

CPS Research Symposium 2018

Charlotte Marriott City Center • Charlotte, North Carolina
June 19-20, 2018



cps CENTER *for* PRODUCE SAFETY

www.centerforproducesafety.org

Welcome



Dear Friends,

Greetings and welcome to Charlotte! We're thrilled to be hosting CPS' 9th annual Research Symposium here in North Carolina and trust you'll find a warm, welcoming community ... brimming with lots of rich Southern traditions, now juxtaposed with progressive centers of excellence in the financial, technology, research, and agricultural arenas.

If you've attended one (or all) of the 8 previous symposia, welcome back. And if you're a first-timer, I'm sure you'll quickly discover why this event is so popular – and critical – to the vast produce community.

The conversations – and the opportunities to learn from one another – are the essence of what makes CPS such a wonderful convener of collaborative, like-minded people ... focused on enhancing produce safety for everyone.

So, thank you to the Center for Produce Safety for providing the vision and the vehicle to lead in this space ... and to the research community for providing the rest of us with science-based tools that we can employ as we work to minimize the risks in the production and distribution of our products.

Over the coming days, I look forward to thought-provoking presentations and engaging dialogue; and I hope y'all enjoy your time in the Queen City!

Sincerely,

John Oxford

President & CEO, L&M



On behalf of the Center for Produce Safety, I'd like to welcome you to the 9th Annual CPS Research Symposium. We are pleased to enjoy a very high level of interest from attendees, which we attribute to the talented scientists and esteemed moderators and panelists being featured this year. We are grateful they have decided to dedicate so much time to creating an informative and compelling symposium.

New this year is the *Meet the Scientist* program, an area dedicated for event participants to visit with research scientists about their projects and the expertise these individuals bring to CPS. Please ask all of the CPS-funded scientists about the students working on these projects. These students are being educated in the science of food safety while learning about the fresh produce industry. A number of these students are attending the symposium and ready to meet you. Who knows, you may be meeting a future research scientist or VP of Food Safety for your business.

I want to thank our generous sponsors for their support in helping us with our mission to enhance produce safety for everyone. Your input and questions about CPS research are welcome. Please share your ideas with the CPS Board of Directors, members of the CPS Technical Committee or contact me directly. Thank you for spending time with us.

Sincerely,

Bonnie Fernandez-Fenaroli

Executive Director, Center for Produce Safety

CPS CENTER for PRODUCE SAFETY *About Center for Produce Safety (CPS)*

The Center for Produce Safety (CPS) is a 501(c)(3), U.S. tax-exempt, charitable organization focused exclusively on providing the produce industry and government with open access to the actionable information needed to continually enhance the safety of produce.

Chairman's Welcome



A Chinese proverb states: The best time to plant a tree was twenty years ago. The second best time is now.

So too is it with food safety research – we're discovering things that we wish we knew twenty years ago but are just now learning, such as the importance of knowing our water sources and pathogen transference. But ... this is the best time to conduct further research and share those results with the industry.

As we go to press, the five deaths and number of illnesses attributed to romaine exceed the numbers from spinach in 2006. How can this happen, when we know so much more? The answer is we don't have all the answers, and further research and action are needed on produce safety! And that's why you're here, and why we've assembled the world's best researchers and scientists in Charlotte – to talk about what we've learned, and prioritize what we don't yet know.

The Center for Produce Safety is the only organization that has proven capable of finding the right people, identifying research priorities, and funding that research. And it's because people like you have made produce safety a priority that we have been so successful these last ten years. You can continue to be of value by encouraging others to engage with CPS, and sharing information with others in the industry. As an industry we are only as strong as our weakest link, and as we have seen again with romaine, we are all in this together.

Let's commit to leaving Charlotte with the resolve to further CPS' work, and be an integral part of the solution to providing ever safer products to our customers.

Timothy York
Chair, Markon Cooperative



2017 CPS Research Symposium, Denver

Agenda at a Glance

Tuesday, June 19, 2018

7:15 am – 8:15 am

Registration, Continental BREAKFAST, Poster Session

8:15 am – 8:30 am

Welcome – Bonnie Fernandez-Fenaroli

Bonnie Fernandez-Fenaroli, Executive Director, Center for Produce Safety

8:30 am – 9:15 am

Getting Up to Speed and What to Expect

It has been a year since we last met to discuss the latest results from CPS-funded produce safety research programs. Since produce safety is a continuous improvement process, we will start by reviewing some of the key outcomes from the 2017 CPS Symposium and set the stage for the important learnings that will emerge from the 2018 Symposium. Learn what to listen for and how the lessons from this year's research builds upon previous findings.

Speaker: Bob Whitaker, Produce Marketing Association

9:15 am – 9:45 am

Lightning Round Session – Learn What Lies Ahead in CPS Research

Lightning Rounds are an opportunity for CPS stakeholders to preview research programs that are in their initial stage of development. These programs were awarded in 2017, meaning they just got started on January 1, 2018. Hear about the research objectives, preliminary findings and where the research is headed next.

Preservation of stone fruits by spray application of edible coatings with antimicrobial properties. **Kay Cooksey**, Clemson University

Identifying optimal methods of recovering bacteria from food processing plants for downstream microbiome analyses. **Edward Dudley**, Penn State University

Engineering and ecological approaches reduce Pacific tree frog intrusion into leafy green agriculture. **Michelle Green**, University of Illinois

FSMA agricultural-water die-off compliance provisions benefit from condition-specific modifiers. **Renata Ivanek**, Cornell University

The effects of storage conditions and the microbiome of non-traditional salad ingredients on the fate of *Listeria monocytogenes*. **Amanda Lathrop**, California Polytechnic State University

Moderator: Rusbelina Silva, 4Earth Farms

9:45 am – 10:15 am

BREAK

10:15 am – 11:45 am

Research Session – Agricultural Water

The safety of agricultural water (irrigation and wash water) has long been a produce safety priority. This session will focus on four CPS-funded research

Agenda at a Glance

programs to help stakeholders better understand the various risk factors associated with open water sources and management practices that can be leveraged to minimize those risks.

Microbial food safety risks of reusing tail water for leafy green production. **Michael Cahn**, University of California, Davis

Cyclospora: Potential reservoirs and occurrence in irrigation waters. **Gerardo Lopez**, University of Arizona

Remotely-sensed and field-collected hydrological, landscape and weather data can predict the quality of surface water used for produce production. **Martin Wiedmann**, Cornell University

Establishment of operating standards for produce wash systems through the identification of specific metrics and test methods. **Ana Allende**, CEBAS-CSIC, Spain

Moderator: **Suresh DeCosta**, Lipman Produce

Panelists: **Samir Assar**, U.S. Food and Drug Administration

Sharan Lanini, Pacific International Marketing

Bob Ziel, J&J Family of Farms

11:45 am – 1:15 pm

LUNCH

1:15 pm – 2:00 pm

Leafy Greens–Associated Illness Outbreaks: Lessons for the Future?

Illness outbreaks have been associated with leafy greens over the last decade. Interestingly, these outbreaks have a number of similarities that may hold the key to preventing future illness outbreaks. This session will feature a compilation of data developed by CDC around these previous outbreaks and a discussion between CDC, FDA CORE and industry leaders targeted toward understanding the lessons previous outbreak investigations have yielded and how these lessons can be leveraged to prevent future outbreaks and identify novel research needs.

Moderator: **Bob Whitaker**, Produce Marketing Association

Panelists: **Kari Irvin**, U.S. Food and Drug Administration, CORE

Kate Marshall, Centers for Disease Control and Prevention

Jennifer McEntire, United Fresh Produce Association

Gurmail Mudahar, Tanimura & Antle

2:00 pm – 2:30 pm

Lightning Round Session – Learn What Lies Ahead in CPS Research

Rechargeable antimicrobial and antifouling plastics for improved cleaning and sanitation of plastic bins and totes. **Nitin Nitin**, University of California, Davis

UA Ag Water app-language expansion and practical grower-inspired improvements. **Channah Rock**, University of Arizona

Agenda at a Glance

Establishment of vegetative buffer zones to reduce the risk of STEC and *Salmonella* transmission from animal operations to fresh produce on co-managed farms. **Sid Thakur**, North Carolina State University

Metagenomics to identify viral indicators in the produce chain. **Gloria Sánchez Moragas**, IATA-CSIC, Spain

Listeria whole genome sequence data reference sets are needed to allow for improved persistence assessment and source tracking. **Martin Wiedmann**, Cornell University

Moderator: **Jill Dunlop**, Florida Fruit and Vegetable Association

2:30 pm – 3:00 pm

BREAK

3:00 pm – 4:30 pm

Research Session – Tools for Validation

Over the last few years CPS has strategically funded research programs seeking to identify surrogates for human pathogens that can be used to validate the efficacy of preventive controls. This session will help stakeholders develop insight into the development of surrogate strains and how they can be used across the production spectrum.

Developing cross-assembly phage as a viral indicator for irrigation waters. **Kyle Bibby**, University of Notre Dame

Identification of novel indicator organisms to determine the risks of fecal contamination of irrigation waters. **Kelly Bright**, University of Arizona

Validating a physically heat-treated process for poultry litter in industry settings using the avirulent *Salmonella* surrogates or indicator microorganisms. **Xiuping Jiang**, Clemson University

Comparative genomics analysis and physiological assessment of the avirulent *Salmonella* surrogate relevant to produce safety. **Julie Meyer**, University of Florida

Moderator: **Jennifer McEntire**, United Fresh Produce Association

Panelists: **Felice Arboisiere**, Yum Brands
Angela Valadez, Publix

4:30 pm – 5:15 pm

Revisiting CPS Research Lessons: Putting Research Findings to Work

Over the last ten years, CPS has funded over 100 research projects that have been reported on during previous CPS symposia. Much of this work has been used to shape industry thoughts on produce safety, catalyze innovative research, inform regulatory guidance and rules, and guide individual and commodity-wide produce safety programs. However, despite this dedication by the produce industry to fill knowledge gaps, it is not surprising that periodic outbreaks still occur. While considering the facts and the evidence we are left to speculate that the root cause may not be a lack

Agenda at a Glance

of knowledge but a failure to systemically and properly implement what we already know. This session will explore this proposition and discuss research findings and practical observations that may provide momentum for change and science-based solutions for growers, packers and processors.

