S. Typhimurium and *E. coli* O157:H7 Transport Modeling for Agricultural Practices

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Justification:

Animal waste is a valuable resource, which, when managed properly, can reduce the need for commercial fertilizer. Similarly, as a new recognized water resource, nutrient-rich reclaimed wastewater supplies not only water, but also plant nutrients (especially nitrogen and phosphorus) that can benefit agricultural production. When animal waste or reclaimed wastewater is used for land applications or agricultural irrigation, the major concern is the possible spreading of infectious agents or pathogenic organisms in the soil and the subsequent possibility of groundwater contamination once the infectious agents or pathogenic organisms pass through the vadose zone and reach the groundwater table.

Objectives:

Our major research interest concerns the impact of physiological growth stage and macro nutrient ratio on the fate and transport of *S. Typhimurium* and *E. coli* O157:H7 in the subsurface soil. We believe that the transport of *S. Typhimurium* and *E. coli* O157:H7 is controlled by their interactions with the surrounding environment, which are determined by their surface thermodynamic properties. This project seeks to provide operation strategies for animal waste land applications and reclaimed wastewater agricultural irrigation. Three major thrusts will be focused on this project: (1) *S. Typhimurium* and *E. coli* O157:H7 surface property characterization and interaction quantification under different physiological stage and macro nutrient ratio conditions, (2) *S. Typhimurium* and *E. coli* O157:H7 transport conceptual model development and validation, and (3) implementation of research discovery in field applications.

Progress to date:

The following major tasks have been accomplished so far: (1) *E. coli* surface property characterization under different physiological stage and macro nutrient ratio conditions, (2) *lux* gene impact evaluation, (3) effect of lipopolysaccharide extraction on bacterial transport, and (4) *E. coli* transport in unsaturated porous media. We demonstrated that *E. coli* had different surface properties under different physiological stage and macro nutrient ratio conditions. We also investigated the effect of *lux* gene insertion on bacterial surface properties and the effect of lipopolysaccharide extraction on bacterial transport. In addition, we conducted laboratory column transport experiments to explore *E. coli* transport in unsaturated porous media. *E. coli* interactions within the system were characterized based on bacterial and media surface thermodynamic properties to provide evidence of the bacterial retention mechanisms in the pore system.

Impacts:

1. Chen, G., 2008, Bacterial interactions and transport in unsaturated porous media, Colloid Surface B., 67: 265-271.
2. Penagonda Srinivasa Ranga, V., A. Chan Hilton and G. Chen, 2008, Lipopolysaccharide extraction on bacterial adhesion and transport, J. Adhes. Sci. Technol., 22: 1073-1088.
3. Chen, G., P. Subramanian and K. Tawfiq, 2009, Bacterial deposition in unsaturated porous media as related to surface properties, Int. J. Environ. Pollut., in press.