fresh Produce* \$389,372

**The Center for Produce Safety with U.S. Department of Agriculture,  
Agricultural Research Service**

The Center for Produce Safety will partner with the U.S. Department of Agriculture, Agricultural Research Service – Beltsville Research Center to evaluate the growth potential, kinetics, and persistence factors of *Listeria monocytogenes* (Lm) on produce. Lm has been implicated in several produce-associated foodborne outbreaks and is a major concern for the fresh produce industry. Information is urgently needed on Lm growth potential and underlying factors for growth on commodities for which there are limited, conflicting, or no data. The goals of this project are: to examine Lm growth potential and kinetics on a large variety of whole and fresh-cut fruits and vegetables representing multiple produce categories, under typical pre-market storage and/or retail display conditions as well as under elevated abusive temperatures; and to investigate how the nutritional and physiochemical characteristics and microbiota of the produce commodity affect Lm growth and persistence. Expected outcomes include, 1) systematically generated information on the Lm growth potential and kinetics on a broad range of whole and fresh-cut produce, and on factors determining Lm growth potential—this information can be used by industry and regulatory agencies to develop best practice and risk-based guidelines; 2) a risk-based temperature abuse index system that will provide industry with a decision-tool applicable to determination of appropriate disposition of temperature abused product; and 3) information on produce indigenous microbial community or species that affect (enhance or reduce) Lm growth and persistence, which can be further explored to use as control applications.

*Non-Fouling Food Contact Surfaces – Prevention of Biofilm and Surface-Mediated Cross-Contamination* \$289,092

**The Center for Produce Safety with University of Massachusetts**

The Center for Produce Safety will partner with the University of Massachusetts, Lowell, to enhance the non-fouling properties of food contact substances (FCS). Sanitary design and sanitization are critical steps to help ensure food safety and prevent pathogen cross-contamination mediated by FCS. Despite previous interest in the fouling of mainstream FCS approved by the Food and Drug Administration (FDA), there has not been a comprehensive evaluation of either the non-fouling properties of any FCS, or of the practicality of industrial sanitization procedures. The overall goal of this project is to fill this knowledge gap and develop an applicable postharvest preventive control approach to enhance the non-fouling properties of FDA-approved FCS against *Listeria monocytogenes* (Lm) biofilms for the produce industry. The research team will: 1) evaluate non-fouling properties of existing FDA-approved FCS; 2) enhance FCS performance by simple and cost-effective physical/topographical modification without altering the chemical composition; 3) evaluate whether the top-performing FCS are compliant with sanitary designs for the fresh produce industry; and 4) validate the research findings at a fresh-cut processing pilot plant. Project outcomes will provide scientific information that will support sanitary design of packing, holding, and processing

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equipment/devices, coatings, and coating modifications to simplify cleaning/sanitization, and to prevent pathogen attachment and biofilms on FCS for new and retrofitted equipment.