Moderator: **Drew McDonald**, Taylor Fresh Foods

Panelists: **Channah Rock**, University of Arizona

Trevor Suslow, University of California, Davis

5:15 pm – 7:00 pm

Official Symposium Reception

Wednesday, June 20, 2018

7:15 am – 8:00 am

Registration, Continental BREAKFAST, Poster Session

8:00 am – 8:15 am

Welcome Back - Questions from Day 1, What Lies Ahead on Day 2

Natalie Dyenson, Dole Food Company, Inc.

8:15 am – 9:30 am

Research Session Part 1 – Packinghouse and Processing Plant Sanitation and Wash Water Control

Sanitation and wash water control issues have been amplified in recent years owing to the implementation of FSMA and sporadic but ongoing recalls associated with *Listeria monocytogenes* (*Lm*) cross contamination. This session will focus on the latest research on *Lm* in fruit packinghouses and potential strategies for mitigating the risks.

Characterization and mitigation of bacteriological risks associated with packing fresh-market citrus. **Linda Harris**, University of California, Davis

Factors that influence the introduction, fate and mitigation of foodborne pathogens on mangoes throughout the production chain. **Michelle Danyluk**, University of Florida

Listeria monocytogenes growth and survival on peaches and nectarines as influenced by stone fruit packinghouse operations, storage and transportation conditions.

Mary Anne Amalaradjou, University of Connecticut

Moderator: **Joan Rosen**, JC Rosen Resources

Panelists: **Fanny Au**, Sunkist

Katherine O'Donnell, Wegmans

George Nikolich, Gerawan Farming

9:30 am – 10:00 am

BREAK, Poster Session

Agenda at a Glance

10:00 am – 11:00 am

Research Session Part 2 – Packinghouse and Processing Plant Sanitation and Wash Water Control

Control of *Listeria monocytogenes* on apple through spray manifold–applied antimicrobial intervention. **Meijun Zhu**, Washington State University

Evaluation of the efficacy of antimicrobial agents to prevent the transfer of *Listeria monocytogenes* from existing biofilms to produce or processing surfaces. **Rolf Joerger**, University of Delaware

Resolving postharvest harborage sites of *Listeria* protects Zone 1 surfaces. **Trevor Suslow**, University of California, Davis

Moderator: **Joan Rosen**, JC Rosen Resources

Panelists: **Fanny Au**, Sunkist

Katherine O'Donnell, Wegmans

George Nikolich, Gerawan Farming

11:00 am – 11:20 am

People You Need To Meet: CPS Travel Grant Recipients

We want two things when it comes to talent in our industry: (1) researchers who are well trained and understand the challenges and opportunities of our industry, and (2) well-trained scientists who can join our companies and help build effective risk-based and science-based produce safety programs. This session will permit us to get to know the next generation of scientists who will enter our industry.

Moderator: **Doug Grant**, The Oppenheimer Group

11:20 am – 11:45 am

Lightning Round Session – Learn What Lies Ahead in CPS Research

Scientifically valid corrective actions for multiple harvest shade-house production systems. **Trevor Suslow**, University of California, Davis

Use of raptors to prevent wild bird and rodent intrusion into fresh produce fields. **Paula Rivadeneira**, University of Arizona

Mathematical modeling tools for practical chlorine control in produce wash process. **Daniel Munther**, Cleveland State University

Application of chitosan microparticles to eliminate foodborne pathogens in agricultural water that contacts fresh produce. **Anita Wright**, University of Florida

Moderator: **Lianna Kelly**, Markon Cooperative

11:45 am – 1:00 pm

LUNCH, Poster Session

1:00 pm – 2:00 pm

Listeria monocytogenes: What Can Be Learned From Outside the Produce Industry?

Lm is not just a produce issue—it is a food industry challenge that also has impacted

Agenda at a Glance

beef, poultry, fish, and frozen foods. This session will focus on learnings that can be gleaned from other sectors of the food industry and how they can be applied to produce.

Speaker: **Martin Wiedmann**, Cornell University

2:00 pm – 2:30 pm

BREAK, Poster Session

2:30 pm – 4:00 pm

Research Session – Hot Topics

This session will focus on research programs that examine produce safety throughout the supply chain, by evaluating potential cross-contamination points from field to retail, and by exploring pathogen persistence and physiology. We will hear from two researchers about pathogens in the dormant or “viable but not culturable” (VBNC) state and the potential risks for fresh produce. And we will hear about how the physiological state of a pathogen, as affected by pre-treatment growth conditions, can influence validation studies.

Detection, validation, and assessment of risks implied by the viable but non-culturable (VBNC) state of enteric bacterial pathogens in fresh produce. **Xiaonan Lu**, University of British Columbia

Significance of the dormant state in the persistence, interaction with growing plants and virulence of Shiga toxin–producing *Escherichia coli*. **Keith Warriner**, University of Guelph

Control of cross-contamination during field-pack and retail handling of cantaloupe. **Laura Strawn**, Virginia Tech

Pathogen physiological state has a greater effect on outcomes of challenge and validation studies than strain diversity. **Martin Wiedmann**, Cornell University

Moderator: **Stacy Stoltenberg**, Hygiena

Panelists: **DeAnn Davis**, Church Brothers Farms

Walter Ram, Giumarra

Brian Zomorodi, APIO, Inc.

4:00 pm – 4:45 pm

So, What Did We Learn Over the Last Two Days?

Join CPS Chairperson **Tim York** and Board member **Dave Corsi** as they share their perspectives and enlist the audience to share theirs regarding the findings that really defined the 2018 CPS Symposium.

4:45 pm – 5:00 pm

Where Do We Go From Here?

Jimmy Bassetti, J&D Produce, Inc.

Bonnie Fernandez-Fenaroli, Center for Produce Safety

5:00 pm – 6:00 pm

CLOSING RECEPTION

General Session

Asterisks denote Specialty Crop Block Grant support. Key on page 35.



AGRICULTURAL WATER

Project Title

Microbial food safety risks of reusing tail water for leafy green production

Principal Investigator

Michael Cahn, University of California Cooperative Extension

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

The use of sprinklers and furrow irrigation frequently results in significant volumes of run-off, also referred to as tail water. Although vegetable growers have made much progress in reducing irrigation run-off by using drip lines, overhead sprinklers are needed for germinating and establishing crops, and for watering high-density leafy greens such as spinach and baby greens. Also, a significant number of acres of lettuce and other vegetables are irrigated by furrow after crop establishment. Many Central Coast ranches have infrastructure for reusing tail water for irrigating crops, including sediment basins, reservoirs, and pumping systems. Currently, growers are reluctant to irrigate crops with tail water due to a lack of information on microbial food safety risks. Several options exist for reusing run-off water, which may minimize microbial food safety risks for produce. Tail water could be used for irrigation practices that do not result in direct contact with the crop, such as pre-irrigation and germination, as well as for dust control of unpaved roads. Reuse of tail water also would help growers conserve ground water. Other options include treating run-off by chlorination or other means to kill microbial pathogens and blending tail water with a clean water source so that microbial levels meet industry or regulatory target levels for

surface water. This project will monitor, characterize and quantify microbial populations in run-off water from Central Coast vegetable fields, and evaluate the risk of using this water source for the production of lettuce and other leafy green crops by quantifying survival of microorganisms during reuse applications. The food safety risk of reusing run-off water needs to be evaluated in commercial vegetable fields under conventional irrigation practices. Our project would address this need and develop information on the food safety risks associated with reusing run-off water for leafy green production.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety; CA Leafy Greens Research Board

Acknowledgements

Co-PIs: Linda Harris, University of California, Davis; Steven Koike, UC Cooperative Extension, Monterey County & Anne-laure Moyne, UC Davis; Laura Murphy, UC Cooperative Extension

Contact

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Project Title

***Cyclospora*: Potential reservoirs and occurrence in irrigation waters**

Principal Investigator

Gerardo Lopez, University of Arizona

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

Cyclospora has recently been implicated in outbreaks associated with U.S. produce imported from Mexico. Outbreaks of *Cyclospora* infections also have been linked to drinking water. Information on the sources and occurrence of this organism are very limited. Currently, only humans and possibly primates are believed to be infected by this parasite. Our goal

General Session

is to determine if produce grown in the United States is at risk of contamination from irrigation waters contaminated with human sewage (e.g., from faulty/leaky septic systems or compromised sewer pipes) and treated wastewater effluents that could potentially be discharged into surface waters used for the irrigation of food crops. Our specific objectives are to determine the occurrence of *Cyclospora cayentanensis* (a) in irrigation waters in Arizona and Texas, which will allow a determination of any risk from *C. cayentanensis* and to identify areas of potential risk; and (b) in raw sewage and treated wastewater effluents in produce growing areas (Yuma, AZ and El Paso, TX), which will allow for an assessment of the incidence of *C. cayentanensis* infection among these communities. In addition, treated wastewater effluents are sometimes released into watersheds and could potentially impact irrigation waters. This study will determine if any risks exist from *Cyclospora* in irrigation waters from these two regions.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**; Center for Produce Safety

Acknowledgements

Co-PIs: Paula Rivadeneira, Kelly Bright, Charles P. Gerba and Walter Betancourt, University of Arizona & Roberto Rodriguez, Daniela Cabrera

Contact

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Project Title

Remotely-sensed and field-collected hydrological, landscape and weather data can predict the quality of surface water used for produce production

