GROWN IN CALIFORNIA

Buy California Marketing Agreement *$2,556,500*

Grown to be Great

The Buy California Marketing Agreement will implement a multi-platform digital campaign as well as retail and foodservice promotions to create strong support from the retail and food service trade and increase consumer demand for California specialty crops and specialty crop products. The multiplatform 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. 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. The project's foodservice promotion component will support the reemergence of the foodservice industry in a post-COVID-19 environment. Post-COVID-19 marketing includes participation in and execution of trade and consumer events. The social media, retail, and foodservice campaigns will be supported by participation in industry events and implementation of specialty crop agritours. The project will continue to include both in-person and digital consumer events. Performance will primarily be measured through sales increase and digital media impressions. Success will be measured through total sales performance and/or category lift for featured specialty crops during the promotional period. California Grown's consumer database will also be utilized to survey target audience to measure intention to access, produce, and preserve specialty crops as a result of campaign reach.

The Regents of the University of California, Davis *$443,399*

Hurdle Approaches for Enhancing the Safety and Quality of Kale, Chard, and Collard Green Juices

Demand for dark green juices, such as kale, chard, and collard greens, has grown significantly given their profound health benefit. California ranks tops in the nation for the production of dark greens. Unfortunately, foodborne outbreaks associated with juices, as well as food losses caused by spoilage, hinder expansion of the dark green juice market. Currently, there is very limited literature about proper preparation of dark green juices. Human pathogens and spoilage microorganisms from the pre- and post-harvest environment play critical roles in the safety and quality of dark green juices. This project aims to promote sales and market opportunities for California-grown dark greens by systematic evaluation of the antimicrobial efficacy of different non-thermal hurdle approaches, investigating their impact on the safety, quality, shelf life, and sensory attributes of dark green juice. Outcomes will provide preparation, production, and

storage guidance documents for dark green growers and juice processors and promote their economic well-being.

Sweetpotato Council of California *$242,000*

Reducing Consumer Confusion Through Clear Retail Signage for Sweet Potatoes

Imagine being at the store and wanting to buy a sweet potato. You arrive at the sweet potato bin, but it's labeled yams. You question everything you thought you knew about sweet potatoes. Are they the same vegetable as yams? Are yams as healthy as sweet potatoes? The confusion makes you wonder if this sweet potato is worth it. You leave confused and empty handed. You do not have to imagine this scenario; it is happening at grocery stores around the United States and is the result of a common retail practice to label certain varieties of sweet potatoes with deep orange flesh as yams to distinguish them from other varieties. This project will explore marketing strategies at point of sale to accurately label sweet potatoes and educate consumers about their many benefits. Market test results will be monitored and evaluated, working from sales data provided by retailers. The goal is to develop a set of merchandising 'best practices' for sweet potatoes that reduce consumer confusion and encourage purchase.

Lake County Winery Association *$440,476*

When You Think Wine, Think Lake County - Reaching the Next Generations

Lake County wineries depend on in-person sales and tasting room traffic as their main source of revenue. The region's customer base is largely from the Gen-X and Baby Boom generations. Only about 20 percent of Millennials are wine drinkers while 71 percent of wine consumption is by the Gen-X and Baby Boom population. Millennials and Gen Z are harder to reach but critical for continued growth in Lake County's wine industry. The goal of this project is to grow Lake County wine's brand recognition and introduce Millennial and Gen Z consumer audiences in the greater San Francisco and Sacramento areas to Lake County wines. The project will employ a robust digital, social media, and video marketing campaign with brand messaging and a fresh website to reach this audience and convert them into customers. The project will increase sales by 10 percent. Success will be measured by tracking direct-to-consumer sales data for this target audience.

Sunsweet Growers, Inc. *$500,000*

Sharing California Prune Benefits to Build Sales Among United States Flexitarian Consumers

California prune growers have faced long-term price declines for their specialty crop: the most recent 4-year price average is approximately 14 percent lower than the prior 4

years. 2020 prune yields were down 31 percent from 2019, creating further need for higher returns. Prices and returns increase when demand and sales can be built for high-value consumer prune products; selling more California prunes into this channel is needed for grower viability. Opportunity exists to achieve this by targeting United States flexitarians (those with a diet centered on plant-based foods; 14 percent of United States consumers). Sunsweet Growers (SSG) will promote the benefits and uses of California prunes in a plant-based diet to this audience via a digital marketing campaign to drive California prune product sales and shift more prunes to this high-value use. The project's goal is to boost sales by $3 million, increasing grower returns. As a grower-owned cooperative, all SSG earnings flow directly to California growers; SSG will evaluate/measure success through retailer Information Resources, Inc. and internal sales data.

Raisin Administrative Committee *$480,000*

Driving California Raisin Awareness and Value as a Naturally Sweet and Nutritious, No Sugar Added Ingredient and Snack

California raisin producer returns declined almost 50 percent the last two years, versus the 2018-2019 crop year, and are currently below a breakeven level. This has detrimentally impacted the specialty crop industry: California lost 10 percent of its raisin acreage in 2020 and another 15 percent in 2021. Declines are, in large part, due to California supply exceeding demand; consumer demand for California raisins must be generated to sustain California's raisin producers and the greater industry. To rebuild needed consumer demand and producer economic viability, the Raisin Administrative Committee, representing 100 percent of the California raisin industry, will launch a social media influencer campaign sharing the nutritional benefits of California raisins and promoting the dried fruit as a no-sugar-added snack and ingredient. Communicating the value of California raisins will drive consumer sales and result in the project outcome of a 5 percent producer revenue increase (measured by crop acquisition tonnage times price) by the project end, as measured by published industry reports.

Allan Hancock College *$126,984*

Interactive Maps of Crops Throughout Santa Barbara County

The Santa Barbara County farm-to-table and grape wine industry will benefit from the development of an interactive and educational map to enhance visitors' experiences and knowledge of the resources in Santa Barbara County via internet-based and cell phone application services. The interactive map will feature county farm-to-table (vegetables, fruits, honey, and flowers) and county vineyards and wineries (varietals). This project will create a digital application and corresponding website to provide information on grape varietals grown, wines offered, fruits, vegetables, flowers, and honey. Through this, both students and visitors will learn where their food is grown.

