

California Department of Food and Agriculture
2020 Specialty Crop Block Grant Program
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ADDITIONAL ASSISTANCE FOR HISTORICALLY UNDERREPRESENTED ORGANIZATIONS

Pie Ranch

\$104,428

Cascade Farm and Ranch Regenerator

This project will incubate new regenerative specialty crop farms by providing access to affordable land, implements, mentoring, markets, economic skill development, financing, and connections to land tenure opportunities for beginning and socially disadvantaged farmers. A new generation of skilled farmers is needed in California to continue feeding the nation, but access to affordable land is one of their biggest challenges. This project will help diverse new farmers launch strong businesses. By 2022, the project will incubate eight new land-based specialty crop production businesses. The project will prioritize supporting women and farmers of color. Results will be evaluated by counting the number of beginning farmers in the program who go into specialty crop production, and the number of farmers in the program who are from socially disadvantaged backgrounds.

A Sweeter Future: Honey, Education, Entrepreneurship

\$99,974

Community Action Partnership of Orange County

Responsible, science-based apiary management is desperately needed in today's beekeeping enterprises. This project provides high school students with a holistic, hands-on educational opportunity focusing on the development of young professional beekeepers by teaching both technical and entrepreneurship skills. Students will learn the business of managing an apiary along with the procedures for collecting, extracting, and packaging of honey and flowers. The project will empower beginning and socially disadvantaged student farmers by providing the knowledge and skills necessary to have impactful careers in the specialty crop industry. Success will be measured by the total number of students that will pursue a career in the specialty crop industry.

Training Juveniles and Foster Youth Between the Ages of Sixteen and Twenty-Five to Produce and Grow Specialty Crops

\$100,485

Aisha Academy

For more than five years, Aisha Academy (AA) has been providing comprehensive health, education, and human support services to Los Angeles County foster and homeless transitional-age-youth (ages 16 to 25). There are approximately 80,000 foster children in California with over 5,000 aging out of the system every year. Studies show that nearly two-thirds of the transitioning foster youth in California face imminent homelessness while older youth and young adults remain among Los Angeles County's most under-served populations, facing multiple barriers to becoming self-sufficient and productive adults. AA has identified gaps in the vocational training landscape and determined that there is a lack of workers to drive tractors for farmers. AA will train juveniles and foster youth between the ages of 16 and

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25 who have aged out of the system. The training will provide job readiness skills, certification in tractor driving, and a guaranteed job through strategic partnerships with organizations such as the California Association of Wine Grape Growers and Sam Cobb Farms. The two-year program will evaluate the youth that graduate and are employed. The measure of success of the project will be all students completing the training with 80 percent of the students becoming employed.

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GROWN IN CALIFORNIA

We Love California Grownifornians

\$2,000,000

The Buy California Marketing Agreement

This project will implement a multi-platform digital campaign and retail promotions to create strong support from the retail trade and increase consumer demand for California specialty crops and specialty crop products. The multi-platform digital campaign will utilize contextually relevant media placements, deliver rich and engaging experiences within impactful media, integrate multiple influencer marketing programs, and utilize social media to reach consumers in shareable environments. Key performance indicators that will measure success of the multi-platform digital media campaign are quality and viewable impressions, content engagements, and content views. The sales performance goal is to realize a 25 percent increase in promotional sales over the 2019 retail promotion sales of \$4 million. Retail trade outreach will be conducted, and promotional partnerships will be established with key California retailers to execute retail promotion programs both in-store and through digital extension. Success will be measured through total sales performance and/or category lift for featured specialty crops during the promotional period.

Growing Domestic California Prune Sales by Increasing Demand for Prune Ingredients in Food Products

\$450,000

Sunsweet Growers, Inc.

Sales of California prunes in global markets have steadily declined each year since the 2015-2016 market year, dropping 19 percent since that time. With exports equaling approximately 50 percent of California prune sales, California prune growers need to build new, high-value customers for their crop to maintain viability. In addition to other functional benefits, California prunes are a natural, low-sugar substitute for sugar and with 77 percent of consumers in the United States seeking to limit or avoid sugar, prunes are an ideal ingredient to meet this need. As such, Sunsweet Growers (SSG) seeks to promote California prune ingredients as a sugar substitute and functional ingredient to food companies, specifically for use in baked goods and bars. Marketing and promotional activities will generate new customers and sales, increasing high-value prune ingredient sales by approximately 32 percent (goal) and increasing California prune grower returns (outcome). As a grower-owned cooperative all SSG earnings flow directly to California prune growers. SSG will evaluate and measure project success through internal sales records.

Acquiring California Dried Fruit in Schools and on the U.S.

Department of Agriculture's Federal Commodity Entitlement List *\$450,000*

California Dried Fruit Coalition

The California Dried Fruit Coalition (CDFC) is a coalition of California's date, dried fig, prune, and raisin farmers. To meet the demands of strict school district guidelines as well as the picky palates of school-aged children, the CDFC created a new product through qualitative and

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quantitative research, prototype testing in schools with kids and staff, and key decision maker engagement. This project will continue the strong momentum and enthusiasm for the new product, by piloting the product in schools and ultimately secure California dried fruit on the U.S. Department of Agriculture Federal Commodity Entitlement list. This is a critical time to develop a new market and differentiate California grown dried fruits due to the devastating impact of nearly 40 percent of imports displacing current domestic market shares. A new opportunity in schools not only provides school-age children with much-needed nutrition but also creates a much-needed new purchasing channel for California dried fruit.

Updating Perceptions: Connecting California Wine to A Well-Balanced Lifestyle

\$448,000

Wine Institute

In 2018, the growth rate of retail wine sales in the United States declined for the first time in more than 25 years and experts also predict ongoing declines in the restaurant channel. Declines are attributed, in part, to consumers shifting from wine to hard seltzers, "light" cocktails, and other alternatives perceived to better align with a well-balanced lifestyle. Declining demand deeply impacts the 5,900 growers and 3,900 wineries who produce California winegrapes and wine, and who need a strong domestic home for their crop and wine for viability. To combat declines, Wine Institute will leverage their 85-years of experience marketing California wine to launch a marketing and public relations campaign establishing California wine as complementary to the well-balanced "California lifestyle" and synonymous with being outdoors and active; enjoying produce-driven cuisine; and valuing sustainability. The goal or outcome of this project is an eight percent sales growth in California winegrapes and wine by 2023. This growth will be evaluated and measured by independent sales and crop data.

Consumer Direct to Dry Creek Valley: Increasing Demand for California's Signature Grape, Zinfandel

\$427,059

Winegrowers of Dry Creek Valley

Restaurant visitation is at a 28-year low, with 80 percent of meals now being prepared at home. This is a significant increase from a decade earlier and will continue to increase over the next five years. For high-end wine drinkers, 77 percent indicate that trial in a restaurant would have a strong influence on choosing a winery to visit. This trend poses a threat to Dry Creek Valley's wineries and its signature wine grape, Zinfandel, 75 percent of which is sold directly to consumers through winery visitation. This project boosts awareness and trial by contracting with chefs and influencers in three direct flight markets (Denver, Seattle, Phoenix) to create food and wine pairings that consumers can cook at home, sample via in-market events, and encourage visitation to the region. The project will boost direct-to-consumer wine sales by three percent and bottle prices by two percent with benefits translating to all California Zinfandel producers. Success will be measured using surveys and industry sales data.