Principal Investigator

Martin Wiedmann, Cornell University

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

There is a clear need for the development of improved, science-based tools to help reduce preharvest introduction of microbial produce safety risks through surface water use. The purpose of this project is (i) to identify and prioritize spatial and temporal risk factors for microbial contamination of surface water, and (ii) to develop geospatial models that predict surface water microbial quality, which will be assessed by quantifying generic *E. coli* and testing for key pathogens (e.g., *Salmonella*). Spatial and temporal variation in water quality will be assessed by repeatedly testing multiple water sources over two years. Publicly available remotely-sensed data (e.g., predominant upstream land use) will be used to identify factors that are associated with elevated *E. coli* levels, and an increased risk of pathogen detection. Data collection will be performed in two produce growing regions (AZ and NY) to assess the robustness of our models and their translatability to other regions. These data and models will allow growers to identify times and locations where surface water sources are more likely to be microbially contaminated. This information will enable growers to better time water use, testing, and treatment to minimize produce safety risks associated with microbially contaminated surface water.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**; Center for Produce Safety

Acknowledgements

Co-PI: Channah Rock, University of Arizona & Daniel Weller, Postdoctoral researcher/Project lead; Natalie Brassill, Lab manager/Arizona lead; Sherry Roof, Ban Saber, Teresa Reyes, Technicians; Alex Belias, Cornell University, Ph.D. student; Aziza Taylor, Kyle Markwadt, Sriya Sunil, Kayla Ferris, Julia Muuse, Undergrad researchers; and Irrigation Districts across Arizona

Contact

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General Session

Project Title

Establishment of operating standards for produce wash systems through the identification of specific metrics and test methods

Principal Investigator

Ana Allende, CEBAS-CSIC, Spain

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

The main objective of this proposal is helping producers to maintain the quality of the process water in commercial washing systems through control of water quality variables and the selection of adequate test methods for monitoring the process. Water disinfection is one of the most critical processing steps in fruit and vegetable production aimed at preventing cross-contamination. In packinghouses and processing facilities, it is difficult to properly treat and maintain the quality of the process water because of the variability in the demand of disinfectant, the lack of operational limits and test methods to monitor the process, and the different commercial operations. This project will investigate the most common disinfection agents used in packinghouses and processing facilities. Four scenarios have been selected based on different water characteristics, including fresh-cut onions (excessive cell exudates, very high organic matter and turbidity), chopped lettuce (high organic matter and low turbidity), baby leaves (low organic matter and low turbidity), and peppers and tomatoes (low organic matter and high turbidity). Operational limits will be established in commercial facilities and lab-scale experiments using inoculated foodborne pathogens. Results obtained should inform producers about the realistic expectations for controlling selected water quality variables in produce washing systems.

Funding

Center for Produce Safety

Acknowledgements

Co-PI: Maria I. Gil, CEBAS-CSIC
& J.A. Tudela, F. López-Gálvez, Post-doc researchers;

S. Andújar, N. Hernandez, A. Marín, Y. Garrido, M. Moreno, Technicians; Trevor Suslow, Academic cooperater; Jim Brennan, Industry advisor; Smartwash Solutions, Florette Iberica, Primaflor, Fruca Marketing, Citrosol and STC S.L.U., Industry cooperators

Contact

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RESEARCH SESSION – TOOLS FOR VALIDATION

Project Title

Developing cross-assembly phage as a viral indicator for irrigation waters

Principal Investigator

Kyle Bibby, University of Notre Dame

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

Ensuring high-quality irrigation water is necessary to protect the public when consuming minimally processed produce. The highest risk from exposure to contaminated water is due to viruses; however, water quality is currently monitored using bacteria that are poor representatives of viruses. All previous viral indicators are limited by a low abundance (i.e. difficult to detect) in the environment. Recently, a bacteriophage (virus that infects bacteria) named “cross-assembly phage” (crAssphage) was discovered and shown to be more abundant than all other bacteriophages in the human gut combined. Investigations in the PI’s research group have shown crAssphage to be highly abundant in sewage. As crAssphage is a virus, it will be a better representative of viral contamination in the environment. In this investigation, we will sample irrigation water

General Session

and measure crAssphage, viruses, and indicators to demonstrate the correlation of crAssphage and pathogens. Also, we will determine the sample volume necessary to accurately measure crAssphage. The development of this viral monitoring tool will enable risk-managers to have an accurate and abundant indicator of viral contamination. This will ultimately provide greater protection of public health and improve consumer confidence in produce consumption.

Funding

Florida Department of Agriculture and Consumer Services Specialty Crop Block Grant***; Center for Produce Safety

Project Title

Identification of novel indicator organisms to determine the risks of fecal contamination of irrigation waters

Principal Investigator

Kelly Bright, University of Arizona

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

The methods used to detect *E. coli* were developed for drinking water and are known to produce high levels of false-positive and false-negative results when used for irrigation waters. Therefore, growers are required to make decisions about water quality/safety based on inaccurate tests. Our project goal is to identify microorganisms that may be used as novel indicators of the presence of pathogens (not just fecal contamination) in irrigation waters to allow the produce industry to make more accurate risk-based assessments to determine when it is safe to irrigate crops. Our specific objectives are to: 1) examine irrigation water to determine the levels of fecal indicator and pathogenic bacterial/viral species by existing cultural and/or molecular methods; 2) determine the composition (presence and relative abundance) of the entire bacterial, protozoan, and fungal communities found in irrigation water using

“next-generation” sequencing; and 3) identify groups or specific species whose presence correlate well (presence/absence and relative abundance) with the occurrence of foodborne pathogens in irrigation waters. The use of more meaningful indicator species will provide growers with more accurate information upon which to optimize their irrigation practices to minimize the risk of contamination of produce by foodborne pathogens.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety

Acknowledgements

Co-PI: Luisa Ikner, University of Arizona & Enue Sicaños-Ruelas, Walter Betancourt, Patricia Gundy

Contact

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Project Title

Validating a physically heat-treated process for poultry litter in industry settings using the avirulent *Salmonella* surrogates or indicator microorganisms

Principal Investigator

Xiuping Jiang, Clemson University

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Poultry litter is an excellent source of nutrients for the growth of agricultural crops. To reduce the microbiological risks associated with the use of raw poultry litter as a soil amendment or organic fertilizer, heat treatment is recommended to reduce or eliminate potential pathogenic microorganisms. Our recent studies have demonstrated that thermal resistance of *Salmonella* in chicken litter is increased significantly when cells are adapted to desiccation or when aged chicken litter with low moisture content is heat treated. By increasing the moisture level in

General Session

chicken litter or applying a two-step heat treatment (wet heat followed by dry heat), *Salmonella* can be inactivated more rapidly. Our preliminary results indicate a good correlation in thermal inactivation rates between desiccation-adapted *Salmonella* and indigenous enterococci in chicken litter, suggesting enterococci as a potential indicator for heat process validation. We will collaborate with poultry litter processors to validate their heat-treatment processes in industrial settings by using *Salmonella* surrogate and indicator microorganisms identified in this study. Results from this research will provide some valid guidelines and tools for the fertilizer industry to produce *Salmonella*-free heat-treated poultry litter, thereby ensuring safe production of fresh produce.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety

Acknowledgements

Co-PI: Annel Greene, Clemson University & Maple Wang and Jack Chen, Graduate students

Contact

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Project Title

Comparative genomics analysis and physiological assessment of the avirulent *Salmonella* surrogate relevant to produce safety

Principal Investigator

Julie Meyer, University of Florida

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Coliforms and generic *E. coli* are poor predictors of the behavior of human pathogens (such as *Salmonella*, pathogenic *E. coli* and *Listeria*) in the crop production environment. Mounting evidence suggests that accurate models of *Salmonella* behavior in the production environment will have to

be built based on the experiments conducted with *Salmonella*, and not based on data from distantly related surrogates like generic *E. coli*. This, however, necessitates availability and careful characterization of “disarmed” strains of *Salmonella* that could be used for on-site research. Upon completion of this study we will have developed robust tools for modeling behavior of these outbreak strains in the pre- and post-harvest production environments. The purpose of this project is to carry out comparative genomic and physiological characterization of the outbreak strains under production conditions and to compare them with the nonvirulent strain of *Salmonella* that we have developed. We will also have tested two key hypotheses aimed at understanding why only a dozen out of over 2,500 *Salmonella* serovars are associated with produce-linked outbreaks of illness. With previous CPS funding we engineered and verified the first nonvirulent, nontransgenic strain of *Salmonella* suitable for on-site studies as an indicator organism.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety

Acknowledgements

Co-PI: Marcos de Moraes, University of Florida /IFAS & Max Teplitski, USDA NIFA

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General Session



RESEARCH SESSION – PACKINGHOUSE AND PROCESSING PLANT SANITATION AND WASH WATER CONTROL

Project Title

Characterization and mitigation of bacteriological risks associated with packing fresh-market citrus

Principal Investigator

Linda Harris, University of California, Davis

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

After harvest, fresh oranges and lemons are sorted, washed and packed in packinghouses for further distribution and sale. Because green and blue molds result in significant losses of citrus fruit during storage and shipping, fungicides are often applied during packing. Recirculating drench applications are common because they significantly increase fungicide efficacy but they also provide an opportunity for cross contamination or movement of microorganisms throughout the facility, which can be a food safety issue if not appropriately managed. The overall goal of this project is to provide data that the California fresh citrus packinghouse industry can use to support the controls that reduce or eliminate foodborne pathogen cross contamination where citrus fruits are comingled or where recirculating materials come into contact with the fruit. A laboratory component is included to determine, for the most common fungicides, minimum compatible sanitizer concentrations that are effective in eliminating *Salmonella* and *Listeria*

monocytogenes. The laboratory data will be verified in a pilot-scale citrus packing facility, and the results of these studies will be used to prepare documents the industry can use to support the efficacy of their food safety practices.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**; Center for Produce Safety

Acknowledgements

Setareh Shiroodi, Jim Cranney, Elena Jimenez, Mohsen Sales

Contact

ljharris@ucdavis.edu

Project Title

Factors that influence the introduction, fate and mitigation of foodborne pathogens on mangoes throughout the production chain

Principal Investigator

Michelle Danyluk, University of Florida

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Understanding the persistence and mitigation of foodborne pathogens on the surface of mangoes is essential to the establishment of Best Management Practices for the responsible handling, packing, distributing, and importing of mangoes, and is a fundamental management prerequisite to providing customers with safe mangoes. There is inadequate science-based data to establish management standards and criteria for mangoes to meet pending requirements of the Food Safety Modernization Act. The purpose of this research project is to evaluate the persistence of foodborne pathogens on the surfaces of whole and fresh-cut mangoes, assess potential mitigation strategies for control of pathogens on mango surfaces, and appraise the ability of *Salmonella* to infiltrate mangoes under

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standard packinghouse conditions and then to determine the fate of the internalized cells. The data resulting from the research will specifically address data gaps the National Mango Board currently faces, and will provide research-based metrics to validate mitigation strategies.

