

Towards a decision-support tool for identifying and mitigating on-farm risks to food safety

SUMMARY

Contaminated produce continues to be a leading cause of foodborne illness. Yet farmers still lack the ability to predict when their crops are at risk and lack effective strategies to manage those risks. While evidence is accumulating regarding the efficacy of many practices, results are often not made available to growers in a useable way. We plan to develop data-driven, pre-harvest tools to help growers predict and mitigate risks associated with foodborne pathogens. This tool will be based on existing literature and will be customizable to each farmer's unique management practices. We also will explore novel methods for suppressing pathogens, when they do occur on farms. Specifically, we will study how soil amendments affect the ability of feces-feeding soil bacteria to suppress *Salmonella* and *Listeria*. Farmers, industry, and conservation organizations have expressed strong interest in making informed decisions about on-farm practices to improve produce safety without comprising environmental health. By combining literature syntheses with lab and field experiments, this project will provide growers with both new strategies for mitigating pathogen prevalence and an effective tool to assist growers in navigating decisions regarding the food safety/conservation "stale-mate."

OBJECTIVES

1. To develop a grower-motivated decision-support tool that synthesizes evidence for the efficacy, feasibility, and costs of food-safety practices.
2. To understand the community dynamics of feces-feeding bacteria in order to harness their activity to bolster food safety

METHODS

Literature review and expert assessment:

Based on a broad literature review and follow-up expert review scores, we will assess the efficacy, costs, and feasibility of on-farm food safety practices and landscape risk factors. As outlined in **Figure 1**, we will scour the literature for studies that quantitatively assess impacts of agricultural practices and the surrounding landscape on foodborne pathogen prevalence in North America. Systematically summarized paragraphs of each paper will then be distributed to an expert panel of scientists and growers. Experts will score the evidence for the efficacy of each practice by adapting Delphi technique. We will then compile results into an interactive web-application for growers.

Pathogen suppression study:

We are utilizing the UC Davis Russell Ranch farm management plots (directed by Co-PI Kate Scow) to evaluate the short-term and long-term effects of compost addition on pathogen suppression. Composite soil samples will be collected at 4 time points from 2 experimental fields—"Long Term Century Experiments" and "Short Term Dairy Manure Experiments"—as outlined in **Figure 2A** and **2B**, respectively. After quantifying soil physico-chemical properties and soil microbial diversity, we will inoculate soils with foodborne pathogens (**Figure 3**) and enumerate soils after 10 and 30 days to identify which soils are most suppressive. We predict soils with compost and manure additions will host more soil microbial diversity and suppress foodborne pathogens.

RESULTS TO DATE

To date, we have focused on building the project team and planning our research activities:

- Successfully recruited personnel to conduct experiments and accomplish the research goals.
- Systematically scheduled research activities by organizing regular meetings, cloud-based data management plans, and sampling protocols.
- Organized a science advisory team to lead the development of the decision support tool.
- By leveraging prior soil data and ongoing experiments, we have developed a concrete experimental design and sampling timeline; field sampling will begin in mid-April 2019.

BENEFITS TO THE INDUSTRY

Our overall goal is to develop an ecologically based, data-driven approach to reducing on-farm food-safety risk. We intend to create an open-source tool to help the produce industry understand how different farming practices affect food safety risk AND begin exploring new soil-based approaches for mitigating risk. We hope to create a decision-support tool that is immediately useful and relevant. Ideally, our work will serve the ~176,400 U.S. farmers that grow fresh produce that is vulnerable to foodborne pathogens, as well as the many auditors, buyers, and regulators involved in on-farm food-safety management.

In the longer term, we hope that our pathogen suppression experiment will identify paths forward for co-managing produce farms for food safety and soil quality. We will understand how historical farm management influences a soil bacterial community's ability to suppress foodborne pathogens and how these communities can be altered through soil management to maximize foodborne pathogen suppression. We also will determine which species of bacteria are most beneficial in suppressing selected foodborne pathogens.