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Substantiating and Communicating "The California Grown Fig Nutrition Story"

\$449,020

California Fig Advisory Board

Figs have a historical and modern-day reputation for their many health benefits. From multiple references in the Bible to Firmenich, a leading global flavor company that named fig the 2018 flavor of the year, figs stand the test of time. However, there is no time like now to solidify and communicate "The California Grown Fig Nutrition Story" to differentiate California figs from foreign imports. While the California fig industry produces 100 percent of figs sold commercially in the United States, imports represent 60 percent of figs sold in the United States. The California Fig industry has seen a staggering 57 percent increase in fig imports (2017 versus 2016), a 361 percent increase from Spain and export trade uncertainties, further threatening the economic viability of the California Fig industry. To raise awareness and drive sales of California grown figs, this project will conduct a nutrition analysis and influencer campaign, "The California Grown Fig Nutrition Story," to specifically target and educate nutrition media who influence the health and wellness-minded consumer.

Boosting California Processing Tomato Sales by Sharing Nutritional Value, Farmers' Stories, and Recipes With Consumers

\$450,000

Tomato Product Wellness Council

California grows 98 percent of the processing tomatoes in the United States, a tomato variety used in sauces, ketchup, and paste. Since 2014, crop prices have declined by approximately 20 percent, in part from low vegetable consumption with only 9.3 percent of adults eating the daily vegetable recommendations. California's tomato growers need to build consumption and demand for viability. Opportunity exists with millennial consumers because they spend a higher percentage on vegetables than Generation X and baby boomers, and 46 percent of millennial primary shoppers have young families for which to buy and cook. To leverage this, the Tomato Product Wellness Council, representing 240 California tomato growers and processors, will launch a consumer marketing campaign aimed at millennials that shares the nutritional value of and ways to cook with California processing tomatoes along with the stories of California's tomato growers. The goal of the project is to achieve a two percent boost in California tomato sales by 2023 as measured by crop price reports.

The Grow Native Campaign: Supporting California's Original Specialty Crop

\$442,690

California Native Plant Society

Water districts and cities are incentivizing homeowners to transition from lawns to water-wise native plants. However, a 2017 State of the Industry Report conducted by Garden Center found specialty categories like native plants comprising only three percent of sales. Nursery professionals have helped the California Native Plant Society (CNPS) clarify the problem: consumers do not know what plants to choose, where to buy native plants, and how to care for them. To address this, CNPS's goal is to work with nearly 90 already-identified California

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nurseries and growers to increase their sales of 10 native specialty crops by 20 percent. CNPS will achieve this through an integrated marketing campaign featuring point of sale materials, how-to micro-videos, and social media. CNPS will evaluate and measure the success of the campaign by tracking native specialty crop sales and using quarterly data from participating nurseries and growers.

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ENVIRONMENTAL STEWARDSHIP AND CONSERVATION

*Development of Efficient Drying Methods for Off-Ground Harvested
Almonds*

\$447,884

The Regents of the University of California, Davis

California produces approximately 1.2 million tons of almonds annually with an economic output of over \$5.6 billion. The current harvesting method of almonds is associated with the two main problems of dust generation and microbial contamination from soil. Recently, the Almond Board of California and the almond industry have determined to address these problems by developing alternate harvesting technologies to reduce dust generation and the risk of microbial contamination. The off-ground, shake-catch harvesting method is considered the most promising method to mitigate dust generation and almond contamination. However, the almonds harvested with the new method need to be dried with heated air to handle the large volume of the product for ensured quality and safety. This project aims to develop and optimize new and efficient almond drying methods by using elevated temperatures. The new drying methods will be disseminated to the almond processors for implementation.

*Development of a Low-Cost and Accessible Evapotranspiration
Toolkit for Irrigation Management of Almonds and Other Woody
Tree Crops*

\$448,105

U. S. Department of Agriculture, Agricultural Research Service

Better water management tools are needed to ensure sustainable irrigated agricultural production in California. Grower-friendly tools emerging from remote sensing show great promise to fill this need. One such tool, the newly developed OpenET platform, will provide low-cost, accessible, and spatially distributed data at sub-field resolutions based on an ensemble of crop evapotranspiration (ET) models. OpenET will be operational in December 2020, but rigorous validation of its almond ET estimates has yet to occur. This project will provide validation by building on the success of the Grape Remote sensing Atmospheric Profile and Evapotranspiration Experiment (GRAPEX), which was led by this project's Co-Principal Investigator whom successfully tested an ET model based on satellite thermal imagery and accurately quantifies daily ET for commercial vineyards at 30 meter resolution. Working closely with industry partners, this project will use a similar approach adapted for commercial almonds to ground truth data from OpenET and train stakeholders on its use.

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Toward a Circular Economy: From Agricultural Waste to Sustainable Citrus Production Through Microbe-Mediated Processes \$446,401

The Regents of the University of California, Riverside

California's 1.4 million acres of almond crop produces 650,000 tons of low value almond shells. This project aims to demonstrate the use of two almond waste by-products, biochar (BC) and pyroligneous acid (PA), to sequester soil carbon, reduce agrochemical use, and enhance the beneficial native citrus microbiome which play a crucial role in plant growth, health, and stress resilience. BC will be amended to soil mixes and PA delivered through irrigation systems under greenhouse and field conditions. The costs and benefits of BC and PA will be estimated throughout its use to determine economic feasibility. Project success will be determined by demonstrating, 1) short- and long-term soil carbon sequestration, 2) the benefits of microbiome manipulation on plant biomass, 3) increased business sustainability as cost saving and enhanced soil fertility, and 4) farmers' increased knowledge and willingness to integrate these new products and practices into their farming operations.

Development of Natural Antimicrobial Agents from Byproducts of Olives \$446,515

The Regents of the University of California, Davis

The pre- and post-harvest, fruit and vegetable processing industries are in need of new, natural, and environmentally sustainable antimicrobials to reduce the use of conventional chemical preservatives. This is an opportunity for the California olive oil industry since the large number of byproducts generated from the processing of olive oil are considered "waste" while, in fact, they contain phenolic compounds that have a high potential as antimicrobials. This project aims to develop natural antimicrobial treatments (sprays, dips, and/or coatings) made from olive byproducts to increase the value of the crop and the overall sustainability of the food ecosystem. The success of the project will be evaluated based on the success in discovery of antibacterial compounds from the olive byproducts, illustration of synergistic enhancement of antimicrobial activity with mild processing technologies, and adoption of the new antimicrobial technologies by industry.

Optimizing Irrigation Innovation, Salinity Management, and Soil Health in California Processing Tomato Systems \$395,348

The Regents of the University of California, Davis

California processing tomatoes grow on 240,000 acres of soil, drink 640,000 acre-feet of water, and generate \$900 million. Though 80 percent of farms converted to subsurface drip irrigation, the Sustainable Groundwater Management Act incentivizes further efforts such as deficit or precision irrigation. However, conservation irrigation practices may exacerbate salinity or deteriorate soil health by perturbing microbial communities and biogeochemistry. This collaborative project will, 1) advance deficit irrigation guidelines for optimizing water, yield, flavor, nutrition, salinity, and soil health in processing tomato; 2) provide mapping and cost-benefit tools for incorporating deficit and precision irrigation into subsurface drip operations;

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and 3) quantify tradeoffs between conservation irrigation practices, salinity, and soil health for climate-smart decision support. Success will be evaluated based on adoption of decision support tools, water use reduction, and increased dollar returns.

