Background

- Manure is commonly used as a fertilizer in vegetable production fields on both conventional and organic farms. Application of untreated biological soil amendments of animal origin may represent a potential risk for fresh produce contamination with enteric pathogenic bacteria.
- FDA is conducting a risk assessment and, in collaboration with the U.S. Department of Agriculture and other stakeholders, is undertaking critical research to strengthen scientific support for any future proposal regarding the use of raw manure and soil amendments and harvest. The present work contributes to that research.

Objectives

1. To examine the survival of generic *E. coli* cocktail strains applied to soil amended with manure for 9 months and potential transfer to tomatoes for 12 months
2. To compare survival of *E. coli* on soil amended with different animal manure types: horse, cattle, goat, chicken litter and no manure (control)

Experimental design and manure treatment

- The field trial was carried out in 2013-2015 in the University of California Davis Vegetative Crop. Field plot (1x2 m) amended with chicken litter (4 lbs.), horse (5 lbs), cattle (5 lbs), goat manures (5 lbs), and no treatments were inoculated with 1L of bacterial fecal slurry.
- Three strains of indicator *E. coli* resistant to rifampicin were inoculated in high (10⁷ CFU/ml) or low (10⁴ CFU/ml) inoculum.

Sampling procedures

- Soil samples from 44 plots including negative control plots (n=4) were collected on day 0, 1, 3, 7, 14, 28, and every month until 9 months
- Four replications were applied all manure types with low and high inoculum
- Five tomato fruits per plot were harvested from month 4 to 7.
- Direct plate count and most probable number (MPN) were used to quantify bacterial concentration.

Methods

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Results and Discussion

- In the present study, an average of a 7 log reduction of inoculated *E. coli* was observed, across all types of manure after 120 days from the time of manure application.
- The generic *E. coli* populations survived longest in untreated chicken litter followed by horse, cattle and goat manure.
- *E. coli* populations increased after heavy rains by an average of 5 to 6 log CFU in both high and low inoculum plots.

Experimental design for inocula

- Figure 1: Low and high inoculum were separately transferred to a backpack sprayer

Soil sampling

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Inoculum

- Inoculum type: Fecal type: Horse manure 1.508 Cattle manure 1.376 Goat manure 0.967 Chicken litter 1.884

Statistical analysis

- Table 1: The linear regression model with predictive mode was used to determine the amount of a cocktail indicator *E. coli* in manure amended soil (log₁₀N₀/N) using MPN determination method within 9 months

Conclusions

- Although die-off of *E. coli* was observed in soil 120 days after inoculation of manure amended soil with *E. coli* during a fall-winter period, resuscitation was observed for all manure types following heavy spring rains. The findings suggest that generic *E. coli* experiences multiple log reductions over 120 days, but exposures to rain can temporarily reverse these reductions. These results indicate that the use of raw or untreated manure may be a source of field contamination with pathogens. However, no *E. coli* contamination of tomatoes from the manure amended soils was observed in this limited study.

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