When the *E. coli* hits the fan! Evaluating the risks of dust-associated produce cross-contamination

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Summary

Dust represents an understudied vehicle for microbial dispersal and produce contamination by pathogens. This study proposes the following: 1) To evaluate the role of dust in transferring foodborne pathogens to produce surfaces grown in eastern and western US regions, 2) To determine the role of humidity in the deposition of dust on produce and the survival of pathogens in dust, and 3) To test dust particulates from animal operations in both regions for the presence of biomarkers indicative of fecal contamination and the potential presence of pathogens. This study will enhance our understanding of pathogen transport from feces into and through produce fields and will quantify the risk associated with contamination from dust under varying environmental and atmospheric conditions.

Objectives

1. Evaluate the role of dust in transferring foodborne pathogens to the surfaces of produce commodities specific to the eastern and western agricultural regions of the United States.
2. Understand the role of humidity in the deposition of dust on produce and the survival of foodborne pathogens in dust particulates.
3. Test dust particulates from animal operations for the presence of biomarkers indicative of fecal contamination and the presence of enteric bacterial pathogens.

Methods

The transfer rates of *E. coli* O157:H7 and *Salmonella* species per gram of dust to surfaces of romaine lettuce, spinach, tomatoes, bell peppers, apples, and peaches have been determined in experiments (examples in **Figures 2–4**) simulating the growing conditions in the region of interest.
The roles of humidity, agricultural practice (organic vs. conventional), and soil characteristics on cross-contamination are being evaluated.
Persistence of bacteria on dust-contaminated produce is also being examined.
Dust particulates from varying distances (e.g., 400 feet, 1,200 feet, and 1 km) from poultry/beef facilities have been collected and are being evaluated for the presence of indicator organisms, pathogens, bacterial endotoxins, and fecal biomarkers including bile salts and fecal genetic markers.
A quantitative microbial risk assessment will be performed at the conclusion of the study.

Results to Date

The dust particle size (**Figure 1**) does not generally affect the ability of the bacteria to be transferred to the surfaces of various produce types (**Figures 2–4**).

The transfer and recovery rates vary greatly by species/strain. No real differences were observed between the transfer rates to the surfaces of tomatoes, bell peppers, and apples; however, larger transfer rates were observed on peaches for both *Salmonella* strains. This greater transfer rate was likely due to the presence of trichomes (fine hairs) on the peaches. These hairs likely trap dust particles (especially particles >100 microns), whereas produce types with smooth surfaces are less efficient at trapping dust particles.

The dust samples collected near animal feeding operations are currently under evaluation and thus results are pending.

Benefits to the Industry

This project will enhance our understanding of pathogen transport from feces into and through produce fields, and quantify the risk associated with contamination from dust. It also investigates contamination of produce grown in two different regions of the US (Arizona and Georgia) with varying environmental and atmospheric conditions. We will develop exposure models using a QMRA framework to estimate risks from dust transporting microbial contamination onto produce and to determine the importance of dust particulate type, produce type, and proximity to animal operations. Information on the occurrence and survival of pathogens on fresh produce and the level of contamination under different conditions will be utilized for the implementation of this model. This research will help to improve the safety of fresh produce.

Figure 1. Dust particle sizes used in cross-contamination and transfer studies (≥3,360 μm, >100 μm, <100 μm).

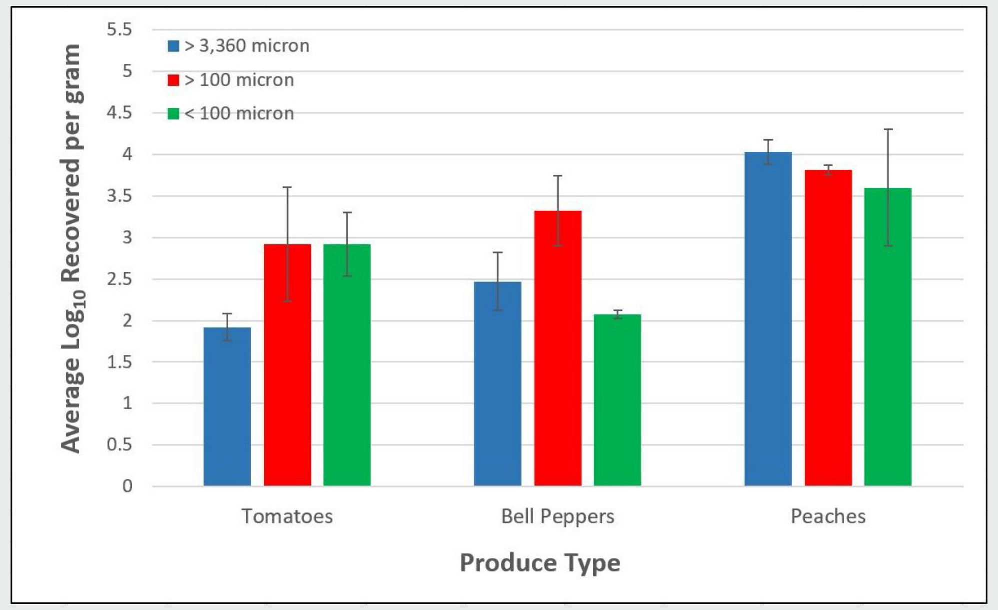

Figure 2. Cross transfer of *Salmonella* Newport from dust of varying particle sizes (<100 microns to ≥3,360 microns) to the surfaces of fresh produce.