*Exploring Genetic Control of Plant Metabolome for Developing
Drought Resilient Lettuce Cultivars* \$375,047

U. S. Department of Agriculture, Agricultural Research Service

Lettuce is produced under high irrigation requirements and is very sensitive to drought conditions. It is reported that drought conditions lead to metabolic reprogramming of plants resulting in the accumulation of antioxidant compounds, amino-acids, carbohydrates, alcohols, and proline, which together have an osmo-protective role. This project will perform comprehensive metabolome studies on drought sensitive and tolerant genotypes to identify key metabolites accumulated in the plants due to water-stress. Genomic loci controlling the concentration of metabolites will be identified using an interspecific recombinant mapping population. A lettuce germplasm collection will be screened to identify cultivars and lines with high levels of drought induced metabolites, including antioxidant compounds, which are also important nutritional compounds. Successful completion of this project will produce nutritionally enriched, drought tolerant lettuce breeding lines along with publications and citations.

*Converting Almond and Walnut Hulls into Food and Health
Products* \$338,853

The Regents of the University of California, Davis

This project aims to create high value food and health products from almond and walnut hulls to increase the economic value and ensure sustainable management of these byproducts. The project objectives are to extract sugars, phenolic compounds, and other nutrients from the hulls; convert the extracts into food and nutraceutical products; and evaluate the nutritional and health benefits and the economic values of these products. Building on a previous project that was funded by the Almond Board of California, processes for extraction and hydrolysis of the hulls to liberate antioxidants and sugars will be optimized and scaled up. The cultivation yield of edible fungi *Aspergillus awamori* will be optimized and the potential nutritional and health benefits of the antioxidant and fungal biomass will be evaluated using animal model feeding trials. Project success will be determined by conducting successful experiments and producing cost-effective products.

*Nutrient Management with Cover Crops: Effectiveness of Recently
Selected Fava Bean Lines as Mix Components* \$427,414

California State University, Chico

Fava bean is a component of most cover crop mixes because of its substantial biological nitrogen fixation (BNF) potential. As part of a 2018 Specialty Crop Block Grant Program award, the U.S. Department of Agriculture fava bean germplasm was screened for BNF, seed size, biomass, height, harvest index, and resistance to lodging, black aphid, and chocolate spot

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disease. This project will grow the selected accessions with common California cover crop mixes at California locations that vary in rainfall and soil type. The research will, 1) identify the BNF and nitrogen benefits of the new fava bean genotypes compared to current varieties and to other legume cover crops, 2) identify small-seeded fava bean genotypes that perform well in mixes with other species to reduce the seeding cost of cover cropping, 3) address the interaction of the new fava bean genotypes, which vary in height and biomass, with other species, and 4) fill the knowledge gap about plant traits that contribute to cover crop benefits.

Root Knot Nematode Control Using Encapsulated Plant Extracts \$449,547

The Regents of the University of California, Davis

The overall goals of this project are, 1) to develop formulations of diverse-class, biochemical pesticides including isothiocyanates, alkaloids, and terpenoids with improved stability, efficacy, and reduced phytotoxicity, and 2) to apply them to control root knot nematodes in soil and demonstrate their efficacy in field trials for strawberries, tomatoes and carrots. The success of this project will address the unmet needs of developing control nematode pathogens in organic and conventional agriculture and providing alternatives to chemical fumigation and pesticides. Biochemical pesticides derived from plants are sustainable but are not commonly used due their limited stability, half-life, and in some cases phytotoxicity. In summary, by developing sustainable bio-pesticides for controlling root-knot nematodes, this project aims to aid in developing alternatives to fumigation of soil.

*High-Throughput Screening of walnut and Pistachio Rootstocks
for Resilience to Water Deficit*

\$206,995

The Regents of the University of California, Davis

The Sustainable Groundwater Management Act (SGMA), combined with interannual variability in California's snowpack and the resulting supply of surface water, will inevitably lead to years of water deficit for California tree crops. Walnut and pistachio are among California's most valuable tree crops and their orchards mature slowly and remain productive for decades, implying that orchards planted today must anticipate SGMA-mandated deadlines for fully sustainable basins, beginning in 2040. Rootstock resilience to water deficit is desirable because it would enable growers to sacrifice yield in drought years without jeopardizing the orchard itself. This project aims to optimize high-throughput greenhouse screens for resilience to water deficit, and to identify predictive markers for rootstock breeding through screening of diverse germplasm. Success will be measured by comparing responses to water deficit between established, elite clonal rootstocks and new sources of tolerance.

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*Regional Orchard Soil Health and Greenhouse Gas Emissions
After Whole Orchard Recycling*

\$449,209

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

Whole orchard recycling (WOR), the process of returning orchard biomass to the soil, can significantly increase soil organic carbon and reduce greenhouse gas (GHG) emissions compared to removal or burning. New incentives to reduce GHGs and sequester carbon suggest that WOR is a viable method to enhance the sustainability of orchard production practices. More than 200,000 acres of California almond orchards are approaching the end of productive life. Regional surveys are needed to document differences in carbon storage and changes to overall soil health in different soil types and climate regimes in WOR replanted orchards. Changes in total GHG emissions of all three major GHGs (carbon dioxide, nitrous oxide, and methane) are needed to understand if adoption of WOR by growers will facilitate the mitigation of climate change. This project will monitor soil carbon changes and overall soil health on a regional level and determine total GHG emissions 2-6 years after WOR in two more intensively managed fields.

*Extension of the CropManage Decision-Support System to
Viticultural Management*

\$385,538

California State University, Monterey Bay

The CropManage (CM) decision-support web-application was originally developed by the University of California Cooperative Extension to address irrigation and nutrient management in cool-season vegetables. CM has undergone extensive verification in scientific irrigation trials in Salinas Valley, performed in concert with the U.S. Department of Agriculture, Agricultural Research Service, and currently serves over 2,000 specialty crop stakeholders. This proposal would extend CM operations to vineyards, which rank highly among statewide planted acreage and revenues. As a heavily managed perennial crop, grapes are somewhat more complex to model than vegetable crops. This project will involve introduction of a vineyard water stress component within CM, addition of sub-models for nitrogen management and early-season depletion of stored soil moisture, and accounting for cover crop and canopy management. The project includes supporting fieldwork, software engineering, and outreach elements.

