

## Plant Pathology's Role in the Safety of the American Fresh Produce Supply

**Background:** Since 1996, over 80 foodborne illness outbreaks were associated with fresh fruits and vegetables consumed raw or minimally-processed. Recalls and litigation have cost the produce industry millions and has impacted every sector of the industry. Uncertainties about our ability to prevent future contamination throughout the supply chain continue to haunt U.S. producers, processors, retailers, and regulators. There have been increasing calls for the government, produce associations, and food retailers to institute improved, science-based food safety standards and audit compliance programs.

The past decade has seen a significant increase in the frequency of produce-associated outbreaks of human diseases, negating the paradigm that food-borne human pathogens are associated primarily with animal products. Scientists recognize that crop plants can be contaminated with human bacterial pathogens in the field. For example, preliminary research on *Salmonella enterica* in association with plants shows:

- Preferential bacterial colonization in the rhizoplane
- Bacterial growth on root surfaces
- Extended survival in soil and population increases when crops are planted subsequently
- Complex surfaces, such as the cantaloupe rind, harbor and protect cells from decontamination methods.

Despite these indications, most studies have focused on potential postharvest solutions rather than addressing microbial-plant interactions in the field. The effectiveness of potential risk reduction and prevention strategies remains unclear and largely empirical since we have insufficient knowledge about the interactions of food borne pathogens with one another, with plants, and with nonpathogenic microflora.

New fundamental and practical research is needed to identify best management practices and to investigate contamination routes, environmental survival, and interactions of human pathogens with plants. The 5,000-member American Phytopathological Society (APS), with 100 years of expertise on the complex relationships between microbes and plants, is a valuable scientific resource to enhance fundamental knowledge of, and design effective solutions to, microbial contamination of food plants. The training and experience routinely applied by plant pathologists to understand the mechanisms of pathogen colonization and translocation within hosts, mechanisms of environmental dispersal, plant responses and strategies to defend themselves, and possible intervention strategies will be critical elements of a balanced program to minimize foodborne illnesses. Already, plant pathologists are contributing to needed research on human pathogen-plant interactions by applying modern plant pathology strategies for understanding host-pathogen interactions. However, more effective solutions will require the application of emerging research tools and strategies, as well as creative cross-disciplinary research efforts. For example, critical unanswered questions related to *S. enterica* include:

- Is *S. enterica*, via natural contamination routes, solely an **epiphyte** or also an **endophyte**? (e.g., can fruit be internally contaminated and can human bacterial pathogens be harbored under the seed coat, external to the embryo?)
- Do human bacterial pathogens **change** in the plant environment? (e.g., are plant-associated *S. enterica* serovars **environmentally** more **adaptable**?)
- What mechanisms are used by *S. enterica* to survive in or on plants?
- Can the presence of plant pathogens influence the colonization of human bacterial pathogens on plants?
- Can **plant resistance** be employed against human bacterial pathogen colonization?

**Solution:** We propose the establishment of an interagency program specifically focused on gaining fundamental and practical knowledge of human pathogen-plant interactions. Recognizing that plant pathologists must work closely with those in the food industry, medical personnel, producers, policy-makers, and others to achieve our food safety goals, the interagency program also would provide a venue for cross-disciplinary interactions among plant pathologists and food safety specialists in academia, industry, and government.

**Contacts:** APS PPB Member **Jeri Barak** (barak@plantpath.wisc.edu), PPB Chair **Jacque Fletcher** (jacqueline.fletcher@okstate.edu) and **Kellye Eversole** (eversole@eversoleassociates.com) are available to answer any additional questions.