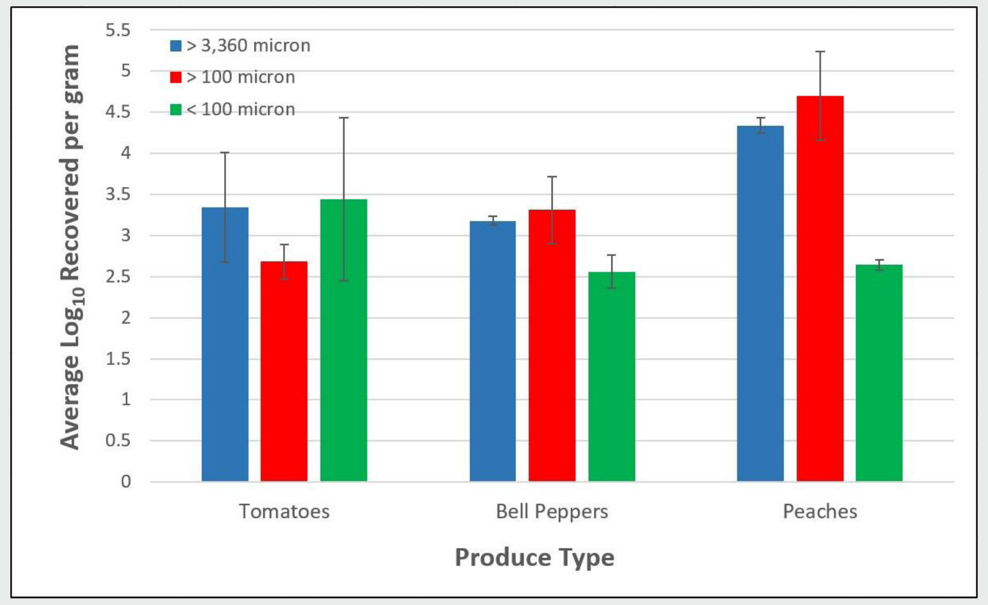

Figure 3. Cross transfer of *Salmonella* Typhimurium from dust of varying particle sizes (<100 microns to ≥3,360 microns) to the surfaces of fresh produce.

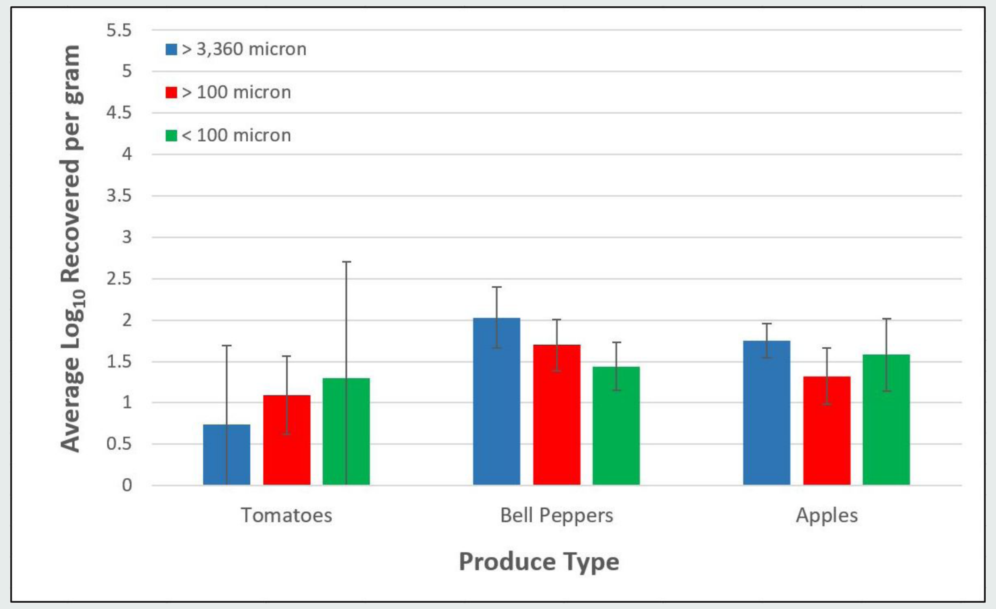

Figure 4. Cross transfer of *E. coli* O157:H7 from dust of varying particle sizes (<100 microns to ≥3,360 microns) to the surfaces of fresh produce.