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EQUIPPING CURRENT AND NEXT GENERATION SPECIALTY CROP FARMERS

Specialty Crop Workforce Ready Academy

\$93,856

AgSafe

California's specialty crop growers are in critical need of a skilled workforce. Skilled labor shortages are meaningfully impacting the economy. Nationally, this gap cost over \$3 billion in gross domestic product growth in 2012 alone. The Specialty Crop Workforce Ready Academy (Academy) is designed to tackle this issue by training a new crop of individuals able to meet the needs of nut growers in Stanislaus County. AgSafe, with the Stanislaus County Office of Education and the Valley Occupational Learning Technology Institute will align education with the industry to create a four-part training program for Come Back Kids. The students are 18 and older, and left the educational system and returned for their General Education Development and specific workforce skills to enhance their ability to secure local jobs. Through this Academy, 200 students will take these industry-identified courses: Food Safety Modernization Act: Produce Safety Rule Grower, Forklift Operator, Optical Grader and Sorter Operator, and Career Readiness for Successful Employment.

Food Safety Modernization Act and Related Training for the California Central Valley Specialty Crop Industry

\$216,809

College of the Sequoias

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

Providing Produce Safety Rule Training to Help Growers Comply With the Food Safety Modernization Act

\$408,679

Farm Employers Labor Service

California experienced 2,672 foodborne illness outbreaks from 1998-2017 which caused 59,075 illnesses, 4,156 hospitalizations and 138 deaths; 46 percent of foodborne illnesses are traced to produce. Education can prevent illness; as such the Food Safety Modernization Act and the Produce Safety Rule require many California specialty crop growers to be trained and

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Produce Safety Alliance (PSA) certified to ensure food safety. Sixty-five percent of California farms required to comply have not done so, mainly due to high compliance costs. Low-cost training is urgently needed as the lack of farms in compliance impacts the competitiveness of the entire industry. Through a proven partnership, Farm Employers Labor Service, California Farm Bureau, and Safe Food Alliance seek to provide 31 low-cost trainings that will bring more California farms into compliance, a high industry priority. The goal of the project is 1,200 growers receiving training and PSA certification. Project success will be measured by the number of growers that become PSA-certified.

*Building and Retaining Current and Next Generation Workforce
for Napa Winegrape Industry*

\$447,141

Napa Valley Farmworker Foundation

California has a severe agriculture labor shortage. A 2017 California Farm Bureau survey found 69 percent of agriculture employers utilizing seasonal labor saw shortages and states the problem is even more acute for grape growers. For example, Napa's 1,338 winegrape growers, employing 9,857 people, are deeply impacted. To combat the economic and environmental impacts of this labor crisis on Napa farms, a larger, regionally-skilled labor force must be attracted and retained. The Napa Valley Farmworker Foundation seeks to leverage its strong training reputation and experience to both introduce new workers to the industry and retain the existing workforce by, 1) executing a mentorship program to recruit new young people to the industry and 2) executing workshops, conferences, and English literacy courses to train and expand the technical skills of the current workforce (operators and farmworkers). The project goals and outcomes will be higher adoption of good agricultural practices, higher wages and retention of trained workforce, new careers created, and the sustainability of Napa's farms as measured by surveys and an economic analysis.

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HEALTHY SPECIALTY CROPS FOR ALL CALIFORNIANS

Foodwise Kids and Families: Increasing California Specialty Crop Consumption Through Cooking, Nutrition Education, and Market Tours \$390,870

Center for Urban Education About Sustainable Agriculture

This project will increase access to and consumption of California specialty crops for approximately 11,500 children and families by providing nutritional education and increasing familiarity of specialty crops through market field trips and cooking classes. Public school students will meet and learn from California specialty crop growers at farmers' markets resulting in, 1) personal connections to growers and familiarity with markets for ongoing direct California specialty crop sales and 2) experience preparing and preserving California specialty crops. After field trips, students will deepen their knowledge and skills during classroom cooking lessons. Then, students and family members will learn to cook and enjoy California specialty crops together in a family cooking night. Pre- and post- program surveys will measure changes in awareness, knowledge, and consumption of California specialty crops.

From the Ground Up: Building Youth Leadership Through Specialty Crop Urban Agriculture and Nutrition Education \$232,875

Community Services Unlimited Inc.

From the Ground Up is an internship and apprenticeship program that engages teens from South Central Los Angeles to increase access to and consumption of specialty crops. By working on Community Services Unlimited urban farms, youth will learn to grow specialty crops, their health benefits, and how to prepare tasty, culturally appropriate, healthy dishes using seasonal specialty crops through hands-on nutrition education. Youth will deepen their knowledge by delivering hands-on gardening workshops and nutrition education, including cooking demonstrations, to the broader community. Youth will develop and implement educational presentations that increase consumption of specialty crops and support for the specialty crop industry among residents of an urban community that have limited access to fresh produce. Project success will be measured by an increase in consumption of specialty crops, new skills and knowledge gained by youth, and by the number of residents reached.

Expanding Farmer to Consumer Relationships at Faith Community Sites in the San Francisco Bay Area \$331,105

Trust for Conservation Innovation DBA Multiplier

This project will increase consumption and sales of specialty crops by promoting direct marketing relationships between producers and faith-based institutions. Project objectives include, 1) developing 40 marketing outlets that include farm stands and community supported

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agriculture at faith sites; 2) providing nutrition education to 600 individuals at market outlets and 20 farm tours; and 3) facilitating farmers using assets owned by faith groups that include land for at least 12 farms and gardens and eight commercial kitchens for processing. The project builds on seven years of experience in Sonoma, Marin, Alameda, and Contra Costa counties with new partnerships with social service providers in underserved communities. The project will offer workshops in the four counties and provide technical assistance to partners in nine counties. Collaborators include farmers, faith groups, and county agencies. Performance will be measured by an independent evaluator through surveys at partner sites and focus groups in both English and Spanish.

Expanding Opportunities in Hospital Food Service for Small and Mid-Scale California Specialty Crop Growers **\$449,496**

The Regents of the University of California, Davis

This project addresses barriers and enhances pathways for specialty crops to move from regional farms into the University of California, Davis Medical Center (UCDMC), a large-scale institutional kitchen and flagship for local purchasing within the Capital region. The project will, 1) increase the purchase of fresh California specialty crops by 20 percent, including shifting from out of the state or the United States; 2) pilot a communication process for sharing UCDMC purchasing projections with regional producers, minimizing market uncertainty or risk for farmers by forecasting sales; 3) provide technical assistance for 75 growers and five food hubs to sell to institutional buyers; 4) develop skills for 227 cooks, dieticians, and managers; and 5) educate patients and cafeteria customers with 500 recipe cards. Project success will be measured by an increase in fresh California specialty crop sales overall, and of 3-5 priority crops specifically; the number of regional growers selling to institutional buyers; and the knowledge and skills of food service staff.

Increasing Access to and Consumption of California Grown Specialty Crops in the California Corrections System **\$439,345**

The Regents of the University of California, Agriculture and Natural Resources

This project will increase demand for California grown specialty crops by working to establish systems to increase procurement of California grown fruits, vegetables, and nuts in California Department of Corrections and Rehabilitation (CDCR) facilities. The project will, 1) educate CDCR stakeholders about the benefits of procuring and serving more California grown specialty crops; 2) work with stakeholders to develop policy and systems-level changes to promote procurement of California grown specialty crops; and 3) work with formerly incarcerated individuals to understand opportunities and barriers to increase consumption of California grown specialty crops in CDCR facilities and to provide them with nutrition education. The project broadly will reach 120,000 incarcerated people. This partnership among Impact Justice, ChangeLab Solutions, and the University of California Nutrition Policy Institute offers a unique opportunity to develop model practices for increasing California specialty crops in the prison system — the largest state food purchaser (\$150 million annually).

