Grants Program: Center for Produce Safety

Public Partners:
California Department of Food and Agriculture – Specialty Crop Block Grant
University of California, Agriculture and Natural Resources

Industry Partners:
Almond Board of California
Cantaloupe Advisory Board / California Melon Research Board
California Pistachio Research Board
California Walnut Commission
Florida Tomato Committee
Washington Tree Fruit Research Commission

Request for Proposals Deadline: July 1, 2009

Time Period: One year and two year (24 month maximum) proposals will be accepted

Total Funds Available: up to $2,000,000

The Center for Produce Safety (CPS) provides ready-to-use science-based solutions that prevent or minimize produce safety vulnerabilities

OBJECTIVE

Research activities to be sponsored by the Center for Produce Safety (CPS) and partnering entities are to be directed to answering critical research questions that fill the gaps in our basic understanding in specific areas of food safety practices for fruit and vegetable production. The objective is to provide the produce industry with practical, translatable research data that can be used at all levels throughout the supply chain.

GENERAL RESEARCH GUIDANCE

Consumption of fresh fruits and vegetables is a key element in the health and nutrition of people worldwide. The variety of products and year around availability has opened up many exciting new ways for consumers to enjoy fruits and vegetables as never before. Multiple consumer studies have shown that consumption is steadily increasing as consumers have adopted healthier life styles and taken advantage of new fruit and vegetable products that offer year round convenience, unique flavor combinations and nutritional balance. But along with this trend, the produce industry has faced numerous incidents over the last few years where outbreaks of foodborne illness have been traced to the consumption of fruits and vegetables. The produce industry has attempted to meet these food safety challenges with the development of commodity specific food safety programs centered on Good Agricultural Practices (GAPs) at the raw or commodity finished product level and fully integrated processing food safety approaches anchored by HACCP-based programs for packaged products. As food safety guidance documents and standards for an array of commodities have evolved to become more measureable, industry scientists have struggled with a deficit of specific scientific knowledge on which to base metrics. This struggle has been further exacerbated by the ever increasing demand from multiple buying groups to have producers meet various microbial specifications for water, soil, raw and finished products as well as food safety metrics that exceed industry standards without any real science-based direction.

The research activities to be coordinated by the Center for Produce Safety are to be directed to answering critical research questions that fill the gaps in our basic understanding in specific areas of food safety practices for the specialty crop industry. The objective is to provide the produce industry with practical, translatable research data that can be used at all levels throughout the supply chain.

RESEARCH PRIORITIES

Printed on pages 10 through 23 of this document.

TYPICAL GRANT

Awarded grants will not be in an amount larger than $150,000 per year. Two year maximum.

ELIGIBILITY

Any individual or group or legal entity affiliated with a university or governmental agency that has appropriate research capabilities is eligible and is encouraged to submit proposals.

Projects should benefit the specialty crop industry and/or the public rather than a single organization, institution, individual, or commercial product. Single organizations, institutions, and individuals are eligible to participate as project partners.

Note: The following pertains to Specialty Crop Block Grant funds:

- To be eligible for a grant, the project must solely enhance the competitiveness of U.S. or U.S. territory grown specialty crops in either domestic or foreign markets. See the USDA Agriculture Marketing Services website, www.ams.usda.gov/scbgp, for a list of eligible specialty crops and ineligible commodities.

- Eligible non-profit organizations, local, state and federal government entities, for-profit organizations, and universities for projects that aim to enhance the production of and access to California specialty crops.

- Those entities that are non-profit or for profit, if awarded a grant, will be required to provide either verification of their non-profit status or a copy of a valid business license

PROPOSAL FORMAT

Proposals will be evaluated by a review of at least three experts drawn from the CPS Technical Committee, ad hoc reviewers and corresponding Partners In Research, as appropriate. The reviewers will use the following as a guide for evaluation of the proposal.

Scoring

Section of Proposal	Maximum Score for Category
(All Sections required)	
Title Page	0
Layman's Summary of Proposal	0
Proposal Proper (A-I, 10 page maximum):	
A. Technical Abstract	5
B. Background	2
C. Hypothesis	8
D. Statement of Research Objectives	10
E. Experimental Plan & Methods	30
F. Expected Results and Relevance to Produce Industry	15
G. Potential Pitfalls to Accomplishing Objective (s)	2
H. Program Timeline	5
I. Facilities & Equipment Available for the Research	5
Proposal Proper - Additional Information (J-K no page limit):	
J. List of Industry Collaborators or Cooperators and Role	4
K. Literature Cited/Bibliography	0
Additional Documents (separate files):	
Budget and Budget Justification (see notes)	8
List of Relevant Existing or Matching Funds	3
C.V. for PI, Co-PI and Cooperators	3
Letter(s) of intent for Co-PIs	0
Letter(s) of intent for Cooperators	0
Total	100

Note: Requirements for Specialty Crop Grant Funds on Page 5

Proposal – 10 page maximum

The body of the proposal (scoring areas A to J) should not exceed 10 pages; reviewers will be instructed to stop reading after Page 10. Literature cited, budget, relevant existing or matching funding, and CV's are not included in page limit. Use 12 point Times New Roman, 1 inch margins on all sides with pages numbered at the bottom center.

Title page (does not count in 10-page limit) should include:

Project Title
Principal Investigator(s):
Name, Institution affiliation, mailing address, phone number, and e-mail address.
CO-PIs: Name, Institutional affiliation, mailing address, phone number, and e-mail address. Include letter of intent signed by Co-PI(s) specifying role in project objectives.

Cooperator(s): Name, Institutional affiliation, mailing address, phone number, and e-mail address. Include letter of intent signed by cooperator(s) specifying their role in the project objectives and any facility infrastructure or in-kind support**.**

Layman's (Executive) Summary of Proposal (does not count in 10-page limit): In non-technical language, summarize your proposal. Be sure to provide a description of the project, objectives and methods to be employed. Maximum of 200 words.

A. Technical Abstract (5): Maximum 500 words.

B. Background (2): A concise statement of the research need.

C. Hypothesis (8): Clearly state the hypothesis-driven approach that conveys the rational and biological or technological foundation for the proposed research.

