

How does weather influence transmission of *E. coli* O157:H7 from animal operations to produce fields?

Summary

Animal operations adjacent to land used for fresh produce production are a known risk for transmission of *E. coli* O157:H7, particularly cattle operations have been suspected as the contaminating source during outbreaks. Weather has been suggested, but not proven, to influence the transmission of foodborne pathogens to the wider environment surrounding cattle operations. The goal of this study is to assess how specific weather conditions influence transmission of *E. coli* O157:H7 from animal operations to adjacent lands, and then develop a weather-based risk assessment model of *E. coli* O157:H7 transmission for field proximity to animal operations. This project will result in critical industry guidance about weather factors to account for environmental assessments during the pre-harvest stage of production for farms near cattle operations.

Objectives

We hypothesize that local weather conditions can be used to estimate the distance and direction that *E. coli* O157:H7 will be transmitted from an animal operation to surrounding fields. We also hypothesize that understanding these transmission dynamics due to weather can be used to develop effective risk assessment models and guidance for industry to maximize identification of high-risk fields adjacent to animal operations.

1. Identify normal and extreme weather events associated with an increased risk of *E. coli* O157:H7 transmission from a cattle feedlot to the surrounding environment.
2. Development of risk assessment models based on field proximity to animal operation and *E. coli* O157:H7 transmission via weather.

Methods

Utilizing the USDA's Meat Animal Research Center (MARC), a cattle feedlot with 6,000 head of cattle, sample collection plots (n=24) are placed at varying distances (500m – 1,500m) around the feedlot. In each plot (Fig. 1), consist of two sets of soil, water, air, and surrogate plant surfaces that are sampled every two weeks. Sampling is conducted from May to September (n=14) and additional sampling is conducted before and after extreme weather events. Cattle and wildlife fecal samples will be collected to identify potential strain transmission to sampling plots. Collected weather data will be utilized to develop a generalized linear mixed model to identify weather factors most likely to result in *E. coli* O157:H7 transmission from cattle feedlots to produce fields.

Results to Date

Facility site restrictions in Year 1 reduced the total sampling to four sets rather than the planned ten; however, two air sampling sets at 500 meters resulted in a confirmed *E. coli* O157:H7 (Fig. 2). Whole genome sequencing identified near identical strains within the cattle feedlot during the sampling timeframe as well as year prior. Preliminary analysis of weather data suggests that atypical northward winds may be responsible for the location of the positively identified strains (Fig. 3). Year 1 sampling weather data identified a high presence of high-precipitation and low-temperature events that could have contributed to a low prevalence of *E. coli* O157:H7 both in the feedlot and the sampling area.

Benefits to the Industry

Objective 1 will demonstrate how weather and severe weather events affect transmission dynamics of *E. coli* O157:H7 from a cattle feedlot to adjacent fields, and provide an understanding of how each weather factor on its own, and combined, contributes to pathogen transmission dynamics (e.g. distance, direction, etc.) near an animal operation. Objective 2 will provide risk assessment and predictive models for the transmission of *E. coli* O157:H7 from animal operations to adjacent fields. These risk assessment models and industry guidance will be based on general weather conditions that impact pathogen transmission dynamics for application in any growing region. Overall, this study will provide industry guidance about how to assess weather patterns for pathogen monitoring in fields adjacent to animal operations.