Funding

Center for Produce Safety

Acknowledgements

National Mango Board; Lorrie Friedrich, Biological scientist; Laurel Dunn, Postdoctoral fellow; Xinyue Wang, MS student; Vijendra Sharma, Technician

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Project Title

***Listeria monocytogenes* growth and survival on peaches and nectarines as influenced by stone fruit packinghouse operations, storage and transportation conditions**

Principal Investigator

Mary Anne Amalaradjou, University of Connecticut

Project Term

January 1, 2017 – December 31, 2017

Non-Technical Summary

The recent multi-state *Listeria monocytogenes* outbreak associated with stone fruit consumption highlights the potential for stone fruits to serve as a vehicle in *Listeria* transmission. Further, the outbreak also demonstrates the pathogen's ability to persist and survive on stone fruits during handling, storage and transportation. While investigations on the persistence of *Listeria* have been performed on other produce, there is a general lack of knowledge on the behavior of pathogens associated with stone fruits. Additionally, each produce type has unique compositional and physical characteristics that require produce-specific management practices. Therefore, to develop stone fruit-specific risk reduction knowledge and preventive controls, this study will investigate

the survival and growth of *Listeria* on peaches and nectarines under packinghouse environment, storage and transportation conditions. The study will be performed under conditions simulating stone fruit unloading and staging, waxing and fungicide application, and storage and transportation from the packing facility. It is expected that results from this study will provide quantifiable data on the effect of current practices on *Listeria* survival on stone fruits. Furthermore, identification of food safety risks associated with different steps within the packinghouse continuum will help develop comprehensive preventive controls for foodborne pathogens including *Listeria monocytogenes*.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**, Center for Produce Safety

Acknowledgements

California Fresh Fruit Association

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Project Title

Control of *Listeria monocytogenes* on apple through spray manifold-applied antimicrobial intervention

Principal Investigator

Meijun Zhu, Washington State University

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

Listeria monocytogenes is listed by the Food and Drug Administration as a "pathogen of concern" and has been singled out on both ready-to-wash and ready-to-eat produce due to its nature as a true environmental species. The Pacific apple industry, led by Washington, suffered a significant loss of income following the *L. monocytogenes* outbreak traced back to a California packer. The final FDA Produce Rule and Preventive Controls Rule are challenging apple packers and handlers to develop

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specific efficacy data for their process controls. The apple industry has an immediate need to begin the process of science-based improvements in *Listeria* control during packing and subsequent storage. The overall goal of the project is to comparatively assess and validate critical operating parameters for registered, commercially practical, and legally allowed sanitizer(s) against *L. monocytogenes*, and to further seek to verify their efficacy on multiple apple packing lines. The project will develop information for apple producers about the practical efficacy of antimicrobial interventions under commercial packing conditions, resulting in tested and proven methods for spray bar intervention in fresh apples, which will fill critical gaps in the knowledge and will be crucial for addressing *L. monocytogenes* safety in fresh apples.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**; Center for Produce Safety

Acknowledgements

Co-PI: Trevor Suslow, University of California, Davis & Ines Hanrahan, Washington Tree Fruit Research Commission; Stemilt Growers, Allan Brothers Fruits, Industry cooperators; Jenfitch, Pace International, Aquaox, and Agri-Neo

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Project Title

Evaluation of the efficacy of antimicrobial agents to prevent the transfer of *Listeria monocytogenes* from existing biofilms to produce or processing surfaces

Principal Investigator

Rolf Joerger, University of Delaware

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Listeria monocytogenes (*Lm*) is a foodborne

pathogenic bacterium that can cause serious illness and even death in susceptible individuals. Outbreaks involving this pathogen have been associated with fruits, sprouts and vegetable row crops. Like most other bacteria, *Lm* can form biofilms or become part of biofilms with other bacteria on produce surfaces and on surfaces in produce harvesting and processing environments. Once established in a biofilm, *Lm* has highly diminished susceptibility to antimicrobial agents and is difficult to eradicate. Cells surviving in such biofilms can detach and be carried to new surfaces where they can start the formation of a new biofilm or become part of an existing biofilm. It is therefore extremely important to prevent the transfer of cells from existing biofilms to previously uncontaminated surfaces on produce or processing equipment. The study will examine the efficacy of antimicrobial agents to inactivate *Lm* released from existing biofilms and prevent the formation of new *Lm*-containing biofilms on produce and equipment surfaces.

Funding

Center for Produce Safety

Acknowledgements

Co-PI: Gordon Johnson, University of Delaware & Arpeeta Ganquly, Visiting scientist; Juliet Wachira and Quincy Hardy, Graduate students; Anjolaoluwa Popoola, Lincoln University, Summer intern

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Project Title

Resolving postharvest harborage sites of *Listeria* protects Zone 1 surfaces

Principal Investigator

Trevor Suslow, University of California, Davis

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

Fresh citrus is an important global commodity and

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a major specialty crop in California. The 2014–2015 California Agricultural Statistics Review placed the combined value of oranges, lemons, and tangerines at over \$2 billion, and all three fruits are among the Top 15 Specialty Crops by value. Fresh whole citrus has not experienced an incident of recall, illness, or outbreak, and CA citrus production practices and regions appear to significantly limit the environmental risk of preharvest contamination. However, recent serious incidents involving the bacterial pathogen *Listeria monocytogenes*, associated with CA apples, have prompted proactive measures to more carefully assess postharvest risks and develop validated interventions for citrus system-wide. In this project, confidentially enrolled handlers will participate in a detailed survey for indicator *Listeria* and *L. monocytogenes*. The major outcome will be the development of model Environmental Monitoring Program (EMP) and guidance in establishing an environmental-zone Master Sanitation Schedule linked to EMP-outcomes for California fresh citrus packinghouses. Other anticipated outcomes are expected to include a general overview and report card of the CA citrus packing environment, and the identification of potential sources of *Listeria* related to citrus growing regions and harvest/postharvest practices. Closing this knowledge gap will result in measurable improvements in reducing *L. monocytogenes* prevalence.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant**; Center for Produce Safety

Acknowledgements

Co-PIs: Adrian Sbordio and Janneth Pinzon-Avila, University of California, Davis & David Hill; Mariya Skots; Tia Dunbar; Jeremy Roland; Lee Ann Richmond; Jim Cranney, CCQC; CA Citrus cooperators; Roka Biosciences and IEH, 3M Food Safety Division; Neogen Corp.; BioSafe Systems, Rely-On, D7

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HOT TOPICS

Project Title

Detection, validation, and assessment of risks implied by the viable but non-culturable (VBNC) state of enteric bacterial pathogens in fresh produce

Principal Investigator

Xiaonan Lu, University of British Columbia

Project Term

January 1, 2017 – December 31, 2018

Non-Technical Summary

More fresh fruits and vegetables are grown, sold and eaten today than at any other time in history. Unfortunately, outbreaks of food poisoning caused by pathogenic bacteria in fresh produce are also more common than in the past. Products are routinely analyzed to ensure that they are free of such bacteria, but some are very difficult to find because they do not grow on media used by quality control laboratories. These are known as “viable but non-culturable” (VBNC) bacteria. We will develop a new, inexpensive and easy-to-use method based on the well-known PCR reaction to make it possible for quality control laboratories to detect two important pathogens in fresh produce, *Salmonella* and *E. coli*, even when they are in the difficult-to-find VBNC form. The performance of the new method will be checked through field trials and pilot plant experiments with leaf lettuce. Information from these experiments will be used to reveal how likely fresh produce is to be contaminated with VBNC pathogens during production and after harvest. Therefore, this research will contribute to an important new laboratory method and key information to support on-going efforts by the

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industry to improve the safety of fresh fruits and vegetables.

Funding

Center for Produce Safety

Acknowledgements

Co-PIs: Pascal Delaquis and Susan Bach, Agriculture and Agri-Food Canada; Jeff Farber, University of Guelph

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Project Title

Significance of the dormant state in the persistence, interaction with growing plants and virulence of Shiga toxin-producing *Escherichia coli*

Principal Investigator

Keith Warriner, University of Guelph

Project Term

January 1, 2017 – December 31, 2017

Non-Technical Summary

Shiga toxin-producing *Escherichia coli* (STEC) are potentially highly virulent and can cause illness at levels of 10 cells if ingested by a susceptible host. Manure is a significant source of STEC and consequently, when applied to land, there is an interval of 90–120 days before harvest to permit any pathogens to die off. In field trials it has been demonstrated that STEC die off rapidly within the first weeks of being incorporated into soil but a sub-population persists and can be recovered beyond 120 days. This led to speculation that there is a persistent sub-population of STEC that have enhanced tolerance to stress encountered in the field and possibly post-harvest. In the proposed study the persistent (dormant) state will be studied in STEC. Specifically, the culture conditions that induce the dormant state will be elucidated along with potential genes implicated. Studies will then determine the extent to which dormancy contributes to persistence in soil and resistance to sanitizers. Finally, the virulence of

STEC in the dormant state will be determined. The main benefit of the research relates to providing data for risk assessment and also to develop novel methods to make STEC more susceptible to pre-harvest along with post-harvest interventions.