D. Statement of Research Objectives (10): Logically arrange and prioritize the objectives.

E. Experimental Plan and Methods (30): For each objective discuss the procedures you propose to employ. Be specific enough to discuss relevant biological strains, experimental design or parameters of data collection, sampling and sample analysis protocols, and anticipated statistical analysis.

F. Expected Results and Relevance to Produce Industry (15): Describe the previous work directly related to objectives that has been done to date and describe the anticipated benefits to near-term food safety solutions for the produce industry. In your discussion please make sure to address how this project will guide more specific and effective risk management practices for the industry.

G. Potential Pitfalls to Accomplishing Objectives(s): Describe the pitfalls that may be anticipated and strategies for overcoming these pitfalls.

H. Project Timeline (7): Clearly delineate the timeframe anticipated to achieve each objective within the total timeframe of the project. Please provide a summary table that states the objective, personnel responsible and the timeline in which the object will be accomplished. (Table will not be counted as part of the 10 page limit).

I. Facilities and Equipment Available for Research (4): Briefly describe the facilities and equipment available to achieve the proposed objectives.

J. List of Industry Collaborators or Cooperators and Role (4):

K. Literature Cited/Bibliography (0)

Budget and Budget Justification (8): Prepare a detailed budget which reflects your needs for the length of the proposed project for up to 12 months or two years. Please see the more detailed description of the Budget Format below.

List of Relevant Pending, Existing or Matching Funds (3): Please note the form provided for this purpose.

CV for PI, Co-PI and Cooperators (3): Include most relevant publications. Maximum of 2 pages for each person.

Letter(s) of intent for Co-PIs (0)

Additional information needed for Specialty Block Grant Funding:

Letter(s) of intent for Cooperators (0)

Note: To be eligible for Specialty Crop Block Grant Funds, the following is needed:

- Statement whether applicant(s) have received SCGP previously.
- Statement on project oversight **Project Oversight**
  Describe the oversight practices that provide sufficient knowledge of grant activities to ensure proper and efficient administration. Who will oversee the project activities? How will oversight be performed? Include timelines.
- **Performance Monitoring Plan**:
  How will performance toward meeting the outcome(s) be monitored?
  - ✓ Define your data sources. Who and where will the data be collected?
  - ✓ How will data be collected?
  - ✓ If using a survey, provide information on the nature of the questions that will be asked, the methodology to be used, and the population to be surveyed.
  - ✓ If a draft questionnaire is available, consider including a copy with the grant proposal solicitation.

  Please include information on a separate page (all three can be on one page if needed). Include with proposal.

SUGGESTIONS FOR A SUCCESSFUL PROPOSAL

- The abstract should offer a concise summation of the proposal to the reviewers. The abstract should conclude with a clear impact statement derived from the anticipated outcomes.
- Review the perspective proposal evaluation guide sheet to gain an understanding of the way the reviewers will be asked to evaluate each proposal. This will give the investigator a road map to what areas of the proposal are most important to the review and ranking process and where to spend the most time in preparation.
- The review process will focus on the scientific merit of the proposed research and the relevance of the proposal to the produce industry as described in the RFP's basic research areas and specific questions.
- It is not necessary for a successful proposal to address each specific question listed in this RFP's research areas. These questions are guidelines as to what the industry has identified as priorities but it is understood that they are broad in scope and may be beyond the reach of a single research proposal.
- The most common criticisms when reviewing research proposals are "vague", "overly ambitious" or "unfocused". Present clear objectives, well founded hypotheses and work plans that address the stated objectives. Clearly address potential pitfalls or experimental

dependencies and how the experimental plan will modulate the occurrence or impact on successful execution of the project plan.

- Provide Letters of Commitment for all aspects of the proposed plan that are dependent on facilities, equipment, and personnel that are not under the PI's direct control. Provide Letter of Collaboration for all aspects of the proposed plan that require access to private land, commercial operations, and commercial information not available through normal public channels.
- A key function of the Center for Produce Safety is to fund research that can be used by growers, harvesters, shippers and processors to solve critical food safety problems, to provide new insights to optimization of processes, or to establish a novel directional basis for future research. Be sure your proposal aims to advance a near-term solution to a specific food safety problem.
- Careful proof reading is essential for professional evaluation of the proposal. In addition to the expectations for professional organizational style, spelling and grammar; give careful attention to correct citations and quality of any imbedded images, figures, or graphs.

PROPOSAL SUBMISSION

- The **complete proposal** is to be uploaded to the CPS Grant Site, https://ucanr.org/cpsgrants, no later than 5:00 pm (Pacific Time) July 1, 2009. Please note body of proposal will have 10 page limit
- **One hardcopy** is to be mailed to the CPS office c/o Bonnie Fernandez, 279 Cousteau Place, Suite 100, Davis, CA 95618. Hardcopy is to be postmarked no later than July 1, 2009
- **Signature pages** should not be included in the proposal. Pages are to be scanned and forwarded by email to CPS (bfernandez@cps.ucdavis.edu) at (530) 757-5717. Signature pages may be submitted separately for each institution, and must be signed by all participating scientists in that institution. The signature page can be downloaded from the website.
- **Disclosure of Additional Fund Resources**, if any, should not be listed in the proposal, but sent directly to CPS (bfernandez@cps.ucdavis.edu). List all existing and pending funding for this research program. Give source and amount of funding, the title of the research, duration of the award and current grant year. PI and Co-PI should use the form provided.

REPORTING

- Mid-year report (2 pages) will be due to the CPS office (email). Format to be provided by CPS.
- All publications must identify CPS and specific funding agency, grant funding will acknowledge both entities.
- All research results will be public information and posted on the CPS.
- Final report will be due 30 days after end of project term. Format to be provided by CPS.
- Funding entity may have additional requirements.
- Specialty Crop Grant Funds:

  Grant recipients will be required to complete Biannual Progress Reports to provide the status of the project, identify milestones, results achieved, success stories, potential concerns, as well as other pertinent information in layman's terms. The Biannual Progress Report will be available in template form. Grant Recipients are expected to provide all information pertinent to their project based on the data available.