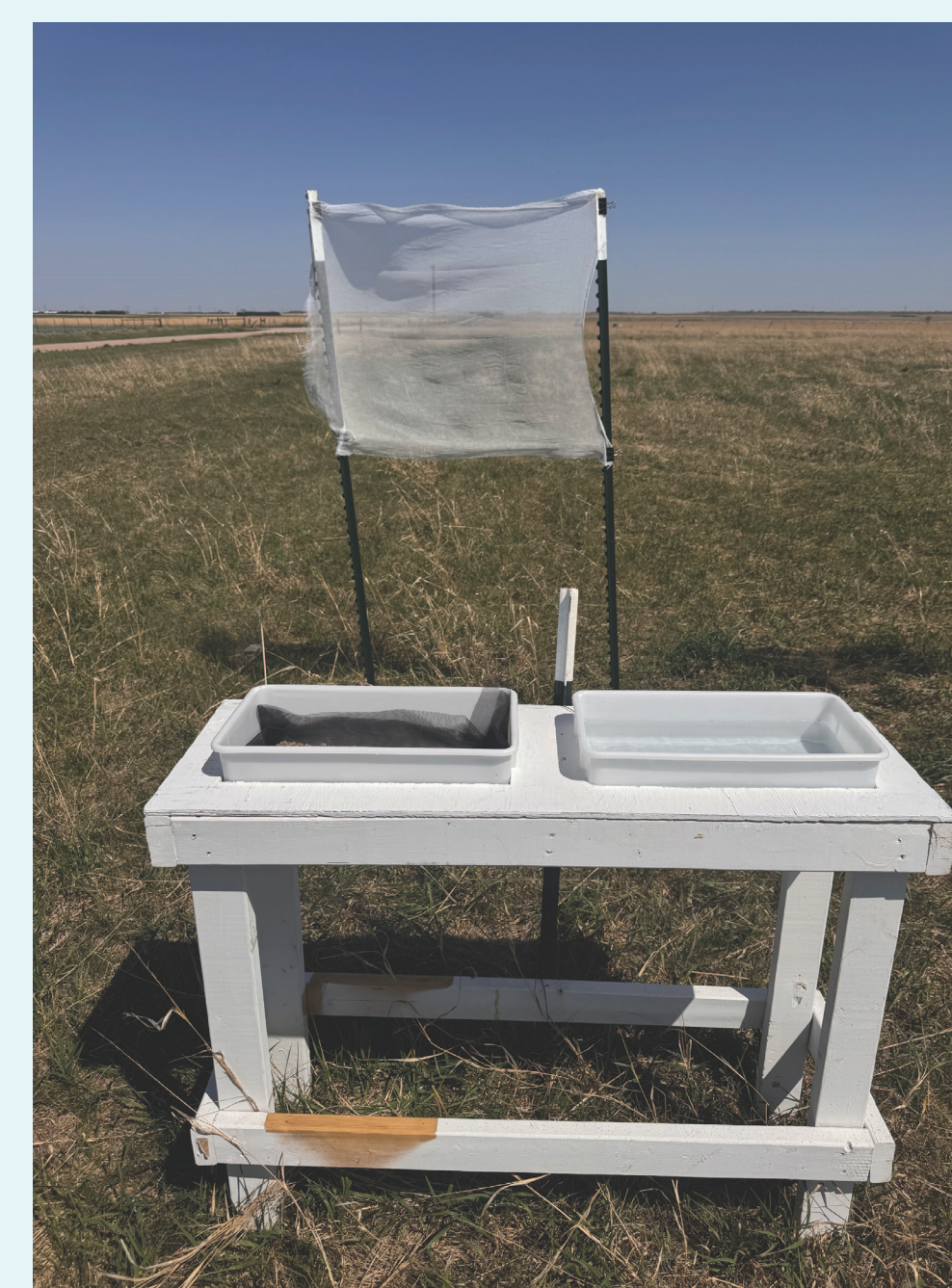


Figure 1: Field setup for *Escherichia coli* O157:H7 sampling at different sites around the feedlot. A white wooden stand holds two plastic collection trays—one containing soil (left) and one with water (right)—passive air sampling is conducted with cheesecloth supported by two metal poles. Two of these field sampling setups are deployed at each of the 24 sampling sites.