Funding

Center for Produce Safety

Acknowledgements

Co-PI: Suresh Neethirajan, University of Guelph & Kari Dunfield, University of Guelph; Ann Huber, SRG; Chelsey Tremblay; Abdulhaeen Alzahar; Xuan Wang

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Project Title

Control of cross-contamination during field-pack and retail handling of cantaloupe

Principal Investigator

Laura Strawn, Virginia Tech

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Following recent melon-associated foodborne outbreaks, California cantaloupe growers voluntarily developed and implemented commodity-specific food safety guidelines for the safe handling of cantaloupes and other netted melons. While this document details best food safety practices to reduce the risk of contamination during production, packing, and distribution, science-based metrics describing transfer coefficients for pathogen contamination onto melons during field-packing operations are needed. Cross-contamination is a known food safety risk in many environments, and is dependent on many variables, including transfer surface, commodity surface, and contamination level. Cross-contamination was highlighted by the Food and Drug Administration as a critical factor contributing to recent cantaloupe-associated outbreaks. To date, no published literature evaluating the cross-contamination potential of whole

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melons has been established under typical field-packing conditions. Furthermore, there is a lack of data on handling practices related to cross-contamination risks for melons in the retail distribution supply chain, as well as guidance on the safe and uniform handling of melons throughout the retail environment. Through this project, potential cross-contamination points likely to increase risk will be identified, and intervention strategies targeted to reduce the occurrence of pathogen transfer events during the handling of melons at harvest and retail will be developed.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety

Acknowledgements

Co-PIs: Michelle Danyluk, University of Florida; Ben Chapman, North Carolina State University & Lorrie Friedrich, Biological scientist, University of Florida; Chris Rupert, MS student, North Carolina State University; Laura Truitt, Research scientist, Virginia Tech; CA/AZ melon producers and our two retail partners

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Project Title

Pathogen physiological state has a greater effect on outcomes of challenge and validation studies than strain diversity

Principal Investigator

Martin Wiedmann, Cornell University

Project Term

January 1, 2016 – December 31, 2017

Non-Technical Summary

Effective control of foodborne disease-causing microbes (“pathogens”) requires science-based validation of interventions and control strategies. For example, it is important to show that a given antimicrobial treatment can reduce bacterial numbers

with a certain target efficiency, regardless of the specific genetic type of organism and regardless of the conditions under which an organism was grown prior to treatment. This is important, as it has been shown that *Salmonella* exposed to dry environments can be >100 times more resistant to some treatment (e.g., heat) than *Salmonella* grown in the presence of high levels of water. This project will assemble a collection of diverse microbes that are appropriate for validation of pathogen interventions in the produce industry, and will evaluate these organisms to determine whether and how exposure to different environmental conditions will affect the ability of these organisms to survive stressful conditions and control strategies. The resulting data, along with the bacterial collection developed as part of this project, will facilitate more reliable identification of effective control strategies that can reduce the risk of foodborne illnesses and pathogen contamination.

Funding

California Department of Food and Agriculture Specialty Crop Block Grant*; Center for Produce Safety

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2017 Travel Grant Award Recipients

Panelist Biographies

FELICE ARBOISIERE

Felice Arboisiere is the Corporate Microbiologist and Produce Manager for Taco Bell. Ms. Arboisiere joined Taco Bell in 2014 and is responsible for managing the Produce Category as well the microbiological work for all commodities. Prior to working at Taco Bell, Felice worked as a Senior Microbiologist for Estee Lauder, where her work was focused on fermentative bacterial studies and overall oversight of the cosmetic microbiology program. Ms. Arboisiere has worked as a microbiologist for Food Safety Net Services, as well as Celgene, a cancer research firm. Felice was born and raised in Nogales, AZ, where her family is deeply involved in produce and this is where her love of agriculture stems from.

SAMIR ASSAR

Dr. Samir Assar is the Director of the Division of Produce Safety, comprised of the Fresh Produce Branch, the Processed Produce Branch and the Produce Safety Network in the Food and Drug Administration's (FDA) Center for Food Safety and Applied Nutrition (CFSAN). The Division focuses on developing and implementing policies and programs related to enhancing the safety of both fresh and minimally processed produce. Since 2008, Dr. Assar has managed the development of FDA's policy, regulation and guidance on produce safety, including those mandated by the 2011 Food Safety Modernization Act. Dr. Assar provides strategic leadership in developing plans for research, training, and compliance activities that target a safe and abundant produce supply. He is committed to enhancing partnerships with produce safety stakeholders, including industry, consumers, federal, and state partners. He has collaboratively forged initiatives and agreements aimed at protecting public health both domestically and internationally, with an emphasis on ensuring the produce industry receives necessary food safety education, outreach and technical assistance. Dr. Assar received his M.S. and Ph.D. in Food Science from the University of Florida.

FANNY AU

Fanny Au began working with Sunkist Growers in

2007, moving into Director of Technical Services of Global Licensing in 2010. In her capacity, she oversees food safety and quality of all Sunkist brand licensed products, with over 700 individual products in ~80 countries. In October 2016, Fanny accepted the role of Director of Global Food Safety, and oversees Sunkist's Global Food Safety Department that incorporates Fresh Fruit and Licensed Products. This includes responsibilities for fresh fruit and licensed products' food safety, quality assurance, manufacturing facility and packinghouse audits, adherence to safe food practices, lab analysis of new and existing products, regulatory, labeling, and product approvals. Prior to her career at Sunkist, Fanny was a Food Technologist at Campbell's Soup, and Quality Assurance Manager at LSG Airline Catering Co. As a Food Technologist at Campbell's, Fanny won the "You Make A Difference Award" for quality improvement and line extension projects. In her position at LSG she not only oversaw the food safety and quality of the catering operations in Hong Kong but also developed and implemented a food safety program in a consultation project at United Airlines Flight Kitchen in Japan. Fanny also worked at United Airlines as a Senior Buyer for frozen food commodities for Food Services and Latin America Catering services, assisting in supplier quality audits. Fanny was born in Hong Kong, obtained a degree in Agriculture (majoring in Food Science) from the University of Alberta in Edmonton, Canada.

DAVE CORSI

Dave Corsi joined the Wegmans family 32 years ago, and in 1999 he became Vice President of Produce and Floral Operations. Dave is responsible for procurement, merchandising, design, fixturing, pricing, and the Wegmans Organic Farm operation. Dave has been a volunteer leader for 16 years with the Produce Marketing Association and during that time, he was the chairman of the association in 2009. Dave served two consecutive terms as a member of the USDA Fruit and Vegetable Advisory Committee from 2001 to 2005. In 2003, industry members nominated Dave and Wegmans as "Retailer of the Year" by Produce Merchandising Magazine. Then, in 2005, Dave was selected for the

Panelist Biographies

“Marketer of the Year” by Vance Publishing for his merchandising excellence, setting high standards for others to emulate, and for his leadership in the produce industry. Dave led a taskforce for United Fresh in 2009 to create a Harmonized Food Safety Good Agricultural Practices Audit that is used today by many in our industry.

DEANN DAVIS

As VP of Food Safety and Quality for Church Brothers Farms, Deann’s responsibilities include strategic development and implementation of food safety and quality programs across all farming, harvesting, and processing operations in the United States and Mexico. Deann previously worked as Vice President of Quality and Food Safety at Earthbound Farm, and as Chief Food Safety Officer at Kraft Foods. On top of these achievements, Deann has also worked in product safety and regulatory leadership roles at Alberto Culver, Kimberly-Clark, The Dial Corporation, and Procter & Gamble. She obtained a bachelor’s degree in Biology and Chemistry from San Diego’s Point Loma College, and a Ph.D. in Biochemistry and Biophysics from Texas A&M University. Deann Davis has been a Diplomate for the American Board of Toxicology since 1996. She was recently appointed to the USDA National Advisory Committee on Microbiological Criteria for Foods.

SURESH DECOSTA

Suresh DeCosta joined Lipman Family Farms as Director of Food Safety in April 2016. Suresh is a recognized subject matter expert with the ability to lead cross-functional groups of suppliers, customers and produce industry representatives. He has broad food science industry experience including product development, beverage formulation, food irradiation, coffee blend management, good agricultural practices and fresh-cut processing. He leverages his holistic understanding of supply chain from farm to fork to mitigate food safety risks at each stage of the supply chain. Suresh uses his interpersonal skills to build consensus in technical and non-technical environments, which helps drive industry change. Suresh has served as the chairman of United Fresh Produce Association Food Safety and

Technology Council and as a board member of its board of directors. Suresh is a member of Center for Produce Safety Technical Committee. He has received multiple industry awards, including the UFPA technical award for his leadership in helping standardize agricultural food safety practices. Suresh received an M.S. in Food Science from Chapman University and a B.S. in Environmental Science from Slippery Rock University.

JILL DUNLOP

Jill Dunlop is responsible for providing support to Florida Fruit & Vegetable Association members in developing and implementing food safety and sustainability programs. She also provides training for and assistance with third-party audits as well as coordinating and conducting food safety and sustainability education and outreach. Before joining FFVA, Jill Dunlop spent five years as food safety manager for FFVA producer member SunnyRidge Farm/Dole Berry Company in Winter Haven, responsible for the southeastern United States and Latin America. Before that she was a researcher at the University of Florida’s Citrus Research and Education Center in Lake Alfred for nine years. She is a graduate of Elon College in North Carolina, with a Bachelor of Science degree in Environmental Studies.

NATALIE DYENSON

Ms. Dyenson joined Dole as Vice President, Food Safety and Quality in October 2016. She has responsibility for food safety and quality programs globally for all divisions of Dole. Prior to Dole, she spent eight years in various senior director positions with Wal-Mart Stores, Inc., most recently leading food safety across 6,500 retail stores, 48 company owned manufacturing facilities and 220 fresh distribution centers in 26 countries for Walmart’s international division. Prior to Walmart, Ms. Dyenson spent eight years with Walt Disney Parks and Resorts, based out of Orlando, Florida, where she held various roles in food safety and public health supporting Walt Disney World, Disney Regional Entertainment, Disney Cruise Line and the Parks and Resorts business globally. Ms. Dyenson holds a B.S. in Microbiology from the University of Iowa and a M.P.H. in Infectious

Panelist Biographies

Disease Epidemiology and Biostatistics from the University of South Florida.

