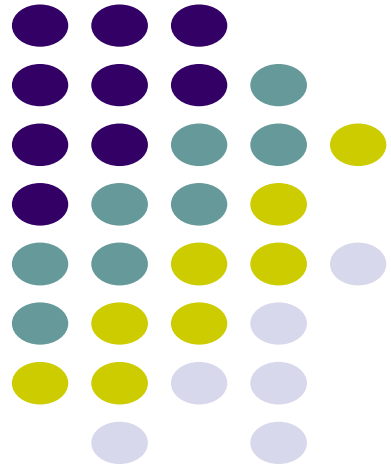
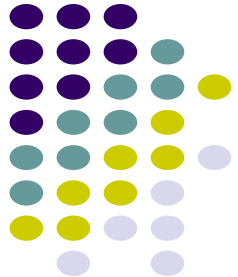
Detection of Human Pathogens on Plants

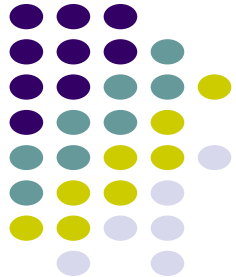


Significance of human pathogens



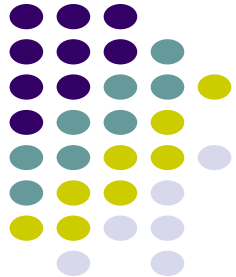
- Unlike most plant pathogens, human pathogens that associate with plants often fail to multiply in plant host and usually occur in low numbers. Nevertheless, their presence on plants could have significant public health and economic consequences.
- National and international disease outbreaks associated with human pathogens on plant products, such as lettuce, spinach, green onions, seeds, sprouts, peppers, spices, tomatoes, and cantaloupes, have occurred frequently. Current standardized assays for the detection of major human pathogens on plants rely largely on microbiological, biochemical, and immunological analyses that are laborious and time consuming.
- Newer molecular-based methods, such as PCR, loop mediated isothermal amplification (LAMP), and metagenomics approaches offer enhanced speed and sensitivity, and some of these have already been incorporated into the standard assays.

- Certain human pathogens, especially enteric microbes such as pathogenic *Escherichia coli* and *Salmonella* spp., also contaminate, colonize and even invade plants.
- Human diseases caused by such plant contaminants are becoming more common, widespread, and consequential, and national food safety agencies across the globe are seeking greater understanding of the mechanisms and interactions of human pathogens on plants (HPOPs).
- Increasing opportunities for interactions, collaborations and cooperation among plant pathologists and food microbiologists, a cross-disciplinary synergy has developed from which novel, robust and sustainable solutions to HPOP challenges have emerged.



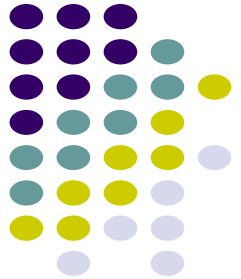
- Fresh produce has been associated repeatedly, and with increasing frequency, with outbreaks of foodborne illnesses. Leafy greens, melons, sprouts, berries, tomatoes and green onions, often eaten with little or no processing steps to eliminate pathogens, are among the most common produce implicated.
- Shiga toxin-producing *Escherichia coli* O157: H7 has been found on leafy greens, *Salmonella* spp. on tomatoes, peppers and cantaloupes, hepatitis A virus on green onions, Shiga toxin-producing *E. coli* O104 on fenugreek seed sprouts and *Listeria monocytogenes* on cantaloupe.
- In many cases contamination occurs either in the field or in the processing phase. Many HPOPs exist in environments where plants are grown. In a single year (2011–2012) the FDA in USA issued recalls of 56 produce items including fresh-cut fruit and vegetables and bagged vegetables that contained *Listeria* spp., pathogenic *E. coli* or *Salmonella.*

- Opportunities for HPOP contamination of fresh produce begin on the farm and continue through all nodes of the food production and distribution chain, not ending until the food is consumed
- How pathogens move, directly or indirectly, from vertebrate sources into plant foods can be complex and multi-faceted. Understanding these sources and pathways is critical for the development of prevention and mitigation strategies.



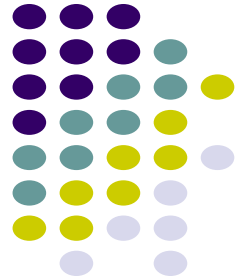
- Interestingly, the Gram negative bacterial family Enterobacteriaceae, which includes many of the human pathogens associated with plant foods (e.g., *Escherichia*, *Salmonella*, *Shigella*), also contains several plant pathogens (*Enterobacter*, *Erwinia*, *Pantoea*, *Pectobacterium*, etc.).
- The taxonomic relatedness of these plant and human pathogens raises interesting questions about the possibilities for niche competition or synergism, horizontal gene exchange in protected plant niches, or even host range expansion.
- A few cross-kingdom pathogens such as *Pseudomonas aeruginosa*, *Burkholderia cepacia*, *Dickeya* spp., *Enterococcus faecalis* and *Serratia marcescens* actually cause disease on both plants and humans

Challenges



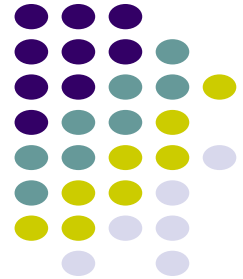
- High Background Microflora, Low Numbers of Target Human Pathogens
- Perishable Nature of Plant Samples
- Nonhomogeneous Distribution of Target Pathogens in Plant Samples
- Moving Target
- Detection and Predicting Infectivity

Detection of Human Pathogens on Plants



- Standard Assays (Culture-Based Methods)
- Molecular-Based Methods
  - PCR-Based Methods
  - DNA Microarrays
  - Next-Generation Sequencing (NGS)
- Biosensor-Based Techniques

Microbes withdrawn from agricultural use



- ***Pseudomonas aeruginosa*** is a Gram-negative environmental species and an opportunistic microorganism, establishes itself in vulnerable patients, such as those with cystic fibrosis or hospitalized in intensive care units. It has become a major cause of nosocomial infections worldwide and a serious threat to Public Health.
- Until some years ago it was used as a plant growth promoter in agriculture and now use of such bacteria has not been recommended for agricultural use