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Making Global Solutions Local: Increasing Awareness and Consumption of Nutrient-Dense Moringa for All Californians \$446,341

The Regents of the University of California, Davis

Increasing consumption and production of climate-sensitive, nutrient-dense specialty crops in California is imperative. Moringa oleifera (moringa) is an ideal crop in speed with California's mission to have a healthier environment, healthier people, and prosperous farmers. While utilization of moringa at a global level is rapidly increasing, there is a vast knowledge gap in California and unmet potential for local market growth. Through presentations and intensive trainings, this project will sequentially increase awareness, knowledge, availability, and access of moringa to over 25,000 California residents, with a focus on underserved communities. Impact assessment of knowledge gained, taste preferences, adoption of cultivation, and consumption of moringa will be measured by quantitative and qualitative means. Results will be published as part of an online website and resource to disseminate information and connect producers with consumers, ultimately scaling the moringa industry in California.

Building the Capacity of Growers and School Food Buyers to Increase Specialty Crop Sales \$367,282

Community Alliance with Family Farmers

Community Alliance with Family Farmers facilitated \$3.5 million in local institutional specialty crop sales in two years. Fifty-four percent of California school districts intend to increase local purchasing, yet many challenges exist, including underutilized resources and confusing bid requirements. The project will increase local specialty crop sales in schools by providing interactive guidance paired with hands-on technical assistance that builds buyers' capacity and producers' response. Transforming existing, static procurement guides into interactive, user-friendly decision and implementation support tools will help 15 school districts, serving over 140,000 students, meet local procurement goals while increasing institutional sales accounts for more specialty crop farmers. The measurements of success are increased local specialty crop use at 15 participating school districts, local preference bid awards, increased specialty crop sales for more farmers, individuals reached, and interactive resource use. Tracking includes seasonal sales reports, bid solicitations, touch points, and resource analytics.

Growing Together: Building Sustainable School Gardens in Los Angeles \$277,950

Occidental College

"Growing Together: Building Sustainable School Gardens in Los Angeles" will promote California specialty crop consumption among Los Angeles (LA) County school students by partnering with LA County's well-established Master Gardener Program to support and sustain school gardens at high-need schools. School gardens introduce students to nutritious specialty crops and influence lifelong eating habits, yet most garden programs in LA County are under resourced. The project will train Master Gardeners on the unique needs of school gardens and

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place them at high-need schools for their required volunteer service hours, providing support to schools to sustain and grow garden programs. The project will also establish a curriculum, program model, and community partnerships that will endure beyond the grant period. Project staff will conduct surveys, focus groups, and interviews to evaluate the program's success and impact on the specialty crop industry.

*From Harvest of the Month to Harvest of the Moment: Increasing
Local Specialty Crops in Humboldt County* \$207,155

Humboldt County Office of Education

The Humboldt County Office of Education (HCOE) has piloted several strategies to help farmers and school districts overcome the challenges of Farm-to-School procurement in rural Humboldt County. One strategy shows the most potential: when procuring a local produce item for the Harvest of the Month (HOTM) education program, HCOE has added onto the order on behalf of school cafeterias when the farmer has enough of the item to meet demand. The farmer delivers produce to HCOE which is then distributed to the schools at no charge. This project will expand this aggregation and distribution model beyond featured HOTM items, providing a critical market outlet for local produce farmers and increasing access to healthy specialty crops in schools. Success will be measured by the number of farmers selling specialty crops to schools, the income generated by these sales, the number of schools with expanded offerings of specialty crops, and the number of students with greater access to specialty crops.

Specialty Crop Nutrition Education and Promotion Program \$450,000

Sustainable Economic Enterprises of Los Angeles

Led by our 18-year-old nutrition education team, Sustainable Economic Enterprises of Los Angeles (SEE-LA) integrates specialty crop promotion and marketing strategies across SEE-LA's six farmers' markets that feature 86 specialty crop producers serving 13,000 Angelenos weekly. This program will provide 36 bilingual adult nutrition education classes developed by a registered dietitian and featuring culturally appropriate recipe demonstrations, 12 summer kids' culinary classes with instructive or hands-on learning in produce preparation, and 24 seasonal specialty crop marketing events annually with interactive learning, taste tests, and market-wide promotion of specialty crop producers. Classes will be prioritized in SEE-LA's four farmers' markets in underserved communities. Producers will receive technical assistance to bolster tested behavioral economic marketing strategies. A social media campaign will feature food demonstration live streams, specialty crop recipe instructional videos, specialty crop producer profiles, and seasonal specialty crop promotion.

*North State Farm to School Project: Edible Education for Butte
County Elementary Schools* \$444,714

California State University, Chico

This Center for Healthy Communities' (CHC) proposed project will improve familiarity with California grown fruits and vegetables among 12,000 children and increase consumption of

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California specialty crops by implementing a farm-to-school Harvest of the Month (HOTM) program in Butte County. Students will have an opportunity to taste the featured fruit or vegetable of the month and meet local farmers through Farmer of the Month newsletters. Classroom tastings will be distributed and accompanied by nutrition education activities provided to teachers. Previous CHC program evaluations have demonstrated that the HOTM program is an effective way to increase the selection and consumption of locally grown fruits and vegetables. Technical assistance will be provided to school food service staff for purchasing local crops. The effectiveness of the program will be measured by analyzing purchasing data which indicates selection of California specialty crops and using food service director surveys.

*California's County Bounty: An Agricultural Tour of California's
Specialty Crops by County*

\$395,212

California Exposition and State Fair

"California's County Bounty" addresses the need to educate consumers about the many benefits of consuming California specialty crops. The project will highlight the top commodities grown within each of California's 58 counties as well as the diversity of specialty crops in California. This will be framed within a 7,000-9,000 square foot interactive exhibit at the annual California State Fair. The exhibit will provide experiential learning to visitors by way of demonstrations, samples, interactive activities, educational signage, farmer/producer talks and more. Additionally, the project will create a Specialty Crop Workshop Series that will take place in the "California Classroom" at the State Fair. The exhibit will be showcased at two California state fairs during the grant period and will continue indefinitely thereafter. The goal of the project is to increase the consumption of California specialty crops by educating consumers about healthy eating habits, preparation techniques, and how to find locally sourced specialty crops.

*Increasing Specialty Crop Access and Education in Underserved
Communities and Schools*

\$449,317

Food Bank Coalition of San Luis Obispo County

This project will expand demand for specialty crop fruits and vegetables while improving the health of underserved Central Coast communities through Food Bank nutrition education and expansion of specialty crop offerings at area school districts. Food Bank nutrition education will reach 2,600 children and 2,200 adults. School district purchasing will impact 4,000 additional children. The project will increase Food Bank clients' familiarity with specialty crops and local farmers' markets through English and Spanish-language nutrition education at Food Bank distributions and Children's Farmers' Markets, after-school programs, preschools, and via cooking classes. Also, Slow Money San Luis Obispo will engage at least three school districts in expanding specialty crop purchases from at least six new California farmers, supporting purchases with farmer visits and tastings to increase the number of students consuming California specialty crops. Success will be measured by nutrition education surveys and district data.