Wine tourists and local wine enthusiasts will be able to seek out wineries with the varietals they are interested in tasting and purchasing. This project will track digital application user analytics and share the data with the Santa Maria Chamber of Commerce and local farms and wineries to increase marketing potential.

EQUITY, OPPORTUNITY, AND EDUCATION FOR ALL CALIFORNIA SPECIALTY CROP FARMERS

The Regents of the University of California, Agriculture and Natural Resources *$487,064*

Increasing California Specialty Crop Competitiveness by Understanding and Addressing Farmworker Technical Training Priorities

Farmworkers make a thousand management micro-decisions every day impacting resource use, crop quality, and the economic competitiveness of California's specialty crop sector. The proposed project seeks to develop appropriate agricultural extension materials for farmworker communities, which have historically been overlooked in extension efforts. First, a participatory needs assessment with farmworker communities and community partners to understand technical agricultural training needs and information priorities of these communities will be conducted. Then training programs with extension materials on the highest priority training needs identified by farmworkers themselves will be developed and deployed. The goal of this project is to increase farmworker knowledge of best agricultural practices and success will be measured through field day formative assessments, key informant interviews, and targeted observations.

Lake County Winegrape Commission *$308,606*

Fostering Vine Health Amid Drought: Educating Winegrowers on Cutting-Edge Pruning Techniques for Sustainable Farming

Winegrape growers face unprecedented challenges and the viability of this specialty crop is at risk. Extreme drought conditions are threatening vine health and vineyard lifespan. Lack of rain and available water for irrigation reduces sap flow, limiting root and vine growth, making vines vulnerable to wood diseases such as *Eutypa*, and threatening vineyard productivity. Growers need strategies to support sustainable vineyard operations. One of the most effective tools to foster vine health is pruning. Proper pruning promotes root growth, vine vigor, and disease resistance. This project will deliver training to 180 growers on innovative pruning techniques that address long-term vine health via seminars, in-the-vineyard trainings, and videos. Robust outreach includes press releases, grower testimonials, and social media. Success will be measured via grower surveys. This project will give growers a valuable tool to support long-term viability of this important specialty crop.

The Regents of the University of California, Santa Cruz *$309,657*

Organic Specialty Crop Training Courses for Growing More Diverse, Sustainable Small Farm Operations

For over 55 years, the University of California, Santa Cruz (UCSC) has been a leader in organic specialty crop production, research, and training at the 33-acre farm and garden run by the UCSC Center for Agroecology. The experienced team at UCSC is planning a new series of short courses and trainings in English and Spanish, tailored to help entry-level farmers successfully grow and market a broad range of specialty crops using environmentally sustainable methods. Organic remains the fastest growing sector of the United States food industry, but organic farming has its own set of challenges requiring constant adaptation, with variables like climate change adding to the need for continual learning on the grower's part. This project's goal is to deliver a wealth of organic specialty crop expertise through in-person and virtual trainings to small-scale, early career, and socially disadvantaged farmers. The project will start with a grower needs assessment and post-training surveys will measure increases in knowledge and the adoption of methods.

Center for Land-Based Learning *$443,598*

Strengthening the Agricultural Apprenticeship Pipeline: Providing New Farmers and Farm Managers for the Specialty Crop Sector

The goal of the California Farm Academy Apprenticeship program is to establish an effective pipeline that provides the specialty crop sector with highly skilled, capable, and knowledgeable farmers and farm managers and supervisors. The Center for Land-Based Learning (CLBL) developed the first state-registered farm manager apprenticeship program in Northern California in 2018. The apprenticeship program structure included 3000 hours of on-the-farm training and 250 hours of supplemental instruction. In the last three years, CLBL developed the curriculum framework, engaged with farmers across the region, worked with specialty crop industry partners to identify workforce needs, and started engaging in the farmworker space. CLBL is now poised to further strengthen this program and expand it across the state while also developing an apprentice tract for farm workers that will provide them with the skills to become farm managers and supervisors.

HEALTHY SPECIALTY CROPS FOR ALL CALIFORNIANS

Fresh Approach *$461,052*

Transforming the Food Landscape in the San Francisco Bay Area Through Trauma-Based Nutrition and Culturally Relevant Interventions

Nutrition and food access interventions are often not culturally relevant to communities of color, nor do they acknowledge structural inequities and systemic racism faced by underserved communities. This project addresses the need to create inclusive food landscapes across the Bay Area through two main strategies. First, the project will advance a trauma-based model of nutrition intervention that is culturally and socially tailored and incentivizes access to specialty crops at farmers' markets for 28,715 low-income individuals. This model will be integrated within existing nutrition and wellness programs in 25 health clinics and community organizations. Next, the project will facilitate access for six beginning and/or marginalized farmers at farmers markets and promote their specialty crops through a culturally relevant outreach campaign. As a result of the project, knowledge of California specialty crops will increase among 41,000 individuals; the promotion and support of beginning and/or socially disadvantaged farmers will generate $250,974 in sales.

Center for Ecoliteracy *$358,060*

Resilient School Food Systems: Increasing Regional Procurement of Specialty Crops

The 1 billion meals served annually in California schools represent a huge opportunity for the specialty crop industry, as only 21 percent of purchases are California-grown in this burgeoning $2.8 billion industry. The Center for Ecoliteracy's Resilient School Food Systems project builds the capacity of schools to serve local specialty crops by, 1) convening a series of six Community of Practice workshops, guided by regional interviews and a task force, that bring together 100 school food leaders, community partners, and farmers; 2) facilitating regional celebrations of specialty crops at 15 school districts; 3) compiling recipes and authoring a guide on using local specialty crops to increase school meal participation; and 4) sharing success stories. Measurements of success include increased purchases of specialty crops in a sample of school districts, workshop participant knowledge gained about procuring and preparing specialty crops, and student knowledge gained about specialty crops.