AWARD NOTIFICATION

The CPS Executive Director will notify successful applicants after a peer review of all proposals and approval of projects by individual funding entities. Estimated date of announcement: October 1, 2009

PI's awarded grants may be asked for additional forms.

FUNDING PERIOD

October 1, 2009 – December 31, 2011.

CENTER FOR PRODUCE SAFETY CONTACT

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ADDITIONAL INFORMATION

BUDGET

Budget Narrative– Present a separate budget for each institution.

Personnel services – Salaries: PI's and Co-PI's who are paid a salary by their institution, are not entitled to receive salaries from the CPS/ANR grant. Support personnel can receive salaries and benefits proportional to the time devoted to the research project.

- For each non-faculty personnel please provide their title, percent of full time equivalents (FTE), and their corresponding salary for the FTE. For each non-faculty please indicate amount and rate of fringe benefit for each salary.

Non-Expendable equipment: Supplies to conduct project are allowed to be purchased with grant funds. Provide a list of projected supply expenditure and dollar amount for each item.

- Rental costs of special purpose equipment should be included here: list separately each item of equipment, intended use and costs

Travel: Please provide the following information in the narrative : destination; purpose of trip; number of people traveling; number of days traveling; estimated airfare costs; estimated ground transportation costs; estimated lodging and meals costs; estimated mileage costs for the travel.

- Include one trip to present project results to CPS Advisory Board and Technical Committee in Davis

Operating Expense (itemize all expenses): Present general operating expenses and a list of estimated costs. Include supplies and services. Provide a detailed breakdown and justification when requesting substantial funds.

Note: Capital expenditures for general purpose equipment, buildings, and land are unallowable as direct and indirect charges.

If project include outreach component, please itemize mailings, postage, other items as appropriate.

BUDGET FORMAT

Prepare a budget page using the form CPS Form A and a detailed budget narrative, following the instructions for the form. Use a separate sheet for each year. Use a separate sheet for each institution.

• All budget categories for which support is requested must be individually listed (with costs) in the same order as the budget and justified in a budget narrative.

• "Nonexpendable Equipment" and "All Other Direct Costs" categories must be itemized and the cost per item must be provided.

Major Budget Restrictions: Following requirements, award funds cannot be used for:

The renovation or refurbishment of research spaces; the purchase or installation of fixed equipment in such spaces; or for the planning, repair, rehabilitation, acquisition, or construction of a building or facility.

No part of the approved funds may be utilized for tuition remission.

Indirect costs are not allowable and no funds will be approved for this purpose. Further, costs that are a part of the institution's indirect cost pool, (e.g., administrative or clerical salaries), may not be reclassified as direct costs for the purpose of making them allowable.

Requests for nonexpendable equipment or foreign travel will be reviewed by CPS and corresponding funding agency.

All budgets must be approved by CPS and corresponding funding agency. These budgets must be detailed or funding may be delayed or rejected.

EVALUATION

Proposals will be evaluated by a review panel of at least three experts drawn from the CPS Technical Committee and /or adhoc reviewers, as appropriate. A written review of each proposal will be prepared and provided to each PI.

Suggested/Restricted reviewer names: Investigators can submit a short list of potential reviewers for CPS' consideration. Likewise, a brief list of persons to whom the proposal should not be sent for review can be included. In both cases, the list must include specific names (not everyone in the a department or laboratory). The address, including e-mail, of the listed persons must be included. This short list must arrive by the submission date. Send to bfernandez@cps.ucdavis.edu.

INVESTIGATORS

Principal Investigator (PI) is that person whose name appears FIRST on the cover page of the proposal. The PI is mutually agreed upon by the cooperating scientists and is responsible for the submission of scientific reports, administration of the grant, notification of changes in the work plan and maintaining contact with CPS. The affiliated institution of the PI becomes the *principal institution* and signs the research agreement.

Co-principal Investigator (Co-PI) is that person whose name appears SECOND on the cover page of the proposal.

Collaborating Investigators are all other investigators, who are listed on the cover page and are neither PI nor Co-PI

Research Priorities (as mentioned on page 2)

Research priorities have been developed by a variety of industry commodity groups over the last few years. These groups have been largely focused on conducting risk assessments for their respective crops (e.g. tomatoes, leafy greens, tree fruits, melons, berries, watermelons, mushrooms, etc.) and using these assessments to prepare commodity specific food safety guidance and standards. As an output of this process, basic research needs to help guide more specific and effective risk management practices have been identified. The 2009 CPS Request for Proposals (RFP) is actually composed of three project categories:

1. **Core Food Safety Research Needs**. These research areas were identified via produce industry risk assessments and prioritized by the CPS Technical Committee. The subject areas cut across all fruit and vegetables as we endeavor to better understand risk potentials and develop more effective management tools. Prospective researchers may choose any one of these areas to prepare a proposal against. CPS will give priority to proposals focused on commodities that have a demonstrated history of foodborne illnesses associated with them (e.g. tomatoes, leafy greens, leafy herbs, green onions, melons, peppers, etc.) or commodities called out by the CPS Partnership in Research (PIR) collaborators (see below). The following areas of focus have been identified and are detailed in the body of the RFP:

    1.1. Compost, soil amendment and fertilizer use

    1.2. Cultivation practices

    1.3 Leafy Greens Growth and Pathogen Survival

    1.4 Buffer Zones for Domestic Animals

    1.5 Other Animal Risk Factors

    1.6 Irrigation Water Risk Factors

    1.7 Natural "Buffer Zones" Versus Water Quality

    1.8 Vegetable Cooling Methods

    1.9 Risk Assessment and Management Tools

2. **PIR Specific Requests**. The PIR program was developed by CPS to enable trade groups or regional commodity boards to surface specific food safety research needs. Working in partnership with CPS, these groups can contribute their ideas, expertise and financial support and leverage the technical expertise and financial matching capabilities of the CPS to attain critical mass to address industry food safety research needs. In 2009, CPS has included requests from the California Melon Research Board, California Cantaloupe Advisory Board, California Pistachio Research Board, Almond Board of California, California Walnut Commission, Florida

Tomato Committee and the Washington Tree Fruit Research Committee. Please note that, in some cases, these various commodity groups share common needs in terms of food safety research and ***may elect to help fund core research areas*** as well as areas listed specifically in this section.