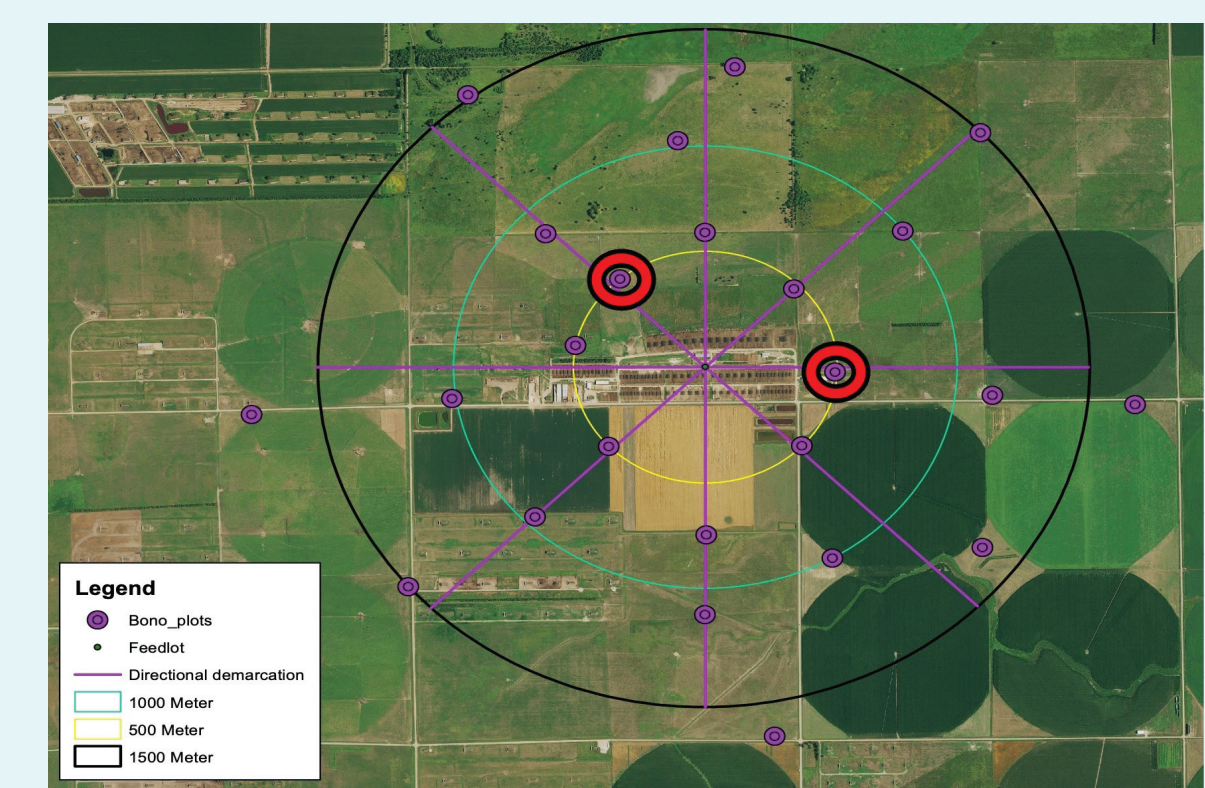


Figure 2: Spatial arrangement of sampling plots relative to cattle feedlot facilities. Aerial map showing the radial sampling design centered USDA MARC feedlot operation. Concentric distance buffers indicate 500 m (yellow), 1,000 m (cyan), and 1,500 m (black) zones from the feedlot center. Purple points mark individual sampling plot locations distributed along eight directional transects (magenta lines) at each distance interval. The two feedlot locations highlighted with red target symbols are locations of positive *E. coli* O157:H7 air samples.

