GRANTS PROGRAM: CENTER FOR PRODUCE SAFETY

2021 RFP Research Priorities Summary – September 10, 2020

The Center for Produce Safety prioritizes research programs that support the development of solutions for critical industry produce safety needs across the entire supply chain. For the 2021 Request for Proposals (RFP), CPS has focused research questions on specific, anticipated data outcomes with high potential for industry adoption.

To successfully fulfill the expectations for funding by CPS partners, CPS encourages principal investigators to secure committed industry collaborators to align these priorities with research objectives that clearly assess, anticipate, and fulfill the outcome goals.

Produce safety research priorities were identified after solicitation of input from the produce industry, government agencies and academic stakeholders. In addition, reviews of previously funded CPS grants and research outcomes were utilized to identify broad fundamental and practice-specific knowledge gaps. Lastly, research priorities have been reviewed by the CPS Technical Committee to assemble this 2021 RFP. Applicants should note the following:

- Research projects that identify broadly adaptive and translational *solutions* are strongly preferred and encouraged. Proposals that further define a well-recognized hazard, are spin-offs of prior research, or largely assess a known risk factor limited to a single region or commodity are a much lower priority.
- CPS prioritizes funding for short-term, applied, practical, and knowledge gap–filling projects with direct application to industry practices. Some CPS research funds also are allocated to longer-term fundamental research to better inform the research community and public health agencies, and to proof-of-concept projects exploring novel solutions of broad interest to the industry and business solutions developers and with high adoptive potential. Research objectives should define the practical outcome opportunity and consider time constraints and recognized pitfalls for commercial applications (e.g., regulatory approval, cost to register products or devices, interference with other practices, worker occupational safety).
- Preference is given to research teams that have, or can establish, committed and participatory collaborations with industry members.
- For 2021, the research priorities provide the focal point for program needs but do not rule out other topics within the broadest context of produce safety. CPS is open to suggestions outside the scope of this RFP, if the researcher can make a compelling case that there is an urgent industry need and *proposed practical and economically viable solution or resolution of public health or other regulatory guidance or policy*.

The CPS 2021 RFP research priorities are listed below and guidance is provided on the following pages.

Coordinated Research Priorities

1. Agricultural Water

Other Research Priorities

1. Growing
    a. *Cyclospora* control
    b. *Cyclospora* transfer
    c. Co-existence with animal agriculture
    d. Pathogen die-off rates
2. Harvest
    a. Pathogen cross contamination
    b. Pathogen risk increase during pre-processing time delays
    c. Harvest bins and containers
3. Packing, Cooling and Storage
    a. Cleaning and sanitation in “dry” vs “wet” operations
    b. Cross contamination in “dry” operations
    c. Onion best practices
4. Organic Disinfection and Sanitation

Coordinated Research Priorities - Contact CPS for specific details, will be covered during webinar on 9.22.2020

1. Agricultural Water

   This priority area is designed to solicit proposals that will substantially improve and establish a broad public database of ag-water quality management. The leading priority is ag-water corrective measures and routine treatment validation, verification, and monitoring, which define the optimal, consensus Best Practices for minimizing the risk of preharvest water as a source of product contamination. Multiple regional awards are anticipated, which will require the PI to participate in a standardization process across all awards, conduct on-farm studies with commercial-scale equipment, follow a collaboratively developed and coordinated baseline standard set of protocols, methodologies, and operational standards for water constituent analysis and quality parameter measurements to ensure comparability and opportunities for resulting aggregated data and associated metadata to be integrated into anonymized predictive modeling.

   Additional factors that could be integrated into the proposal may include:

   i. Defining and illuminating critical components of system design, management, and dose definition to meet current industry performance criteria and, potentially, proposed Food Safety Modernization Act (FSMA) Produce Safety Rule (PSR) standards and metrics for ag water, if available during pre-proposal preparation.
   ii. Validity of large-sample volume (e.g., 100 L by filtration) assessment of wells, aquifers, and surface to groundwater sub-surface connectivity to define conditions and factors that alter the assumption of inherent safe water quality based on absence of indicators, using 100-ml or 1-L samples or single sample pathogen absence of detection
   iii. Impacts of commonly used antimicrobial water treatments on crop phytotoxicity to second-cut or rotational crop, soil properties, soil microbiome, disinfection-by-product (DBP) accumulation, and DBP uptake into the edible portion of the harvested crop.
   iv. Critical timing of antimicrobial treatment in risk reduction of contamination of the irrigated crops, which may occur during the interval between overhead system operational start-up and the timepoint at which the operational dose is distributed throughout the system or delayed due to application of antimicrobial-incompatible fertigation treatment practices
   v. Conducting validation studies on labeled formulation or novel chemistries within the format and specific procedures of the Environmental Protection Agency (EPA) Revised Protocol for Label Amendment or new chemistry registration
   vi. Optimizing challenge inoculum (e.g., stress adapted and stabilized with organic: soil aggregate particulates capable of passing through a granular composite or sand filter system) for validation and on-farm establishment and verification studies across diverse water quality constituent qualities