2.1 Tomato Wash Water Sanitation Practices

2.2 Tomato Re-Packing/Carton Re-Use Risk Management

2.3 Tree Fruit Food Safety Priorities

2.4 Cantaloupe/Melon Food Safety Practices

2.5 Pistachio Food Safety Priorities

2.5.1 Harvest Sanitation

2.5.2 Risk Assessment

2.6 Almond Food Safety Research Priority Areas

2.7 Walnut Research Priorities

3. **Collaborative Research Efforts**. The produce industry has been actively engaged in research and data collection for several years (e.g. raw and finished product testing, irrigation water testing, wash water sanitation validations, food safety auditing, etc.). These data generally reside within individual companies and are often considered to be proprietary. CPS has developed relationships with several private companies that have expressed an interest in working with qualified researches to provide data on a confidential basis. The general objective is to bring scientific discipline to evaluating these data bases and enhance resident information with observational or related input data from growers or processors to identify underlying cause and effect relationships behind the seasonal nature of produce outbreaks, create quantitative risk assessments around irrigation water sources or validate industry-developed sanitation systems for wash water. Prospective Principal Investigators will need to contact CPS prior to submitting a proposal so that they can be matched up with participating companies based on interest. Opportunities are available in the following areas:

3.1 Chemical Stabilization of Chlorine

3.2 Seasonality of Produce-Related Outbreaks and Industry Data-Bases

3.3 California Leafy Green Marketing Agreement Audit Data

Section 1: Core Food Safety Research Needs

1.1 Compost, Soil Amendment and Fertilizer Use. Vegetable growers use an array of organic nitrogen sources (e.g. composted cow, sheep, pig or chicken manure, fish emulsions, bird or bat guano, expended mushroom mulch, super-heated chicken pellets, green mulch, etc.) in both organic and conventional farming operations. Incomplete thermal inactivation of pathogens during composting or related treatments is suspected as a risk factor that can lead to subsequent product contamination.

- Do specific organic composts, used in fruit, vegetable and tree nut commercial operations, represent different levels of contamination risks based on source or treatment method? Does pathogen contamination risk from these composted materials vary by season, compost operation or location?
- Under current industry composting and/or sterilization methods, what is the recovery of live pathogens from these materials?
- Is it possible to create a set of risk coefficients based on compost type (e.g. super-heated, dried pellets versus windrowed compost) and crop (leafy greens or melons with close proximity to soil versus staked tomatoes or apples) that can be used as a guide to help growers manage potential cross contamination risks?
- What are 'd' and 'z' values for pathogen inactivation under current industry composting and/or sterilization methods for various types of compost? How do other composting parameters influence these values? What practical improvements in composting process control or handling practices might result in more consistent inactivation of human pathogens (e.g. such as minimizing cross contamination between incoming raw materials and outgoing composted materials)?
- Some operations use composted materials mixed with water to spur growth or "green-up" a crop prior to harvest. What risks do these practices present? Can live pathogens be recovered from these cocktails within the framework of actual commercial practices, applications, storage practices, etc.? Can live pathogens be recovered from crops treated with these cocktails and for how long after treatment? Is recovery affected by weather conditions post application?
- How does prior induction of stress tolerance or stress adaptation by pathogens influence their ability to survive composting and/or re-contaminate "clean" compost? What environmental factors contribute to re-contamination risks and how might they be controlled?
- How far should a composting operation be from a commercial field to minimize the risk of pathogen transfer?

1.2 Cultivation Practices. Much of our science-based knowledge to define survival or environmental capacities of human pathogens in soil is based on static model systems or non-cultivated land. The produce industry needs a more robust approach to understanding actual pathogen contamination levels in soils in production areas so that the risk of pathogen transference from soil to the crop can be properly understood in risk management terms.

- Are data currently available from academic, regulatory or industry soil testing programs that can help define the frequency of pathogen detection in various soils, growing locations, seasons, etc.? Can this data be collected and analyzed to identify trends and to create risk coefficients?
- How do human pathogens (e.g. *E. coli* O157:H7 and *Salmonella* sp.) and/or attenuated or indicator organisms survive, amplify or diminish in various intensely managed and cultivated soils or growing environments as compared to less cultivated?
- Are there soil preparations, cultivation, rotation, or inter-crop practices that influence human pathogen's survivability, amplification, or decline?

1.3 Leafy Greens Growth Rate and Pathogen Survival. Leafy greens grown in the Salinas Valley and surrounding areas have been implicated in recent *E. coli* O157:H7 illness outbreaks. These outbreaks have generally occurred in the August to September timeframe meaning the crop was grown and harvested in July to early August. The discussion on seasonality and these outbreaks has generally focused on environmental conditions, animal intrusion, and irrigation water quality and on-farm practices that might increase the presence of *E. coli* O157:H7 during this period. Very little consideration has been given to potential physiological changes that might occur in the crops themselves during this particular period of time that might make them more vulnerable to contamination by *E. coli* O157:H7 or other pathogens. For example, we know that spinach is a rapid growth cycle crop. During much of the year, its seed to harvest cycle runs thirty to forty-five days. However, during this July to August timeframe when weather and environmental conditions are nearly perfect for spinach production, that cycle can be as little as twenty to twenty five days. Further, processors know that while the spinach harvested during this period is of superior physical and visual quality, it is more difficult to handle, wash and dry. The leaves tend to bruise, become water soaked and discolor if the process conditions are not fine-tuned to accommodate the raw material. The assumption in the industry has been that the rapidly growing crop does not lay down cuticular waxes or somehow has a different cell structure that renders it more susceptible to injury than during periods of slower growth. These observations open up a different approach to addressing outbreak seasonality, i.e. the crop physiology and structural characteristics might play an important role in supporting the presence of *E. coli* O157:H7 on the surface of some leafy greens.