Sustainable Solano *$499,871*

Solano County Specialty Crop Education and Training Program

This project creates cooking courses tailored to specific target audiences to increase access, consumption, and knowledge of specialty crops, supports an annual public event showcasing specialty crops from local farms and restaurants, and grows capacity for a healthy prepared meals program. There is great demand for education on specialty crops relating to health and the local food system. Bringing together multiple stakeholders to broaden and deepen an existing educational pilot project will connect new audiences (community leaders, medical students, entrepreneurs, workforce, youth) to healthy specialty crops, promote consumption, and cultivate an authentic, lasting appreciation. This project aims to strengthen relationships between farmers and their communities and ensure an expanded market that values specialty crops. Measurements for success are increased knowledge, consumption, and capacity to prepare and/or procure specialty crops among all audiences and increased interest in healthy prepared meals.

Olivewood Gardens and Learning Center *$417,264*

Cultivating Community Health Through Specialty Crop Education, Access, and Activation

National City is a low income community of color with limited produce access, barriers to health education, and low land access. These inequities correlate with disproportionate chronic disease and food insecurity. This project's goal is to improve the food system and health outcomes by increasing knowledge, access, consumption, purchasing, and production of specialty crops among 8,700 youth and adults. Outcomes include, 1) provide specialty crop nutrition, cooking, and growing education to elementary students, parents, and families, 2) train 200 high schoolers in specialty crop production and preparation, 3) educate teachers on best practices to incorporate garden-based learning (GBL) and nutrition into classrooms, 4) support 10 school gardens to increase production and GBL, and 5) increase specialty crop purchasing district-wide and at 10 corner stores. The program will be evaluated through surveys, focus groups, interviews, garden production data, and analysis of district and corner store purchasing.

KVIE Public Television *$500,212*

"America's Heartland" PBS Television Series and Website Showcases

Healthy foods can reduce a host of public health issues, yet many Americans' diets are seriously lacking in them. Key factors affecting consumer food choices are appeal, health impacts, cost, and accessibility. Focusing on these variables, a Public Broadcasting Service (PBS) ten-episode television series, "America's Heartland," will air on more than 340 stations and the national RFD-TV cable/satellite channel. KVIE will increase consumption of California specialty crops by educating consumers about the

health benefits of these foods and will include useful information on how to prepare and source them. Episode segments include farmer and crop stories, “Fast Facts About Food,” health and nutrition information, cultural aspects, farm-to-fork cooking, sustainable production methods, and more. Program episodes, related recipes, viewer clips, ways to purchase, and other useful information will be added to websites, social media, and YouTube, with surveys administered at different times to measure the impact of the project.

California Fresh Farmers Market Association *$500,000*

Be Inspired by the Bounty: Boosting Specialty Crop Consumption Among Central Valley Consumers

United States fruit and vegetable consumption has declined approximately 10 percent since 2004; 80 percent of Americans under-consume fruit and 90 percent under-consume vegetables, contributing to health risks. Increased fruit and vegetable consumption - including the bounty of specialty crops grown in California's Central Valley - can mitigate health issues, but knowledge of how to use and prepare specialty crops is a recognized barrier for many. Accessible and engaging education is needed. As such, California Fresh Farmers Market Association (CFFMA), hosting eight year-round certified farmers' markets reaching 500,000 individuals monthly, will launch a pilot educational campaign at its busiest markets including no-cost cooking courses featuring meals made with seasonal produce. Crop information and videos will be created and promoted for wider consumer reach. The project’s goal is to increase sales of specialty crops grown by CFFMA's producers and boost 1,000 regional consumers' fruit and vegetable consumption by 50 percent, as measured through surveys.

ENVIRONMENTAL STEWARDSHIP, CONSERVATION, AND CLIMATE SMART AGRICULTURE

The Regents of the University of California, Davis *$448,219*

Creating Nutritious and Highly Digestible Fermented Animal Feeds from Almond Hulls and Tomato Pomace

Large quantities of almond hulls and tomato pomace and biomass are produced as byproducts by the almond and tomato industry, respectively. They are currently used as low value feed or disposed of as waste. These byproducts can spoil quickly, causing environmental pollution. The goal of this project is to increase the feed value of almond hulls and tomato pomace and biomass for the cattle industry. The research objectives are to develop new fermentation methods and produce probiotic and highly digestible feed; quantify the nutritional values of feed and potential for reducing enteric methane emissions of cattle, estimate the production cost, and disseminate results to stakeholders. Feed will be produced in laboratory and pilot scale experiments and tested in laboratory and cattle trials. The new method for producing fermented feed is expected to be practical and could increase the economic value of hulls and pomace by over 40 percent.

California Sustainable Winegrowing Alliance *$466,124*

California Winegrower Strategies and Tools to Mitigate and Adapt to Climate Change

Given the climate crisis and related pressures, California winegrowers must mitigate and adapt to climate change. Potential impacts and climate beneficial practices have been identified in prior research; however, actionable guidance, sound strategies, training, tools, and resources are needed to expand climate smart practices in vineyards and wineries. The project objectives are to, 1) conduct a literature review of scientific research and create a summary report; 2) create a "toolbox" of climate smart practices, resources, tools, case studies, and videos that winegrowers can use to create mitigation and adaptation strategies; 3) assist winegrowers with cost share opportunities; 4) disseminate strategies and tools via over 10 workshops and webinars for more than 500 winegrowers and via newsletters and website; 5) develop communication materials to inform over 6,000 growers, trade, and consumers about California wine's climate action; and 6) evaluate success by number of participants using toolbox and increased adoption of practices.

The Regents of the University of California, Davis *$388,901*

Nitrogen Budgeting in Organic Vegetable Production: Improving and Validating Tools for Growers

Organic vegetable production relies on organic sources to supply Nitrogen (N) to the crops. Depending on the properties of these sources and environmental conditions, the amount of N that becomes crop-available during the growing season can vary considerably. This project proposes to develop a site-specific N budget worksheet for organic vegetable systems. The project team created a worksheet based on a previous Specialty Crop Block Grant Program project and data from the literature. However, this worksheet needs to be validated in the field and a more robust estimate for N mineralization from soil organic matter needs to be included. To do that, trials will be conducted in commercial certified organic fields located in the southern Sacramento Valley and the southern Central Coast. The results from the project will be presented to growers through multiple channels. The results of the project have the potential to make organic vegetable production in California more competitive and reduce the risk of N losses to the environment.

