Evaluating the Persistence of *Escherichia coli* in the Soil of an Organic Mixed Crop-Livestock Farm

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Abstract

Mixed crop-livestock farms—those that integrate crops and livestock and use their animals to graze crop residues or cover crops—are sustainable farming systems that utilize grazing because it enhances soil fertility, recycles farm nutrients and provides another source of revenue through meat production. Yet third-party food safety auditors have directed attention toward these farms, due to possible risks associated with grazing vegetable fields. Raw manure from grazing animals may introduce zoonotic foodborne pathogens, such as Shiga toxin-producing *Escherichia coli* (STEC), into fields planted to high-risk crops (e.g., spinach, lettuce, melons) and these pathogens can exist in the soil for extended periods of time. STEC remains one of the leading causes of foodborne outbreaks. Leafy greens accounted for 21% of *E. coli* O157 outbreaks between 2002-2013.

Although farmers want to ensure that the food they raise is safe, they are also concerned about complying with guidelines that make it burdensome to continue these mixed crop-livestock systems. Current National Organic Program (NOP) standards require 120 days between raw manure application and harvest, if the crop touches the soil. However, third-party food safety auditors may have stricter guidelines and upcoming federal regulations remain vague on interval times between grazing and harvest. Research on the persistence of *E. coli* in the soil, within mixed crop-livestock environments, is limited and this pilot study provides baseline data to assess any risk associated with these types of farms.

Soil samples were collected from a mixed crop-livestock organic farm to ascertain the concentration and persistence of generic *E. coli* and fecal coliforms, as indicators of microbial contamination. Fecal samples were tested to establish the baseline prevalence of STEC within the farm's sheep flock (sheep are asymptomatic reservoirs for STEC and fecal shedding may increase during periods of stress).

A five-acre cover crop plot was grazed by sheep in the spring of 2015 and later planted to summer crops. This plot was divided into three fields and twelve random soil samples were collected from each field on each sample day: Day 0, 7, 14, 21, 28, 56, 84 and 122. The MPN (most probable number) of generic *E. coli* was measured. Information regarding farming practices and environmental parameters was also collected, including type of irrigation, soil temperature and humidity.

The overall STEC prevalence in the sheep flock was 4.2%. Since STEC exists in this sheep flock, estimating generic *E. coli* persistence in the soil is important for developing guidelines for food safety. Preliminary results indicate that in late spring to early summer, generic *E. coli* levels in the soil peaked at 14-43 days post-grazing and declined to near zero by day 105 in all fields.

Although environmental conditions and farming practices vary by season and region, this pilot study indicates that *E. coli* in the soil post grazing is undetectable by the 120 day NOP standard. Establishing research-based waiting periods between grazing and harvest, allows mixed crop-livestock farmers to continue integrating grazing within production fields, while keeping food safe from farm to fork.

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