Testing wetting agents for soil drag and bootie swabs and validating them in varied agricultural soils

Contact

Matthew J. Stasiewicz, PhD
University of Illinois at Urbana-Champaign
Dept. of Food Science and Human Nutrition
mstasie@illinois.edu

Authors

Matthew J. Stasiewicz (PI), Co-PIs Pratik Banerjee & Andrew J. Margenot, Jiaying (Tina) Wu (PhD Candidate)

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Summary

Practical and powerful soil sampling methods can improve microbial quality and safety in produce production. Aggregative sampling methods, such as drag and bootie swabs, have been studied in animal and produce production but have not been fully optimized for produce. This project optimizes the wetting agent for drag and bootie swabs for use in different agricultural soils. We tested increasingly practical wetting agents–deionized water, phosphate-buffered saline, buffered peptone water, and tryptic soy broth–by comparing them with reference methods: evaporated milk and soil composite grabs. Also, this project will validate the best wetting agent by testing in varying soils for different commodities, using bacteria recovery and diversity as metrics. The best wetting agent will be determined for aggregative soil sampling across multiple produce-relevant soil types.

Objectives

1. Test increasingly practical wetting agents for drag and bootie swabs.
2. Validate optimal wetting agent for the drag and bootie swabs on varying soil created by various stages of ground preparation for different commodities.

Methods

Drag and bootie swabs are hydrated a night before sampling using 12-ml and 18-ml wetting agents, respectively. To test practical wetting agents, samples were taken in a field with swine manure applied via liquid injection, a field with dairy manure applied through a dry spreader, and a field with no manure. Samples were processed within 24 hours to enumerate aerobic plate bacteria (APC), total coliforms, and generic *Escherichia coli*. To validate the optimal wetting agent, samples will be taken in melon and spinach fields in Texas, two fields in Illinois specialty crop farms, and two fields in the sustainable student farm at the University of Illinois. We will process samples to enumerate APC, total coliforms, and generic *E. coli*; enrich for generic *E. coli*; and perform sequencing.

Results to Date

To date, methods have been developed (**Figure 1**). 472 samples were collected from swine manure, dairy manure, and control fields, depending on field and weather conditions. Samples from the swine manure field were taken on day 6, 10, 17, and 31 post application, while samples from dairy manure fields were taken on day 0, 2, and 4 post application. Control field samples were taken on a random day.

Results indicate swine manure fields represent low contamination scenarios (**Figure 2**), while dairy manure fields represent high contamination scenarios (**Figure 3**). Control field results served as a baseline (**Figure 4**). Overall, all sampling methods showed similar results for APC recovery, with booties and drags more powerful than grabs for total coliforms and generic E. coli. Wetting agents showed no significant differences in performance.

Benefits to the Industry

The beneficiaries of this project are members of produce production working to improve food quality and safety. Drag and bootie swabs perform like grabs for recovering quality and safety indicator organisms. Also, swabs collect soil closer to the surface–more likely to be a contamination route compared to grabs that collect soil from a depth as low as 3–5 cm under the surface. For practical reasons, swabs are more labor- and cost-effective. Grab sampling methods require crews to bend down and collect soil samples. Drag swabs only require being attached to crew footwear, and bootie swabs only require wearing the booties while walking in fields. Also, swabs could save media used for the lab testing because of the low sample weight.

Figure 1. Photos of drag and bootie swab preparation and one of our sampling teams in a field collecting all sample types.