DOUG GRANT

Doug joined The Oppenheimer Group in 1995 as director of information technology and was promoted to vice president and chief operations officer in 2006. He has since taken on executive oversight for grower relations, IT, operations, quality control, transportation, and food safety, as well as the South American offices. Doug is co-chair of the PTI (Produce Traceability Initiative) Leadership and Executive Council and sits on the Center for Produce Safety Board of Directors and the PMA (Produce Marketing Association) Board of Directors. As well, he has authored numerous white papers on key topics facing our industry. Doug is a past recipient of the Canadian Produce Marketing Association's "Produce Man of the Year" award, and he was featured among the 2012 Packer 25 industry leaders.

KARI IRVIN

Kari Irvin is currently the Deputy Director of FDA's Coordinated Outbreak Response and Evaluation (CORE) Network. CDR Irvin joined FDA in 2008 as a microbiologist conducting research on *Salmonella* spp. detection methods in a variety of commodities. In 2011, she joined CORE and has participated in foodborne outbreak investigations involving a variety of pathogen and commodity pairs. Prior to joining FDA, CDR Irvin worked as a scientist for the Virginia Division of Consolidated Laboratory Services (DCLS) and held an Association of Public Health Laboratories/Centers for Disease Control and Prevention Emerging Infections Diseases fellowship.

LIANNA KELLY

As Markon's Food Safety Director, Lianna Kelly works closely with Markon's team of field and facility inspectors, produce managers, and industry officials to further the cause of produce safety and quality. Lianna's responsibilities include ensuring that all Markon First Crop, Ready-Set-Serve, and Markon Essentials products meet or exceed Markon's 5-Star Food Safety® Program standards. She serves as the voice of Markon in food safety-

related matters, delivering relevant industry information to members, and alerting customers about food safety concerns.

SHARAN LANINI

Sharan Lanini is the Director of Food Safety at Pacific International and its affiliated companies. She is actively involved in all aspects of the Food Safety Program and Regulatory Affairs, including development and management of food safety programs across all growing regions and commodities, facilitating food safety communications and issue management and proactively managing trends and continuous program and process improvement. Sharan Lanini also serves as the corporate Food Safety Regulatory Affairs and Compliance liaison for PIM and Dynasty Farms with federal, state and regional regulators, certification bodies and NGOs. Sharan is actively involved in many industry boards and committees such as PMA Science and Technology Committee, United Fresh Technology Council, LGMA Executive Board and Technical Committee, Center for Produce Safety Technical Committee and many others. Sharan Lanini is a proud third generation California farm family member and a graduate of the University of California, Davis, and recipient of the prestigious UC Davis Award of Distinction from the College of Agriculture.

KATHERINE MARSHALL

Katherine Marshall is an epidemiologist in the Prevention and Evaluation Activity in the Outbreak Response and Prevention Branch within the Division of Foodborne, Waterborne and Environmental Diseases at the Centers for Disease Control and Prevention (CDC). Ms. Marshall began working at CDC in 2010 as a surveillance epidemiologist, tracking enteric illness due to Shiga toxin-producing *E. coli* and *Shigella*. During her 8 years at CDC, she has investigated over 150 outbreaks of *Salmonella*, Shiga toxin-producing *E. coli*, *Listeria monocytogenes* and other enteric infections. She is a graduate of the University of Illinois with a Bachelor of Science in Molecular and Cellular Biology (2005), and a Master of Public Health in Infectious Disease Epidemiology and Global Health (2010).

Panelist Biographies

DREW MCDONALD

Drew is the Vice President Quality & Food Safety at Taylor Fresh Foods, Salinas, California. He has over 20 years' experience in fresh produce and fresh foods. He oversees the quality and food safety programs across the food service, retail, and deli operations. Drew works with an impressive team developing and managing appropriate and practical quality and food safety programs for fresh food and produce products. Over the course of his career he has worked with growers and processors of fresh produce items all over the world. He currently serves on numerous food safety-related technical committees and has participated in the authorship of many produce food safety guidelines. Drew received his education from Lawrence University in Wisconsin.

JENNIFER MCENTIRE

Jennifer McEntire is VP Food Safety and Technology at United Fresh Produce Association. A food microbiologist by background, she has always worked in the Washington DC area, bringing the scientific perspective to food safety regulatory issues. She was previously Vice President of Science Operations at the Grocery Manufacturers Association, overseeing the microbiology laboratory, process authority team, and claims laboratory. She has also had roles as VP and Chief Science Officer at The Acheson Group and as the Senior Staff Scientist and Director of Science & Technology Projects at the Institute of Food Technologists. Jennifer McEntire earned a Ph.D. from Rutgers University and received a Bachelor of Science with Distinction, magna cum laude, in Food Science from the University of Delaware. She serves as an advisory board member of the Global Food Traceability Center, is on the Center for Produce Safety's Technical Committee, is a member of the International Association for Food Protection, and is on the steering and executive committees of the Food Safety Preventive Controls Alliance.

GURMAIL MUDAHAR

Gurmail, a 30-year veteran of the produce industry, currently holds the position of Vice President, R&D and Food Safety at Tanimura & Antle, a

company that he initially worked for in the late 1990s and then rejoined in 2008. Gurmail started his career with Dole Food Company as product development scientist in 1989, and among other accomplishments was responsible for developing over 15 fresh-cut salad and vegetable products, optimizing MAP packaging for retail salad products, and designing the manufacturing processes. He also has worked for Reliance Industries in Mumbai, where he developed and implemented strategies to produce and source over 6 million tons of fresh produce annually to retail stores in India. Widely regarded as an expert in food safety and quality of fresh produce and in developing self-sustainable businesses in agriculture, including growing and post-harvest handling, Gurmail is an active member of LGMA and the technical committees of PMA, the Grower Shipper Association, and Center for Produce Safety. Gurmail holds an M.Sc. in Food Technology from the Punjab Agricultural University, India, and a Ph.D. in Food Science from the University of Georgia.

GEORGE NIKOLICH

George Nikolich originally joined Gerawan Farming more than 30 years ago as the pest control advisor, agronomist and ranch manager. In 2009, George was promoted to Vice President of Technical Operations, overseeing Gerawan's compliance program for food safety regulations, quality assurance, postharvest handling, packaging, cooling, storage and transportation. George serves on the CA Fresh Fruit Association Board of Directors and the Center for Produce Safety Technical Committee, and is a member of the Food Science and Nutrition Advisory Committee at California State University, Fresno. George received his B.S. degree in Agricultural Science from California State University, Fresno, and his M.S. degree in Agronomy from the University of California, Davis.

KATHLEEN O'DONNELL

Kathleen O'Donnell started her career at Wegmans as a part-time employee in the bakery. Following her graduation from Cornell University (B.S., M.S.), she became a member of the quality assurance

Panelist Biographies

team at Wegmans Meat Center, focusing on product quality assurance, environmental monitoring programs and product development. She developed the first HACCP program for the Wegmans Meat Center. Kathleen is now Chief Food Scientist and addresses issues of a regulatory, technical or scientific nature for food and non-food products.

WALTER RAM

Mr. Ram is Vice President of Food Safety at The Giumarra Companies and has been with Giumarra since 1995. He is responsible for food safety and regulatory affairs for Giumarra's 15 operating divisions, and is active in food safety and food defense work at the industry level. Giumarra is one of the world's largest table grape producers, and is a major supplier of over 60 fresh fruits and vegetables from a dozen countries. His current industry activities include: Center for Produce Safety's Technical Committee; Produce Marketing Association Food Safety, Science and Technology Committee; Fresh Produce Association of the Americas Board of Directors; and Canadian Produce Marketing Association Food Safety Committee. Previous industry activities have included: chairman of United Fresh Produce Association's Food Safety and Technology Council; contributor and editor of Commodity Specific Guidelines for the Fresh Tomato Supply Chain; contributor to Commodity Specific Guidelines for the Melons Supply Chain; member of the steering committee for the National Mango Board; and Strategic Partnership Program for Agroterrorism (a joint government/industry program).

JOAN ROSEN

Ms. Rosen is the founder of JC Rosen Resources, a consulting firm that provides services globally with expertise in food safety, quality systems, postharvest technology, and regulatory affairs for the fresh produce and food industries. Previously, Ms. Rosen was Director of Global Food Safety and Quality for Chiquita Brands International/ Fresh Express, where for over 22 years she had increasing responsibilities in key management leadership positions. Her role ensured standardized quality and food safety systems across growing, packing, processing and distribution operations

in North America, Europe, Latin America and Asia including compliance with customer, brand and regulatory standards throughout the supply chain. She received her M.S. in Food Science and Postharvest Physiology from the University of California, Davis, and her B.S. in Food Science from Cornell University. Ms. Rosen is a recipient of the International Fresh-Cut Produce Association's Technical Excellence Award for her achievements in advancing the common good of the fresh-cut industry, enhancing food safety and quality initiatives and supporting innovative technological advancements. She serves on the Technical Committees for the Center for Produce Safety, Produce Marketing Association and United Fresh Produce Association. Ms. Rosen is a lead instructor for FSMA's Preventive Controls for Human Foods and a trainer for the Produce Rule. Previously, she led postharvest research programs at Campbell Soup Company, and also worked in flavor development and application at Florasynth Inc.

RUSBELINA SILVA

Ms. Rusbelina Silva has been working in quality assurance since earning her Bachelor of Science degree in Biochemical Engineering with a focus on Food Science and Technology. Before joining 4Earth Farms, Rusbelina worked for baker Mission Foods for over 23 years, holding several positions, including Total Quality Manager and Total Quality Director, and ending her tenure as Vice President of Total Quality. Rusbelina also has worked for a manufacturer of quick-frozen vegetables, grains, salsas and soups, and she was responsible for regulatory compliance and managing the microbiology laboratory as well as quality assurance. 4Earth Farms is one of the largest vertically integrated conventional, organic, and specialty grower-packer-shippers in the nation.