The Regents of the University of California, Davis *$393,597*

How to Irrigate Nut Orchards Based on Expected Yields

Multiyear drought became a major problem for nut growers in California. How to irrigate orchards to maximize yield and assure survival is often a make-or-break decision, yet there is very limited know-how that can help growers. This project proposes to reduce the knowledge gap and use a time and spatial approach to quantify the impact of irrigation on future orchard performance. The general goal of the project is to determine the impact of matching irrigation to the spring estimates of year's yield on final yield and the following year's yield potential (maximum production capacity). The project objectives are, 1) develop a near-real-time yield prediction model based on climatic parameters and physiological (carbohydrate content) data at orchard level, 2) evaluate the impact of different irrigation regimes on actual yield versus orchard yield potential using large-scale multi-orchard approach, and 3) estimate water savings resulting from irrigating for actual versus potential yield. Project will be leveraged on an existing five-year carbohydrate and yield data set.

The Regents of the University of California, Davis *$452,047*

Conversion of Almond and Walnut Hulls to Fungal Protein, Biogas, and Biofertilizers

The project aims to produce fungal protein, biogas, and biofertilizers from almond and walnut hulls to increase the economic return to farmers and hullers and ensure sustainable management of these byproducts. The project objectives include fermentation process development to use hulls as the substrate for fungal biomass

production, extraction of the protein from the fermentation residues, production of biogas and fertilizers from the organic waste generated from the process, and economic and life cycle analysis of the integrated process. Project success will be determined by positive economic and environmental evaluations of the process, farmers' willingness to adopt the new product, and investors' willingness to invest in the technology.

The Regents of the University of California, Davis *$451,363*

Irrigation Strategies to Improve Water Productivity and Yield Quality of Olive Orchards in California

Olive acreage has increased in California within the last two decades, as well as challenges related to climate change and groundwater management policies. However, information on olive water-use and efficient irrigation practices for high density systems is scarce. This project aims to develop and extend new information to enhance olive productivity through precision timing and quantities of irrigation. The project objectives are to, 1) characterize water use and develop crop coefficients for California oil and table olive orchards, 2) develop protocols to reduce water during drought tolerant phenological stages without impacting productivity but improving yield quality, and 3) develop irrigation guidelines to implement innovative proximate and remote sensing technologies in water management. Success will be evaluated as degree of achievement and outreach of the three objectives and number of growers learning new knowledge.

U.S. Department of Agriculture, Agricultural Research Service *$401,379*

Almond-Alfalfa Intercropping in Young Orchards for Profitability and Sustainability

Almond is the most economically important perennial crop in California, adding $9.2 billion to the total economy. Diversification of a cropping system offers both economic benefits and ecosystem services. During early years, almond trees are non-bearing, but have interrow space that allows forage cultivation and harvest. Intercropping provides earlier and more frequent incomes for a new orchard and can confer soil health and ecosystem benefits, but these outcomes have not been evaluated in California almond orchards. Project goals are to provide scientific documentation of the benefits of almond-alfalfa intercropping with regards to orchard soil fertility, water dynamics, profitability, and tree health. Results will be disseminated with growers and industry professionals during field days, via grower targeted publications and blogs, and in peer-reviewed journals. Research success will be evaluated by grower interest in or adoption of intercropping.

Rodale Institute *$261,827*

Production of Short, Medium, and Long Season Specialty Crops in High-Residue, No-Till Farming Systems

A two-year field experiment will be carried out at the Rodale Institute, California Organic Center in Camarillo, CA, to evaluate production of transplanted specialty crops including zucchini, pepper, and eggplants using regenerative practices compared to conventional practices. The project team will evaluate yield and quality of transplanted vegetables in high residue, no-till systems, where weed management will be facilitated using roller-crimped cover crops, compared to the standard management of weed control using plastic mulch or frequent tilling. The team will also evaluate and document the effects of high residue, no-till systems on soil organic matter, soil health, soil water holding capacity, and water use efficiency. An economic analysis will be performed to show the viability of specialty crop production using regenerative practices. Results will be disseminated via on-farm field days, web articles, webinars, and conference presentations.

The Regents of the University of California, Davis *$495,687*

Can Polyploidy Increase Drought Tolerance in Landscape Plants?

Polyploidy, the state of having multiple chromosomes, is used by breeders to reduce seed set. Polyploidy can lead to other useful traits, though its effects on reduced water use and increased drought tolerance are unclear. Water-related traits are key to nursery productions and landscaping in the West's drying climate. This project aims to gain new knowledge of drought tolerance in landscape plants by measuring the physiological stress of polyploids under water deficit to identify whether ploidy can be used as a tool to improve drought tolerance. Eight polyploids of four species will be measured to test the hypothesis that higher ploidy determines higher drought tolerance. Project success will be measured as a statistically significant increase of drought tolerance in plants with higher ploidy and the willingness of specialty crop breeders and growers to utilize this tool on a larger palette of species to increase the drought tolerance of landscape plants facing climate change.

The Regents of the University of California, Davis *$325,722*

Boron Removal from Irrigation Waters: Biological Principles and Derivation of Maximum Crop Tolerance Levels

Boron (B) toxicity limits the utility of a significant amount of the underutilized irrigation resources in California; understanding of the management of irrigation B is, however, inadequate. This project will determine the acute, chronic, and phenology-critical impact of B in irrigation water on almond performance. This information will assist growers, water district managers, and regulators with strategies for the management of B in irrigation and drainage waters by providing specific information on the B rate and B

timing that results in negative crop impact. While this project is made possible by the availability of a new B removal technology, irrigation B reduction can also be achieved by blending irrigation sources or by selecting the time of year when the B-compromised irrigation source is used. This project will also establish the critical rates and times of B exposure that impact crops and inform management of B in irrigation and drainage waters.