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*Make Mine California: Improving Specialty Crop Access and
Education in Schools*

\$335,738

Center for Ecoliteracy

The one billion school meals served each year in California represent one billion opportunities to create lifelong consumers of California specialty crops by providing students with fresh, delicious fruits and vegetables, and education that increases their awareness of healthy specialty crops. Yet, most food service directors lack accessible information about available specialty crops grown in California, the tools to procure them, and resources to meaningfully engage students. The Make Mine California project will encourage public school districts to procure specialty crops by providing Make Mine California specialty crop lists from distributors and proven strategies to engage youth through farm-to-school events and farmer visits. Success will be determined by the ability to provide access, training, and education that increase California specialty crop consumption, as measured by specialty crop sales and student knowledge gained in a sample of the 50 participating school districts.

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PLANT HEALTH AND PEST MANAGEMENT

*Management Solutions for Fusarium Falciforme, an Emerging,
Destructive Disease of Tomato and Other Annual Specialty Crops*

\$202,536

The Regents of the University of California, Davis

Fusarium falciforme is emerging in California as one of the most destructive diseases of tomato, rapidly killing plants and significantly reducing yields. Recent work indicates this is also a pathogen of cucurbits, pepper, and legumes. The goal of this project is to establish fundamental management parameters that can effectively mitigate losses in affected specialty crops by, 1) determining pathogen host range, 2) establishing optimal and harmful crop rotations (targeting management in tomato), and 3) identifying resistance in commercial cultivars of tomato, pumpkin, melon, and other specialty crops. The project team will transfer new information and technologies through diagnosis and management guidelines and workshops, outreach publications and presentations, and diagnosis services. Success indicators include, 1) the number of specialty crops identified as being at risk, 2) growers, extension faculty, and diagnosticians trained in Fusarium falciforme diagnosis and management, and 3) producers following recommendations.

*Advanced Breeding for Broad Genetic Resistance to Downy Mildew
in Spinach for Organic Production*

\$449,374

The Regents of the University of California, Davis

In spinach, new genetic resistance-breaking races of downy mildew (DM) appear every two years, threatening crops, especially for organic production. This project extends the project team's current program by, 1) developing race-specific DNA assays to survey DM diversity in spinach growing regions over two years, 2) genetically mapping genes and breeding broad genetic resistance to DM for organic production to reduce losses, and 3) training students in pathology, plant breeding, and extension, and extending knowledge to growers and industry personnel. The impact of this project will be measured with, 1) survey and interview data from the University of California Cooperative Extension, industry personnel, and growers, 2) the specificity and adoption of in-field DM assays, 3) the development and adoption of germplasm with improved genetic resistance across multiple DM races, and 4) experiential learning opportunities by students. Outreach will be achieved with workshops, field days, professional classes, meetings, internships, and media.

*Early Detection of Botrytis Species and Rapid Characterization of
Fungicide-Resistant Isolates in Strawberry*

\$298,903

The Regents of the University of California, Davis

Strawberry production, distribution, and retail suffer from significant losses due to fruit spoilage caused by Botrytis species. The disease is not easily detectable until fruit show visible infection

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symptoms. The project proposes to develop non-destructive methods for early detection of Botrytis via multi/hyperspectral imaging and sensing of volatiles, allowing the timely application of disease management in the field, decision making at harvest, and control conditions during storage and distribution of fruit. The project also plans to design a rapid and precise clustered regularly interspaced short palindromic repeats (CRISPR) - CRISPR associated (Cas) approach for detecting known fungicide-resistant Botrytis isolates in the field without the need for polymerase chain reaction (PCR), in order to support targeted disease control. These tools will be evaluated in commercial settings ensuring their widespread applicability. Results will be made available to industry stakeholders at field days, through presentations and handouts, and via activities organized with the University of California Cooperative Extension and the University of California Postharvest Center.

Systematic Identification of Oomycete Plant Pathogens Important to California Specialty Crops \$442,411

U. S. Department of Agriculture, Agricultural Research Service

Virtually every specialty crop is susceptible to an Oomycete plant pathogen (Phytophthora, Pythium, Phytophthora), so having a method for systematically identifying all species in a production system would facilitate improving management practices as well as provide a means for monitoring the presence and spread of regulated invasive species. This project expands the validation of an existing marker technology to address this need using the DNA sequence analysis of a highly specific selectively amplified template from environmental samples. A database of sequence data for species identification has been under development, and along with tools for assisting in analysis, is listed on a publicly available website. The proposed research will provide a more comprehensive sequence database and validate the technology for pathogen identification and quantification on a broader scale for use in California specialty crop production systems.

Host Resistance and Fumigation Alternatives for Control of Macrophomina Phaseolina in Strawberry \$318,796

U.S. Department of Agriculture, Agricultural Research Service

Disease caused by Macrophomina phaseolina is a serious constraint on strawberry production in California. Robust resistance is not currently available in cultivars, and little is known about alternatives to soil fumigation for management of this disease. The goal of this project is to accelerate efforts to breed Macrophomina-resistant strawberry cultivars and test non-fumigation methods for disease reduction. The outcomes of this project will result in significant progress by strawberry breeding programs in producing cultivars with resistance to Macrophomina, validation of Macrophomina-resistance for 28 off-patent cultivars that breeders can use as resistance donors, critical information on the genomics of resistance to this pathogen, and non-fumigation methods for disease control. The success of this project will be measured by the number of resistant cultivars released, grower adoption of new methods for disease reduction, and the number of growers who gained knowledge from this project.

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*Interregional Surveillance of Spinach and Lettuce Downy Mildew
in California to Improve Management Practices* \$438,518

U.S. Department of Agriculture, Agricultural Research Service

Downy mildews (DM) are major disease constraints for spinach and lettuce industries in California, causing severe damage to leaves and rendering the fresh products unmarketable. DMs can be managed with the application of fungicides but routine fungicide applications result in large expenditures and can lead to fungicide resistance in the pathogen. There is also an increasing demand to limit chemical inputs due to the potentially negative environmental impacts. This project aims to, 1) multiplex two current detection assays into one for dual pathogen detection in a single a reaction, 2) determine levels of these pathogens in different regions (Salinas, Imperial, and Coachella Valleys), and 3) use this information to associate spore load with increased or decreased disease risk in the different regions examined. This project will enable a more comprehensive assessment of pathogen inoculum density during the season and the relationship of environmental parameters on disease severity.

Testing New Apple Rootstocks in California \$61,684

California Apple Commission

This project will focus on providing support for testing the viability of utilizing new rootstocks on California apples. In 2019, the California Apple Commission (CAC) met with an Apple Rootstock Breeder and Geneticist of the U.S. Department of Agriculture, Agricultural Research Service, National Apple Rootstock Breeding Program. As a result of this meeting, the CAC was presented with the opportunity to participate in the study to test several of these new rootstocks in California. This project will assist the industry in implementing rootstock trials that have the potential to increase the overall productivity of California apple growers, reduce the number of pesticides and post-harvest treatments, and create resistance to the destructive disease, fire blight. The rootstocks developed through this program have proven to be highly beneficial to other apple producing states, and California hopes to reap some of these benefits.