- What are the differences in the leaf composition and physical structural elements in commercial varieties of spinach and/or lettuce grown under commercial conditions from April to October?
- Looking at a collection of current commercial varieties, do they all show variations in structural and compositional make up over the course of a growing season? How much genotypic or variety variation is there?
- If compositional or structural differences are confirmed, is there anything about these changes that might affect pathogen interaction with the leaf surface, e.g. availability of nutrients, availability of moisture, biofilm establishment, absence of competing microorganisms, etc.?
- If the same varieties that can grow in July and reach maturity in twenty days could be managed to grow more slowly during this timeframe (e.g. limiting water, fertilizer, etc.) would they be less supportive of pathogens on their leaf surfaces?

A successful proposal to research these questions or some subset of these questions would have to include the establishment of a collaborative relationship with a Salinas-area grower who could provide access to samples of leafy green materials throughout a growing season. CPS can help interested researchers establish these contacts if needed.

1.4 *Buffer Zones for Domestic Animals.* Domesticated animals are recognized as a potential reservoir or source of human pathogens (e.g. *E. coli* O157:H7, *Salmonella* sp.) that directly or indirectly results in contamination of fruits and vegetables. Food safety professionals and growers now set “buffer” zones between domesticated animal operations (dairy, feedlot and grazing lands) and crop production without adequate data to help define proper distances for diverse situations. Indeed many buffer zones are based on pesticide residue drift parameters laid out by EPA several years ago. This task is made difficult by a lack of knowledge regarding the movement of pathogens by wind or air currents.

- Can pathogens (e.g. *E. coli* O157:H7 or *Salmonella* sp.) be transferred from animal operations to crops by the wind? How effective is this transfer? At what distance is this transfer efficiency zero?
- Is the transfer impacted by the physiological state of the microorganism?
- Are there other mitigating environmental conditions that make wind transfer more or less likely? Do vegetation or ground cover crops, paved or un-paved roads or other crop plantings impact potential pathogen movement?
- What impact do physical barriers have in mitigating movement of pathogens?
- Can risk coefficients be developed; crop x distance x pathogen x environmental factors?
- Can a tool be developed that food safety professionals could use to measure the likelihood of pathogen transfer (if pathogens were present) in various production environments?

1.5 Other Animal Risk Factors. Preliminary data suggests that certain types of insects may be capable of transferring *E. coli* O157:H7 to leafy greens and some have suggested potential roles for avian, rodent, deer, amphibian or reptilian vectoring for *E. coli* O157:H7 and/or *Salmonella* spp. for leafy greens, tomatoes and melons.

- What is the relative significance of these potential pathogen vectors?
- What is known about the frequency of recovery of human pathogens from these animals?
- What best practices might be employed to control these vectors and thus mitigate risk?
- How does the proximity of domesticated animals influence the assumptions?
- Following harvest of leafy greens, trimmings and un-harvested plants often sit in the field for a period of time before being turned back under the ground in the necessary and beneficial practice to build organic content in the soil and improve aeration. This decaying plant material often draws feeding insects and other animals (e.g. birds, rodents, etc.). Is there an optimal window when soil should be turned under after harvest to minimize insects that could potentially transfer pathogens?

1.6 *Irrigation Water Risk Factors*. Growers use a variety of water sources for field operations and irrigation (e.g. wells, on-farm reservoirs supplied by wells, municipal reservoirs, canals, natural ponds, water reclamation projects, lakes, rivers and springs). Often the choice of water source is driven by availability and sometimes by local water districts or boards.

- What are the risk factors associated with each source of water by source and use?
- What are the transfer coefficients for pathogens by source, concentration and use?
- Can these transfer coefficients be used to model pathogen risk profiles for each type of water source?
- What mitigation steps can be employed to diminish these risks?
- What effect does irrigation delivery method, e.g. drip, flood, sprinkle or furrow irrigation have on pathogen transference?

1.7 Natural "Buffer-Zones" Versus Water Quality. One of the predominate discussions today between suppliers and buyers of produce is the quality of water used for irrigation. Environmental and water conservation groups have suggested that certain practices to create buffer zones to prevent animal intrusion have a negative impact on water quality by eliminating riparian areas that may serve to "filter" water and remove some proportion of any pathogens that may be present. This area of research has been productive for a number of years and perhaps its lessons need to be re-surfaced and translated for the benefit of produce growers and their customers to permit improvements in current food safety practices.

- Can a literature review be assembled focused on the role of riparian areas in microbial ecology? This should include a summary of any data around the impact of buffer zones on water quality changes.
- What are the characteristics of these areas and their impact on the surrounding environment?
- Are there any specific research needs in this area that have not been addressed that might be priorities for future research RFPs?

1.8 *Vegetable Cooling Methods*. Many vegetables are cooled after harvest to preserve quality. Commercial cooling is generally accomplished via vacuum cooling, hydro-vacuum cooling, hydro-cooling or forced air cooling depending on the crop, season and availability of equipment. Because cooling equipment represents a "choke-point" where packed commodities and bulk container raw products for processing all pass through, most risk assessments would identify cooling equipment operation and sanitation as a point where cross contamination could occur and careful management is needed. This is especially relevant in high throughput vacuum or hydrovacuum cooling operations for vegetables, where multiple loads of different commodities from different lots are cooled throughout the day without a sanitation period between loads. The implication is that a single load that might have been contaminated might transfer the pathogen via the spray/reservoir water in the cooling tube to other cooled lots as the day goes on. This becomes more concerning when one considers preliminary reports that vacuum cooling may facilitate internalization of bacteria (if they are present) by infusion. Similarly, when water or ice slurry reservoirs are used to cool products any contamination of the water and/or ice mixtures has the potential to cross contaminate subsequent loads.

- What are the microbial populations found in typical vacuum tube reservoirs, ice slurry machines, hydro-coolers and forced air tunnels? Can risk coefficients be developed for each type of cooling method x commodity x season? What management practices could be employed to reduce these risk coefficients?
- Does infusion occur under actual commercial vacuum cooling conditions? If infusion occurs, does it occur uniformly for all commodities or are some more prone than others?
- What spray water and/or vacuum tube sanitation methods might permit rapid, cost effective sanitation solutions for vacuum tubes? Will these methods be effective enough to manage the potential for cross-load contamination?
- Can gas phase sanitizers, e.g. ClO_2 or O_3 be used within the cooling cycle or as an addition to the cycle to sanitize the equipment?