STACY STOLTENBERG

Ms. Stacy Stoltenberg is a Western Territory Technical Sales Manager for Hygiena, a life sciences company that delivers rapid microbial detection, monitoring, and identification solutions to improve food safety. For the past 8 years, she has been dedicated to working with food companies and third-party laboratories to help

Panelist Biographies

make faster release decisions while testing their food products for harmful pathogens. Prior to her work with Hygiena and Qualicon Diagnostics, Ms. Stoltenberg worked in business development/sales and as the lead Microbiologist at PrimusLabs for 9 years. Ms. Stoltenberg received her B.S. and M.S. degrees from Kansas State University in Food Science and Microbiology.

ANGELA VALADEZ

Angela Valadez, a Chicagoland native, started with Publix Super Markets in 2013 as their Produce Food Safety Coordinator. She supported both Publix Fresh Foods Manufacturing and the Produce Retail Business Unit to continuously improve and strengthen food safety programs internally and improve the Produce Good Agricultural Practices associated with suppliers. In 2018, she was promoted as the new CQA Food Safety & Quality Assurance Manager for Supply Chain. In addition to her produce safety responsibilities, she leads the CQA Supply Chain team's support of Publix's business partners in corporate purchasing with supplier review and selection of Publix store brand products. She is an FSPCA lead instructor for FSMA's Preventive Controls for Human Food, the Produce Safety Rule, and Foreign Supplier Verification, and she teaches internally to her industrial operation partners and externally with the University of Florida – IFAS. Prior to Publix, Angela held various food and plant science research and educational activities at formerly Silliker Labs in Illinois, USDA-ARS in Pennsylvania, and the National Renewable Energy Laboratory in Colorado. Angela earned her B.S. and M.S. from Purdue and Penn State Universities in Genetics, Microbiology, and Food Science, and a Ph.D. from the University of Florida in Food Science, specializing in produce food safety. Her dissertation focused on the risk of *Salmonella* spp. for fresh market tomatoes during pre- and post-harvest practices.

BOB WHITAKER

As Chief Science & Technology Officer for Produce Marketing Association (PMA), Dr. Bob Whitaker oversees PMA's food safety, technology and sustainability efforts across the produce supply chain. This work focuses on delivering

education content and connecting members to technical solution providers. Before joining PMA, Dr. Whitaker held various scientific and senior management positions at DNA Plant Technology Corporation, and senior operation and technical functions at NewStar Fresh Foods. Dr. Whitaker served as Chairman of the Board of Directors for the International Fresh-Cut Processing Association (IFPA), and was a board member for the United Fresh Produce Association. Dr. Whitaker has received a number of industry awards for achievement, has served on the USDA National Advisory Board for Microbial Criteria in Foods, the National Academies of Sciences Genetic Engineering Review Panel and worked on a number of industry and government food safety and technology initiatives. He was named to the Executive Committee for the Center for Produce Safety (CPS) in 2007, and served as Chairman of the CPS Technical Committee from 2008–2013. Dr. Whitaker received his Ph.D. in Biology from State University of New York at Binghamton.

MARTIN WIEDMANN

Dr. Martin Wiedmann leads several initiatives and works to develop and communicate the scientific knowledge needed to prevent and control foodborne and zoonotic diseases caused by bacteria. Martin's academic programs focus on a comprehensive and interdisciplinary farm-to-table approach to food safety, and involve the application of a variety of disciplines (including microbiology and microbial genetics, population genetics, molecular biology, genomics, evolution and modeling) and collaboration from a variety of disciplines (economics, computer science, veterinary medicine, epidemiology and statistics) from many universities, state and federal health agencies, and trade organizations. His research program objective is to develop a better understanding of the pathogenesis, ecology, evolution, and transmission of bacterial foodborne and zoonotic diseases, and is currently focused on two model organisms, including *Listeria monocytogenes* and *Salmonella*. Martin Wiedmann received his Ph.D. from Cornell University, Ph.D. and Veterinary Degree from University of Munich and has been awarded several honors. He is a Fellow of the Institute of Food Technologists (IFT), a Fellow

Panelist Biographies

of the American Academy of Microbiology (AAM), member of the International Academy of Food Science and Technology, and currently serves as co-director of the New York Integrated Food Safety Center of Excellence.

TIM YORK

Tim York is President of Markon Cooperative, Inc., a purchasing, marketing and logistics cooperative serving North America's leading independent foodservice distributors. Based in Salinas, California, Markon distributes produce to over 75 facilities in the United States and Canada. Tim has 40 years of experience in the produce and foodservice industries. He began his career in 1977 at H. Hall & Company, a grower/shipper of strawberries and mixed vegetables. Tim York joined Markon in 1985 as Purchasing Director, and he was promoted to his current position of President in 1990. Tim York has held numerous committee and task force positions, including Chairman of the Produce Marketing Association (PMA) (2002– 2003) and Chairman of PMA's Foodservice Division (1994– 1996); he is currently a member of the Canadian Produce Marketing Association Board of Directors.

BOB ZIEL

Bob Ziel joined J&J Family of Farms in July 2016 as the new Director of Food Safety and Social Responsibility. Bob Ziel has more than 30 years of food safety experience and has held key food

safety roles with McEntire Produce, The Kraft Heinz Company, and ConAgra Foods. As an active leader in the produce industry, Bob Ziel has held distinguished roles with PMA, the United Fresh Technical Council and the Center for Produce Safety. He attended Valparaiso University in Indiana, where he obtained a Bachelor's degree in Microbiology, and furthered his food safety expertise by acquiring a Master's degree in Food Science from Rutgers University in New Jersey.

BRIAN ZOMORODI

Brian Zomorodi, a 35-year veteran of the fresh-cut produce industry, joined Apio Inc., a leader in fresh-cut vegetables and salads in 2015. Brian started his career with Ready Pac in 1984. He developed and led their Research & Development, Quality Assurance and Food Safety Departments as Sr. Vice President for 32 years. He has been responsible for launching several successful fresh-cut product lines for the retail and food service industry and in developing many food safety and quality assurance systems. He has been actively involved in establishing standards and guidelines for fresh-cut produce and has many publications. Brian holds an MS degree in Food Science and is a recipient of many distinguished awards. He has actively served in a number of technical councils for trade organizations including PMA, UFPFA, and global food service companies such as McDonald's and YUM! as a founding member.



2017 CPS Research Symposium, Denver

Poster Session



Preservation of stone fruits by spray application of edible coatings with antimicrobial properties****

Contact

Kay Cooksey, Clemson University
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Project Date

January 1, 2018 – December 31, 2018

Summary

Results have shown that surface roughness can play a role in potential formation of a biofilm produced under laboratory conditions using *Listeria monocytogenes* Scott A. Optimization of biofilm formation conditions is underway, and media experiments have been completed. We determined that Hsiang-Ning-Tsai (HTM) broth supports higher overall biofilm mass compared with Modified Welshimer's broth. Testing of coating solutions showed that incorporation of bacteriophage P100 into Aloe vera or whey protein isolate provides significantly higher zones of inhibition in spot-on-lawn assays compared with sodium alginate, methyl cellulose and controls.

Poster Session

Identifying optimal methods of recovering bacteria from food processing plants for downstream microbiome analyses

Contact

Ed Dudley, Pennsylvania State University
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Project Date

January 1, 2018 – December 31, 2018

Summary

Microbiome studies have provided important insights into how microorganisms impact human and public health. While a large number identify microbial communities in the gastrointestinal tract of humans and animals, there is increasing interest in understanding diversity in the built environment such as food processing facilities. An accurate map of a building's microbiome requires the use of robust methods capable of recovering a representative collection of all microorganisms found on food-contact and non-contact surfaces. The current approach starts by swabbing surfaces with a pre-wetted swab or sponge, followed by DNA extraction. Given the importance of this step, it is surprising that potential sources of sampling bias are not rigorously tested in most microbiome surveys of food processing plants. In this proof-of-principle study, we will test four sampling-related assumptions made in many microbiome studies.

.....

Engineering and ecological approaches reduce Pacific tree frog intrusion into leafy green agriculture****

Contact

Michelle L. Green, University of Illinois
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Project Date

January 1, 2018 – December 31, 2019

Summary

It's no secret that consumers expect perfection. In the case of fresh produce, consumers expect a product that is safe for consumption and visually appealing. Unfortunately, the Pacific tree frog, also known as the Hollywood frog, is challenging the leafy green production environment with its high reproductive capacity and extraordinary ability to scale traditional exclusion fences. We are using information at the intersection of Pacific tree frog biology and agricultural engineering to mitigate tree frog intrusion into production environments. Our approach is multifaceted, with the overall aim to provide producers with several options to reduce frog intrusions. We intend to provide data on a variety of exclusion methods, which will ultimately allow producers to tailor mitigation efforts to their own unique growing situation.

Poster Session

FSMA agricultural-water die-off compliance provisions benefit from condition-specific modifiers

Contact

Renata Ivanek, Cornell University
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Project Date

January 1, 2018 – December 31, 2019

Summary

The FSMA Produce Safety Rule includes a provision stating that if *E. coli* levels exceed a certain threshold in agricultural water, produce growers must wait a set period from water application to harvest according to a die-off rate of 0.5 log CFU/day. Validation is needed to confirm the accuracy of this die-off rate and to evaluate die-off of *E. coli* as an indicator for die-off of pathogens. This study will track the die-off of generic *E. coli* and attenuated *Salmonella* on baby spinach and baby lettuce in replicated, controlled field trials in Davis, CA, Freeville, NY, and Murcia, Spain. An irrigation event using water contaminated above the set threshold will be simulated using a cocktail of *E. coli* and *Salmonella* strains. Survival of these strains on the produce will be enumerated at several time points following application. This data will be used to evaluate the accuracy of the FDA estimated die-off rate and to identify factors that affect the die-off rate.

.....