*Preventing Xylella Fastidiosa in California Ripe Olive by Determining
Susceptibility of California Ripe Olive Varieties* \$60,180

California Olive Committee

Xylella fastidiosa (Xf) is a plant pathogenic bacterium that causes economically devastating diseases worldwide and has a wide host range. Previous California Olive Committee funded research showed that California strains of Xf from field-infected olive trees can be transmitted by the glassy-winged sharpshooter, but olive varieties used in California are resistant to California strains of Xf. In 2013, Xf was detected for the first time in Europe and devastated olive orchards in Italy. The Italian strain of Xf belongs to subspecies pauca, which is not known to occur in California. Currently, the California ripe olive industry utilizes and is reliant on two olive varieties for ripe olive production. Therefore, preventing its invasion and obtaining information for development of disease management strategies is of importance to protect ripe olive industries in California. The aim of this project is to determine the susceptibility of California ripe olive trees to Italian Xf and develop a potential disease management strategy.

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*Varietal Improvement of Fresh Market Long Bean to Overcome
Biotic Stresses and Expand Production*

\$404,041

The Regents of the University of California, Riverside

Long bean (asparagus bean, Asian yardlong bean) is the vegetable type of cowpea; a climate-resilient and nutritious food legume grown by Southeast Asian farmers in the Central Valley of California and marketed to Asian immigrant communities across the United States. Insect pests are major threats, reducing yield and quality of all current cultivars. The project team will implement short-term plant breeding protocols and extension activities to develop resistant varieties. Sources of natural resistance found in African cowpea germplasm and existing knowledge of marker-trait associations for aphid and root-knot nematode resistance will be applied in marker-assisted breeding. Local cultivars with stacked resistance genes will be developed. Novel, resistant, bush-type long bean will also be developed to enable scaling up production and improving nematode management in commercial farming. The improved germplasm will be evaluated by controlled experiments along with outreach activities to enable adoption.

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FOOD SAFETY

Bio-Based Antimicrobial Coatings for Reducing Risk of Cross-Contamination During Harvesting

\$330,700

The Center for Produce Safety

The Center for Produce Safety will partner with the University of California, Davis, to develop food ingredient-based antimicrobial coatings for harvesting equipment and tools. Cross contamination is a major food safety risk when pathogens from soil, humans, or other environmental factors are introduced or persist on harvesting equipment and tool surfaces during produce harvesting. The overall goal of this project is to develop field-deployable food ingredient-based antimicrobial coatings to manage cross-contamination risks during harvesting. These antimicrobial coatings will be formulated with selected food-grade ingredients and a commonly used chlorine-based sanitizer. The project will develop coating formulations that can be readily deposited on legacy equipment and diverse food contact surfaces, including stainless steel and plastics, and can maintain antimicrobial properties during a harvesting shift; these coatings also will be designed to be easily removable during standard sanitation procedures. The coatings will be evaluated in lab and pilot-scale experiments and in field trials with an industry partner. Also, potential chemical residues from chlorine byproducts or chlorine bound to the coating material will be evaluated on fresh produce. Results of this study will be summarized in project reports and presented at the annual Center for Produce Safety Research Symposium. Success will be measured by achieving, 1) over 3-log reduction in inoculated bacteria and background microflora on harvesting knives and conveyor belt surfaces using the antimicrobial coating approach, 2) at least 3-log reduction of bacteria in persistent biofilms as well as preventing formation of biofilms, and 3) extended antimicrobial activity of the coating on food contact surfaces during harvesting (at least between sanitation cycles).

Waxing of Whole Produce and its Involvement in and Impact on Microbial Food Safety

\$238,336

The Center for Produce Safety

The Center for Produce Safety will partner with the University of California, Davis, to assess the impact of commercial storage and finishing waxes on microbial food safety. After harvest, many fresh fruits and vegetables are washed and waxed to prevent premature rotting and to extend shelf life. Waxing has been widely used by the produce industry, but information about its impact on microbial food safety is very limited. To address this knowledge gap, this project will use citrus fruit (oranges and lemons) as the model commodities and conduct a systematic evaluation of waxes used by the produce industry. The microbial and chemical properties of a wide range of citrus storage and finishing waxes available from industry collaborators will be evaluated. Salmonella and Listeria monocytogenes will be separately inoculated into the waxes to mimic potential contamination of the wax at a packinghouse, and the survival of pathogens will be monitored at ambient temperature and 4°C. The behavior of the pathogens

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will also be evaluated on fruit surfaces during citrus storage after the application of storage wax and after application and dry heating of finishing waxes. Wax applications that demonstrate significant bactericidal efficacy under laboratory conditions will then be evaluated via pilot-scale studies at the pilot packinghouse operated by the University of California Lindcove Research and Extension Center. Results of this study will be summarized in project reports, presented at the annual Center for Produce Safety Research Symposium, and published in peer-reviewed journals. The outcomes of this project will assist the produce industry with risk assessment and management of waxing by providing information about pathogen behavior in a range of storage and finishing waxes and how the application of storage and finishing wax impacts the survival of pathogens on fruit surfaces.

When the E. coli Hits the Fan! Evaluating the Risks of Dust-Associated Produce Cross-Contamination

\$207,287

The Center for Produce Safety

The Center for Produce Safety will partner with the University of Arizona to better understand how wind-driven dust in agricultural environments can impact produce safety. Dust represents an understudied vehicle for microbial dispersal and produce contamination by pathogens. Dust deposits onto plant surfaces during cultivation and from wind-driven dust in agricultural environments. These deposits can impact food safety when the sources include particles from reservoirs of pathogens, both natural and those related to animal feedlot operations. This project will, 1) evaluate the role of dust in transferring foodborne pathogens to produce surfaces grown in eastern and western agricultural regions of the United States, 2) determine the role of humidity in the deposition of dust on produce and the survival of pathogens in dust, and 3) test dust particulates from animal operations in both regions for the presence of biomarkers that are indicative of fecal contamination and potentially the presence of pathogens. Results of this study will be summarized in reports, presented at the Center for Produce Safety Research Symposium, and published in an extension bulletin together with recommendations for best management practices. The project outcomes will enhance understanding of pathogen transport from feces into and through produce fields, and will quantify the risk associated with contamination from dust under various environmental and atmospheric conditions.

Field Evaluation of Microfluidic Paper-Based Analytical Devices for Microbial Source Tracking

\$413,500

The Center for Produce Safety

The Center for Produce Safety will partner with Purdue University to develop a novel and rapid risk assessment tool that can be used in the field by growers to assess fecal contamination. Foodborne pathogens on fresh produce can lead to serious health issues. The sources of these pathogens often are wild animals or animal feeding operations. Current methods for assessing the risk of animal-source contamination on produce are costly, time-consuming, and lab-based. The anticipated outcome of this project is a validated, field-deployable growers' risk assessment biomarkers investigative tool (Grower's Risk Assessment Biomarkers Investigative

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Tool [GRABIT]) that will provide results of animal-source contamination within an hour (instead of waiting for days with traditional methods). This novel tool will be based on methods for detecting DNA from animal feces and it will distinguish between different animal hosts (swine, poultry, or ruminants). The tool builds on paper-based devices (similar to a pregnancy test) that are simple-to-use, low-cost, and portable. To validate this tool, it will be tested in a controlled lab setting, around animal feeding operations, and in produce fields during growing and harvesting seasons. Results of this study will be summarized in project reports, presented at the annual Center for Produce Safety Research Symposium, and published in peer-reviewed journals. As a result of this project, specialty crop growers will have a new science-based method to measure and manage the risk of animal-source contamination in their products.