- Would these sanitizers provide any additional microbial population reductions on the product?
- How much penetration of sanitizer into a full pallet would one expect to see on carton commodities?
- What is the impact of these sanitizers on the cooling equipment?
- Can water filtration systems be used effectively with common cooling systems to reduce microflora in recycled water?

1.9 ***Risk Assessment and Management Tools***. Increasingly, risk assessment and management is being recognized as the central focus in the development of effective food safety programs along the entire produce supply chain. Food safety audits, product and environmental testing, sanitation programs, worker training and other components of food safety programs are important foundational elements to be sure, but each needs to be built around solid, operation-specific risk assessment. However, the task of conducting a risk assessment program for a specific operation and the development of effective risk management practices can be a daunting task. This may be especially true for smaller operators who often feel they do not have the technical sophistication or resources to develop risk-based food safety programs. CPS is specifically seeking a proposal to develop a curriculum that can be used to train food safety professionals and agricultural extension specialists in risk assessment at the farm level and/or in Hazard Analysis Critical Control Point (HACCP) for processors of fruit and vegetable products. This "train the trainer" approach should permit maximum outreach to small to med-sized growers around the country. The successful proposal would be expected to contain a discrete number of training sessions to test and fine tune the training tool and messaging. Collaborations between universities in various areas of the country would also strengthen the proposal and further guarantee national outreach.

<u>Section 2 PIR Specific Requests</u>

2.1 Tomato Wash Water Sanitation Practices. A great deal of work has been undertaken by the tomato industries in Florida and California to establish GAP metrics and associated comprehensive, commodity-specific audit checklists to help producers, handlers, and buyers to better identify and manage potential food safety risks in the production and packing of tomatoes. These standards and quantifiable limits will also serve to better manage the hazards at all points in the supply chain. During development of these control point 'metrics' and limits, several important data gaps have been identified. One of these areas is wash water sanitation including tomato dump tanks and flumes; spray-wash beds, and repack wash lines. This area has been the focus of many previous studies owing to the potential for internalization of decay and spoilage pathogens as well as food-borne pathogens, primarily through the stem scar, when the pulp temperature of the fruit is more than ten degrees warmer than the temperature of the immersion water. Owing to this variable, it is highly important to maintain sufficient sanitizer, particularly in dump tank and flume water, to minimize fruit to fruit and production lot to lot cross-contamination. Past research has demonstrated the potential for rapid uptake of pathogens from inadequately treated water. Attention to multiple factors are needed to manage the microbial population build up as tomatoes are continually passed through the system with varying influxes of dirt and organic materials that chemically react with various disinfectants and reduce performance. While the research database is rich with model system data, many previous studies were conducted at sanitizer doses that exceeded EPA label rates by at least double or were conducted with formulations not approved for use on fresh tomatoes. Furthermore, test conditions for these data do not overlap commercial practices sufficiently to predict outcomes of diverse systems and conditions. Therefore, it remains very difficult to set functional standards of performance in a commercial packing or re-pack operation. This lack of specific information is hampering efforts to set physical, chemical, and microbiological limits, especially for dump tank water quality, in support of GAP metrics development. The aim of this research area would be to conduct short-term, applied research to address these questions:

- What are the water quality measurements that can be used to monitor tomato dump tank efficiency, e.g. turbidity, pH, sanitizer level, temperature, etc.?
- Using these measures, what are the functional limits an operator can use to insure that effective sanitizer concentrations are present in the dump tank? For example, is there a relationship between TSS, turbidity, or conductivity and sanitizer (e.g. chlorine) where the addition of additional chlorine is ill-advised or ineffective and the water needs to be partially or fully changed?
- Are there real time assay techniques that can be used with tomato dump tanks to monitor microbial indicators, generic E. coli levels or APC levels to guide operators on the status of the wash water?
- As indicated, temperature differential between the fruit and the wash water has been identified as a potential food safety risk as water can be drawn into the fruit presumably bringing with it any microorganisms that are present at natural or minor wound openings or to these sites from the wash water. Are monitoring tools that operators can use to accurately assess temperature differentials between fruit and wash tanks needed? What refinements in extrapolating the limits in temperature differential that may cause internalization are needed? Is there a 'safe' residence time frame for dump tanks which obviate the need for the strict 10F degree differential? Are current standards for maintaining these temperature differentials needed for non-immersion wash systems? What are the effects of elevated temperature water on non-chlorine disinfectants?
- Are dump tank and other wash water system management criteria for re-wash and re-pack the same as for incoming raw fruit?

2.2 ***Tomato Repacking/Carton Re-Use Risk Management Practices***. During the 2008 *Salmonella saintpaul* outbreak, the practice of re-using tomato cartons, i.e. tomato cartons that are packed and shipped or transferred from the original packing operation to a re-packer who then sorts the products for color, size and quality and then re-packs them in the original cartons, was called into question by some as a potential cross contamination risk. The worry is that if tomatoes packed in original use of the carton were somehow contaminated with *Salmonella*, then all subsequent tomatoes packed in those same cartons might become contaminated as well thereby enlarging any potential outbreak.

- Can typical outbreak strains of *Salmonella* survive on commercial tomato cartons? Are there temperature, time, moisture, etc. factors that impact survival?
- If *Salmonella* can survive on fiber cartons, what frequency is it found in commercial operations?
- Can a transfer coefficient be developed to help packers and re-packers quantitate this risk?
- What processes could be put in place to manage this potential risk, e.g. some operators use a light chlorine-based sprays, hot water, etc.?

2.3 *Washington Tree Fruit Food Safety Research Priorities*. Compiled by the Northwest Horticultural Council and the Washington Tree Fruit Research Commission, these priorities focus on: (1) assessment of potential microbial contamination risks of tree fruit from field production through harvest, storage, and packing; and, (2) determination of the effectiveness of mitigation steps employed in current fresh tree fruit production. storage, and handling processes.