The effects of storage conditions and the microbiome of non-traditional salad ingredients on the fate of *Listeria monocytogenes*****

Contact

Amanda Lathrop, California Polytechnic State University
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Project Date

January 1, 2018 – December 31, 2019

Summary

Consumer demand for bagged salad has moved beyond shredded iceberg and chopped romaine to more nutritionally dense greens with bold flavors. Many of these new ingredients have not normally been consumed raw or may not have even been widely consumed. This project will investigate the fate of *Listeria monocytogenes* on non-traditional salad ingredients under ideal, abusive and “real-world” storage conditions, and the influence of the produce microbiome on *L. monocytogenes* behavior. Beet greens, kale, Brussels sprouts, and broccoli stalk will be inoculated with *L. monocytogenes* and incubated at 4, 12, 22 and 35°C. *L. monocytogenes* populations and the microbiome will be monitored over the incubation period. To further assess *L. monocytogenes* growth risk, products will be tested under simulated storage and distribution conditions using *L. innocua*. Producers will be able to use this data to develop management strategies to minimize food safety risk.

Poster Session

Mathematical modeling tools for practical chlorine control in produce wash process

Contact

Daniel Munther, Cleveland State University
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Project Date

January 1, 2018 – December 31, 2018

Summary

The produce wash stage has received much attention as a critical control point, however, recent studies indicate a limited understanding of the dynamics of sanitizer control during washing. One problem is that the relationships between water quality constituents and sanitizer levels have only been described via experimental/correlative approaches or by risk models that are difficult to parameterize accurately. Accordingly, there is an urgent need to mathematically describe the fundamental dynamics that generate the observed relationships between sanitizer levels and water quality parameters. Based on such formulations, the primary objective of this proposal is to develop data-informed modeling tools which quantitatively link easily measurable water quality parameters to commodity specific organic load and free chlorine (FC) consumption during recirculated wash conditions. Based on USDA experimental data and our recent modeling results, we hypothesize that our modeling tools will provide the industry with predictive capabilities that are not possible using correlations alone.

.....

Rechargeable antimicrobial and antifouling plastics for improved cleaning and sanitation of plastic bins and totes****

Contact

Nitin Nitin, University of California, Davis
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Project Date

January 1, 2018 – December 31, 2019

Summary

Sanitation of reusable plastic containers (RPCs) is a significant challenge and can lead to cross-contamination of fresh produce. These cross-contamination events can result in a foodborne disease outbreak as well as reduce the shelf life or quality of the product. To address this challenge, the project is aimed at development of a rechargeable antimicrobial and antifouling plastic material and its evaluation for eliminating contamination of RPCs by various sources and reducing biofilm formation. This novel plastic material can be used as a rechargeable liner attached to existing RPCs and/or development of new RPCs with this material. In summary, this research proposal addresses a significant unmet need in the industry to improve sanitation of RPCs.

Poster Session

Use of raptors to prevent wild bird and rodent intrusion into fresh produce fields

Contact

Paula Rivadeneira, University of Arizona Cooperative Extension
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Project Date

January 1, 2018 – December 31, 2019

Summary

Wild animals, such as birds and rodents, carry foodborne pathogens that may be a threat to fresh produce crops. This project will determine if the use of falconry is an efficient and cost-effective natural way to deter birds and control rodents in fresh produce fields. Falconers are flying captive-bred predatory birds every hour from sunrise to sunset to deter nuisance birds, and in later stages of the project, we will control rodent populations by attracting native owls and kestrels to fresh produce fields using nest boxes. We will also release native rehabilitated birds in agricultural areas. We are measuring the success of falconry using bird counts, pre- and post-rodent trapping, and documentation of food safety risks in fields with and without falconry. To date, we have a 97% success rate in deterring nuisance birds with the use of falconry.

.....

UA Ag Water app-language expansion and practical grower-inspired improvements

Contact

Channah Rock, University of Arizona
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Project Date

January 1, 2018 – December 31, 2018

Summary

This project builds on the current body of knowledge related to agricultural water and its evaluation for the protection of public health. The project specifically addresses stakeholder needs in an immediate way to help provide needed information to comply with FDA FSMA regulations to the broadest stakeholder group possible. Whether the Ag Water app is used as a training tool to help growers and food safety managers better understand water quality, or as a resource to meet the FDA FSMA regulations, updates are required to meet grower needs as well as reach the broadest stakeholder group possible (including Spanish speakers). This project focuses on improving the functionality of the Ag Water app based on real-world grower feedback as well as deploying a fully functioning Spanish version of the app and associated on-line tools developed by the University of Arizona.

Poster Session

Metagenomics to identify viral indicators in the produce chain (MAGIC)

Contact

Gloria Sánchez Moragas, IATA-CSIC, Spain
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Project Date

January 1, 2018 – December 31, 2019

Summary

Detection of human pathogenic viruses in produce or irrigation water currently relies on culture-based methods of bacterial indicators, which frequently fail to correlate with the presence of enteric viruses (e.g., human norovirus and hepatitis A virus). Culture-independent metagenomic approaches (i.e., massive sequencing) provide the highest resolution to analyze species diversity, and will be applied to irrigation water, stools (which may contaminate agricultural and produce handling facilities by food handlers), and produce in order to search for new indicators. Our project goal is to identify viral species that correlate with presence/abundance of human enteric viruses in irrigation waters and produce by using next-generation sequencing techniques. The identification of meaningful viral indicator/s will allow the produce industry to simplify the control of enteric viruses by a simple and rapid procedure to detect and quantify the indicator, which in the short term will be implemented in the produce chain.

.....

Scientifically valid corrective actions for multiple harvest shade-house production systems****

Contact

Trevor Suslow, University of California, Davis
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Project Date

January 1, 2018 – December 31, 2019

Summary

From 1996 to 2016, multiple outbreaks associated with consumption of shade-house or greenhouse grown produce were reported. Environmental investigations underscored the need for science-based practices to prevent or respond to detected contamination on multiple-harvest crops produced in protected culture systems. Pathogen detection typically results in destruction of the remaining crop; however, a knowledge-based foundation for pathogen die-off and systematic sampling regimes has broad industry support. At this time, there is very sparse science-based guidance for assessing the risk of contamination of fresh produce grown under protected culture. Closing this knowledge gap is critical to decision-making and application of valid corrective actions following pathogen detection in product or environmental samples. Our specific goal is the assessment of die-off expectations for bacterial pathogens and assessment of corrective action options for shade-house grown crops. We will evaluate measures to minimize the risk of transference and persistence of bacterial pathogens in the shade-house culture.

Poster Session

Establishment of vegetative buffer zones to reduce the risk of STEC and *Salmonella* transmission from animal operations to fresh produce on co-managed farms****

Contact

Siddhartha Thakur, North Carolina State University
sthakur@ncsu.edu

Project Date

January 1, 2018 – December 31, 2019

Summary

To provide fresh, healthy and safe produce to consumers, we need to find effective and efficient practices that will allow us to continue farming with limited resources and land availability. Sustainable farming practices have, at their core, an integration of crops and livestock, recycling of nutrients and the well-being of humans and the environment. These farming practices increase crop productivity and environmental stewardship, although knowledge gaps exist, specific to the presence or removal of vegetative buffer zones (VBZ) between animal production areas and produce fields and the potential relationship for pathogen transfer. This project will evaluate the effectiveness in reducing or eliminating movement of Shiga toxin-producing *Escherichia coli* (STEC) and *Salmonella* from animal production areas to adjacent produce fields by establishing a fast-growing and cost-effective VBZ between these areas within a 1–2 year growing season. Our proposal is unique and based on data collected from previous CPS and USDA projects.

.....

Listeria whole genome sequence data reference sets are needed to allow for improved persistence assessment and source tracking*****

Contact

Martin Wiedmann, Cornell University
mw16@cornell.edu

Project Date

January 1, 2018 – December 31, 2019

Summary

Routine use of whole genome sequencing (WGS) to “fingerprint” *Listeria monocytogenes* (*Lm*) from humans and foods has considerably increased the number of disease outbreaks detected and traced back to specific foods, including produce. WGS also is used to identify instances where a specific type of bacteria appears to survive in a given food processing facility, indicating a particular food safety risk. However, our ability to interpret WGS data is hampered by (i) a lack of WGS data for bacteria from sources other than humans and foods and (ii) the need to better define how likely closely related bacteria can be found in different locations. Thus, collection of *Lm* and other *Listeria* spp. from environmental sources and comprehensive genomic comparisons among these bacterial isolates along with isolates from produce associated environments and human cases will facilitate more accurate interpretation of WGS data relevant to produce related food safety issues.

Poster Session

Application of chitosan microparticles to eliminate foodborne pathogens in agricultural water that contacts fresh produce*****

Contact

Anita Wright, University of Florida
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Project Date

January 1, 2018 – December 31, 2018

Summary

The consumption of raw fruits and vegetables requires the prevention of contamination by foodborne pathogens in the pre- and post-harvest stages. Agriculture water, either for applications of irrigation or produce sanitation, is a possible source of foodborne diseases. Disinfection of irrigation or wash water is most often carried out by treatment with chlorine. However, because treatment with chlorine results in only a 100-fold reduction and the creation of toxic byproducts, a safer, more effective, and less toxic treatment is needed. We are investigating the feasibility of using chitosan microparticles (CM, a cross-linked derivative of chitosan) as an alternative treatment for surface waters used for irrigation. Prior research showed that CM treatment required a concentration of 0.3% CM (w/v) to effectively reduce *Salmonella* inocula (100,000 CFU/ml) to below detectable levels in 24 h, and was not effective for stationary growth phase cells. Furthermore, CM efficacy was greatly reduced when used in conjunction with intact pond water. The current research aims to develop and optimize applications for treatment of agricultural water.

(*) 2015 RFP This project was supported by the Specialty Crop Block Grant Program at the U.S. Department of Agriculture (USDA) through Grant 15-SCBGP-CA-0046.

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(***) 2017 RFP** This project was supported by the Specialty Crop Block Grant Program at the Florida Department of Agriculture and Consumer Services through Grant USDA-AMS-SCBGP-2017.

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