Waste Residuals Determine Microbial Risks

The recent and seemingly ongoing outbreaks associated with various fresh food crops have increased scrutiny on pathogens and wastes. Likewise, concentrated animal feeding operations (CAFOs) and municipal wastewater treatment plants continue to produce millions of tons of waste per year. The quantitative microbial risk assessment (QMRA) is one tool that can be used to assess the impact of anthropogenic and environmental decisions and factors, which ultimately affect regulatory decisions and environmental and public health. QMRA has been applied to a number of studies, but to date, no study has compared the microbial risks associated with various waste residuals.

To better understand the effect of waste residuals on pathogenic risk, a team of researchers from the USDA-ARS Genetics and Precision Agriculture Unit and the University of Arizona applied predictive models to available pathogen survival data during and following land application of waste residuals. Land application of waste residuals is a vital management tool, meant to simultaneously dispose of a waste by-product, but also enhance soil nutrients and organic matter. Inherent risk has always been associated with the practice, given that there are many types of pathogens potentially present in wastes. Anecdotally, there are implications regarding wastes and infections, but few if any documented cases. Nevertheless, the connection between wastes and pathogen risks will always be questioned.

A handful of risk assessment studies have looked into this; many have revolved around occupational aerosol exposures or a single waste type. There has never been a direct comparison of risks associated with various wastes, particularly manure. The need for QMRA and manure application is necessary, given the proliferation of CAFO wastes and the need for proper disposal.

A pathogen must survive the environment to become a public problem; moisture, organic matter, and soil type play significant roles in this survival. Add to this, manure or biosolids, and the combination of these factors can significantly alter pathogen survival, particularly given a waste with high total solids. The complexities and nuances of a biological system, such as a bacterial cell, and an environment are difficult to surmise, and thus risk assessments are used to predict what the pathogen may or may not do.

In the November–December 2012 issue of the *Journal of Environmental Quality*, researchers predicted microbial risks associated with pathogens arising from various public and occupational exposures to land-applied biosolids and manure. Previous approaches were refined and suggested that risks were highly dependent on waste; particularly, bacterial risks were greater with manures while viral risks were greater with biosolids. Occupational, more direct risks were greater than indirect public risks, which often occur after time and dilution have reduced pathogen loads to tolerable levels. Approximately 30 days were required to reduce most pathogens, in most scenarios, to levels where risks would be acceptable. However, recalcitrant pathogens, high waste-pathogen levels, or recent contamination pose the greatest threat.

Applying minimal harvest delays (e.g., four months) appears to be enough time to reduce risks for most scenarios. Overall, it appears that in the short-term, risks were high for both types of waste residuals, but treatment, attenuation, and dilution reduce risks. That said, the researchers suggest that limited-data sets, site-specific inactivation rates, pathogen spikes, environmental change, regrowth, and wildlife all increase risk and uncertainty and remain poorly understood areas of research.