The Regents of the University of California, Agriculture and Natural Resources *$384,692*

Developing Sustainable Strategies to Adapt California Walnut Production to Warmer Winters Under Climate Change

Warmer winters, due to climate change, threaten sustainable walnut production through increased costs and decreased yields. Walnuts need a high amount of winter cold to bloom and leaf-out, normally in the spring. Dormancy Breaking Strategies (DBS) known to compensate for inadequate winter chill in other crops and competing countries have not been widely tested in California walnuts. This project's goal is to give California walnut growers environmentally sound and profitable tools to adapt existing orchards to warmer winters by testing at or near-market DBS for efficacy, testing additional chemistries to inform future research, and increasing understanding of the physiological impact of DBS to improve their efficacy. Project success will be measured by finding at least two DBS that adapt walnuts to warmer winters, increasing knowledge among growers of these DBS, and increasing knowledge of physiological metrics to improve DBS effectiveness.

Cal Poly Corporation *$435,282*

Comprehensive Utilization of Olive Byproduct for Improved Economic Feasibility and Environmental Sustainability

California is the largest olive oil producer in the United States. The production of olive oil generates a list of byproducts, including olive mill wastewater, olive pomace, and olive pit. Among those byproducts, olive pomace is currently used as cattle feed (valued at $10-$50 per ton), while there is no efficient treatment for olive mill wastewater and olive pit. Each year, more than 800,000 tons of olive are produced in California, leaving the olive byproducts as a significant environmental and economic burden. This study proposes a biorefinery strategy to improve the economic profitability and environmental sustainability of olive byproducts, including four objectives, 1) extract phenolic compounds as value-added antioxidants, 2) produce biogas from olive pomace by enzymatic treatment and anaerobic digestion, 3) produce biochar from olive pit for wastewater and soil treatment, and 4) undertake a techno-economic and life-cycle assessment to determine the economic feasibility and environmental impact of olive byproducts.

Yard Stick PBC *$493,817*

Application of Spectral Soil Carbon Measurement and Artificial Intelligence-Driven Analytics to Increase Competitiveness of California Specialty Crops

Specialty crops in California are subject to increasing climate vulnerability and degraded soils. Yet, growers lack cost-effective tools to manage soil health. The cost of conventional soil carbon measurement makes most soil carbon markets uneconomical. Soil carbon markets work overwhelmingly with Midwest commodity crops, excluding California growers. This project will research the application of spectral soil carbon measurement and artificial intelligence-driven analytics software to the California specialty crop market. The technology's technical feasibility has been proven in the Midwest, but it requires regionalized machine learning models and upgraded hardware to be appropriate for California specialty crops. Researchers will assess whether the technology achieves parity with best-available conventional testing methods. Once adapted to specialty crops, the system will reduce soil carbon measurement costs by 90 percent, unlocking billion-dollar soil carbon offset markets and providing growers with tools to manage soil health.

PLANT HEALTH AND PEST MANAGEMENT

U.S. Department of Agriculture, Agricultural Research Service *$275,070*

Characterization of Lettuce Resistance to Impatiens Necrotic Spot Virus

California's Monterey County harvests 100,000 acres of lettuce (*Lactuca sativa L.*) annually at a value of $1.2 billion. In recent years, incidence of Impatiens Necrotic Spot Virus (INSV) has increased significantly, causing devastating losses to lettuce production. Genetic resistance is the most economical and environmentally sound control method, but no complete resistance to INSV has been identified. Therefore, further characterization of this resistance and development of improved lettuce germplasm is imperative. With the goal of releasing INSV resistant lettuce, project objectives are to, 1) combine two sources of partial resistance into a single genotype, 2) characterize inheritance of INSV resistance, and 3) develop improved crisphead and romaine germplasm. Success will be indicated by releasing new lettuce germplasm, publications, citations of published work, and requests for seeds and information from the industry.

U.S. Department of Agriculture, Agricultural Research Service *$499,733*

Stacking RNAi-Based Resistance to Phytophthora, Crown Gall, and Nematodes in Almond and Walnut Rootstocks

Phytophthora root and crown rot, crown gall, and nematode diseases are serious threats to almond and walnut production in California. These diseases affect commercially used rootstocks, resulting in lower water use efficiency and significant yield reduction. Currently, preplant soil fumigation and systemic chemicals are central to managing these soilborne diseases. This project targets advancement of crop-adaptable RNAi-based resistance technology for managing the three soilborne diseases. The rootstocks with "stackable" resistances to multiple soilborne pathogens will be vital for facing sustainability challenges of land, air, and water use and safety in California. Once worked out, the stackable feature of RNAi-resistance has potential to accomplish in less than a decade what would likely take much longer, if even possible, using conventional breeding strategies. Success of this project will be measured by the number of multiple disease-resistant almond and walnut lines produced.

The Regents of the University of California, Davis *$472,997*

Flattening the Curve on Branched Broomrape - Reducing the Threat to the California Processing Tomato Industry

The parasitic weed branched broomrape (*Phelipanche ramosa*) is a critical threat to the processing tomato industry and could be a risk to other specialty crops grown in California. Because it is an "A-listed" weed, infested crops usually are destroyed without harvest, resulting in 100 percent economic loss. This parasitic plant is a prolific seed producer, and the seed can survive in soil for many years. The focus of this project is on developing and extending interventions tomato farmers can take to "flatten the curve," by reducing the incidence of this weed and reducing spread within the region and to other regions of California. Specifically, this project will build on previous research on chemical management of this unique weed, examine cultivar sensitivity data to guide future breeding efforts, and conduct vital equipment sanitation. This information is relevant to both broomrape and a suite of soil-borne pathogens that can be spread on mechanized planting and harvesting equipment used in specialty crops.