Other Research Priorities

1. Growing
   a. ***Cyclospora* control**: Previous and on-going CPS research continues to assess the prevalence, persistence and transference of *Cyclospora* to produce during production. We seek research aimed at excluding or otherwise **controlling** this parasite. What are the most effective chemical and physical methods to reduce or eliminate *Cyclospora* in agricultural water sources (i.e., not replicating existing primary wastewater treatment strategies), soil reservoirs, and/or other nonhuman sources impacting vectoring or transference to the produce growing environment? Under what real-life conditions and temporal parameters do the mature oocysts become infective or "die off"? What interventions – biological, chemical, physical or social* – might be employed to reduce or eliminate infectivity on the produce or during harvest (spray applications, treatments, etc.)?
   *** Pre-proposals that include human subject involvement and social components must include evidence for prior Institutional Review Board according to US federal requirements** (45 CFR 46 102.f)

b. ***Cyclospora* transfer**: Many regionally localized acres of fruit and vegetable production in the U.S. are watered by seepage irrigation, which is a process of physically bringing up the water table for access by the plant root zone. This irrigation management practice, though sharing some similarities, is distinct from dry land farming of certain specialty crops, such as melons. As in well-managed sub-surface drip irrigation, no water should touch any above-ground edible part of the plant in properly leveled fields. However, in practice, direct contact does happen in various specific applications and management conditions. Regrettably, limited data exists to verify the presumptive efficacy of physical soil impedance and adsorption associated with seepage irrigation to prevent horizontal and vertical transport of waterborne oocysts. Scientific papers on water filtration through the soil indicate that particles the size of bacteria and parasites should be removed by passage through a column of cultivated soil. We seek field research indicating the soil texture, aggregate structure, water capillarity, and preferential flow dynamic conditions that facilitate or inhibit the transference of *Cyclospora* under seepage irrigation conditions.

   A proof of concept of seepage efficacy could initially be determined in a combined laboratory/macro-scale lysimeter setting (or similar research quality soil research unit) with relevant sand to peat/muck soil types. Proposals must include extending these mesocosm studies in subsequent and more extensive on-farm field research within the overall objectives. Objectives are encouraged to include a systems approach that minimizes all mechanisms of transference from a contaminated body of water adjacent to a production field.

c. **Co-existence with animal agriculture**: Recognizing that a variety of factors will influence the risk of contamination of fresh produce grown in proximity to animals, we seek research (field-based data to support predictive modeling) that evaluates the conditions for short-range and long-range transport under which pathogen-associated particulates (e.g., PM 2.5 to 25) may be dispersed and deposited on crops, surfaces, and water sources. In 2019, CPS presented three awards for biomarker tools. The development and use of these or similar rapid, real-time platforms or kits in field studies is a priority. Field-based research should include multiple locations, surveying a radius or justified set of vectors around various animal operations (beef, dairy, swine, poultry), manure and compost handling operations, or non-point source wildlife habitat for the prevalence of predictive indicators or pathogen-specific markers at varying distances from the animal source. If viable recovery is proposed, all isolates must be subjected to whole genome sequencing (WGS) for comparison to an identified or selected focal point or non-point source, and to track movement of target microorganisms. These data, along with relevant metadata (e.g., weather data preceding each sampling; wind direction and speed; conditions where the animals are kept, and concentrations of animals; presence of natural or man-made wind blocks and effects on altering particulate dispersion and settling distances; presence of insects, birds or other animals that can vector pathogens), can help field-validate whether rapid detection will help growers make informed decisions about co-existence with animal agriculture.

   Research may be conducted on dedicated research farms or experimental field locations, but proposals must include research objectives conducted with industry cooperator participation. Sites must be selected within production locations and an extended and defined perimeter of risk-relevant adjacent land uses and features.

d. **Pathogen die-off rates:** Build upon existing research to determine die-off rates of pathogens of concern on fruit surfaces in various orchard/field conditions. Die-off rates on tree fruit have been studied in several systems and regional locations and using various pathogen surrogates or indicators. The available scientific evidence is that the process of net survival and die-off kinetics is highly variable and subject to wide influence by many factors including orchard topography, microclimate, variety, crop inputs, and orchard management (e.g. stand density, trellising, foliar sprays). The justification, rationale, and detailed description of proposal objectives needs to have a central risk-based focus and clearly defined

over-arching research question with a significant anticipated translational relevance to risk management and practical interventions.