- Any proposal should include one or more of the following components in a systems approach:
  - Compile public and private food safety best practices, risk assessments and risk management strategies currently employed in WA packing operations
  - Collect and analyze validation procedures and/or data for fresh fruit packing food safety interventions
  - Conduct a baseline survey of microbiological contaminants at receiving, during storage, and prior to shipment
  - Investigate microbiological contamination of water used for irrigation and/or overhead cooling and any impact on microbial contamination of fruit in the field

2.4 *Cantaloupe/Melon Food Safety Priorities.* Melons, specifically imported cantaloupe melons have been associated with *Salmonella* outbreaks in recent years. This has led to multiple product testing requirements from the buying community, e.g. testing imported melons from Honduras, Costa Rica, Mexico or Guatemala for Salmonella cultivars and testing domestically produced melons prior to export to Pacific-Rim markets. The California Cantaloupe Advisory Board and the California Melon Research Board request a project to help their members better understand the scope and limits of the testing procedures their industry is experiencing. This project may take the form of a "white paper" and should include:

- What types of testing kits are currently in use in various national and international markets and/or ports of entry? Are these specific for melons or are they applied to other commodities?
- What are the limits of detection for these various kits? How accurate are these test kits? What is there specificity?
- What are the procedures commonly practiced when a test is positive for a pathogen? Are verification procedures commonly practiced? What is the frequency of positive tests from

the initial screening (generally PCR-based but others as well) that do not confirm (e.g. BAM plating methods)? Can a decision tree be constructed to guide growers, shippers, importers and receivers on what to do when positive and negative tests are performed?

- What sampling protocols are typically used and what is the significance of the sampling procedure, i.e. degree of confidence that if a positive sample is present, it will be detected?

2.5 *Pistachio Food Safety Priorities* – The pistachio industry has entered into Partners *in Research* collaboration with CPS to promote the elicitation of research proposals on key areas impacting pistachio product safety. Specifically, the Pistachio Board has identified the following:

2.5.1 *Harvest Sanitation*. It is unclear what the frequency and level of *Salmonella* and other foodborne pathogen contamination might be on pistachios as they go through the harvest process.

- What is this frequency***?*** Are there any management practices that could be reasonable employed to diminish contamination levels?
- After pistachios are harvested, the hulling, floating, rinsing, and drying activities that must take place before pistachios are stabilized as a raw agricultural commodity may represent risks for contamination and opportunities to manage contamination. As an example, one might consider the risk for pathogen contamination in the float tanks and the opportunity to manage this risk by using antimicrobials in the float and rinse water. Similarly, effect of various drying regimes on microbial populations needs to be better understood in pistachios. What float tank and rinse water practices can be used to minimize *Salmonella* contamination? What sanitizers and their range of concentrations are effective in commercial applications? How do current practices for drying impact Salmonella? Are their minimum heat and duration requirements that can be implemented to eliminate Salmonella?

2.5.2 Risk Assessment. The Pistachio Board would like a project to focus on conducting a risk assessment for pistachio production. It is expected that this risk assessment would help the industry identify potential contamination risks and help set priorities for their management in terms of resources, microbial testing, etc. The Pistachio Board would also like to see this risk assessment compared and contrasted to other tree nut risk assessments, e.g. the Almond program to identify practices that have been successful with that commodity. Are there similarities that could lead to a general tree nut food safety program? Are there data available from other tree nut programs that might guide the risk assessment for pistachios?

2.6 *Almond Food Safety Research Priority Areas* – Almonds have been implicated in two separate *Salmonella* outbreaks over the last several years. The Almond Board of California has established a Partner in Research (PIR) program with CPS to address key research areas to help the industry better define management practices to address contamination risks. The Almond Board has already invested in a significant amount of preliminary research that has quantified the prevalence of *Salmonella* throughout the almond growing region. It was determined that *Salmonella* is present in up to 1-2% of the almond samples taken throughout the California growing area. The "perfect storm" which led to the two outbreaks is not well understood. In particular, it is not known what production or environmental conditions might have favored survival, growth and proliferation of *Salmonella* in the orchards. Similarly, the vectors for *Salmonella* transference in almonds are not defined nor are suspected mitigating factors such as cultural practices (e.g. tree planting density, canopies density, irrigation methods, etc.). The industry is faced with a number of questions for consideration by researchers:

- What is the impact on *Salmonella* of moisture reduction achieved during thermal processing of almonds?
- Are there differences in heat sensitivity among different *Salmonella* strains found in commercially grown almonds?
- The Almond Board has funded some research to identify dry roasting time and temperature parameters for eliminating *Salmonella* on almonds. However, many dry roaster operators use higher temperatures or utilize forced air and do not necessarily fit into the prescribed time/temperature profile. Can surrogate microorganisms be used to better define dry roasting parameters to cover the spectrum of roasting operations that comprise the industry?
- The Almond Board has stated a need for an evaluation of current sanitation practices in nut-processing facilities (hulling facilities, etc.) and the development of sanitation guidelines processors could use to develop their own internal programs for sanitation (sanitizers to be employed, best practices for cleaning, verification methods, master sanitation schedules, SSOP formats and examples, cleaning and sanitation frequencies, record keeping, etc.). The Almond Board is seeking a researcher and/or extension specialist to work with processors to carry out this task with an expected output of a risk-based, written sanitation guideline and outreach training for processors.

2.7 *Walnut Research Priorities*. The California Walnut Commission (CWC) is seeking to take a leadership role in developing a program to educate the walnut supply chain as it pertains to product handling and safety, and is seeking proposals that address the following:

- Comprehensive training program to include, but not limited to: Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP), Homeland Security (HMLS), Product Protection and Defense and Safety and Hazard Analysis and Critical Control Point practices for walnut growers and processors.
- Identify how best to implement education/training for employees, disseminating information to every level of the various stakeholders to ensure their knowledge, understanding and role in the food/supply chain process, right down to the day to day nuances of their job that contribute, not only to the safety of walnut industry, but California agriculture at large.
- Enhance traceability – Establish training for the plant management and employees to ensure traceability of all products sent into the consumer market.
- Define educational materials to support industry-wide training programs.