U.S. Department of Agriculture, Agricultural Research Service *$324,009*

Assessing the Effect of Exogenous Silicon Application on Yield and Quality of Lettuce Produce

Lettuce production and its postharvest quality is frequently affected by environmental stresses, causing substantial food waste and economic loss. The application of exogenous silicon (Si) can enhance growth and quality of diverse crops, such as soybean and tomato, but its effect on lettuce production has not been sufficiently tested. This project proposes to investigate the effect of Si on the growth, stress response, and postharvest quality of lettuce and the factors affecting Si effect, alongside the study of the molecular basis of its effect. Understanding the effect of exogenous Si on lettuce yield, quality, and stability will help to sustain the supply of high-quality lettuce in a changing climate. The project will be successful if the effectiveness of Si application is tested on at least 15 cultivars in replicated trials using evaluations of crop yield; resistance to abiotic stress factors, pests, and diseases; and postharvest quality.

UAV-IQ *$159,153*

Drone-Based Biological Control of The Vine Mealybug in California Vineyards

Releasing predators and parasitoids as a biological control method for the management of vine mealybug (VMB) has been studied for over a decade. However, biocontrol in vineyards has been underutilized, in part due to the challenges of applying natural enemies in large areas and the absence of established, economically viable protocols. UAV-IQ has developed operational and technological capabilities to fly drones equipped

with intelligent release systems directly over crops to release beneficial insects and mites. It has generated positive results in numerous crop types, which supports the hypothesis that this method can be effective for vine mealybug control in vineyards. This project will evaluate the effectiveness of predators (*Cryptolaemus montrouzieri*) and parasitoids (*Anagyrus pseudococci*) released by drones in vineyards to control vine mealybug and aims to develop economically viable treatment protocols. Project success will be measured by a reduction in vine mealybug abundance in treated vineyard blocks.

The Regents of the University of California, Berkeley *$425,385*

Establishment and Evaluation of *Ganaspis brasiliensis* to Suppress Spotted Wing Drosophila

Spotted-wing drosophila (SWD) is a world-wide invasive pest and can severely damage California specialty fruits, such as caneberries, strawberries and cherries. SWD control currently relies on repeated insecticide applications, which can harm beneficial insects, lead to secondary pest outbreaks, and leave toxic residues on fruits. Moreover, this strategy may be lost with increasing development of SWD insecticidal resistance and ongoing consumer demands for clean fruit. SWD also develops on wild and ornamental species in the surrounding landscape, and sustainable areawide tools are needed for long-term control solutions. This project will release the beneficial wasp *Ganaspis brasiliensis*, just approved by the U.S. Department of Agriculture, to improve areawide SWD bio-controls. Project subobjectives are to improve mass rearing, conduct releases throughout California's susceptible specialty crops, and evaluate effectiveness to adjust release procedures as needed.

The Regents of the University of California, Davis *$250,963*

Development of Innovative Approaches to Manage *Botryosphaeria* Branch Canker and Dieback in California Avocado

Recent surveys of young and mature avocado groves have shown that Avocado Branch Canker (ABC), caused by several *Botryosphaeriaceae*, is well established in all growing areas, with incidences having been accentuated by drought, as experienced in California. These fungi mainly infect trees through wounds, causing death of graft union, dieback, and canker. They are very difficult to control once inside the plant and the absence of registered materials for treating pruning and grafting wounds is a serious concern for the avocado industry. Risk of infection through pruning wounds is likely to increase with the use of high-density planting, which requires more frequent pruning to manage tree growth. This proposal will assess the impact of ABC in relation to cultural practices and abiotic stressors and provide ABC management solutions to avocado stakeholders. Its success will be measured using pre- and post-project surveys evaluating grower's education, tool adoptions, and associated benefits.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service *$400,447*

Development of a Rat Specific Toxicant for the Protection of Specialty Crops

Anticoagulant rodenticides have been available for decades. However, California's citrus farmers are no longer able to control rats using anticoagulants due to a lack of efficacy. Moreover, social acceptance of anticoagulants is shifting and more regulations governing their use are being adopted. To address these concerns, this proposal will develop a novel rat specific toxicant, DR8, a norbormide analog, through oral gavage and feeding trials. A novel bait matrix will also be developed by testing the preference and acceptance of possible ingredients and attractants by black rats. The project team will measure the success of this project by the efficacy of the final bait formulation containing the DR8. This will be done by offering the DR8 bait to rats in addition to their normal food ration. This will be done both in individual cages and in a colony (group housed) setting. This models the likelihood of rats to consume and die from the bait in citrus fields where other food sources are available.

U.S. Department of Agriculture, Agricultural Research Service *$237,824*

Development of Immuno-detection for Lettuce Dieback Associated Virus and Greenhouse Evaluation of Lettuce for Resistance

Lettuce dieback causes stunting, necrosis, and often complete loss of lettuce crops, but diagnosis has been challenging because the disease was believed to have been caused by two tombusviruses (TBSV and MPV) that are inconsistently associated with the disease. At best, either MPV or TBSV can be found in only 60 to 70 percent of symptomatic plants. Recent studies demonstrated that a novel virus, now called lettuce dieback associated virus (LDaV), is actually responsible for causing the disease and its presence in infected lettuce is highly correlated with lettuce dieback. This project will, 1) develop antiserum for the detection of LDaV that can be used for serological detection, 2) clone LDaV and develop an agro-inoculation system for easier inoculation of plants during greenhouse evaluation of germplasm for LDaV resistance, and 3) determine if disease symptoms on lettuce are more severe when plants are infected by LDaV along with either tombusvirus or by LDaV alone.

U.S. Department of Agriculture, Agricultural Research Service — *$283,148*

Identifying Landscape Variables and Cropping Patterns Associated with Viral Epidemics in Lettuce

In recent years, lettuce production in the Salinas Valley has been severely impacted by Impatiens necrotic spot virus (INSV). INSV is transmitted by thrips, a tiny insect pest with an extensive host range that includes numerous crops that are part of a diverse agricultural system within the Salinas Valley. While this scenario creates management challenges, there are opportunities to identify landscape variables that influence virus outbreaks. The goals of this proposal are to characterize the migration patterns of thrips between lettuce and non-lettuce crops and identify problematic areas that support populations of thrips vectoring INSV. Outcomes will result in a greater understanding of cropping and landscape factors that pose the greatest risk for thrips infestations and INSV outbreaks in lettuce crops. The success of this project will be measured by the number of growers and pest control advisors that have gained knowledge and adopted methods to reduce pest and disease risk.