2. Harvest
    a. **Pathogen cross contamination**: What are the science-based strategies for cleaning and sanitation across a cross-section of harvest and field-pack equipment associated with multiple specialty crops during and between harvest days, including field to field movement, which would be practical yet effective in preventing cross contamination? We seek a protocol to assess harvest equipment risk points based on design or in-use operations, as well as how these risk points can help drive the frequency of periodic deep cleaning and/or equipment maintenance. This could include research to investigate how various harvest equipment materials and cleaning practices contribute to or mitigate cross contamination, as well as understanding of potential pathogen transfer coefficients, to help with understanding "when to clean" and lot management decisions. Objectives may include developing a risk assessment tool or template to differentiate contamination from the crop vs contamination from the equipment in multiple harvest sequences of between fields and crops.
    b. **Pathogen risk increase during pre-processing time delays**: There is a body of associative evidence that product lots or sub-lots that test "negative" prior to harvest may test "positive" at subsequent points in the supply chain or be more frequently implicated in outbreaks. There have been similar hypotheses that product (particularly leafy greens) transported to another part of the country prior to processing may be more likely to be associated with illness compared with lot-related product that is processed shortly after harvest. This associative evidence, discussed by the industry, forms the foundation for this priority and approach as part of a broad effort to characterize and explain the frequently observed, regionally limited distribution of illnesses, which is puzzling given the much broader distribution of products linked and highly related to the implicated lots. There are ample existing studies that demonstrate pathogen growth as a function of time and temperature, therefore, proposals to study pathogen growth at sub-optimal or abusive temperatures will *not* be considered. Instead, we seek research that examines if and how a given population of pathogens may adapt, resulting in increased likelihood of detection (using common industry methods), increased infectivity and/or increased virulence. Proposals should define a balanced approach, including fundamental approaches in acute non-lethal stress responses among bacterial pathogens, temporal aspects of gene regulation and expression in resuscitation, microbial physiology, and transcriptomics/proteomics (e.g., stimulation and impact of stress response factors) with a diversity of harvest practices, cut-to-cool temporal aspects, postharvest cooling practices and atmospheres, pre-processing handling, transportation, and product categories/commodities.
    c. **Harvest bins and containers**: We seek proposals to evaluate existing processes to clean and sanitize bins and picker bags, as well as investigate new approaches that are commercially workable and economically feasible. (Partner: Northwest Tree Fruit Industry)

3. Packing, Cooling and Storage
    a. **Cleaning and sanitation in "dry" vs "wet" operations**: The diversity of produce handling practices means that some items are packed in dry environments while other commodities are packed in wet environments. Similarly, cleaning and sanitation activities differ greatly depending if it is a dry or wet environment. Dry packing environments may or may not use wet cleaning and sanitation, whereas wet environments typically execute wet cleaning and sanitation. *Listeria* has generally been the target of environmental monitoring programs in "wet" operations. The risks of environmental contamination from *Salmonella* are not well studied. This research will help the industry evaluate the need for and value of performing environmental monitoring for *Listeria* and *Salmonella* in raw agricultural commodity packinghouses.
        i. We seek input on the effectiveness of "dry clean" practices on pathogen reduction to inform the establishment of a "clean break" in a dry environment.

ii. We seek research that assesses the prevalence of *Salmonella* in packing operations (e.g., zones 2, 3 and/or 4), including packinghouses that are wet cleaned and dry cleaned.

b. **Cross contamination in "dry" operations**: Facilities that are "wet cleaned" often use sanitation to establish a "clean break". Some packing operations are dry cleaned. The produce industry would like to understand the risk of cross contamination in operations that solely dry pack and dry clean. Transfer coefficients for different type materials as well as different commodities (that are commonly dry packed) are sought.

c. **Onion best practices**: There is a need for a comprehensive assessment of differences in onion industry harvesting and storage practices, and an examination of their impact on pathogen survival, with consideration of varietal and seasonal effects. The assessment should include postharvest handling practices, notably storage, packaging, and distribution and their impact on pathogen survival. Proposals must include a minimum of two industry partners.

4. Organic Sanitation and Disinfection

There is a need to determine the efficacy of commercially available and allowed sanitation and disinfection products for use under certified organic management systems to reduce human pathogens in packinghouses. This priority seeks to expand the limited performance database on the specific formulations Approved or under Restricted Use approvals under the National Organic Program (NOP) and recognized by the National Organic Standards Board (NOSB). Several commercial EPA-registered formulations for cleaning, sanitation, and disinfection are currently allowed under NOSB and OMRI programs, for which there is a substantial body of scientific and practical knowledge. However, this priority was identified by the industry with greatest emphasis for efficacy data and novel alternatives around the "dry side" of the packing line. Many sanitizers are currently available that are approved for use in organic production, but they require an intervening post-treatment potable rinse step to remove cleaner or sanitizer residues. We seek practical solutions supported by scientifically valid data to support industry best practices for keeping the dry side and dry handling equipment dry. Objectives with novel interventions intended for use under organic management must include consideration of their regulatory status and distribution marketing and technical support business plans disclosed.

Please check the Center for Produce website, www.centerforproducesafety.org for research priority updates