Prairie Strips

Research Highlight: Prairie Strips Mitigate the Spread of AMR

Introduction

WHAT IS ANTIMICROBIAL RESISTANCE (AMR)?

Antimicrobial resistance is the ability of microorganisms (bacteria, fungi, viruses, and parasites) to survive and grow in the presence of an antibiotic or other antimicrobial drug to which it was once sensitive or susceptible. As a result, medicines previously used to treat these potential pathogens become ineffective, threatening our ability to treat infections. The emergence of antimicrobial resistance is a global threat to public health.

WHAT IS THE RELATIONSHIP BETWEEN AMR AND AGRICULTURE?

The use of antibiotics in animal agriculture increases the presence of antibiotic resistant bacteria (ARBs), antibiotic resistance genes (ARGs), and residual antibiotics found excreted in animal manure. Manure is commonly applied to crop fields as fertilizer and can introduce antibiotics and ARGs into the environment (Fig. 1). Agricultural soils that are amended with manure can also impact downstream waters. Soils and water can act as reservoirs where resistance can be transferred between microorganisms.

Figure 2. Members of the STRIPS AMR team pose at Worle research farm, a location utilized in a number of our previous and ongoing experiments.

Research

BACKGROUND: The integration of prairie strips within and at the edge of crop fields are a potential management solution to reduce the presence of ARBs, ARGs, and antibiotics downstream of treated cropland.

CURRENT GOALS:

- Evaluate ability of prairie strips to prevent ARBs, ARGs, and antibiotics moving from manure amended crop fields downstream
- Create a prairie strip model to evaluate performance and inform field implementation designs
- Characterize differences between prairie soil and crop soil microbial communities
- Investigate the response of these soil microbial communities to manure application

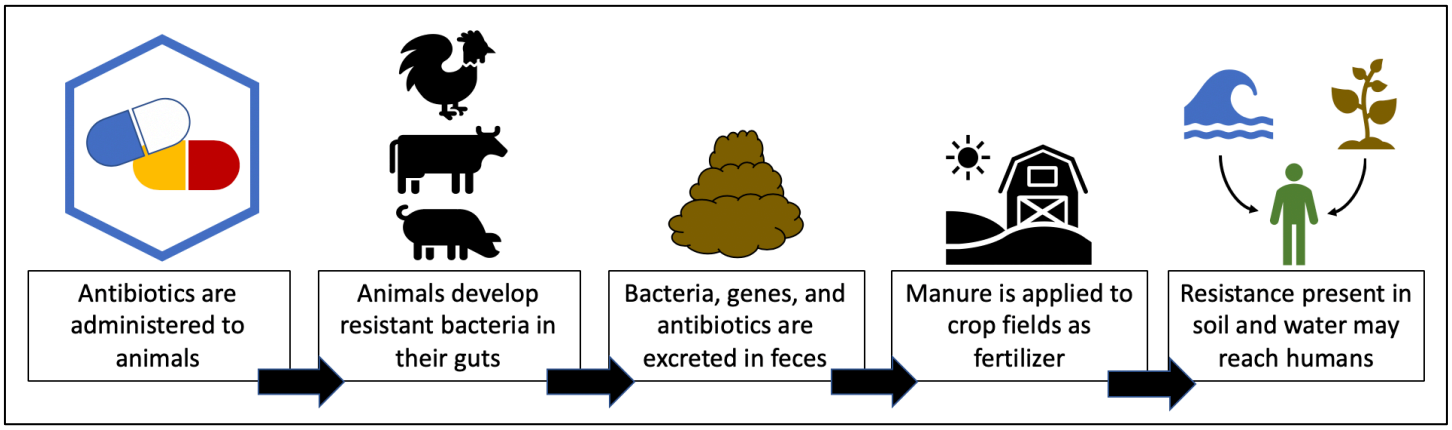

Figure 1: Descriptive illustration of antibiotic resistance movement to and from agricultural fields.

Ongoing Experiments

Flume

A flume is an engineered channel for water in which we can control certain variables, such as water depth and flow rate. These experiments involve the use of a flume system to simulate an overland flow passing through an extracted section of prairie strip (Fig. 3).

By integrating our field studies with laboratory models we are able to resolve many of the key challenges that can accompany investigating complex environmental systems.

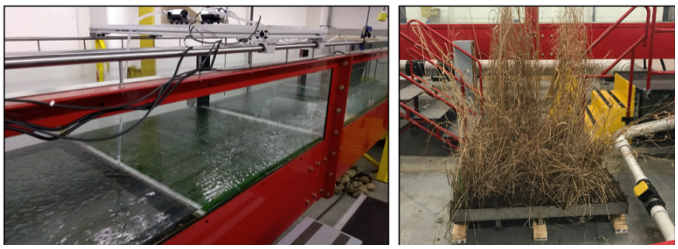

Figure 3. State of the art experimental flume system running a controlled flow condition and extracted prairie strip to be installed into the flume test section.

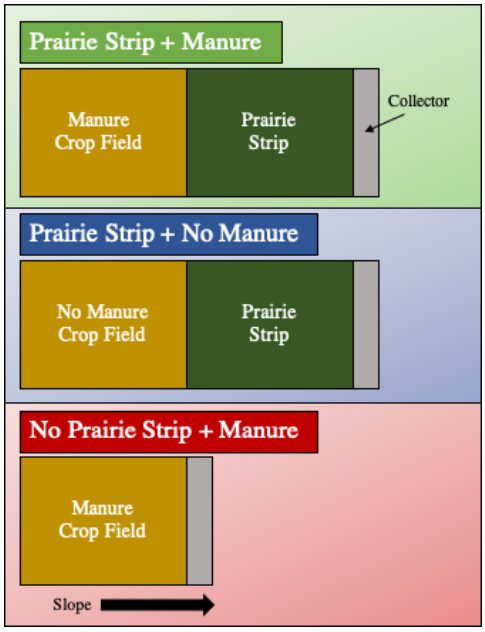

Figure 4. Schematic of the rainfall simulation plots.

Rainfall Simulations

The rainfall simulations focus on evaluating the effectiveness of prairie strips to mitigate manure-derived ARBs and ARGs at the landscape scale. The simulations are conducted on plots that contain either a section of manured crop with a prairie strip, a section of non-manured crop with a prairie strip, or a section of manured crop without prairie strip (Fig. 4).

During the rainfall simulation water sampling is conducted at each plot. As well, soil samples are collected at numerous time points before and after the simulation occurs. To date two rainfall simulations have been performed, the first of which utilized chicken litter as the source of manure, the second using swine manure.

Soil Incubation

The soil incubation experiment seeks to better understand of the fate and persistence of introduced ARGs and the rate of degradation of introduced antibiotics.

Row crop (corn and soybean) soil or prairie strip soil was mixed with a swine manure slurry spiked with antibiotics. Monitoring of the measured concentrations of antibiotics and characterization of the microbial communities of the manure and soil samples over a 72-day period was conducted.

Figure 5. A snapshot of the various soil treatment sample in their incubation chamber.

This ongoing evaluation is supported by AFRI food safety grant no. 2018-68003-27468 from the USDA National Institute of Food and Agriculture. Principal investigators include Michelle Soupir, Adina Howe, Lisa Schulte Moore, and Matthew Helmers from Iowa State University (ISU), Thomas Moorman and Heather Allen from USDA ARS, and Diana Aga from University at Buffalo (UB). Graduate students include Laura Alt, Andy Craig, Jared Flater, and Alyssa Iverson from ISU and Jena Congilosi from UB.