Cal Poly Corporation — *$167,469*

High Throughput Phenotyping of Downy Mildew Resistance in Baby Leaf Salad Greens

In the past two decades, the market of ready-to-eat salad mix has grown five-fold and has achieved a market value of more than $2.7 billion. Cultivated arugula (*Eruca sativa*), wild arugula (*Diplotaxis tenuifolia*), and baby kale (*Brassica oleracea*) make up a significant portion of California's baby leaf salad greens (BLSG) market. Despite the large market within and outside of the United States, little information exists about disease resistance in public and private germplasm. Downy mildew (DM), caused by *Hyloperonospora parasitica*, presents a major threat to BLSG production. Disease control has relied on fungicides due to the lack of DM-resistant varieties. To help growers and breeders develop downy mildew resistant varieties and accelerate the phenotyping process, this project proposes to develop a method to use multispectral imaging for high throughput phenotyping. This technique facilitates DM resistance breeding through early detection and fast screening of DM in BLSG.

Cal Poly Corporation — *$268,017*

Investigating the Impact of Biofungicides on Wine Grape Disease Control and Wine Quality

The fungal pathogens *Erysiphe necator* and *Botrytis cinerea* cause powdery mildew and Botrytis bunch rot in wine grape, respectively. Both diseases are difficult to control due to their resistance against many synthetic fungicides as a result of repetitive use of fungicides with similar modes of action. Therefore, they pose a tremendous threat to the

wine grape industry in California. Biofungicides, as the only option for organic/biodynamic growers and a good rotating option for conventional growers, lead to increased cost and pose unknown influence on the berry microbial community and the fermentation process when used too frequently or too close to harvest. The proposed work focuses on, 1) identifying the effective and economic use of biofungicides in wine grape powdery mildew and Botrytis bunch rot management and 2) studying the effect on the microbial community, especially pro-fermentation microbes, and the subsequent wine quality when using biofungicides solely and integrated in programs.

The Regents of the University of California, Davis *$478,739*

Impact of *Brevipalpus* Transmitted Viruses on the Production and Export of California Citrus

This project will determine whether native *Brevipalpus* mites found in citrus can vector *Brevipalpus* transmitted viruses (BTVs) that cause citrus leprosis and develop educational materials for vector and disease management. The vector status of the two native mites is needed to inform the possible regulatory and management approaches needed for citrus leprosis in California. Educating growers about the native mites and BTVs allows for more timely detection and mitigation of BTVs when they enter California, reducing the impact of this disease. The measurable outcomes for this project are determining the vector status of the two mite species for each virus and the impact of outreach efforts for citrus growers. Success of the educational program will be measured by recording the number of attendees at training sessions, field days, and other outreach events and the number page hits of online educational materials, with a goal of educating greater than 25 percent of California citrus growers.

The Regents of the University of California, Davis *$361,940*

Implementing Area-wide, Long-term Programs for Biological Control of Aflatoxin/Ochratoxin in Nut Crops in California

Mycotoxins pose health risks to consumers, are regulated in foods worldwide, and affect nut growers' revenue when their product is rejected from the market. Currently, the only proven method to reduce aflatoxin contamination is the use of atoxigenic *Aspergillus flavus* strains as biocontrol. However, in California nut and fig orchards, this biocontrol treatment does not reach its full potential, mainly due to cross effects between treated and untreated orchards, where toxigenic strains from untreated orchards move to treated orchards. Area-wide programs, where all crops susceptible to mycotoxins will be treated with a biocontrol, could reduce the risks of cross effects by increasing the rates of atoxigenic strains and reducing the toxin producing potential of the population. The proposed research will focus on establishing bases to implement area-wide, long-term programs, including developing additional atoxigenic strains and application strategies for timely delivery of the biocontrol.

FOOD SAFETY

The Center for Produce Safety *$432,566*

Testbeds for Microbial Source Tracking using Microfluidic Paper-Based Analytical Devices

The Center for Produce Safety (CPS) will partner with Purdue University to provide a site-specific risk-assessment tool for fresh produce operations that are adjacent or nearby to an animal operation. Pathogen contamination on fresh produce can lead to serious health issues. These pathogens often originate from animal feeding operations that are in proximity to fresh produce operations. Current methods for preventing such contamination are based on guidelines of maintaining a certain distance between animal and produce operations. However, these guidelines do not provide information that is specific to a particular site. This project will test a novel growers' risk assessment biomarker investigative tool kit in locations that have nearby animal and produce operations. The tool detects DNA from feces of animals (swine, poultry, cattle) using a paper-based device that produces a color change (like a pH strip). The tool also incorporates data from local weather conditions and air quality to determine their influence on the contamination risk. The tool kit will be tested at three different locations and at two different times of the year to illustrate versatility. Results of this study will be summarized in project reports, presented at the annual CPS Research Symposium, and published in peer-review journals. The outcome of the project will be a user-friendly growers' risk assessment biomarkers investigative tool (GRABIT) kit that quantifies site-specific risk at the interface of animal and fresh produce operations. Mitigating risk from animal operations will ultimately improve food safety and reduce foodborne illnesses.

The Center for Produce Safety *$367,273*

A Metagenomic Approach to Food Safety Risk Mitigation in Pears

The Center for Produce Safety (CPS) will partner with Virginia Polytechnical Institute and State University (Virginia Tech) to determine the microbiome profiles of marketable and unmarketable fresh pears. Research on conditions that can support the growth of foodborne pathogens on fruit surfaces has primarily been focused on fresh apples or stone fruit, leaving the pear industry without science-backed recommendations to prevent contamination or control microbial growth under industry-relevant conditions. To help inform the pear industry, this project will conduct experiments to better understand, 1) the pear surface microbiome before storage, 2) how the storage environment impacts the microbiome of marketable and unmarketable pears, and 3) how key organisms in the microbiome can impact food safety risks, such as *Listeria monocytogenes*, throughout pear storage. Results from these studies will yield data for the fresh pear industry on metagenomic profiles of marketable and unmarketable pears. This information can direct existing and future management practices to optimize the quality and food safety of pears simultaneously. Project findings will be shared with the industry through presentations to stakeholders, articles for grower and packer audiences, and peer-reviewed scientific literature.