*Determination of Physical and Chemical Mechanisms to Prevent
Cyclospora Infection*

\$419,521

The Center for Produce Safety

The Center for Produce Safety will partner with the University of Tennessee to identify new control measures for inactivation of Cyclospora in agricultural water and on the surface of produce. Cyclospora is a ubiquitous parasite that causes gastrointestinal illness in humans and is typically acquired through consumption of contaminated water or contaminated fresh produce. In 2018, the first Cyclospora infection tied to domestically grown produce was reported, demonstrating the increased threat to consumers in the United States. Few studies have investigated methods to inactivate Cyclospora due to two bottlenecks: the inability to culture the organism has limited the number of oocysts that can be collected for inactivation studies; and the viability or infectivity of Cyclospora oocysts can only be assessed by analysis of sporulation rates, which must be determined microscopically by a trained investigator. The primary goal of this project is to identify new control measures for inactivation of Cyclospora in agricultural water inputs and on the surface of produce. This project will systematically evaluate inactivation of Cyclospora oocysts by gamma radiation, ultraviolet radiation, ozonation, and chlorine dioxide gas; develop a high-throughput, automated method for determining inactivation of Cyclospora oocysts; and employ the automated method to screen a library of chemical compounds for inactivation of Cyclospora. Results of this study will be summarized in project reports and presented at the annual Center for Produce Safety Research Symposium. The outcomes of this project will include, 1) the identification of two or more methods for inactivation of Cyclospora oocysts, to reduce or eliminate the risks associated with agricultural water inputs; and 2) evaluation of the successful methods for feasibility of use on produce and in the produce processing environment, with consideration paid to cost, availability, effectiveness, and regulation.

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Survival of Infectious Human Norovirus in Water and on Leafy Greens

\$219,143

The Center for Produce Safety

The Center for Produce Safety will partner with the University of Georgia to assess the survival of infectious human norovirus in water and on lettuce. In the United States, the majority of foodborne illnesses are caused by human norovirus (HuNoV). Lettuce and other leafy greens are most often implicated in outbreaks associated with HuNoV. Previous research has reported the presence of the virus genetic material in surface water, but data on the survival of the infectious virus in the water are limited. Until recently, it was challenging to determine HuNoV infectivity because the virus was difficult to grow in cell culture; however, a new cell culture system based on human intestinal enteroid (HIE) cells was developed to measure HuNoV infectivity. This project will adapt the HIE cell culture system to answer critical knowledge gaps regarding the survival of infectious HuNoV in surface water and in relation to generic *Escherichia coli*, and the preharvest survival of the infectious virus on lettuce. Surface water will be sampled from multiple produce growing regions and used to set up microcosms spiked with HuNoV, with or without generic *Escherichia coli*. The microcosms will be incubated under controlled conditions (simulating preharvest environments) and sampled weekly for two months. In addition, greenhouse grown lettuce will be spiked with HuNoV and incubated for two weeks under the same controlled conditions. The infectivity of HuNoV and its concentration (as RNA titers) from the water and lettuce samples will be determined using the HIE cell culture system and real-time quantitative polymerase chain reaction (RT-qPCR) assays. Also, the die-off of HuNoV in water samples in relation to generic *Escherichia coli* will be determined. Results of this study will be summarized in project reports, presented at the annual Center for Produce Safety Research Symposium, and published in peer-reviewed journals. The outcomes of this project will assist the produce industry with risk assessment by providing information on the survival and transmission of infectious HuNoV in water and leafy greens.

Digital Farm-to-Facility Food Safety Testing Optimization

\$236,936

The Center for Produce Safety

The Center for Produce Safety will partner with the University of Illinois at Urbana-Champaign to create an integrated model to define optimum food safety testing for produce. Effective food safety testing in the produce industry is limited by inconsistent requirements for product testing and a history of approaches focusing on single points in the supply chain. This project will build on previous work simulating both in-field and packinghouse pathogen product testing to create an integrated production, harvesting, processing, and packing model to define optimum food safety testing schemes for produce. To do this, the project will first build a field-to-facility model of leafy green produce safety testing using spreadsheet- and flowchart-based computer simulation. A range of alternative testing plans, potential processing impacts on pathogen risk, and contamination scenarios will be incorporated. Second, the project will generalize that model to incorporate a variety of higher-risk commodities (tomatoes, apples, cilantro, and jalapenos) each with distinct risk profiles and risk-management options determined through literature review and site visits to growers and processors in multiple states. Third, the project

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will optimize testing across the supply chain of each commodity. Many iterations of these supply chains will be simulated, tracking the variability and uncertainty in the ability of specific testing schemes to identify and reject produce contaminated by different risk profiles. These results will determine recommendations for optimized field-to-facility food safety product testing. Results of this study will be summarized in project reports, presented at the annual Center for Produce Safety Research Symposium, and published in peer-reviewed journals. The goal of this project is to affect real change in produce food safety testing. Success will be measured by, 1) industry partners using the model to improve their internal sampling practices, 2) this work being included in discussions to harmonize food safety testing across the supply chain, and 3) academic rigor demonstrated by peer-reviewed publication.

*Overcome Critical Food Safety Challenges of Blueberry
Harvesting*

\$209,817

The Center for Produce Safety

The Center for Produce Safety will partner with the University of Georgia to help blueberry growers and packers improve the microbial safety of harvested blueberries. Blueberry growers and packers in the United States implement Good Agricultural and Management Practices to ensure berry safety. However, berries are grown in the field and are prone to contamination by microorganisms. Containers or lugs for harvested berries may carry a relatively high level of microorganisms and, if not properly cleaned and sanitized, the lugs can transfer the microorganisms from one load of fruit to another. The hygiene condition of berry lugs and other harvest containers and equipment is very important to the microbial safety of harvested blueberries. This project will first collect information about the cleaning and sanitation practices currently used by blueberry growers and packers, through anonymous online and in-person surveys in different states. The promising cleaning and sanitation practices will be identified through collaboration between the project team and an expert advisory board, and then validated in blueberry production fields and/or packing facilities for their effectiveness in decontaminating mechanical harvesters and harvest containers. Also, the identified cleaning and sanitation practices will be evaluated in a laboratory setting to determine their effectiveness in removing microbial buildup and accumulated biofilm mass from selected materials used to manufacture harvest containers and mechanical harvesters. Results of this study will be summarized in project reports, presented at the annual Center for Produce Safety Research Symposium, and published in peer-reviewed journals. The knowledge gained from the project will help berry growers and packers improve their cleaning and sanitation practices, and subsequently the microbial safety of harvested blueberries. Knowledge on industry best practices to improve the hygiene status of harvest containers and equipment will be promoted for broad adoption.