- Where appropriate, the program should include resources of the FDA, USDA, County Farm Advisors and University of California Davis, Cooperative Extension will be utilized to ensure consistent and thorough information to all stakeholders.

Section 3 Collaborative Research Efforts

3.1 *Chemical stabilization of Chlorine*. Many fruit and vegetable products are washed prior to packing. In general, the produce industry employs wash tanks and flumes singly or in series to remove surface soil or other contaminants. To keep the wash water from accumulating high levels of microorganisms that may "wash-off" the produce, wash water sanitizers, pH control and management of organic material load are commonly applied flume water management techniques. Of the sanitizers employed in wash water sanitation, chlorine, i.e. sodium hypochlorite is most commonly used. It has been widely reported that well managed wash water sanitizer systems, filtration units and other processing aids may also reduce the microbial populations on the surface of the fruit or vegetable by 1-1.5 logs. However some of the most widely used water sanitizers are highly impacted by dirt debris and excessive organic material. This is a significant issue in shred products like iceberg and cabbage where maintenance of any level of antimicrobial activity can be a challenge. More recently, industry scientists from a large processor have been working on chemical mechanisms to increase the stability and enhance the effectiveness of specific wash water sanitation systems. Preliminary data show these chemistries (F86-128), using cost-effective, GRAS materials to stabilize hypochlorous acid, effectively control microbial populations in wash water and reduce surface populations by greater than 2 logs ***under commercial wash conditions***. The CPS can facilitate collaboration between these industry scientists and prospective research groups to validate and extend the scope of their preliminary studies:

- How does the adjuvant F86-128 in combined use with hypochlorous acid compare to other common (hypochlorous acid, etc) wash water sanitizers in the presence of high organic loads?
  - ✓ Enhanced maintenance of the active antimicrobial in solution
  - ✓ Ability to maintain microbial control of the wash solution
  - ✓ Prevention of leaf to leaf cross-contamination
- The F86-128 chemistry has been tested extensively with leafy greens. At what level of organic material, pH or temperature does the enhanced stabilization of hypochlorous acid by F86-128 breakdown?
- Is F86-128 effective in wash systems designed for other vegetables and fruits?

The makers of F86-128 will provide supplies of: F86-128 or other proprietary formulations as needed, produce raw materials, access to process wash equipment if needed, dirty wash water as needed and any materials or practical access that would benefit the project (within reason).

3.2 *Seasonality of Produce-Related Outbreaks and Industry Data-bases*. In general, there seems to be a seasonal element to recent foodborne illness outbreaks associated with various produce items. For the most part, foodborne illness outbreaks associated with leafy greens from California have occurred with crops grown and harvested in the late summer i.e. late July through mid-September. Similarly, *Salmonella* outbreaks associated with tomatoes seem to arise in early to mid-summer and *Salmonella* contaminations in cantaloupe melons most commonly occur in the spring. In the last few years, many leafy greens producers and tomato growers have been conducting pre-harvest raw product testing for *E. coli* O157H:7 and *Salmonella* spp. Many of these corporate data bases are quite extensive, containing several thousand data points. CPS will work with interested investigators (with the demonstrated experience in evaluating large microbial data bases and assessing field level contamination risk factors) to set up collaborations with specific growers or processors that have testing data. The objective is to explore this issue of seasonality and disease outbreaks. A number of questions can be posed:

- Are there any significant animal or bird population migratory patterns that intersect this timeframe?
- Are there any geospatial or topographical features in areas that have yielded positive test results versus those that have not during the same time periods?
- Tomatoes and leafy greens productions move with the seasons. Is there anything we can identify based on the characteristics or risk factors for various production regions that might point to observed seasonality?
- Are there any differences in irrigation water sources or methods of application between fields that have yielded positive tests and those that have not over the course of regional growing seasons?
- Are there any distinguishing features (compost/fertilizer use, soil amendment applications, cropping history, adjacent field treatments or crop use, etc.) between fields that have produced samples that test positive for pathogens and those that do not in this July to September timeframe?
- Can any specific climatological factors be correlated to the late July to mid-September time period that might explain the increased frequency of detection of positive samples on leafy greens during this time versus the same locations at other times of the growing season?
- Are there specific screening test methods that have been proven to identify culture-confirmed positives in leafy green and, if so, are there data to support new approaches to validate new or existing statistical sampling plans?
- What activities are generally occurring during these timeframes that might increase the likelihood of pathogen presence or transfer?

3.3 *California Leafy Greens Marketing Agreement Audit Data*. The California Leafy Greens Marketing Agreement (LGMA) has been operational since 2007. During that time, the California Department of Food and Agriculture (CDFA) has been conducting on-farm audits according to the checklist developed by the industry, CDFA and USDA from the LGMA GAP Metrics. The data from these audits are collected and stored electronically. This audit data represents an exciting opportunity to identify specific areas of risk management where growers typically do well or conversely, struggle to comply. The CPS can facilitate a collaboration between a qualified researcher and the LGMA to mine this data base (while preserving grower confidentiality) to answer the questions listed below. The outcome of this research project is expected to be region-specific grower/handler outreach or educational programs sponsored by LGMA and CDFA to improve handler compliance and specific recommendations to assist LGMA and CDFA in the refinement of the GAP Metrics and audit documentation.

- What are the simple metrics or frequencies of compliance by question?
- What questions and/or observations on the LGMA audit are most frequently found to be out of compliance?   Can this list of "most frequently missed questions" be dissected by region, season, grower size, relevance to the safety of the product, etc.?
- Do any patterns emerge that might instruct LGMA and CDFA in the development of training tools for grower/handlers to address these deficiencies? When these areas are found to be deficient, is there any commonality in what the grower/handlers are doing?
- When questions or areas are found to be out of compliance, what corrective measures are put in place? How do these compare by area? Are there any similarities in the solutions handlers use to correct deficiencies? What aspects of these corrective actions could be made available to growers to improve their performance?

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