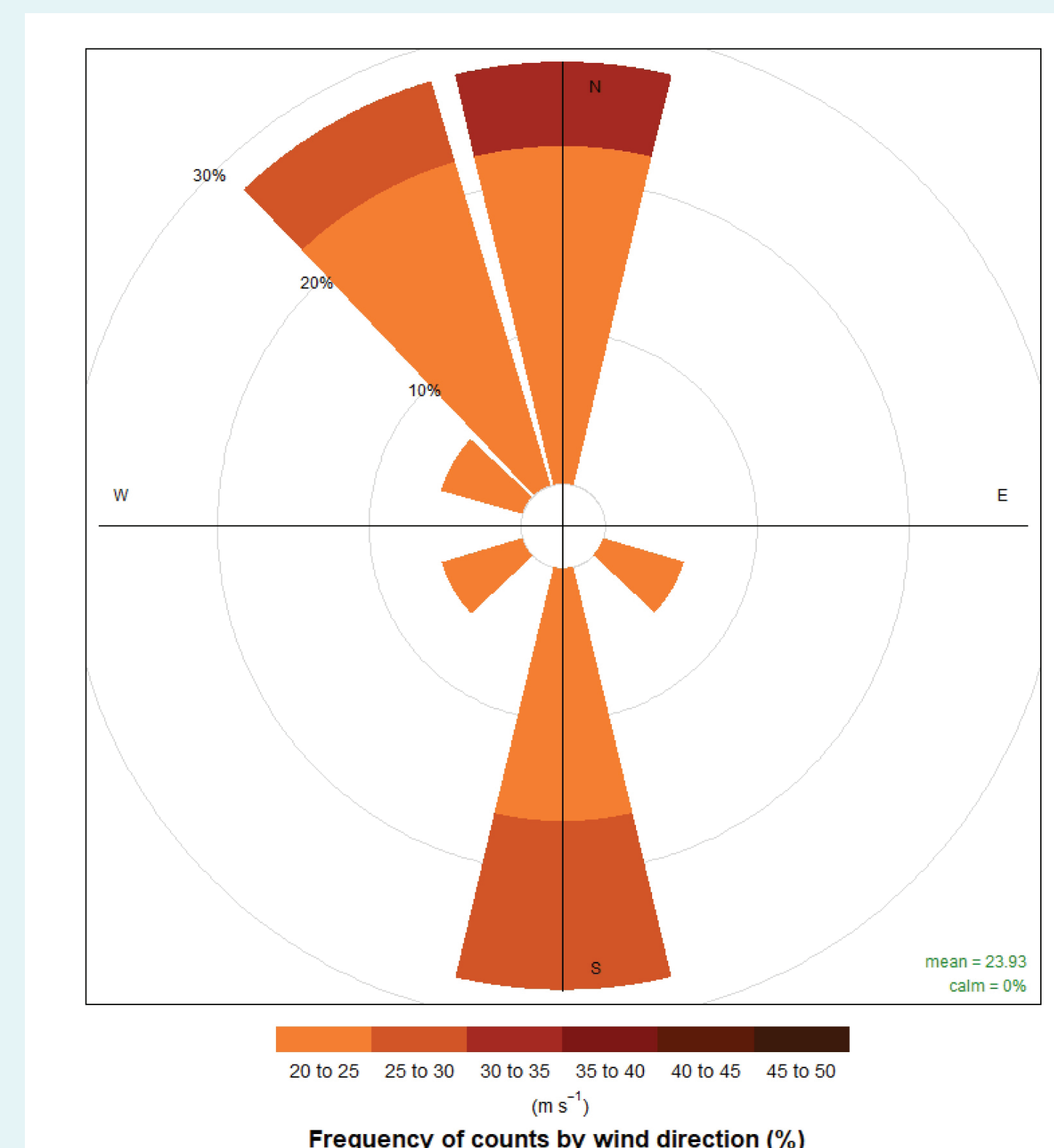


Figure 3: Wind rose diagram showing wind direction frequency and speed distribution during the sampling period. Radial bars indicate the percentage of observations from each compass direction, with bar length corresponding to frequency (concentric circles at 10%, 20%, and 30%). Color gradients represent wind speed classes ranging from 20–25 m s⁻¹ (light orange) to 45–50 m s⁻¹ (dark brown). Prevailing winds originated predominantly from the south and north-northwest directions, with southerly winds exhibiting the highest frequencies (>30%) and strongest sustained speeds.



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