The Center for Produce Safety *$435,118*

Control of Salmonella and Listeria Monocytogenes on Peaches through Spray-Bar Brush Bed Sanitizer Intervention

The Center for Produce Safety (CPS) will partner with Washington State University to provide data on the antimicrobial effectiveness of sanitizer treatments in peach packing lines. Recent multistate foodborne illness outbreaks linked to peaches and other stone fruits indicate that *Salmonella* and *Listeria monocytogenes* can survive and persist during production and postharvest handling and packing, highlighting the need to control these pathogens. Although sanitizers interventions have been used in stone fruit processing, there is a lack of data on the antimicrobial efficacy of current sanitizers under commercial packing conditions for peaches. To address this knowledge gap, this project will first validate the efficacies of selected sanitizers against *Salmonella* and *L. monocytogenes* on peaches at the lab scale and in a pilot-scale spray-bar brush bed system, and then verify the selected sanitizer interventions in multiple commercial peach packing lines. Critical operating parameters for chlorine and chlorine dioxide will be assessed and compared with two other commercial sanitizers, peracetic acid and JC9465 (an oxidizing wash process aid). Also, this project will evaluate *Enterococcus faecium* NNRL B-2354 as a surrogate for *Salmonella* and *L. monocytogenes* on peaches for the sanitizer intervention studies. Results 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 be science-based guidance on optimal process parameters and standard operating procedures for selected sanitizers in spray-bar brush beds for the peach packing industry.

The Center for Produce Safety *$440,814*

Microbiological Risk Assessment using QMRA in Preharvest Agriculture Water Treatment Systems for Leafy Greens

The Center for Produce Safety (CPS) will partner with University of Arizona to evaluate how agricultural water treated with common sanitizers may impact human pathogens established on leafy greens or in soil. While much is known on the efficacy of commonly used sanitizers to reduce human pathogens or indicator organisms in water, little research has focused on the potential added benefit of sanitizer-treated agricultural water on pathogens already established on crop surfaces or in soil. Also, the variability in water treatment or “breakthrough” has also not been properly characterized in an agricultural setting. This project will directly address these knowledge gaps through laboratory evaluations and in-field evaluations over two growing seasons, using agricultural water treated with peracetic acid or calcium hypochlorite, and then using the data collected to conduct a quantitative microbial risk assessment (QMRA) for Shiga-toxigenic *Escherichia coli* (*E. coli*) in leafy greens (romaine and spinach). Success of the project will include a comprehensive understanding of the impact of residual agricultural water treatment chemistries on pathogen persistence in water, on plant tissues, and in soil, and how that relates to risk. The scientific data generated can be used by growers to justify enhanced benefits of antimicrobial water treatment, beyond die-off of

organisms found in agricultural water alone. Ultimately, the project aims to provide growers and regulators with an improved understanding of the impact of water treatment on risk reduction for consumers.

The Center for Produce Safety *$352,832*

Supplementing Food Antimicrobials in Commercial Edible Coatings to Enhance the Safety and Extend the Shelf-Life of Stone Fruits

The Center for Produce Safety (CPS) will partner with the University of Tennessee to evaluate commercial edible coatings supplemented with commercial food antimicrobials to enhance the safety and extend the shelf life of stone fruits. Stone fruits are low-risk commodities but have been linked to multistate foodborne illness outbreaks and product recalls as recently as 2020. Stone fruits are usually waxed to preserve freshness and reduce decay, but fungicides used in edible commercial coatings (waxes) are not active against foodborne pathogens. This project will supplement five commercial coatings for stone fruits with generally-recognized-as-safe food antimicrobials effective against common foodborne pathogens and fungi. The physical, chemical, and antimicrobial properties of various edible coating–antimicrobial formulations will first be established. Selected antimicrobial coating formulations will be applied on yellow peaches and white nectarines inoculated with *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella enterica*, and the survival of these pathogens and native fungi, as well as the quality and decay of the coated fruit, will be evaluated during storage at simulated retail conditions. Effective antimicrobial coatings for stone fruits provide an effective intervention technology, enabling growers to better manage risks. Results of this study will be summarized in project reports and presented at the annual Center for Produce Safety Research Symposium. The project findings will contribute directly to the enhanced microbial safety and extended shelf life of stone fruits.

The Center for Produce Safety *$221,962*

Optimizing Methods for the Detection and Quantification of Infectious Human Norovirus from Fresh Berries Using Human Intestinal Enteroids

The Center for Produce Safety (CPS) will partner with the University of Georgia to optimize the detection of infectious viral pathogens, human norovirus (HuNoV), and hepatitis A virus (HAV), from berries. Berries can become contaminated with these viral pathogens that originate in human feces, leading to gastrointestinal illness outbreaks, chronic health complications, and product recalls. The sources of berry contamination include unhygienic food handlers and contact with unclean water or food-contact surfaces. Detection of viral pathogens in foods is complicated by the low levels present and the low recovery efficiency of current detection methods. Also, detection of these viruses by standard methods relies on detecting pieces of viral RNA but does not provide information on the infectivity of the virus. Recent advances in HuNoV cell culture allow for the detection of infectious noroviruses. This project will harness the latest technology in norovirus cell culture to first optimize the standard extraction and

detection methodology to recover infectious HuNoV and HAV virus from berries, and then fill critical knowledge gaps regarding detection and persistence of these viruses in common types of fresh berries postharvest. Early detection of infectious viruses in berries will provide better protection for consumers and for industry to avoid recalls of contaminated product. Results of this study will be summarized in project reports, presented at the annual CPS Research Symposium, and published in peer-reviewed journals. The outcomes of the project will be an improved detection method for industry and regulators and a better understanding of the risks associated with the presence of viruses on berries.