Western Regional Research Center

The dynamics of human pathogen colonization of produce.

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Produce Safety and Microbiology Research Unit

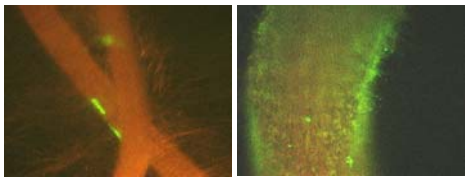
Norwalk virus

- **intestinal illness that often occurs in outbreaks.**
- **Norwalk and Norwalk-like viruses are increasingly being recognized as leading causes of foodborne disease in the United States.**

Research GOALS:

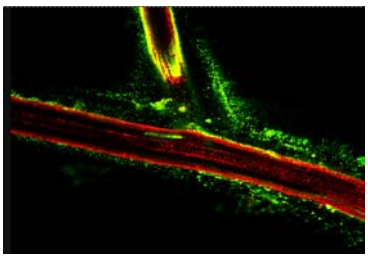
- to develop an easy, sensitive assay for contamination in produce
- to further understand molecular biology, molecular ecology, and pathogenesis of this unique virus

Differential colonization of sprouts by *Listeria monocytogenes*

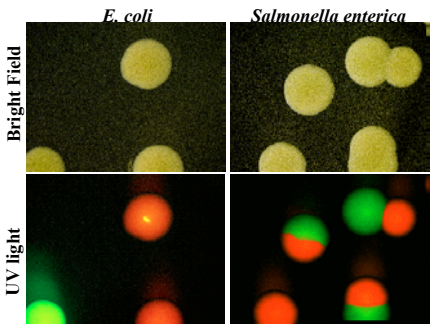


3-day-old radish sprouts 3-day-old alfalfa sprouts

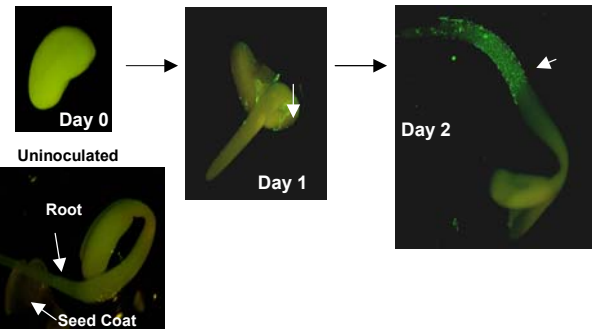
L. monocytogenes colonizes the root and root hairs of alfalfa sprouts, but only the root of radish sprouts.



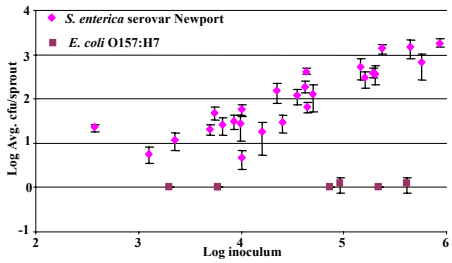
GFP-labeled *Salmonella* (green) is shown to invade the Arabidopsis root (red). Invasion has only been found to occur at the point of lateral root development. During development cell division and expansion within the lateral root pushes through the outer layers of the epidermis of the primary root, essentially tearing the cells apart. This allows the bacteria to enter the primary root.



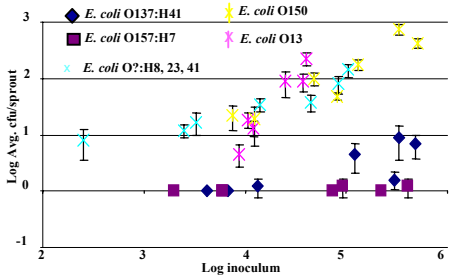
E. coli and *Salmonella enterica* colonies transformed with plasmids constructively expressing *gfp* or *D*sred. Single colony forming units viewed under bright field microscopy are revealed as mixed colonies (two strains per colony) under UV light microscopy.



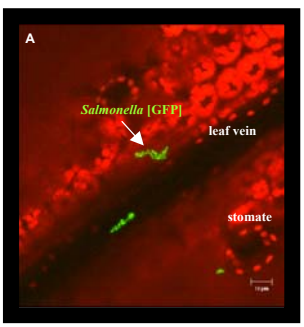
Salmonella enterica multiplies on sprouting alfalfa seeds. Alfalfa seeds were inoculated with a fluorescent green *S. enterica* strain. The alfalfa seeds are slightly fluorescent at day 0 and few bacteria are present (approximately 10-100 per seed), so the bacteria are not visible. After one day of seed sprouting, the *S. enterica* bacteria have multiplied to approximately 50,000 per sprout and they are visible on the alfalfa seed coat edges. By the second day of sprouting, the *S. enterica* have have multiplied to over 1,000,000 per sprout and they have colonized the alfalfa root.

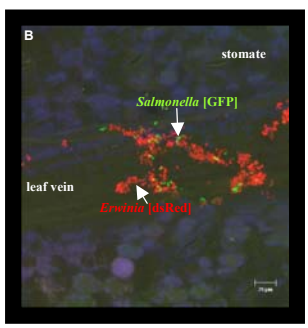


Attachment assays on 3-day-old alfalfa sprouts revealed that at a given inoculum, 1 to 3 logs higher populations of *S. enterica* cells attach than *E. coli* O157:H7

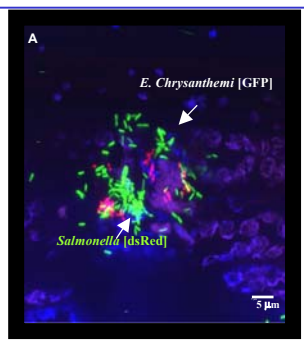


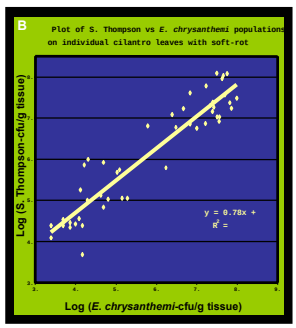
There was no significant difference in attachment among *S. enterica* serovars; however, there were significant differences between attachment of *E. coli* serotypes. Four *E. coli* serotypes, recovered from cabbage roots following a sewage spill, varied in their ability to attach to sprouts.





Salmonella enterica serovar Thompson has the ability to colonize plant surfaces. Confocal Laser Scanning Microscopy revealed that (A) *Salmonella* grew into distinct microcolonies on the veins of cilantro leaves and (B) *Salmonella* cells were part of large bacterial aggregates nine days after its coinoculation onto cilantro with the plant-associated *Erwinia herbicola*. The presence of *Salmonella* in large aggregates has major implications for sanitation measures aimed at preventing food-borne illnesses.





The presence of soft-rot disease promotes the growth of *Salmonella* on plants. (A) *Salmonella* was closely associated with the plant pathogen, *Erwinia chrysanthemi* , which causes soft-rot lesions on leaves. (B) The population size of *Salmonella* was strongly correlated with that of *E. chrysanthemi* on cilantro leaves, suggesting a possible interaction between these bacterial species on plants.