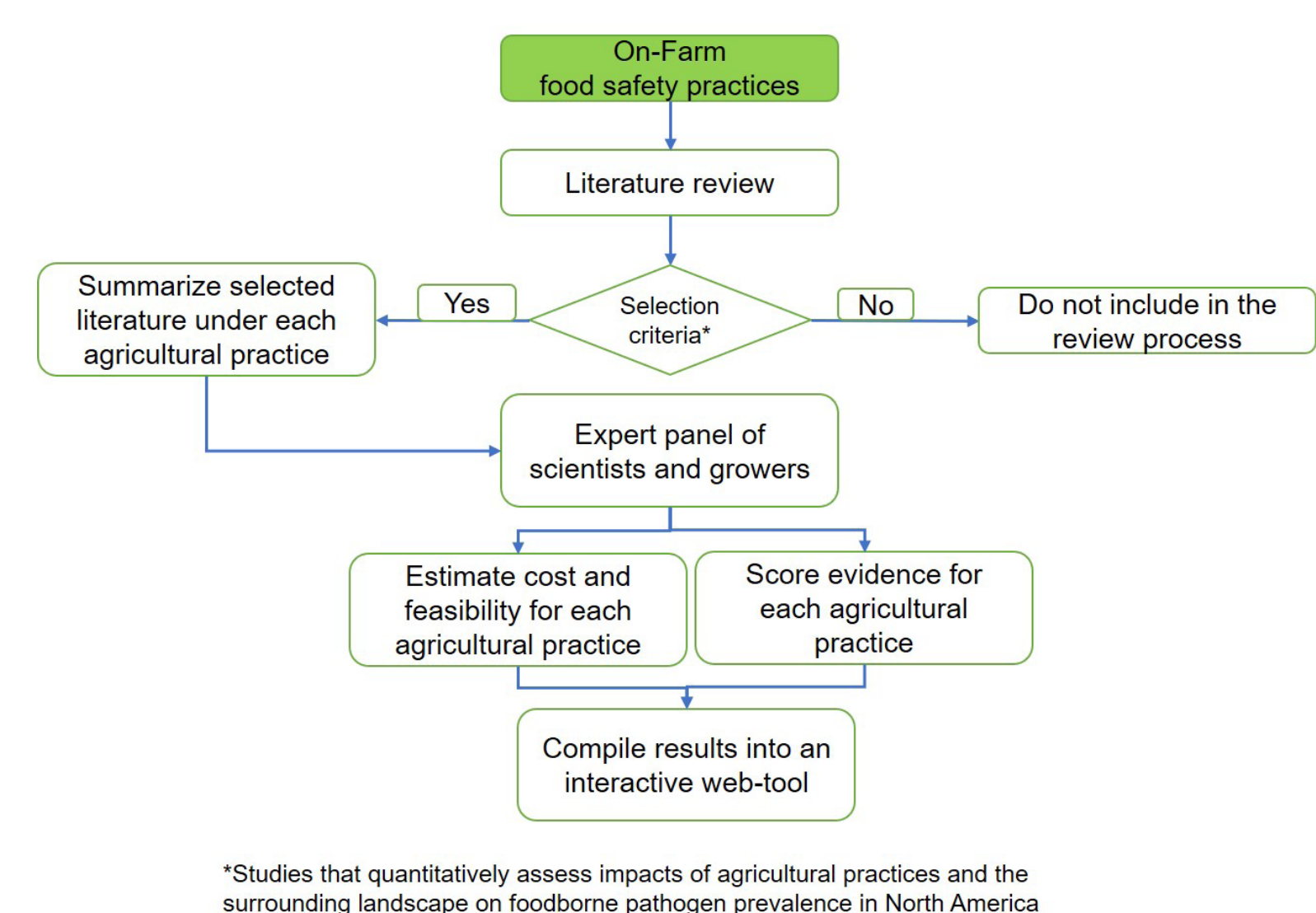


Figure 1. A graphical representation of the literature review procedure.