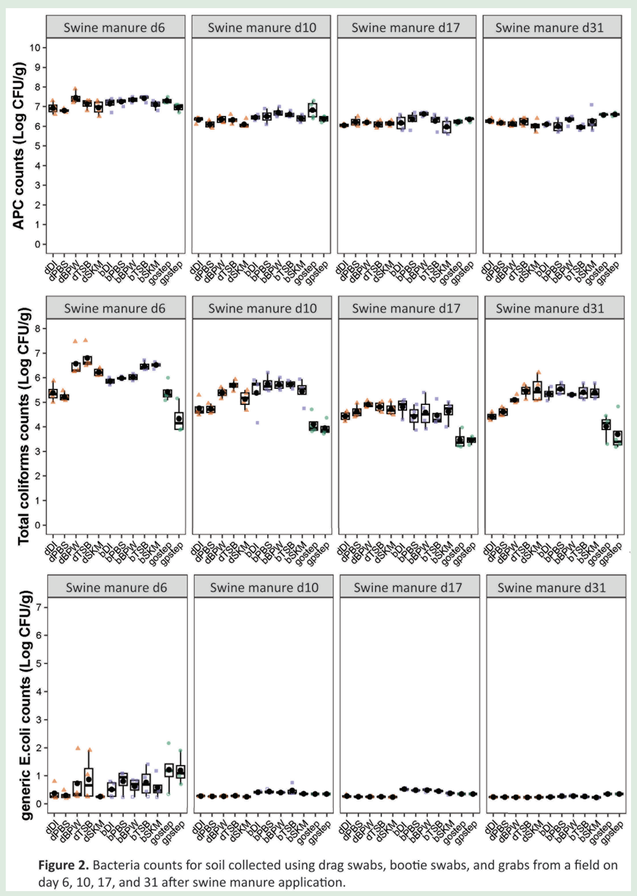

Figure 2. Bacteria counts for soil collected using drag swabs, bootie swabs, and grabs from a field on day 6, 10, 17, and 31 after swine manure application.

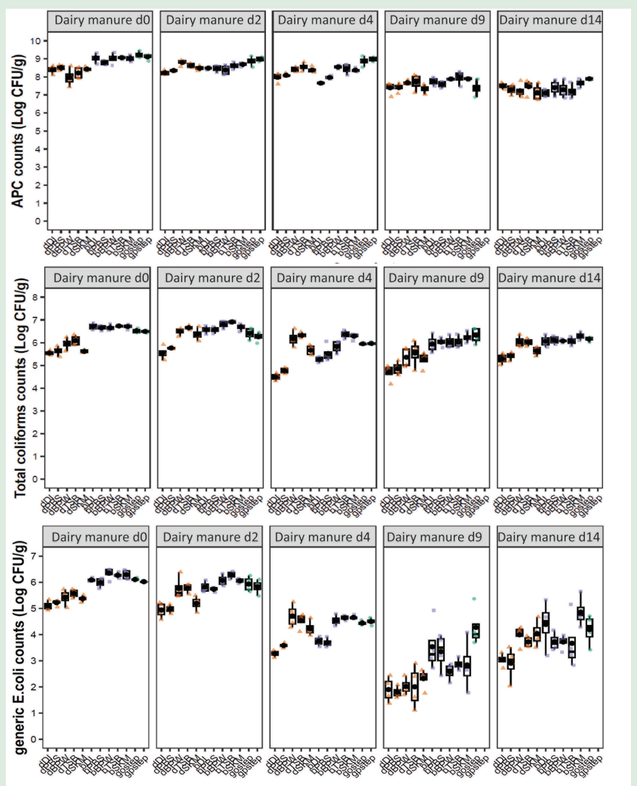

Figure 3. Bacteria counts for soil collected using drag swabs, bootie swabs, and grabs from a field on day 0, 2, 4, 9, and 14 after dairy manure application.

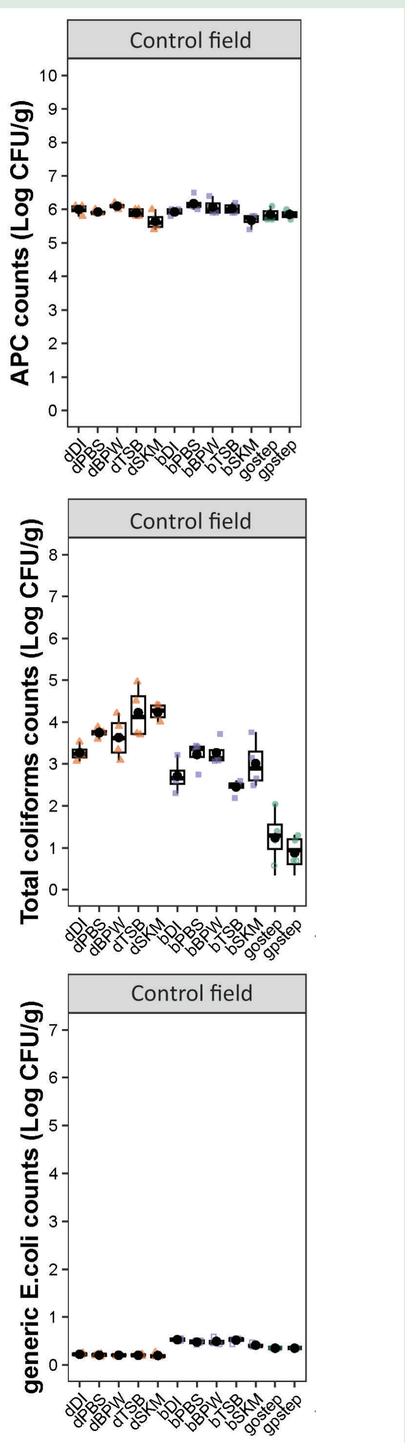

Figure 4. Bacteria counts for soil collected using drag swabs, bootie swabs, and grabs from a control field.