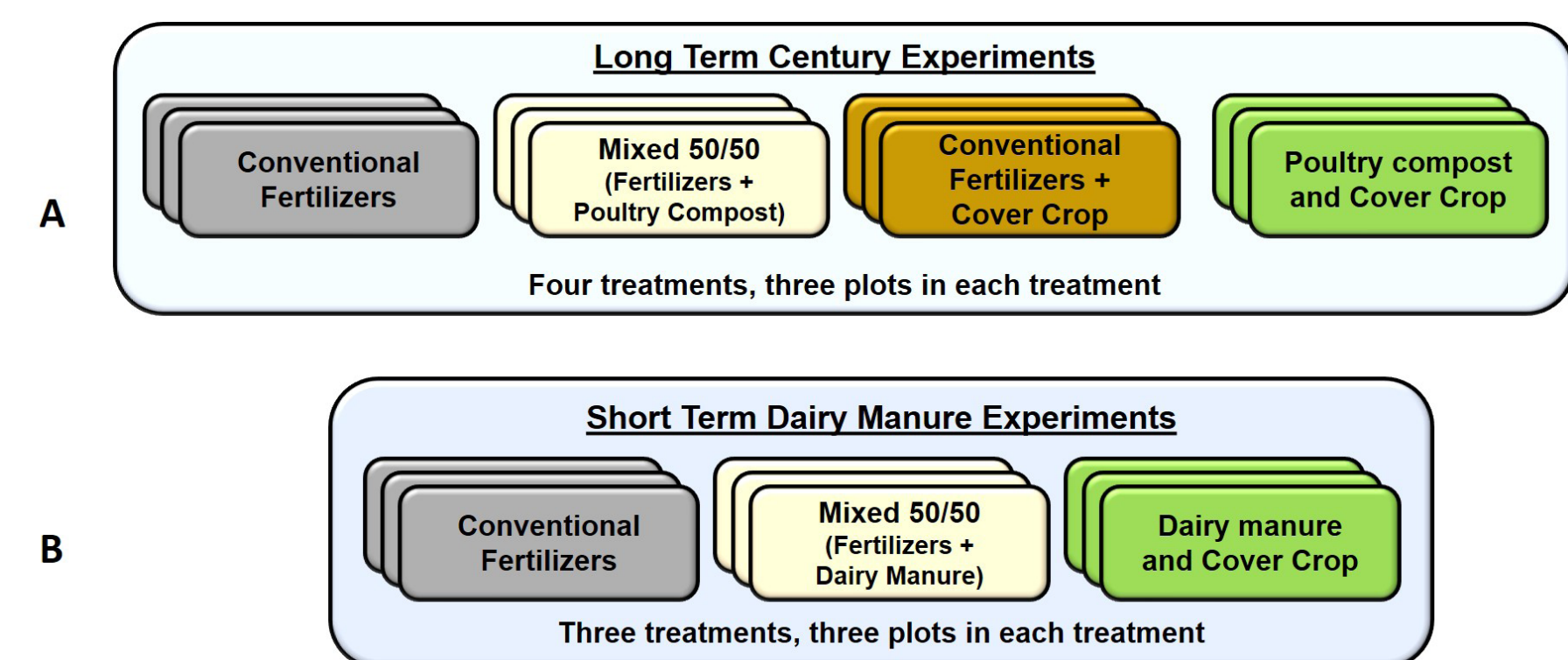


Figure 2. A graphical representation of the overall experimental design: A) long term century experiments, B) short term dairy manure experiments.

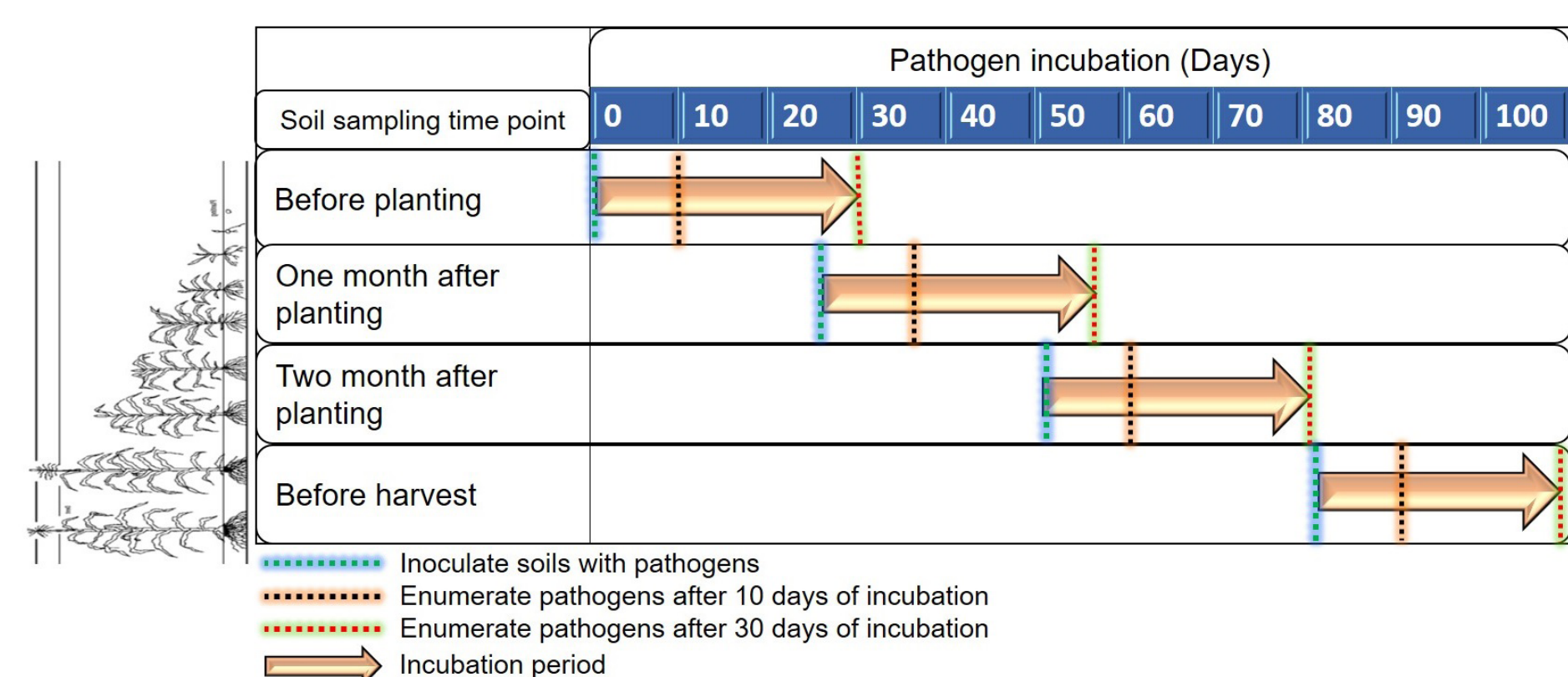


Figure 3. A graphical representation of the pathogen suppression experiment.



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